2014 Update

AIR QUALITY MAINTENANCE PLAN AND REDESIGNATION REQUEST for the Town of Mammoth Lakes

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2014

AIR QUALITY MAINTENANCE PLAN AND REDESIGNATION REQUEST for the Town of Mammoth Lakes

Prepared for the

PM-10 State Implementation Plan

By
The Town of Mammoth Lakes and
The Great Basin Unified Air Pollution Control District

Authors
William Taylor, Duane Ono, and Jen Daugherty

Contributors
Phil Kiddoo and Megan Rybacki

Mammoth Lakes Air Quality Maintenance Plan and Redesignation Request 2014

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EXECUTIVE SUMMARY

Introduction

This document is a revision to the 1990 Air Quality Management Plan (AQMP) for the Town of Mammoth Lakes. It includes 1) a request to redesignate the area from nonattainment for the National Ambient Air Quality Standard for PM10 (NAAQS) to attainment based on monitoring data and a modeling analysis, and 2) a maintenance plan that contains requirements to ensure the federal PM10 standard will not be violated in the future.

Background

From 1985 to 1990, monitoring in Mammoth Lakes by the Great Basin Unified Air Pollution Control District (GBUAPCD) recorded 10 violations of the federal 24-hour PM10 standard. Since monitoring was on a once every six day cycle, extrapolation of the data predicted 11.2 expected violations of the NAAQS per year.

In response to the violations of the NAAQS, and determination by the EPA that the Town of Mammoth Lakes was non-attainment for the federal PM-10 standard, the Town of Mammoth Lakes (Town) and the GBUAPCD formed an ad hoc air quality committee. The committee investigated potential control strategies to be included in new particulate emissions regulations for the Town. Multiple potential control strategies were evaluated resulting in a recommendation to the Town of Mammoth Lakes Town Council. On November 30, 1990, the Town Council adopted the recommended measures. Implementation of the adopted measures resulted in an immediate decline in PM-10 levels in the planning area, and since 1994, despite continued community growth, there have been no further exceedences of the NAAQS.

This Air Quality Maintenance Plan and Redesignation Request is an update to the 1990 Air Quality Management Plan for the Town of Mammoth Lakes. This plan reviews the background of the 1990 plan, the measures implemented as a result of that plan and their effectiveness, and changes to clean air regulations since the adoption of the 1990 plan. This plan then recommends maintenance measures and requests that the Town of Mammoth Lakes be redesignated as attainment for the federal PM-10 standard.

PM Standards

PM-10 stands for particulate matter less than 10 microns in diameter. The National Ambient Air Quality Standard (NAAQS, or federal standard) for PM-10 was set July 1, 1987 at 150 micrograms per cubic meter (μg/m³) for the 24 hour standard. Levels for the PM-10 standard were selected to protect the health of people who may be sensitive to exposure to airborne particulate matter (OAQPS 2005).

The state 24-hour average PM-10 standard is set at 50 μg/m³. Violations of the state standard have also declined significantly since the adoption of the AQMP. The number of monitored state standard violations was as high as 56 days in 1993. Over the last four years (2009-12) the number of state standard violations has ranged from four to 31 per year.

Area Description and Population

The Town of Mammoth Lakes is located on the eastern slopes of the Sierra Nevada mountains at an elevation of 7,861 feet (2,396 m). The Town was incorporated in 1984 and has grown from a permanent population of 4,785 in 1990 to 8,234 in 2010. Included in the Town boundaries is Mammoth Mountain ski area which attracts about 1.2 to 1.5 million skiers each winter. During major winter weekends there are about 35,000 people in Mammoth Lakes. It is anticipated this figure will grow to about 45,000 to 52,000 people by 2025 (Town of Mammoth Lakes, 2007a).

Need for a Plan Update

In the 23 years since the adoption of the 1990 AQMP, the conditions affecting PM-10 in Mammoth Lakes have changed significantly. This AQMP update addresses improved air quality in Mammoth Lakes; a revised General Plan for the Town of Mammoth Lakes; updated traffic modeling for the Town; an updated chemical mass balance study; revisions to the GBUAPCD Rules; and a request to have Mammoth Lakes redesignated as attainment for the federal PM-10 standard.

1990 AQMP Summary

In 1987, the Town and the Great Basin Unified Air Pollution Control District (APCD) began developing a plan to reduce air pollution from fireplaces, woodstoves and dust caused by vehicles traveling on roads treated with volcanic cinders.

The AQMP relied on controlling wood smoke by replacing old wood stoves and fireplaces with cleaner wood burning appliances and curtailing wood burning on days that could violate the air quality standard. The Town reduced road dust emissions by using vacuum street sweepers to remove volcanic cinders soon after the roads dried and through promotion of increased transit usage. After adoption of the AQMP, monitored air pollution levels dropped significantly in Mammoth Lakes.

PM-10 and Data Summary

Based on airborne pollutant and meteorological monitoring conducted at the Gateway Center (also known as the Rite Aid/Do-It Yourself shopping center) in Mammoth Lakes, the Mammoth Lakes Planning Area has not exceeded the federal 24-hour NAAQS since 1994. In 1990 when the AQMP was adopted, three exceedences were recorded. Since then, only two exceedances of the 24-hour NAAQS were recorded – one in 1991 and one in 1994.

Emissions Inventory

The emissions inventory section describes the PM-10 emission estimates for residential wood combustion (RWC), resuspended road dust, cinders, mobile source tailpipe emissions and point sources. The methodology and data used to determine emissions is discussed for each source type. Because Mammoth Lakes exceeds the state 24-hour PM-10 standard, the emissions inventory is estimated for a peak 24-hour period.

Woodburning and resuspended road dust comprise almost all the PM-10 emissions during the winter. Motor vehicle exhaust, tire wear industrial sources contribute only approximately 1.4% of the area wide inventory. Estimates for the annual and 24-hour PM-10 emissions are calculated for wood burning and road dust. The annual residential wood combustion emissions estimates, which are based on survey data, provide good information to improve the estimates for the peak 24-hour period. The PM-10 emission estimate for resuspended road dust is based on the AP-42 methodology for estimating reentrained road dust emissions from paved roads (EPA, 2013).

The current total PM-10 emissions on a peak winter day in the Town of Mammoth Lakes are 3,385 kg/day in the Town of Mammoth Lakes and 4,324 in the entire nonattainment area boundary, see Table ES-1. A distinction is made for the in-Town emissions inventory that was used for Chemical Mass Balance receptor model and the maintenance demonstration, as opposed to the inventory for the larger nonattainment area. The inventory for the larger nonattainment area included emissions from road dust, motor vehicles and industrial sources from areas east of the Town that did not contribute to high PM-10 levels monitored in the Town. It is also important to refer to the In-Town emissions inventory when making any comparisons to the analysis in the 1990 Air Quality Management Plan for the Town of Mammoth Lakes, which was based on In-Town emissions.

Table ES-1 Summary of 24-hour PM-10 Emissions (kg/day) 2012

Source	In Town of Mammoth Lakes	Nonattainment Area Total
Residential Wood Combustion	850	850
Resuspended Road Dust & Cinders	2,522	3,455
Tailpipe, Tire and Brake Wear	9	11
Industrial Sources	4	8
Total	3,385	4,324

Chemical Mass Balance Results

The Desert Research Institute of Reno, Nevada (DRI) conducted a chemical mass balance (CMB) study for Mammoth Lakes in 2013. Chemical source profiles, or fingerprints, were taken from the 1990 AQMP. The sources profiled were:

- Mammoth Lakes road cinder storage
- Mammoth Lakes paved road dust
- idling diesel ski tour buses in Mammoth Lakes
- fireplace burning a typical Mammoth Lakes wood mix
- a Fisher woodstove with typical Mammoth Lakes wood mix

CMB model version 8 (USEPA) was used to estimate source contributions to PM-10 and PM-2.5 for days with chemically speciated data. For the winter 1987-1988 study (Ono et al, 1990), on average, fireplaces contributed 75% of the PM-10 and road dust 25%. Table 6-4 compares the results of the 1987-88 study to this study. Three of the days in the 1987-88 study showed wood smoke contributing >95% of the PM-10; the current study shows no high PM-10 days with greater than 75% of the PM-10 contributed from wood smoke (DRI, 2013). The CMB study found that since the adoption of the 1990 AQMP, peak PM-10 impacts from wood smoke and road dust have both dropped by about 33%. (DRI, 2013).

Control Measures

In December of 1990, the Town of Mammoth Lakes adopted the Air Quality Management Plan (AQMP) for the Town of Mammoth Lakes. The 1990 AQMP relied on controlling wood smoke by replacing old wood stoves and fireplaces with cleaner wood burning appliances and curtailing wood burning on days that could violate the air quality standard. The Town reduced road dust emissions by using vacuum street sweepers to remove volcanic cinders applied for traction control during icy conditions soon after the roads dried and by limiting future VMT growth. Control measures were adopted by the Town of Mammoth Lakes as Municipal Code Chapter 8.30, Particulate Emissions Regulations. Major controls in the Chapter 8.30 regulations were:

- Replacement or removal of existing uncertified residential wood combustion appliances at the time of sale of a property;
- Limit the maximum number of residential wood combustion appliances in new construction to one certified appliance plus one pellet fueled appliance;
- Institute voluntary and mandatory wood burning curtailment days;
- Implement a public education program;
- Implement a vacuum street sweeping program; and
- Limit peak VMTs to 106,600.

With the implementation of the control measures from the 1990 AQMP, PM-10 levels in Mammoth Lakes declined significantly. The 1990 AQMP estimated 4,259 kg/day of PM-10 for the peak 24-hour period and forecast 8,036 kg/day for the peak 24 hour total PM-10 emissions in the Town by 2005 absent any controls (Ono et al. 1990). The updated emissions estimate shows 3,385 kg/day PM-10 in 2012, which is a 20% reduction in emissions since 1990 when the AQMP was adopted. This reduction was achieved despite a 72% population increase from 4,785 in 1990 to 8,234 in 2010. Table ES-2 shows the peak 24-hour PM-10 emissions inventory for Mammoth Lakes in 1990 when the AQMP was adopted, the current inventory in 2012, and the projected emissions inventory in 2030 after the town has reached its buildout population and visitor numbers. The emissions inventory projections for 2030 are based on current control measures for residential wood combustion and on a change to the peak daily traffic volume limit derived from the modeling analysis that was performed for this plan update.

Table ES-2 Peak In-Town 24-hour PM-10 Emissions (kg/day)

Source Category	1990	2012	2030
Residential Wood Combustion	1,839	850	802
Road Dust and Cinders	2,390	2,522	3,143
Tailpipe, Tire & Brake Wear	23	9	11
Industrial Sources	1	4	4
Total	4,253	3,385	3,960

Amendments to Control Measures

Most of the changes to the implementing regulations of the Town of Mammoth Lakes MC 8.30 revise outdated sections or make non-substantive technical edits. The three meaningful amendments are:

- Section 8.30.040 B. This section is modified to clarify that no new wood burning appliances may be installed in multi-family developments. Prohibition of new wood burning appliances in multi-family projects has been the policy of the Town. The proposed revision formalizes that practice and implements General Plan Policy R.10.3.

- Section 8.30.080, Mandatory Curtailment. This section has been modified to include all wood burning appliances, except pellet stoves, in the no-burn day program. Currently, EPA certified stoves are exempted under Town regulations, but are required to participate under the District regulations.

- Section 8.30.100 B. This section sets a limit for vehicle miles traveled (VMT) within the town. The current limit is one hundred six thousand six hundred (106,600) VMT on any given day. Proposed development projects and other Town approved activities which affect vehicle trips are evaluated against this limit. A revised traffic model for the community incorporates additional roadway segments and revises VMT projections based on updated traffic counts and current modeling technologies. It shows an estimated VMT at General Plan buildout of one hundred seventy nine thousand seven hundred eight (179,708) for the revised model roadway segments. The air quality modeling shows that this overall level of traffic will not cause an exceedence of the NAAQS and is suggested as the VMT limit for the AQMP.

Maintenance Demonstration

The AQMP evaluates the effects of increased population and visitors on PM-10 emissions and forecasts the resulting change in the ambient PM-10 design concentration. Receptor modeling results were used with the revised emissions inventory (Table ES-2) that reflected changes in permanent and visitor populations and the adopted control measures to forecast changes in ambient PM-10 concentrations.

The 2007 Town of Mammoth Lakes General Plan evaluated population in terms of People at One Time (PAOT). PAOT is the number of people in town on a peak winter Saturday and includes both residents and visitors. PAOT is expected to grow from 34,265 in 2007 to 52,000 in 2025. 2025 was considered the build out year by the General Plan. The buildout number from the General Plan has been used as the year 2030 projected population in both the RWC and VMT analyses. This provides supporting information for an analysis to demonstrate that the PM-10 standard can be maintained in Mammoth Lakes for at least a 10-year period. This 10-year maintenance demonstration is required under the Clean Air Act (CAA) to allow the area to be redesignated from nonattainment to attainment for PM-10.

Proportional Rollback Analysis for Control Measure Evaluation

The effect of PM-10 emissions increases or decreases on the ambient PM-10 concentration can be determined by using a linear rollback method of calculation. This method is based on the assumption that the ambient concentration due to a given source is proportional to the emissions from that source. The effect on the design day PM-10 concentration was used to evaluate the overall effect on future ambient PM-10 levels. The design day concentration, which is the statistical fourth highest daily PM-10 concentration over a three-year period, was used for PM-10 forecasts because it is the value used by the EPA to determine compliance with the federal PM-10 standard. Based on PM-10 data collected over the last three years (2010-12), the fourth high PM-10 concentration, and therefore the PM-10 design day concentration, is 99 $\mu g/m^3$.

As was described in the 1990 AQMP, Mammoth Lakes' air pollution episodes are characterized by two different scenarios. One with high wood smoke contributions and one with high road dust contributions. The proportional roll-back analysis tested both cases. Using the peak wood smoke and peak road dust and cinders days, Tables ES-3 and ES-4 show the expected PM-10 emissions and concentrations due to growth with continued implementation of existing controls. These results show that with current control measures, growth could result in a 1% to 6% increase in the design day ambient PM-10 concentrations over the next 15 years. Since buildout conditions under the General Plan are expected to be sustained beyond 2030, PM-10 projections for 2050 are the same as for 2030. These PM-10 forecasts are also shown graphically in Figures ES-1 and ES-2.

Table ES-3. Forecasted PM-10 Design Day Concentrations for High Residential Wood Combustion Day

Source Category	1990	2012	2030	2050
Background	5 µg/m^3	5 µg/m^3	5 µg/m^3	5 µg/m^3
Road Dust	5 µg/m^3	23 µg/m^3	29 µg/m^3	29 µg/m^3
Residential Wood Combustion	195 µg/m^3	71 µg/m^3	66 µg/m^3	66 µg/m^3
Vehicles*	5 µg/m^3	negligible	negligible	negligible
Industrial Sources	negligible	negligible	negligible	negligible
Total	210 µg/m^3	99 µg/m^3	100 µg/m^3	100 µg/m^3

Figure ES-1 Design Day Projection for High Residential Wood Combustion Day

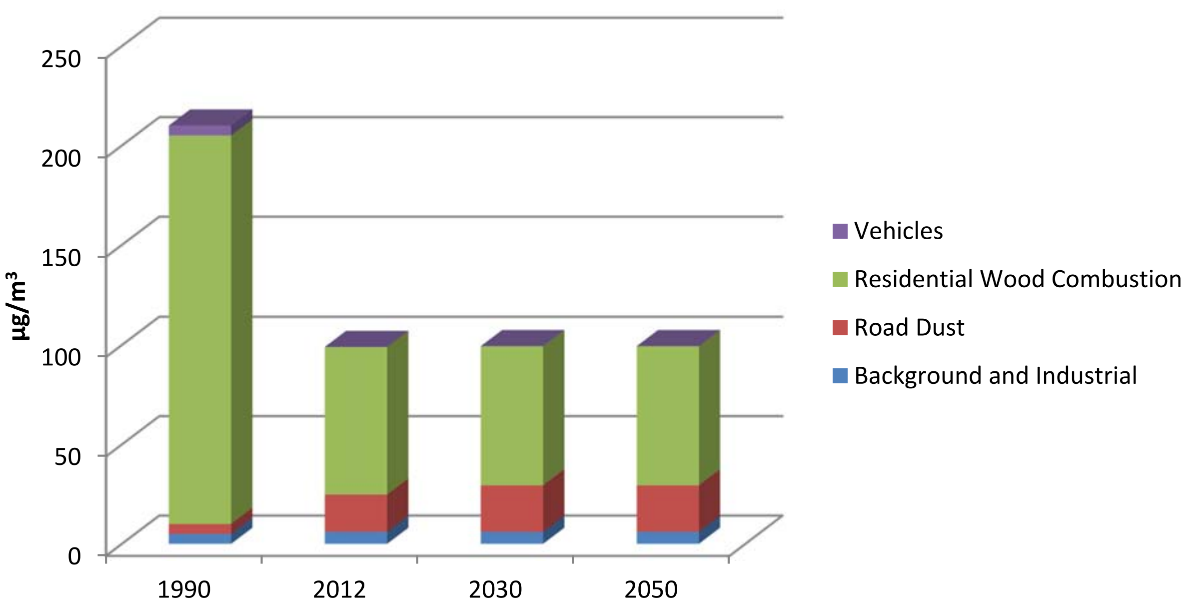
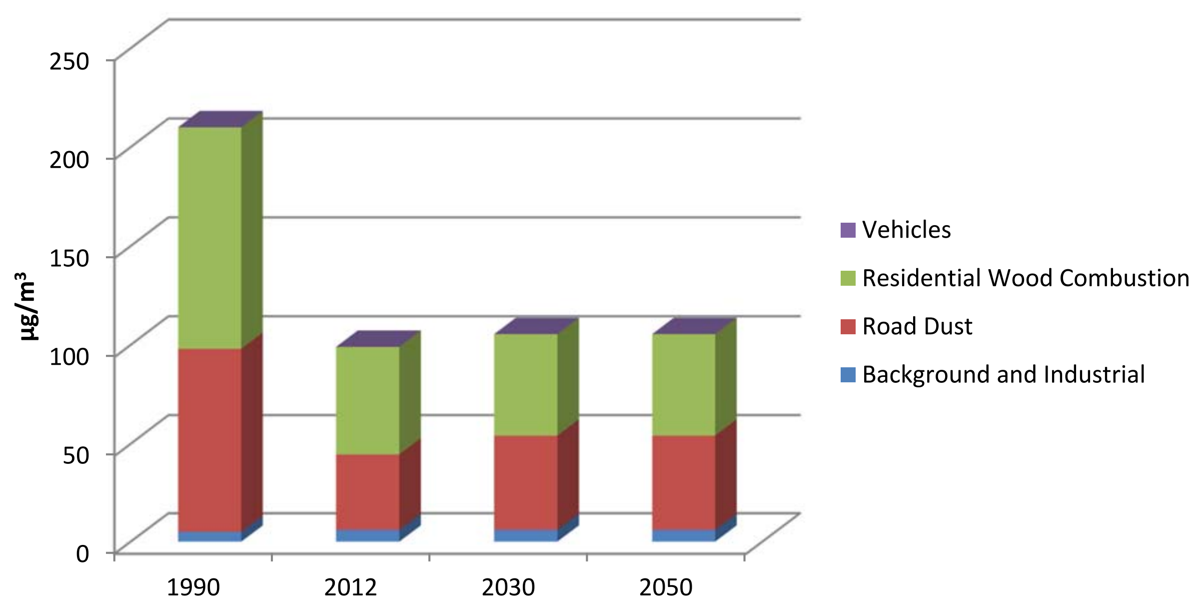


Table ES-4. Forecasted PM-10 Design Day Concentrations for High Road Dust Day

Source Category	1990	2012	2030	2050
Background	5 μg/m^3	5 μg/m^3	5 μg/m^3	5 μg/m^3
Road Dust	93 μg/m^3	37 μg/m^3	46 μg/m^3	46 μg/m^3
Residential Wood Combustion	112 μg/m^3	57μg/m^3	54 μg/m^3	54 μg/m^3
Vehicles*	negligible	negligible	negligible	negligible
Industrial Sources	negligible	negligible	negligible	negligible
Total	210 μg/m^3	99 μg/m^3	105 μg/m^3	105 μg/m^3

* Vehicle tailpipe and brake wear emission amount to less than 0.3 μg/m^3 except for the 1990 RWC case.

Figure ES-2 Design Day Projection for High Road Dust Day



Contingency Plan and Maintenance Measures

The analysis in this Plan shows that the adopted control measures for the Town of Mammoth Lakes are sufficient to maintain compliance with the NAAQS for PM-10 with a substantial buffer in the event that the measures do not fully achieve the same level of PM-10 reduction going forward that has been achieved to date. The Plan indicates a future PM-10 level of 105 $\mu g/m^3$ on a high road dust day (Table ES-4). This is 45 $\mu g/m^3$ (30%) lower than the NAAQS of 150 $\mu g/m^3$.

The success of the existing control measures demonstrates that PM-10 levels have been reduced and will be reduced to a sufficient degree that contingency measures are not required. Nonetheless, additional measures have been incorporated into the AQMP to assist in further reductions of PM-10 levels with the goal of improved compliance with the California Ambient Air Quality Standard for PM-10. These measures include amending the Town of Mammoth Lakes Particulate Emissions Regulations to match GBUAPCD Rule 431, requiring all wood burning fireplaces and stoves, whether certified or not, to comply with no-burn days.

The District will continue to maintain monitoring network integrity and, with the Town, will continue to monitor PM-10 in order to (1) verify the attainment status of the area as required by the US EPA (CAA Sec 175A, Calcagni, 1992) and (2) to implement the no burn day program, which relies on daily PM-10 monitoring. Although the intention is to continue monitoring indefinitely in order to implement the no burn day program, the Town and the District will commit to continue ambient PM-10 monitoring for at least 20 years following the redesignation of the area to attainment in order to comply with CAA Sec 175A(b).

The US EPA requires areas to track the progress of maintenance plans. (Calcagni, 1992) This would include updating the emissions inventory, assessing air quality trends and re-evaluating modeling assumptions. The Town and the District will commit to submitting progress reports every third year starting in 2017 to track the progress of the maintenance plan. Progress reports will include an update on PM-10 air quality, a revised peak daily emission inventory for all sources in the planning area, a reassessment of the modeled air quality trend using the modeling assumptions in Section 8.3, and additional information that may be relevant to the air quality program in the Town.

Section 175A of the Clean Air Act requires that maintenance plans include contingency provisions to assure that any air quality violation of the NAAQS that occurs after the redesignation of the area as attainment is promptly corrected. As per guidance provided by the US EPA, (Calcagni, 1992) the maintenance plan should identify the measures to be adopted and a schedule and procedures for action. This plan takes a two-tiered approach to address contingency measures; 1) to adopt additional measures with this plan to strengthen existing rules and to prevent NAAQS violations, and 2) to commit to adopt additional measures if the standard is violated in the future.

If a monitored violation of the federal PM-10 standard occurs in the Town of Mammoth Lakes or the surrounding nonattainment area, the Town and the District will investigate the cause of the violation(s). Violation days would exclude days that are considered to be exceptional events, such as high PM-10 due to smoke from wildfires as provided for under the EPA's Exceptional Event Rule. (72 FR 13560)

Within 18 months of the violation, the Town and District will adopt additional control measures needed to meet the PM-10 NAAQS. Depending on the cause of the violation these control measures may include the following:

- Reducing the no burn day trigger threshold from a target of 130 to 100 $\mu g/m^3$, if residential wood smoke is found to be a significant contributor.

- Implementing measures to reduce the use of volcanic cinders or to improve street clean up procedures on roadways during the winter, if road dust is found to be a significant contributor.

Redesignation Request

States may ask U.S. EPA to redesignate an area "attainment" if:

- the area has monitored attainment of the air quality standard;
- the area has a fully approved State Implementation Plan;
- U.S. EPA has determined that the improvement in air quality is due to permanent and enforceable reductions in emissions;
- the state has submitted, and U.S. EPA has approved, a maintenance plan for the area; and,
- the area has met all other applicable federal CAA requirements.

As described in Chapter 8, the Town of Mammoth Lakes last exceeded the federal PM-10 24-hour standard in 1993. Attainment of the PM-10 standard is a direct result of the implementation of control measures by the Town as described in the 1990 Air Quality Management Plan.

The daily ambient PM-10 monitoring data collected by the Great Basin Unified Air Pollution Control District in Mammoth Lakes demonstrates that no more than 1.0 statistical exceedances of the NAAQS have occurred over the last three years as is required to demonstrate attainment of the federal standard. In fact, the data show that there have been no exceedances of the federal PM-10 standard during the last 19 years.

Applying a proportional roll back analysis to the PM-10 present and future emissions this document demonstrates that no more than 1.0 exceedances per year would be expected through the next 20 year planning period and beyond. With continued implementation of the control measures, attainment will be maintained.

The District finds that the Mammoth Lakes PM-10 Planning Area has attained the federal PM-10 standard and requests the California Air Resources Board recommend to the US Environmental Protection Agency that the area be redesignated from nonattainment to attainment with the federal PM-10 standard.

1. Introduction

1.1 BACKGROUND

Twenty five years ago, the normally clean air in Mammoth Lakes was often polluted during the winter by wood smoke and dust. Smoke from wood stoves and fireplaces and dust from volcanic cinders used on roadways for traction control contributed to high particulate matter levels that caused violations of air quality standards. Air pollution obscured visibility in what should be an idyllic mountain setting, and it posed a health hazard to the public, especially to those that might be sensitive to particulate matter air pollution, such as children, the elderly, and people with existing heart or lung problems. Poor air quality was usually associated with calm winter days when there was little wind to blow the pollution away. Due to these conditions, federal air quality standards for particulate matter were violated on about 11 days each year, and the US Environmental Protection Agency (EPA) required an air pollution control plan for the Town of Mammoth Lakes.

In 1987, the EPA identified the Mammoth Lakes area as having a high probability of violating the federal PM-10 standard (52 FR 29384). This designation was based on measurements of PM-10 that exceeded the standard. As a result of this Group I classification, a PM-10 State Implementation Plan (SIP) for the Mammoth Lakes area was required under the Federal Clean Air Act. The 1990 Air Quality Management Plan (AQMP) for the Town of Mammoth Lakes was developed to satisfy this requirement for a PM-10 SIP.

Implementation of the measures included in the 1990 AQMP, resulted in the PM-10 levels in Mammoth Lakes dropping significantly. The result has been no exceedences of the federal standard since 1994.

This Air Quality Maintenance Plan is an update to the 1990 Air Quality Management Plan for the Town of Mammoth Lakes. This plan reviews the background of the 1990 plan, the measures implemented as a result of that plan and their effectiveness, and changes to clean air regulations since the adoption of the Plan. This plan then recommends maintenance measures and requests that the Town of Mammoth Lakes be redesignated as attainment for the federal PM-10 standard.

1.2 PM STANDARDS AND HEALTH EFFECTS

PM-10 stands for particulate matter less than 10 microns in diameter. For comparison a human hair is about 70 microns in diameter. The National Ambient Air Quality Standard (NAAQS, or federal standard) for PM-10 was set July 1, 1987 at 150 micrograms per cubic meter ($\mu g/m^3$) for the 24 hour standard. Levels for the PM-10 standard were selected to help the people who may be sensitive to exposure to airborne particulate matter. (OAQPS 2005)

Particles less than 10 microns are usually inhaled and retained in the deepest part of the lungs. Children, the elderly, those with cardiovascular and respiratory problems, and those with influenza are especially susceptible to increased respiratory problems and illnesses due to exposure to high levels of PM-10. In addition, some PM-10 sources emit particles which contain toxic and carcinogenic compounds.

Wood smoke, which is a major contributor to the high PM-10 levels of Mammoth Lakes, includes several air pollutants aside from PM-10 that contribute to the health effects problems. These are carbon monoxide, hydrocarbons and polycyclic aromatic hydrocarbons (PAH's). Wood burning is a major source of PAH's which has been identified as a class of compounds containing carcinogens (Davis and Read 1989). Particulate matter from wood smoke is largely composed of particles less than 2.5 microns or PM-2.5. Due to the smaller size of smoke particles, exposure to PM-2.5 poses additional health risks to sensitive populations at lower concentrations than PM-10.

1.3 AREA DESCRIPTION AND POPULATION

The Town of Mammoth Lakes is located on the eastern slopes of the Sierra Nevada mountains at an elevation of 7,861 feet (2,396 m). Figure 1-1 shows the relative location of Mammoth Lakes. The Town was incorporated in 1984 and has grown from a permanent population of 4,785 in 1990 to 8,234 in 2010. Included in the Town boundaries is Mammoth Mountain ski area which attracts about 1.2 to 1.5 million skiers each winter. During major winter weekends there are about 35,000 people in Mammoth Lakes. It is anticipated this figure will grow to about 45,000 to 52,000 people by 2025 (Town of Mammoth Lakes, 2007a).

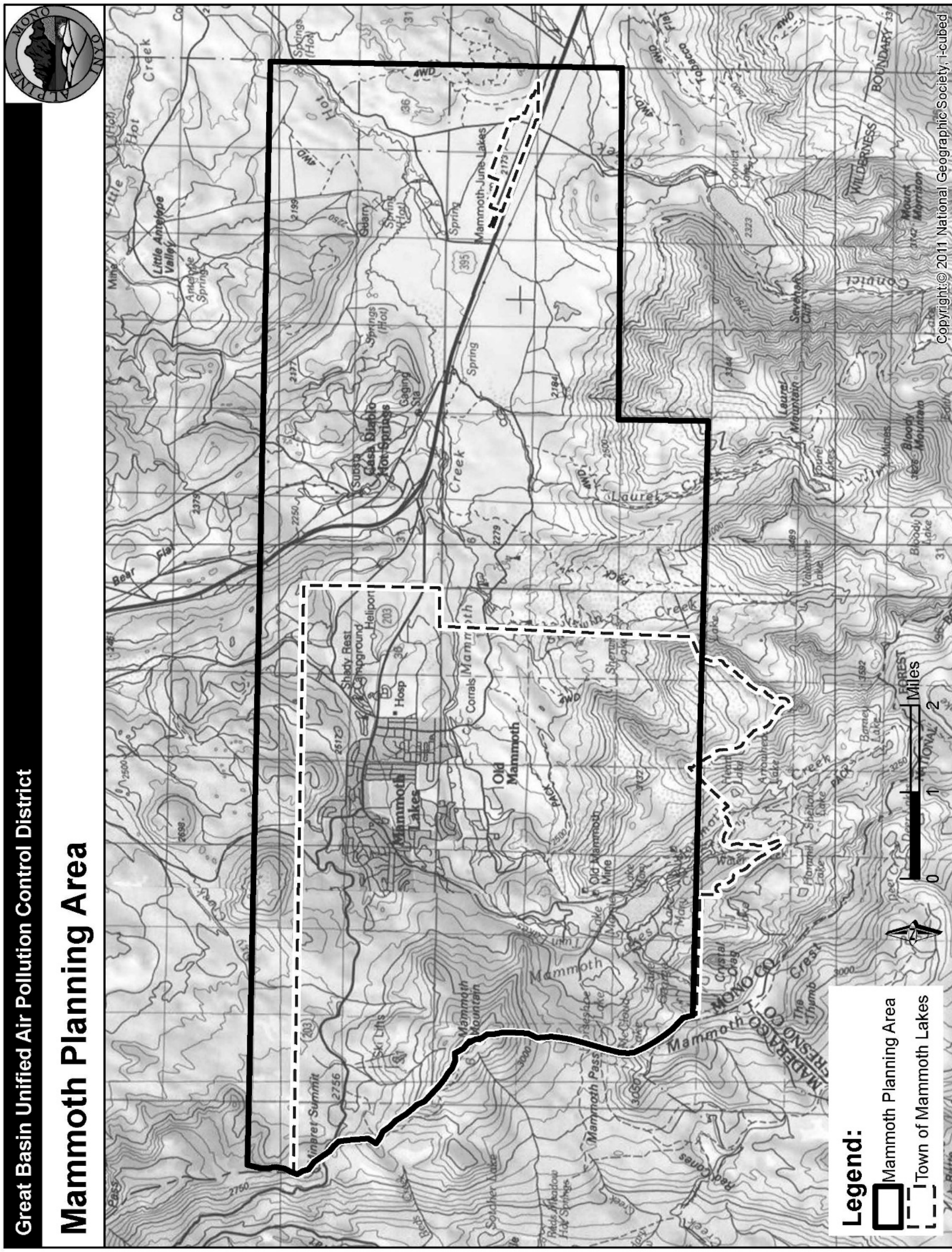
Most homes and rental units in Mammoth Lakes contain woodstoves or fireplaces. Temperature inversions during the winter season cause a buildup of wood smoke in the lower elevations of the town. In addition to wood smoke, particulates generated from re-suspended road dust and cinders that are applied to roadways during snowstorms can add significantly to PM-10 levels after these roads dry. The combination of road dust, wood smoke and meteorological stagnations, especially during peak periods of the ski season, has been associated with elevated PM-10 in Mammoth Lakes.

1.4 BOUNDARIES OF THE PM-10 PLANNING AREA

The U.S. Environmental Protection Agency identified the boundaries in Figure 1-2 as the initial designation for the Group I area or Planning Area. Through the course of the development of this document it was determined that the boundaries for the Town of Mammoth Lakes are more appropriate for the PM-10 Planning Area. This is justified by the lack of significant sources outside the Town boundaries. The shrinking of the planning area boundaries is not expected to have any significant effects on the adequacy of the SIP, since all the sources affected by the controls discussed in the SIP are inside the Town boundaries.

Figure 1-1 Mono County, CA boundary and Mammoth Lakes vicinity.

Figure 1-2 Mammoth Lakes Planning Area



1.5 NEED FOR PLAN UPDATE

In the 23 years since the adoption of the 1990 AQMP, the conditions pertaining to PM-10 in Mammoth Lakes have changed significantly. This AQMP update addresses improved air quality in Mammoth Lakes; a revised General Plan for the Town of Mammoth Lakes; updated traffic modeling for the Town; an updated chemical mass balance study; revisions to the GBUAPCD Rules; and a request to have Mammoth Lakes redesignated as attainment for the federal PM-10 standard.

1.5.1 *Redesignation Requirements*

As a result of the significant air quality improvements following the implementation of the 1990 AQMP, Mammoth Lakes has not exceeded the federal standard for PM-10 since 1994. With that success and the projected maintenance of air quality through adopted implementation measures, the Great Basin Unified Air Pollution Control District recommends that the CARB request that the EPA redesignate the Mammoth Lakes Planning Area to attainment. To be formally redesignated to attainment, the AQMP must demonstrate that:

- The area has monitored attainment of the air quality standard;
- The area has a fully approved State Implementation Plan;
- The U.S. EPA has determined that the improvement in air quality is due to permanent and enforceable reductions in emissions; and
- The state has submitted, and U.S. EPA has approved, a maintenance plan for the area.

This update to the AQMP fulfills the requirements for redesignation. It incorporates the latest monitoring data from Mammoth Lakes showing that the Planning Area has attained the federal standard for PM-10. The Plan includes existing and proposed measures to maintain PM-10 levels below the federal NAAQS for the next 10 years and beyond. It incorporates an updated vehicle miles traveled (VMT) analysis, residential wood combustion device inventory, and revised community growth estimates from the 2007 Town of Mammoth Lakes General Plan.

2. 1990 AQMP Summary

2.1 DEVELOPMENT OF THE PLAN

In 1987, the Town of Mammoth Lakes (Town) and the Great Basin Unified Air Pollution Control District (APCD) began developing a plan to reduce air pollution from fireplaces, woodstoves and dust caused by vehicles traveling on roads treated with volcanic cinders. The cinders were applied as an anti-skid material on roads during the winter and became airborne when the roads dried. The Town and the APCD worked with an *ad hoc* advisory committee representing local businesses, government agencies, health professionals and the general public to develop an air pollution control strategy. In 1990, this strategy was adopted as the Air Quality Management Plan (AQMP) for the Town of Mammoth Lakes. (Ono, *et al.*, 1990)

2.2 PLAN SUMMARY

The AQMP relied on controlling wood smoke by replacing old wood stoves and fireplaces with cleaner wood burning appliances and curtailing wood burning on days that could violate the air quality standard. The Town reduced road dust emissions by using vacuum street sweepers to remove volcanic cinders soon after the roads dried and through promotion of increased transit usage. After adoption of the AQMP, monitored air pollution levels dropped significantly in Mammoth Lakes.

The federal air quality standard for particulate matter is measured as PM-10 and PM-2.5, which stands for particulate matter less than 10 microns and 2.5 microns in diameter. The AQMP was based on reducing PM-10 emissions to meet the federal 24-hour average standard of 150 $\mu g/m^3$. After the adoption of the AQMP in 1990, three exceedances of the federal PM-10 standard were monitored in the first year. Following that only one exceedance of the federal PM-10 standard was measured in 1991 and none were measured in 1992 and 1993. The last measured exceedance of the federal PM-10 standard was monitored in 1994 (Table 2-1).

Although the federal standard for PM-10 is currently being met, the more stringent California Ambient Air Quality Standard for PM-10 is still violated in the Town. The state 24-hour average PM-10 standard is set at 50 $\mu g/m^3$. Violations of the state standard have declined significantly since the adoption of the AQMP. As seen in Table 2-1, the number of monitored state standard violations was as high as 56 days in 1993. Over the last four years (2009-12) the number of state standard violations has ranged from four to 31 per year.

At the time of adoption, the Town's wood smoke and street sweeping control measures were the most stringent in the state. Since then, other areas have recognized the success of these measures and adopted similar control requirements for their areas.

PM-10 emission projections and air quality monitoring show that the adopted wood smoke and road dust control measures succeeded in bringing the area into attainment with the federal PM-10 standard. Additional measures; however, will be needed to meet the state PM-10 standard.

2.3 1990 CONTROL MEASURES

2.3.1 *Wood Smoke*

The 1990 Air Quality Management Plan relied on regulations for reducing PM-10 emissions from wood smoke by limiting the number of wood burning appliances to one EPA certified woodstove per dwelling, requiring change-outs of non-EPA certified woodstoves and fireplaces upon resale of a home or dwelling and by instituting no-burn days on days that could violate the standard. The plan also included a public awareness program to encourage compliance with no-burn days.

2.3.2 *Wood Stove & Fireplace Change-outs*

In 1990, it was estimated that there were 5,946 woodstoves and fireplaces with less than 1% of those being EPA-certified. To reduce wood smoke emissions, it was required that upon resale of a property any fireplace or non-EPA certified woodstove must be replaced with an EPA Phase II certified wood stove or a pellet stove. As an alternative to replacement, non-EPA certified wood burning appliances can also be removed or otherwise rendered inoperable. .

2.3.3 *Public Awareness Program.*

The Town has a public awareness program to educate residents and visitors about the air pollution problem in Mammoth Lakes. During the winter, daily weather reports include a “red-yellow-green” burn day call to alert people to the no-burn day status for residential wood burning. Because about 80% of the people in town during the winter are visitors, they must be educated on a daily basis about the air pollution problem and the no-burn day program. The Town's public awareness program includes:

- Daily radio and TV announcements of red, yellow or green burn days, including a no-burn day ticker on the local public access TV channel,
- Newspaper advertisements with the (760) 934-1010 burn day status phone number,
- Newspaper articles about local air pollution and no-burn days,
- Tent cards and pamphlets for visitor rooms providing burning information, and
- Woodburning handbooks published by the California Air Resources Board.

2.3.4 *No-burn Days.*

No-burn days are called when a meteorological inversion and calm wind conditions could persist for a given day. The calm air prevents the dilution and transport of air pollutants and allows PM-10 concentrations to build up in the evening from about 4:00 PM to midnight and then again in the morning from 6:00 to 10:00 AM. When calm weather is predicted, the Town's meteorologist may call a mandatory or a voluntary no-burn day based on the strength of the forecasted inversion and the population in town. The meteorologist indicates if it is a red, yellow or green burn day to let the public know if it is mandatory or voluntary no-burn day, or if it is okay to burn. Under the 1990 AQMP, appliances meeting the emissions requirements of the EPA were exempted from the no-burn days. Because 85% to 90% of the woodstoves and fireplaces are now EPA certified appliances, pellet stoves, or gas appliances, only a small percentage of the wood burning appliances are now subject to the no burn days. To continue to achieve emission reductions, this updated AQMP removes the no burn day exemption for EPA certified appliances.

2.3.5 *Traffic Related Control Measures*

After winter storms, volcanic cinders are spread on the roadways in town to provide additional traction and prevent vehicles from sliding on the icy roads. These cinders are crushed into ever smaller pieces by passing vehicles. When the roads dry, vehicles kick up fine dust from the roadway. In the 1990 AQMP, road dust was found to contribute up to 44% of the PM-10 on days that violated the federal air quality standard. The AQMP relies on vacuum street sweeping to remove the cinders after the roads dry and a limit on traffic volume to prevent the problem from growing with the population. The traffic volume limit was set at 106,600 vehicle miles traveled on any day and is regulated through the approval of new developments by the Town.

2.3.5.1 *Vacuum Street Sweeping.*

The Public Works Director is directed by the regulations to undertake a vacuum street sweeping program to reduce PM-10 emissions resulting from excessive accumulations of cinders and dirt. This program has been running continuously since the adoption of the 1990 AQMP.

2.3.5.2 *Traffic Volume.*

The traffic volume limit in the 1990 AQMP was based on the PM-10 impact in 1990 when daily peak traffic volume was estimated at 66,275 vehicle miles traveled (VMT). The Final Program Environmental Impact Report (FPEIR) to support the 2007 Town of Mammoth Lakes General Plan Update estimates the 2004 peak traffic volume at 74,051 VMT for 2004. The FPEIR indicated that unconstrained vehicle traffic could reach 128,270 VMT on peak visitor days by 2024. However, it concluded that through transportation mitigation measures included in the General Plan FPEIR, VMT will not exceed the 106,600 VMT limit (Town of Mammoth Lakes, 2007b).

Since adoption of the General Plan, the Town has developed a revised traffic model. This model includes additional roadway segments and as a result, shows a higher current and future VMT. This AQMP relies on the updated model and the revised VMT numbers. Currently, District rule 431 and Town Ordinance (8.30.110) prohibits the approval of any new development or project that would cause projected vehicle traffic to exceed 106,600 VMT. The Town’s revised traffic model combined with the updated Chemical Mass Balance study will lead to amendments to these regulations. If and when it can be reliably determined that a higher VMT level may be sustained without exceeding the NAAQS, due to restrictions from other emission sources or to refined analytic inputs and/or other methodologies, then the appropriate amendments to the Town's Municipal Code and AQMP may be considered (Town of Mammoth Lakes, 2007b).

2.4 AIR QUALITY IMPACTS

The 1990 AQMP is based on reducing PM-10 emissions to meet the federal standard of 150 µg/m^3 for a 24-hour period. After its adoption, three exceedances of the federal PM-10 standard were monitored in the first year. Following that one exceedance of the federal PM-10 standard was measured in 1991 and none were measured in 1992 and 1993. The last measured exceedance of the federal PM-10 standard was monitored in 1994. Table 2-1 shows the actual number of monitored exceedances and the expected number of exceedances based on the proportion of sample days each year. Note that an expected number of exceedances is not calculated for years when the data capture rate is less than 75% for any quarter. (US EPA, 2014)

Although the federal standard for PM-10 is currently being met, the more stringent California Ambient Air Quality Standard for PM-10 (50 µg/m^3) is still violated in Mammoth Lakes. The number of monitored state standard violations was as high as 88 in 1990, the year the plan was adopted, but has declined significantly since then. Over the last four years of daily monitoring in the Mammoth Lakes (2009-12) the number of state PM-10 standard violations has ranged from 5 to 46 per year. (US EPA, 2014)

2.4.1 *Projected PM-10 Impacts*

The PM-10 analysis in the 1990 AQMP showed that two scenarios existed that could cause violations of the federal standard. One violation day was dominated by PM-10 from wood smoke (95%), with 5% from road dust, while another violation day was 66% wood smoke and 44% road dust. The control strategy in the plan was designed to bring concentrations on both "design days" down to levels that would meet the standard. Chapter 6 has an updated analysis of PM-10 and PM-2.5 filter samples collected from 2003 through 2011 that shows high PM days are still associated with wood smoke and road dust dominated days, but at concentrations that are below the federal standards.

2.5 1990 AQMP Succeeds in Achieving Federal Attainment

PM-10 emission projections and air quality monitoring show that wood smoke and road dust control measures have succeeded in bringing the Town into attainment with the federal PM-10 standard. Furthermore, as discussed in Chapter 8, the currently adopted control measures are expected to be sufficient to maintain compliance with the federal standard into the future. The Town has been successful in meeting the federal PM-10 standard; however, additional control measures will be needed to meet the more stringent state PM-10 standard.

Table 2-1. Summary of PM-10 air quality standard violations for the Town of Mammoth Lakes

Year	Max PM-10 (µg/m³)	Number of Federal Exceedances (>150 µg/m³)	Number of State Exceedances (>50 µg/m³)	Number of Valid Sample Days	Data Capture OK?	Expected # of Federal Exceedances (>150 µg/m³)	Expected # of State Exceedances (>50 µg/m³)
1990	161	2	14	58	Y	12.6	88.1
1991	134	0	9	48	N	0	68.4
1992	138	0	14	60	Y	0	85.2
1993	178	1	10	59	Y	6.2	61.9
1994	92	0	10	58	Y	0	62.9
1995	122	0	6	58	Y	0	37.8
1996	74	0	4	51	Y	0	28.6
1997	112	0	6	59	Y	0	37.1
1998	106	0	3	37	N	0	29.6
1999*				0	N		
2000*	70	0	3	18	N	0	60.8
2001	134	0	4	48	Y	0	30.4
2002	129	0	4	17	N	0	85.9
2003	74	0	3	86	N	0	12.7
2004	86	0	8	109	Y	0	26.8
2005	85	0	8	92	N	0	31.7
2006	78	0	7	110	Y	0	23.2
2007	67	0	5	115	Y	0	15.9
2008	138	0	17	164	Y	0	37.8
2009	118	0	26	365	Y	0	26
2010	104	0	44	348	Y	0	46.1
2011	128	0	38	360	Y	0	38.5
2012	56	0	5	342	Y	0	5.3

*PM10 monitor site closed for building renovation. AQS data for 1990 - 2001 is 1 in 6 day PM-10 Partisol; 2002 - Oct. 24, 2008 is 1 in 3 day PM-10 Partisol; Oct. 24, 2008 - 2012 is both 1 in 3 day Partisol and daily FDMS TEOM. Source: US EPA Air Quality System (US EPA, 2014)

3. Federal and State Air Quality Standards for Particulate Matter

3.1 FEDERAL PM-10 AND PM-2.5 STANDARDS

On July 1, 1987, EPA revised the NAAQS for particulate matter with a new PM-10 indicator as the basis for the standards (52 FR 24634). The level of the federal PM-10 standard was set at 150 μg/m^3 for a 24-hour average concentration and 50 μg/m^3 for an annual average concentration. The new PM-10 standard replaced the previous standard for total suspended particulates (TSP less than 30 microns in diameter). The change from the TSP standard to PM-10 was in response to updated information from health officials indicating adverse human health effects from the smaller PM-10 penetrating deep into the lower respiratory tract and lung tissue.

In 1997, EPA retained the existing 24-hour and annual PM-10 standard after reviewing the PM NAAQS. However, EPA expanded the PM NAAQS by adding a new PM-2.5 standard based on updated human health research impacts from fine-sized particles 2.5 microns or less in diameter. The PM-2.5 standard was set at 65 μg/m^3 for a 24-hour average concentration and 15 μg/m^3 for an annual average concentration (62 FR 38652).

In 2006, EPA reaffirmed the 24-hour PM-10 standard after reviewing the air quality criteria and PM NAAQS again. EPA concluded that the research "evidence continues to support a 24-hour averaging time for a coarse particulate standard, based primarily on evidence suggestive of associations between short-term (24-hour) exposure and morbidity effects and, to a lesser degree, mortality" (71 FR 61144-64233). However, effective December 18, 2006, EPA revoked the annual average PM-10 standard based on the more recent studies indicating long-term health impacts were mainly related to PM-2.5 exposure. EPA also tightened the 24-hour average PM-2.5 standard by lowering the concentration level from 65 μg/m^3 to 35 μg/m^3 (71 FR 61144-64233).

<table>
<tr><th colspan="6">Table 3-1. National Ambient Air Quality Standard for Particulates*</th></tr>
<tr><th colspan="2">Pollutant</th><th>Primary/ Secondary</th><th>Averaging Time</th><th>Level</th><th>Form</th></tr>
<tr><td rowspan="4">Particle Pollution Dec 14, 2012</td><td rowspan="3">PM-2.5</td><td>primary</td><td>Annual</td><td>12 μg/m^3</td><td>annual mean, averaged over 3 years</td></tr>
<tr><td>secondary</td><td>Annual</td><td>15 μg/m^3</td><td>annual mean, averaged over 3 years</td></tr>
<tr><td>primary and secondary</td><td>24-hour</td><td>35 μg/m^3</td><td>98th percentile, averaged over 3 years</td></tr>
<tr><td>PM-10</td><td>primary and secondary</td><td>24-hour</td><td>150 μg/m^3</td><td>Not to be exceeded more than once per year on average over 3 years</td></tr>
</table>

*U.S. EPA 2013

3.2 CALIFORNIA CLEAN AIR ACT REQUIREMENTS

The California Air Resources Board adopted new state PM standards in June of 2002, responding to requirements of the Children's Environmental Health Protection Act. This Act requires the evaluation of all health-based ambient air quality standards to determine if the standards adequately protect human health, particularly that of infants and children. The subsequent review of the PM standards resulted in the recommendation of more health-protective ambient air quality standards for PM-10 and a new standard for PM-2.5. The new California PM standards became effective in 2003.

Table 3-2. California Ambient Air Quality Standard for Particulates*

Pollutant	Annual Average	24-Hour Average
PM-10	20 $\mu g/m^3$	50 $\mu g/m^3$
PM-2.5	12 $\mu g/m^3$	-

*California Air Resources Board, 2013

3.3 MAMMOTH LAKES PM COMPLIANCE

As discussed in the following section, air monitoring data for Mammoth Lakes shows that the area has been in compliance with the federal PM-10 standard since 1993, when the number of standard exceedances was less than 1.0 per year averaged over three years This compliance status has been maintained continuously since 1993. However, the area continues to violate the more stringent State PM-10 standard.

The Town of Mammoth Lakes is designated as attainment/unclassified for the federal PM-2.5 standard and attainment for the state PM-2.5 standard. These designations also apply to the larger Great Basin Valleys Air Basin, which includes all of Mono, Inyo and Alpine Counties in California. (CARB, 2013)

4. Air Quality Data

The air quality data section covers the ambient particulate matter monitoring and meteorological data. This information is incorporated into the air quality modeling and control strategy analysis along with emissions inventory data that is covered in subsequent chapters of this Plan.

4.1 PM-10 AND METEOROLOGICAL MONITORING SITE

Airborne pollutant and meteorological monitoring are conducted at the Gateway (also known as the Rite Aid/Do-It Yourself) shopping center in Mammoth Lakes. Four types of PM-10 monitors have been used at the monitoring site; a Size Selective Inlet (SSI) and a dichotomous sampler (dichot), which both measure once every six days, PM-10 Partisol, which measures once every 3 days, and a TEOM (Tapered Element Oscillating Microbalance) which provides daily and hourly PM-10 concentrations. The TEOM was often operated with a co-located PM-10 Partisol. Although each monitor is a U.S. EPA approved reference or equivalent method sampler, PM-10 concentration measurements can vary. Due to the 50ºC inlet temperature of the TEOM, particulate matter from wood smoke can volatize and cause the mass measurement to be low as compared to the other PM-10 monitors. TEOM values during periods of heavy wood smoke can be estimated by multiplying the TEOM measured value by 1.8. In 2006, the TEOM was modified to an FDMS (Filter Dynamics Measurement System) TEOM. The FDMS TEOM can account for particulate matter volatilization and provide the correct mass. However, due to operational problems with the FDMS it was replaced with a regular TEOM in 2007. A new FDMS TEOM was installed in November 2008. PM-10 monitor data is not available for 1999 and 2000 because the building that housed the monitor was being renovated. The type of PM-10 monitor used in each year is identified in Table 2-1.

4.2 PM-10 AND DATA SUMMARY

Table 2-1 shows that the Mammoth Lakes Planning Area has not exceeded the federal 24-hour NAAQS since 1994. From 1990 through 1994, five exceedences were recorded. Because of the sampling interval, this equates to an expected total of 21 exceedences with 19 occurring in 1990, prior to the adoption and implementation of the 1990 AQMP. Since 1990, only two exceedances of the 24-hour NAAQS were recorded – one in 1991 and one in 1994.

Although the federal standard for PM-10 is currently being met, the more stringent California Ambient Air Quality Standard for PM-10 is still violated in Mammoth Lakes. The state 24-hour average PM-10 standard is set at 50 $\mu g/m^3$. As seen in Table 2-1, the number of monitored state standard violations was as high as 88 days in 1990, the year the AQMP was adopted. Violations of the state standard have declined since then. Over the last three years (2010-12), the average number of state PM-10 violations was around 30 per year.

4.3 PRE AQMP PM-10 VIOLATIONS

Prior to the adoption of the 1990 AQMP, violations of the 150 µg/m^3 24-hour National Ambient Air Quality Standard (NAAQS) for PM-10 were measured on seven occasions the Gateway Center monitoring site. Because the samples were being measured on a one every six day cycle, the actual number of violations was estimated to be higher. These violations occurred during the winter season 1985-86 through 1988-89. The highest measured PM-10 concentration was 210 µg/m^3. Since 1995, there have been no violations of the 24-hour NAAQS and the highest recorded value was 136 µg/m^3. Monitoring since 1991 has been daily.

The measured exceedances evaluated in the 1990 AQMP occurred during periods of low average wind speed, less than 3.5 mph. Violations primarily occurred on weekends (Friday, Saturday, or Sunday) or during the holiday period around Christmas and New Year's. Data analyzed for this Plan follow that same trend.

4.4 PARTICULATE MATTER TREND

The particulate matter trend has generally shown air quality improvement since the adoption of the 1990 AQMP. Figure 4-1 shows that the trend of quarterly average PM-10 concentrations decreased following the adoption of the AQMP with a leveling over the last 10 years. Figure 4-2, shows that for the winter months (November-March) the average winter and peak winter concentrations were generally downward after control measures were implemented, but have started to increase since 2008.

4.5 PM-2.5 Data

PM-2.5 monitoring at the Gateway Center shows that since 2000, Mammoth Lakes has met the 24-hour and Annual NAAQS for PM-2.5 (35 and 12 µg/m^3, respectively). The 98th percentile and annual average PM-2.5 levels are shown in Table 4-1.

Table 4-1 PM-2.5 Monitoring Results

	98th Percentile Concentration (µg/m^3)	Annual Average
2000	30.8	N/A
2001	36.2	N/A
2002	N/A	N/A
2003	30.5	7.48
2004	24.7	N/A
2005	26.9	N/A

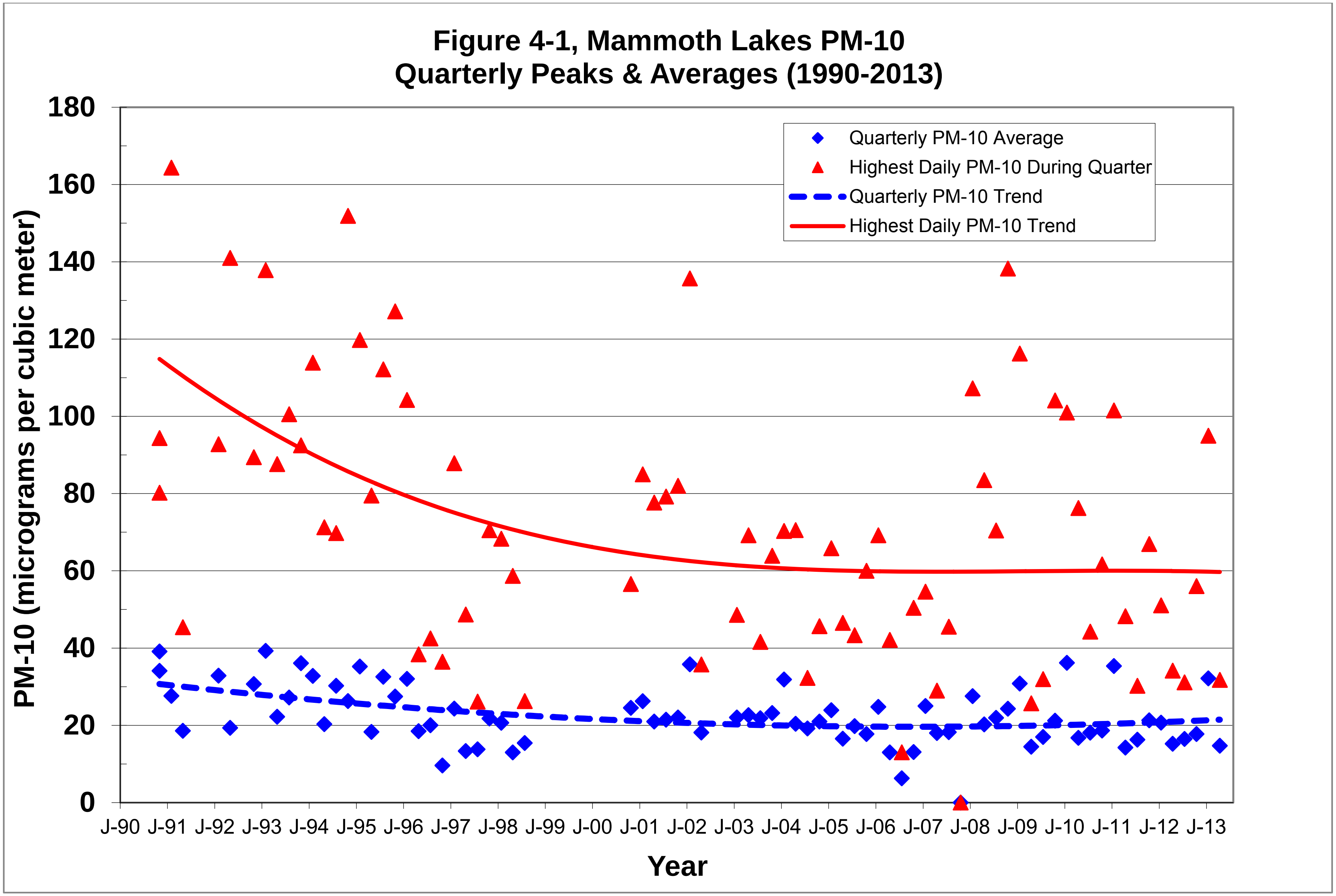


Figure 4-1, Mammoth Lakes PM-10
Quarterly Peaks & Averages (1990-2013)
PM-10 (micrograms per cubic meter)
0
20
40
60
80
100
120
140
160
180
Year
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13
Quarterly PM-10 Average
Highest Daily PM-10 During Quarter
Quarterly PM-10 Trend
Highest Daily PM-10 Trend

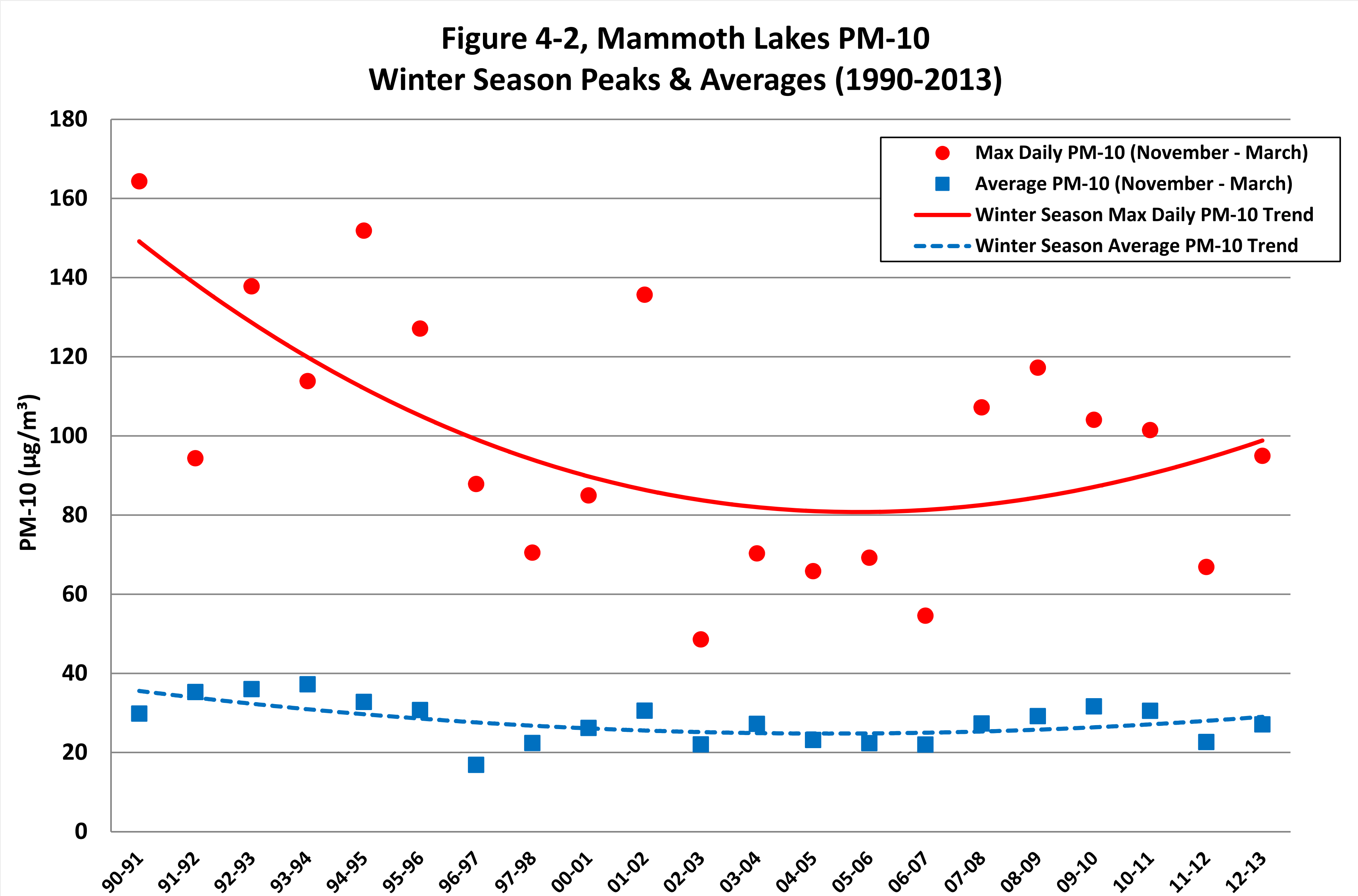


Figure 4-2, Mammoth Lakes PM-10
Winter Season Peaks & Averages (1990-2013)
PM-10 (µg/m³)
180
160
140
120
100
80
60
40
20
0
90-91
91-92
92-93
93-94
94-95
95-96
96-97
97-98
00-01
01-02
02-03
03-04
04-05
05-06
06-07
07-08
08-09
09-10
10-11
11-12
12-13
Max Daily PM-10 (November - March)
Average PM-10 (November - March)
Winter Season Max Daily PM-10 Trend
Winter Season Average PM-10 Trend

5. Emissions Inventory

The emissions inventory section covers the PM-10 emission estimates for residential wood combustion (RWC), resuspended road dust and cinders, mobile source tailpipe emissions and point sources. The methodology and data used to determine emissions is discussed for each source type. Because Mammoth Lakes exceeds the state 24-hour PM-10 standard, the emissions inventory is estimated for a peak 24-hour period. These emission estimates consider the large influx of visitors to Mammoth Lakes during the winter ski season.

Road dust and vehicle emissions are provided separately for traffic within the boundaries of the Town of Mammoth Lakes and for highways 203 and US 395 that are located outside of the Town boundaries. Although vehicle-related emissions from roadways located outside the town are generated within the nonattainment area boundary, PM-10 emissions from areas east of the Town do not contribute to the air quality problem in the Town. An analysis of wind speeds and directions on the high PM-10 days used for the receptor modeling analysis in Chapter 6 shows that 98% of the hourly winds were low (< 2 m/s) and primarily from the west, which would push emissions from areas east of the Town away from the monitor location that was used for the receptor modeling analysis. Therefore, PM-10 emissions from areas outside of the Town boundaries are not considered relevant to the maintenance demonstration in Chapter 8 and were separated from the in-town emission estimates. The areas outside of the Town boundaries are also largely uninhabited public lands, therefore there is an absence of residences that would contribute wood smoke emissions to the emissions inventory. The in-town emissions inventory is considered to be the appropriate inventory for sources that are most likely to contribute to high PM-10 concentrations at the monitor site.

The peak daily emissions inventory for the Mammoth Lakes Planning Area does not include emissions from unpaved road dust or construction activities. Emissions from these sources are seasonal and are absent during the winter when high PM10 concentrations occur. Unpaved roads are either snow covered or muddy during the winter season and outdoor building and roadway construction activities generally do not take place until around May when the weather warms.

5.1 WOODSTOVES AND FIREPLACES

Emission rates for woodstoves and fireplaces are based on the type of wood burner, the type of wood burned, and the usage rate. The usage rate was based on the different burning habits of 1) condominium residents, 2) residents in single-family homes and 3) residents in apartments and mobile homes. Estimates for the annual and 24-hour PM-10 emissions are calculated for wood burning. The annual emissions estimates, which are based on survey data, provide good information to improve the estimates for the peak 24-hour period.

5.2 NUMBER OF WOODSTOVES AND FIREPLACES

The numbers of woodstoves and fireplaces are based on the numbers of condominiums, single-family homes, apartments and mobile homes, and the estimated number of woodstoves and fireplaces in each type of housing. Table 5-1 shows the estimated number of wood burning units from surveys for each housing type in the Planning Area.

Table 5-1, Residential Wood Burning Device Count				
	Condominium	Single Family	Mobile home/ apartment	Total
Fireplaces	264	29	0	293
Woodstoves (EPA)	3,289	1,290	193	4,772
Pellet Stoves	297	87	16	400
Woodstoves (uncert)	116	106	9	231
	3,966	1,512	2,18	5,696

Town of Mammoth Lakes 2013

A partial survey being conducted by the Mammoth Lakes Fire Protection District indicates a higher number of unregulated fireplaces (437 versus 293). The AQMP uses the lower number to maintain a conservative estimate of control measure effectiveness. Replacement of a larger number of fireplaces would create a greater reduction in PM-10 than forecast by this AQMP.

5.3 WOODSTOVE AND FIREPLACE USAGE

The estimate of the amount of wood burned is based on a survey conducted during the winter of 2012 – 2013. The survey was sent to over 6,000 property owners and 4,500 Post Office Box holders in Mammoth Lakes. 574 of the surveys were returned. Table 5.2 summarizes the average amount of wood burned during the winter heating season in homes that have a wood burning device.

Table 5-2, Amount of Wood Burned Annually in Homes With Wood Combustion Devices*					
Condominium		Single-Family		Mobile Home & Apartment	
Wood Burning	Pellet	Wood Burning	Pellet	Wood Burning	Pellet
1.4 cords	2000 lbs	2.4 cords	2400 lbs	2.3 cords	3000 lbs
* Town of Mammoth Lakes 2013					

5.4 ANNUAL PM-10 EMISSIONS ESTIMATE FOR RWC DEVICES

The emission estimates for RWC devices are based on the Environmental Protection Agency's emission factors (US EPA AP 42). These emission factors are based on in situ tests of wood burning devices. Emission factors are given as grams of PM-10 per kilogram of dry wood burned. The emission factors are shown in Table 5-3. This table also summarizes the total emissions for each RWC device and housing type. Emissions for each RWC device are calculated using the following equation:

PM-10 emissions/device = $mass_{wood}$ x EF where:

EF = 16.3 g/kg for uncertified woodstoves and fireplaces
7.3 g/kg for EPA certified woodstoves
2.1 g/kg for pellet stoves

The cord density (800 kg per cord) is assumed for ponderosa pine which has a weight density of 10 kg/ft.^{3} A cord is approximately 80 ft.^{3} wood per cord (Davis and Read, 1989). Based on available data this is the best approximation for the Jeffrey and Lodgepole pine that is primarily burned in Mammoth Lakes. The total number of fireplaces and wood stoves is taken from Table 5-1, but this category is further broken down into uncertified, and EPA-certified based upon the Town of Mammoth Lakes building permit records for change outs and new construction.

The annual emission estimate for PM-10 of 58,663 kg provides a good basis for comparison with a peak 24-hour emission estimate. The 24-hour emission estimate is critical since woodburning is a significant contributor to 24-hour PM-10 standard exceedances.

Table 5-3 Annual PM-10 Emission Estimates for Residential Wood Combustion

		Condominiums			Single Family			Mobile Homes and Apartments			
RWC Device	Emission Factor	Wood/ Pellets	Units	PM-10 kg	Wood/ Pellets	Units	PM-10 kg	Wood/ Pellets	Units	PM-10 kg	Emissions Total (kg)
Fireplace/ uncertified stove[1]	16.3	1.17 cords	380	5,798	2.4 cords	135	4,225	2.3 cords	9	270	10,292
Woodstove (EPA)	7.3	1.4 cords	3,289	26,891	2.4 cords	1,290	18,081	2.3 cords	193	2,592	47,564
Pellet	2.1	900 kg	297	561	1,090 kg	87	199	1,360 kg	16	46	806
				33,250			22,505			2,908	58,663

5.5 24-HOUR PM-10 EMISSIONS ESTIMATE FOR RWC DEVICES

To estimate the peak 24-hour emissions inventory for wood burning, it is assumed that all RWC devices are operating and burn an average of 2.4 ft.^{3} (or 24 kg) of wood per day. The amount of wood burned is based on the information provided through the Town's 2013 wood burning survey. Table 5-4 shows a summary of the estimates for the PM-10 emissions from each type of wood burning device and from different housing types. With these assumptions, it is estimated that RWC devices contribute approximately 850 kg of PM-10 during a peak wood-burning day.

Table 5-4 Peak 24-Hour Emission Estimates for Residential Wood Combustion

		Condominiums			Single Family			Mobile Homes and Apartments			
RWC Device	Emission Factor g/kg	Fuel kg/day	Units	PM-10 kg/day	Fuel kg/day	Units	PM-10 kg/day	Fuel kg/day	Units	PM-10 kg	Emissions Total (kg)
Fireplace/ uncertified stove	16.3	19	380	118	27	135	59	19	9	3	180
Woodstove (EPA)	7.3	19	3,289	456	19	1,290	179	19	193	27	662
Pellet	2.1	9	297	6	11	87	2	14	16	0	8
				579			240			30	850

5.6 24-HOUR PM-10 EMISSIONS ESTIMATE FOR ROAD CINDERS

The PM-10 emission estimate for resuspended road cinders is based on the AP-42 methodology for estimating reentrained road dust emissions from paved roads (US EPA, Compilation of Air Pollution Emissions Factors, AP-42, 1995, updated). The formula for the emissions factor is:

$E = k(sL)^{0.91} \times (W)^{1.02}$ where:

E = Emissions Factor
k = Particle size multiplier
sL = Road surface silt loading (g/m^2)
W = Average weight (tons) of the vehicles traveling the road

The silt loading factor is taken from the calculations in the 1990 SIP and is estimated to be 8.7 g/m^2, Statewide average vehicle weight is 2.4 tons (CARB, 1997), and the particle size multiplier from AP-42 is 1. (US EPA AP-42) This produces an emissions factor of 17.49 grams of PM-10 per VMT. When multiplied by VMT per day, the result is the estimated mass of PM-10 per day from road dust (Table 5-5). Total peak day PM-10 emissions from road dust is estimated at 2,522 kg/day based on peak traffic volume in 2009 within the boundaries of the Town of Mammoth Lakes (see Figure 1.2).

A separate PM10 emissions estimate is provided for road dust generated from traffic on US Highway 395 and the portion of Highway 203 that is outside the Town of Mammoth Lakes boundary. Although emissions in this area are generated within the larger nonattainment area boundary, the emissions from the areas to the east of the Town do not contribute to the air quality problem in the Town. An analysis of the wind speeds and directions on the high PM10 days used for the receptor modeling analysis shows that 98% of the hourly winds were low ($\leq$ 2 m/s) and primarily from the west, which would push emissions from these areas away from the Town. The planning area emissions inventory for road dust emissions were based on the winter 2008-09 vehicle traffic data for Highways 395 and 203 (Caltrans, 2014). This yielded an average of 53,319 vehicle miles travelled per day. Since road cinders are applied to Highways 203 and 395 in the winter the same emission factor used in the Town was applied. This yielded an estimate of 933 kg/day for road dust emissions from areas outside of the Town.

An annual emissions estimate for road dust was not calculated since it is not needed to evaluate compliance with the 24-hour PM-10 standard.

Table 5-5. 24-Hour Road Dust Emissions

Area	Particle Size Multiplier	Silt Loading	Average Vehicle Weight	Emissions Factor g/VMT	2009 VMT*	Total 24-Hr PM-10 (kg)
In-town	1	8.7	2.4	17.49	144,192	2,522
Out-of-town	1	8.7	2.4	17.49	53,319	933

*LSC, 2012a for In-town, and Caltrans, 2014 for Out-of-town

5.7 VEHICLE TAILPIPE, TIRE AND BRAKE WEAR EMISSIONS

PM-10 emissions from motor vehicle exhaust, tire and brake wear were determined by the California Air Resources Board using EMFAC2011 (CARB, 2014) . As discussed for road dust emissions, these emissions were estimated for vehicles operating within the Town of Mammoth Lakes boundary and those that were on Highways 203 and 395 in the portion of the nonattainment area that is outside of the town. Tailpipe, tire and brake wear were calculated to be 0.060 g/VMT in the Town and 0.046 g/VMT outside of the Town. Different emission factors were generated by EMFAC2011 to account for the vehicle speed ranges in-town (0-45 mph) as compared to the higher out-of-town vehicle speeds on highways 203 and US 395 (0-65 mph). Using the daily peak traffic volume of 144,192 vehicle miles travelled for roadways in the Town and 53,319 for the highways 203 and 395 for the remainder of the planning area, the vehicle emissions estimate is 9 kg/day in town and 2 kg/day out of town.

An annual emissions estimate for tailpipe emissions was not calculated since it is not needed to evaluate compliance with the 24-hour PM-10 standard,

5.8 INDUSTRIAL POINT SOURCES

The Great Basin Unified Air Pollution Control District permits industrial sources within the Town of Mammoth Lakes. Those sources produce a total of 8 kg/day during the winter (Table 5-6).

Table 5-6 Permitted Particulate Matter Sources Within the Mammoth Lakes AQMP

Facility: equipment *Indicates facilities located in Town	PM-2.5		PM-10	
	Peak Winter Day (kg/day)	Annual (kg/yr)	Peak Winter Day (kg/day)	Annual (kg/yr)
7/11 Materials: concrete batch plant	NA	1,998	NA	4,147
CA Dept. Fish & Game - Hot Creek: 1 backup engine	0.04	1.6	0.04	1.6
Mammoth Hospital: 7 boilers, 1 fire & 2 backup engines	3.18	1,130	3.18	1,130
Mammoth Mountain*: 4 boilers, 19 backup engines	4.18	130	4.18	130
Mammoth Pacific: 2 engines	0.05	2.4	0.05	2.4
Marzano & Sons: concrete batch plant	NA	1,801	NA	3,740
Monache Condominium*: 1 backup engine	0.05	2.6	0.05	2.6
Verizon (Mammoth H.S.)*: 1 backup engine	0.036	1.9	0.036	1.9
Verizon California - Mammoth Lakes*: 1 backup engine	0.03	1.4	0.03	1.4
Nonattainment Area Total	8	5,069	8	9,157
In-Town Total	4	136	4	136

GBUAPCD, 2014

5.9 SUMMARY OF PM-10 EMISSIONS

Woodburning and resuspended road cinders comprise almost all the PM-10 emissions during the winter. Motor vehicle exhaust, tire and brake wear, and industrial sources contribute approximately 1.4% of the area wide inventory. The current total PM-10 emissions on a peak winter day in the Town of Mammoth Lakes and the larger nonattainment area are summarized in Table 5-7.

Table 5-7. Summary of Peak 24 hour PM-10 Emissions (kg/day) 2012

Source	In Town of Mammoth Lakes	Nonattainment Area Total
Residential Wood Combustion	850	850
Road Dust/Cinders	2,522	3,455
Tailpipe, Tire & Brake Wear	9	11
Industrial Sources	4	8
Total	**3,385**	**4,324**

6. Receptor Modeling

Receptor modeling is based on the idea that the total mass of the receptor (ambient sample) is a sum of the contributions from individual sources. Each source has a unique “fingerprint” of various proportions of chemical elements which comprise it. This fingerprint is expressed in fractions of the total (e.g., 20% potassium, 30% silica, 40% carbon, etc.). Knowing the composition of the ambient sample, and the compositions of the possible sources, one can estimate (using least-squares estimation) the fraction of each source contribution to the total ambient mass. This type of data manipulation is called receptor modeling because it bases its analysis of an air pollution scenario on information gathered at the receptor.

Another air pollution modeling method is dispersion modeling, which starts with precise information about source characteristics, terrain and meteorology to predict the pollutant concentrations at downwind receptor locations. Dispersion models are especially useful in predicting the effects of point source emissions, such as from industrial smokestacks. But their predictive accuracy is strained under low wind speed conditions and situations dominated by emissions from numerous small point sources, such as resuspended road dust and residential wood combustion, the precise conditions that characterize the air pollution problem in Mammoth Lakes.

The receptor model does not directly consider the wind speed or source characteristics, other than chemical composition to determine the ambient impact of sources. So receptor modeling is particularly useful for performing the air quality analysis for the conditions that exist in Mammoth Lakes.

6.1 AMBIENT PROFILES

The Desert Research Institute of Reno, Nevada (DRI) conducted a chemical mass balance (CMB) study for Mammoth Lakes in 2013. DRI analyzed twelve PM-10 and four PM-2.5 filters (dates and concentrations shown in Tables 6-1 and 6-2) for elements and ions. The twelve PM-10 filters included the nine highest and 11th highest PM-10 filter concentration days since 2001, eight of which were since the start of 2008. The other four PM-10 filters are days for which high PM-10 and/or PM-2.5 concentrations were measured and both PM-10 and PM-2.5 filters are available for each day. Three of these four days had the highest PM-10 for days with PM-2.5 filters also. The other day had high PM-2.5 and high PM-2.5 to PM-10 ratios (indicative of large relative wood smoke impact). Because road dust is expected to be mostly in the larger particle sizes and wood smoke mostly in the smaller sizes (PM-2.5) analyzing both PM-10 and PM-2.5 for a few days provided supporting evidence for the estimates based on the PM-10 data. The full report is included as Appendix G.

The chemical analysis included X-ray fluorescence (XRF), which quantified most of the chemical elements, ion chromatography for anions and cations, and light absorption. The XRF analysis provided the contributions from road dust elements, ion chromatography the contributions from sulfate and nitrate, and ammonium. The light absorption measurement is a good indicator of elemental carbon (EC) (diesel exhaust and wood smoke primarily). What the analysis could not identify that is important is organic carbon (OC), because the carbon-based Teflon filters interfere with measurements of carbon associated with the collected particulates. Because of this, organic carbon was estimated from the residual mass in the CMB analysis.

Table 6-1. Dates with only PM-10 filters:

Date	PM-10 concentration
1/1/2008	85.9
2/9/2008	96.7
2/27/2008	95.5
2/21/2009	117.6
1/2/2010	101.3
1/29/2010	104.0
2/13/2010	92.0
1/12/2011	127.6

Table 6-2. Dates with PM-10 and PM-2.5 filters:

Date	PM-10	PM-2.5
12/17/2003	74.6	33.5
1/13/2005	39.3	27.0
1/19/2005	85.1	25.2
1/22/2005	77.8	27.4

6.2 SOURCE PROFILES

6.2.1 *PM-10 analysis*

The chemical source profiles, or fingerprints, were taken from the 1990 AQMP. The sources profiled were:

- Mammoth Lakes road cinder storage
- Mammoth Lakes paved road dust
- idling diesel ski tour buses in Mammoth Lakes
- fireplace burning a typical Mammoth Lakes wood mix
- a Fisher woodstove with typical Mammoth Lakes wood mix

Profiles for Mammoth Lakes woodstoves and fireplaces were used plus road dust and cinders. When running CMB it was found that due to their similar chemical fingerprints, significant collinearity occurred between the wood stove and fireplace sources, giving high uncertainty to wood stove contributions (sometimes significantly negative). CMB was run again not using the wood stove source, just fireplaces, cinders, and road dust. This gave better results. It was attempted to improve results by averaging the wood stove and fireplace profiles, but the quality of the results deteriorated. A weighted average of three parts fireplace to one part wood stove profile was also tried and results were not as good as simply using the fireplace profile.

6.2.2 *PM-2.5 analysis*

The PM-2.5 analysis had collinearity problems between woodstove and fireplace and between road dust and cinders. The analysis with the best results used fireplaces and road dust source profiles only.

6.2.3 *Fitting species*

CMB results can vary significantly based on the choice of fitting species selected. In the initial run, all species measured with available source analysis were used. This gave poor results. Species that were noted from the ambient data to represent the mix of sources were added and subtracted in a trial and error method until the best results were obtained. Attention was paid to squared correlation coefficient, the Chi square statistic and percent of mass explained performance measures (Watson, 2004). The fitting species included: soluble Cl, ammonium, soluble K, total K, Na, Al, Si, S, Ca, Ti, Fe, EC, OC, Ba, Sr, and Zn.

6.3 CHEMICAL MASS BALANCE RESULTS

CMB model version 8 (USEPA) was used to estimate source contributions to PM-10 and PM-2.5 for days with chemically speciated data. CMB analysis done in support of the 1990 Air Quality Management Plan (AQMP, Ono et al, 1990) for Mammoth Lakes showed most of the PM-10 was due to road dust and residential wood combustion (RWC). One of the goals of the 2013 study was to try to determine if the relative contribution of RWC and road dust has changed since the1990 report (DRI, 2013).

Results for the best fitting CMB analysis are shown in Table 6-3. Recommended performance measures (Watson, 2004) are % mass accounted for 100±20%, R-squared>0.80, and Chi-squared < 4.0. For the PM-10 results (discounting the 1/12/2010 sample), 10/11 cases have % mass 100±20%, all cases have R-squared>0.80, and 5/11 meet the Chi-squared <4.0 criteria. For the PM-2.5 results, three out of four met the mass criteria and all four met the R-squared and chi-squared criteria.

The percent of each sample attributed to each source is shown in Table 6-4. On average, residential wood combustion contributed about 64% of the PM-10, road dust plus cinders contributed about 33%, according to the CMB results (DRI, 2013).

Table 6-3. CMB attribution results and performance statistics.									
DATE	SIZE	Conc.	FP	RD	CIND	SUM	% mass	R^2	Chi^2
12/17/03	10	74.6	53.0	9.6	10.2	72.8	97.5	0.94	3.70
01/13/05	10	39.3	31.1	3.6	1.7	36.5	92.7	0.92	3.76
01/19/05	10	85.1	51.8	18.1	11.5	81.3	95.5	0.93	4.39
01/22/05	10	77.8	47.5	16.9	8.7	73.0	93.8	0.94	3.70
01/01/08	10	85.9	53.4	24.6	14.8	92.9	108.1	0.93	4.73
02/09/08	10	96.7	68.0	10.2	13.8	92.0	95.1	0.94	3.35
02/27/08	10	95.5	52.6	26.1	12.7	91.3	95.6	0.90	6.40
02/21/09	10	117.6	91.7	26.6	21.0	139.3	118.5	0.94	3.89
01/02/10	10	101.3	100.4	23.2	19.0	142.6	140.8	0.90	6.88
01/29/10	10	104.0	65.8	24.5	16.8	107.1	103.0	0.93	4.52
02/13/10	10	92.0	68.9	25.9	13.9	108.7	118.2	0.91	6.09
01/12/11	10	127.6	43.9	2.2	1.8	47.9	37.5	0.82	8.77
12/17/03	2.5	40.6	28.6	1.5		30.0	74.0	0.96	0.90
01/13/05	2.5	32.7	27.5	0.6		28.1	86.0	0.81	3.90
01/19/05	2.5	30.5	28.1	2.2		30.3	99.3	0.89	2.73
01/22/05	2.5	33.2	27.6	1.9		29.5	89.0	0.92	2.00

DRI, 2013

Table 6-4. CMB Percent Contributions by Road Dust (RD), and Residential Wood Combustion (RWC) 1987-88 and 2003-2011 Data Sets								
1990 AQMP PM-10 Source Percentages					2013 AQMP PM-10 Source Percentages			
Date	Conc.	RD%	RWC%		Date	Conc.	RD%	RWC%
12/26/1987	125.9	2.3	97.7		12/17/2003	74.6	25.3	74.7
12/30/1987	132.8	1.3	98.7		1/19/2005	85.1	33.7	66.3
12/31/1987	142.8	2.5	97.5		1/22/2005	77.8	32.5	67.5
1/1/1988	117.4	10.3	89.7		1/1/2008	85.9	39.5	60.5
1/22/1988	143.8	33.7	66.3		2/9/2008	96.7	24.3	75.7
1/23/1988	157.8	41.2	58.8		2/27/2008	95.5	39.4	60.6
2/3/1988	104.3	31.5	68.5		2/21/2009	117.6	32	68
2/5/1988	148.2	33.8	66.2		1/2/2010	101.3	27.7	72.3
2/6/1988	160	31.2	68.8		1/29/2010	104	36	64
2/13/1988	137.6	38.8	61.2		2/13/2010	92	33.8	66.2
2/14/1988	144	45.2	54.8					
2/19/1988	148.5	28.7	71.3					
1987-88 study average		25	75		This study average		32.4	67.6

DRI, 2013

For the winter 1987-1988 study (Ono et al, 1990), on average, fireplaces contributed 75% of the PM-10 and road dust 25%. Table 6-4 compares the results of the 1987-88 study to this study. Three of the days in the 1987-88 study showed wood smoke contributing >95% of the PM-10; the current study shows no high PM-10 days with greater than 75% of the PM-10 contributed from wood smoke (DRI, 2013).

Furthermore, the peak contributions of road dust and residential wood combustion to PM-10 appear to have diminished. A comparison of the results from the 1987-88 study to the 2008-2010 study period showed that the average PM-10 contributions for the top three days in each study dropped from 107 to 72 $\mu g/m^3$ for wood smoke and from 72 to 56 $\mu g/m^3$ for road dust. This represents about a 33% reduction in the ambient PM-10 concentrations for both source categories that can be attributed to the implementation of the 1990 AQMP. (DRI, 2013).

6.4 CHEMICAL MASS BALANCE SUMMARY AND CONCLUSIONS

The question of the relative contributions of wood smoke and road dust to PM-10 in Mammoth Lakes was considered. Teflon filters from high PM-10 days between 2003 and 2011 were subjected to chemical analysis with XRF, ion chromatography, and filter light absorption. Four days analyzed also had PM-2.5 filters that underwent chemical analysis. A major limitation was the inability to measure carbon on the filters. The filter light absorption provided a reasonable estimate of elemental carbon and the unexplained mass (on average 58% of PM-10 and 68% of PM-2.5) was assumed to be organic mass (OC*1.8). Estimates of the contribution of wood smoke and road dust were made using Chemical mass balance and a simple method based on abundance of crustal elements in the samples. For PM-10, CMB showed an average of 32% due to road dust and 68% due to residential wood combustion. This compares to 25% from road dust and 75% from residential wood combustion for the winter 1987-88 study. The CMB maximum contributions (average of three highest days) to PM-10 from road dust and residential wood combustion dropped by about 33% for each source category between 1987-1988 and 2008-2010 (DRI, 2013).

7. Control Measures

In December of 1990, the Town of Mammoth Lakes adopted the Air Quality Management Plan (AQMP) for the Town of Mammoth Lakes. The AQMP relied on controlling wood smoke by replacing old wood stoves and fireplaces with cleaner wood burning appliances and curtailing wood burning on days that could violate the air quality standard. The Town reduced road dust emissions by using vacuum street sweepers to remove volcanic cinders soon after the roads dried. The 1990 control measures are described in Section 2 and are summarized below. An assessment of their effectiveness follows:

7.1 PARTICULATE EMISSIONS REGULATIONS

As a part of the implementation program, the Town of Mammoth Lakes adopted Municipal Code Chapter 8.30, Particulate Emissions Regulations. Major controls in the Chapter 8.30 regulations were:

- Replacement or removal of existing uncertified residential wood combustion appliances at the time of sale of a property;
- Limit the maximum number of residential wood combustion appliances in new construction to one certified appliance plus one pellet fueled appliance;
- Institute voluntary and mandatory wood burning curtailment days;
- Implement a public education Program;
- Implement a vacuum street sweeping program; and
- Limit peak VMTs to 106,600.

7.2 CONTROL MEASURES OVERVIEW AND EFFECTIVENESS

7.2.1 *Wood Stove & Fireplace Change-outs*

In 1990, there were 5,946 woodstoves and fireplaces with less than 1% of those being EPA-certified. In 2013, the number of wood burning appliances is estimated at 5,696 with approximately 91% of the appliances being EPA certified woodstoves (Town of Mammoth Lakes, 2013)).

Although the number of wood burning appliances decreased by roughly 4% from 1990 to 2013, wood smoke emissions went down by about 50% as a result of replacing old wood stoves and fireplaces with EPA-certified wood stoves, pellet stoves and gas fueled appliances. This reduced wood burning PM-10 emissions on permissive burn days from 2,087 kg/day to 850 kg/day during this same time period.

There are indicators that wood heating has decreased since the adoption of the regulations in the AQMP. Town of Mammoth records through June of 2013 show that of the total of 5,414 change outs between December of 1990 and March of 2013, 577 were replaced with propane fueled appliances. It is expected that this trend will continue as older residences are torn down and replaced or renovated. Many of the older buildings in town have poor insulation and rely on electric heat as their primary heat source.

Occupants of these older residences tend to use more wood as a cost-effective alternative to electricity or propane and the amount of wood needed is higher. As these properties are upgraded, their residential wood combustion use should decline.

Anecdotally, there appeared to be an initial decline in personal fuelwood gathering based on data maintained by the Mammoth Ranger District. (Kusumoto 2007 and 2013) Those records showed a decline of approximately 30% in the volume of wood collected from 1999 through 2007. However, since that time, personal fuelwood gathering has increased. The increase follows the spike in fuel prices in 2007 and the recession beginning in 2008. It also appears to coincide with the slight rebound in peak winter PM-10 levels shown in Figure 4-2.

Since 1990, most new condominiums were approved for construction without woodstoves. Since the adoption of the 2007 General Plan, the Town has prohibited wood burning appliances in new multi-unit developments (Town of Mammoth Lakes, 2007). This prohibition is incorporated in the updated Chapter 8.30 of the Mammoth Lakes Municipal Code.

To enforce the change out requirements, the Town of Mammoth Lakes worked with local real estate agents to assure that the seller requirements were disclosed. It also instituted a program that permitted purchasers to assume responsibility for completing the change out provided that the assumption was in writing and filed with the Town. The Town obtained copies of all recorded real estate transactions from the County Recorder and cross-checked those transactions with building permit records to assure that property sales and transfers complied with the Particulate Emissions Regulations. As a result of staffing reductions in the Town, these follow-up programs lapsed in the last five to ten years. The GBUAPCD and the Town have agreed to conduct an inventory of real estate sales for comparison with change out records and to pursue compliance for noncompliant properties.

Although the rule adopted in 1990 limited the installation of solid fuel burning appliances to EPA-certified Phase II woodstoves, EPA has recently created another certification program for EPA Phase II qualified fireplaces and fireplace retrofit devices. Due the Phase II test requirements, fireplaces were not allowed to be tested under the original EPA certification program. They can now be tested under this new program and if the fireplaces or fireplace retrofit devices are listed by the US EPA as Phase II qualified, they will be allowed to be installed in the Town of Mammoth Lakes. This change is codified in the Town of Mammoth Lakes regulations with the adoption of this AQMP (http://www.epa.gov/burnwise/fireplacelist.html#retrofits).

7.2.2 *Public Awareness Program.*

As described in Section 2, the Town implemented a public awareness program beginning in 1990. All components of the program except for the rental unit tent cards continue to be fully implemented. The tent card program has not been maintained in recent years and the Town is now investigating having additional cards printed for visitor accommodations. Restoring the tent card program will aid in getting no-burn day compliance (see below).

7.2.3 *No-burn Days.*

No-burn days are called when a meteorological inversion and calm wind conditions could persist for a given day. The calm air prevents the dilution and transport of air pollutants and allows PM-10 concentrations to build up from about 4:00 PM to midnight and then again from 6:00 to 10:00 AM. When calm weather is predicted, the Town's meteorologist may call a mandatory or a voluntary no-burn day based on the strength of the forecasted inversion and the Town's population. The meteorologist indicates if it is a red, yellow or green burn day to let the public know if it is mandatory, voluntary or if it is okay to burn.

At the beginning of the program, 10 to 14 mandatory no-burn days were called each winter. Over the past six winters, the Town has averaged one mandatory and one voluntary no-burn day per winter (Daugherty, 2013). A survey of a residential neighborhood and a condominium complex, which was primarily occupied by visitors, showed that full-time residents did not comply with the no-burn day calls, while visitors were more responsive, but not fully compliant (Satterfield, 1994a). The survey showed a negative 36% compliance rate for residents (more wood burned on no burn days) and a positive 35% compliance rate for visitors. The negative compliance rate for the residents was due to having more residents burn on the no-burn survey days than were burning on the survey days when burning was allowed. Since the resident population in the survey was small, the negative value is likely within the statistical uncertainty of the survey and the compliance rate for full-time residents should be considered around zero. Because visitors make up 80% of the population, they had a significant influence on the overall town average. The combined town average with visitors and residents is about 21% compliance on no-burn days (Satterfield, 1994a). This is short of the expected 50% compliance rate that was expected in the plan. There have been no compliance checks for no-burn days since the 1994 study. The effect of the no-burn day compliance shortfall on air quality trends is evaluated in the Maintenance Demonstration section of this report.

In December 2006, a significant change was made to GBUAPCD Rule 431 to make all wood burning appliances, except pellet stoves, subject to no-burn day requirements. Previous to the rule change, only non-EPA certified wood burning appliances were prohibited from being used on no-burn days. EPA certified wood stoves were exempted from the no-burn days and could still be operated. Since 85% to 90% of the non-EPA certified wood burning appliances had been replaced since the adoption of the AQMP in 1990, the large majority of wood stoves were exempt from the no-burn days. Therefore, the removal of the exemption for EPA certified wood stoves is expected to significantly reduce PM-10 on no-burn days. This change in the exemption will also simplify enforcement of the no-burn days as it eliminates the difficulty of pinpointing non-compliant appliance locations, especially in multi-unit buildings. This rule was adopted by the GBUAPCD and is codified in the Town of Mammoth Lakes regulations with the adoption of this AQMP.

7.2.4 *Traffic Related Control Measures*

After winter storms, volcanic cinders are spread on the Town's roadways to provide additional traction and prevent vehicles from sliding on the icy roads. These cinders are crushed into ever smaller pieces by passing vehicles. When the roads dry, vehicles kick up fine dust from the roadway. In the 1990 AQMP, road dust was found to contribute up to 44% of the PM-10 on days that violated the federal air quality standard. The 1990 AQMP relied on vacuum street sweeping to remove the cinders after the roads dry and a limit on traffic volume to prevent the problem from growing with the population. The traffic volume limit was set at 106,600 vehicle miles traveled on any day and is regulated through the approval of new developments by the Town.

In conjunction with the 2007 update of the Town of Mammoth Lakes General Plan, an updated traffic model was prepared. This new model incorporated additional roadway segments increasing the baseline VMT calculations.

7.2.5 *Vacuum Street Sweeping.*

A test of the effectiveness of the street sweeper showed that PM-10 emissions could be reduced by 68% after use of the Town's Johnson vacuum street sweepers (Satterfield, 1994b). Assuming that it takes two days to clean the heavily trafficked streets, this equates to an overall control efficiency of about 34% for street sweeping. This is consistent with the control efficiency assumption used in the 1990 AQMP. The 34% reduction is also consistent with the CMB analysis that found that ambient PM-10 contributions from road dust have been reduced by 32% from the levels prior to adoption of the AQMP.

7.2.6 *Traffic Volume.*

To provide the most current data for this plan update, the Town of Mammoth Lakes contracted with LSC Transportation Consultants, Inc. for an updated Vehicle Miles Traveled Analysis using a revised traffic model and growth projections from the 2007 Town General Plan.

In 1990 a similar VMT study was completed in combination with the 1990 AQMP. The methodology used in the 1990 study and this VMT study are similar. Both studies are based on a travel demand model that assumes full buildout of the Town’s General Plan in the future. Both studies include all of the Town’s major roadways. The main difference is the extent of the roadways analyzed in each study. The 1990 study had a total of 10.9 miles of roadways on 8 different roads (with 17 segments) for the existing year 1990 VMT, while the future year 2005 had a total of 15.8 miles of roadways on 10 different roads (with 31 segments). In contrast, the updated study’s VMT analysis included 93.1 miles of roadways on 420 different roads (with 1,037 segments) for both the existing and future analysis years (LSC, 2012a)..

To reconcile the VMT estimates, the VMT in the current TransCAD model was estimated for only those roadway segments included in the 1990 study. As shown in the right columns in Table 7-2, a total of approximately 80,586 existing VMT and 110,641 future VMT are estimated on those roadways included in the 1990 study. Of the total existing VMT in the current TransCAD model network (144,192), about 56 percent are reflected on the roadways included in the 1990 study. Similarly, of the total future VMT in the current model (179,708), about 62 percent occur on roadways included on the 1990 study. The remaining VMT occurs on the smaller roads that were not included in the 1990 study. Note that these figures are based on peak-day conditions, consistent with the 1990 study (LSC, 2012b).

The following findings are made regarding the VMT on the roadways included in the 1990 Study:

- Overall, the VMT in Mammoth Lakes has increased from approximately 66,275 in 1990 to approximately 80,856 in 2009 based on the roadway segments evaluated in 1990. This equates to a total increase of approximately 22 percent over 19 years.

- In 1990, the forecast indicated that the existing VMT would increase by more than double (approximately 222 percent) by 2005. Given that the VMT in 2009 was only slightly higher than the VMT in 1990, this high rate of growth has not occurred.

- The 2005 VMT forecasts made in 1990 are much higher than the 2030 forecasts in the current TransCAD model for the same roadway segments, reflecting that the growth rate has decreased since 1990 and future development is expected to occur at a slower rate. Based on the current TransCAD model, VMT on the roadways included in the 1990 study is expected to increase by a total of 37 percent from 2009 to 2030.

- The roadway segments evaluated in 1990 account for 56% of the total traffic on all roadways in the current TransCAD model for 2009 and 62% of the 2030 VMT. The Emissions Inventory in this AQMP uses all the roadway segments identified in the current TransCAD model.

It should be noted that the increase in VMT from 1990 to 2009 was spread over a larger roadway network, with the addition of roads away from the town center. Although the additional roads contributed to an increase in VMT, they also dispersed the road dust emissions over a larger area. This meant that the increase in VMT did not affect monitored PM-10 concentrations at the Gateway Center in proportion to the increase in overall roadway emissions within the town. To account for the VMT change over the current road network, the maintenance demonstration in Chapter 8 re-examines the relationship of VMT using the current traffic model to the ambient impact at the PM-10 monitoring site.

7.3 SUMMARY OF THE EFFECT OF CONTROL MEASURES ON AMBIENT PM-10 CONCENTRATIONS

With the implementation of the control measures from the 1990 AQMP, PM-10 levels in the Town of Mammoth Lakes have declined significantly. The 1990 AQMP estimated 4,253 kg/day of PM-10 for the peak 24-hour period and forecast 8,030 kg/day for the peak 24 hour total PM-10 emissions by 2005 absent any controls. (Ono et al. 1990) The updated emissions estimate shows 3,385 kg/day PM-10 in 2012, which is a 20% reduction in emissions since 1990 when the AQMP was adopted. This reduction was achieved despite a 72% population increase from 4,785 in 1990 to 8,234 in 2010. The reduction in emissions is divided as follows:

Table 7-1. Change in Peak 24-Hour In-Town Emissions 1990-2012

	1990	2012	Difference
RWC devices	1,839	850	-989
Road dust/cinders	2,390	2,522	132
Tailpipe, tire & brake wear	23	9	-14
Industrial (in-Town)	1	4	3
	4,253	3,385	-868

7.4 AMENDMENTS TO 1990 CONTROL MEASURES

Most of the changes to the implementing regulations of the Town of Mammoth Lakes MC 8.30 revise outdated sections or make non-substantive technical edits. The three meaningful amendments are:

- Section 8.30.040 B. This section is modified to clarify that no new wood burning appliances may be installed in multi-family developments. Prohibition of new wood burning appliances in multi-family projects has been the policy of the Town. The proposed revision formalizes that practice and implements General Plan Policy R.10.3.

- Section 8.30.080, Mandatory Curtailment. This section has been modified to include all wood burning appliances, except pellet stoves, in the no-burn day program. Currently, EPA certified stoves are exempted under Town regulations, but are required to participate under the District regulations. This revision eliminates ambiguity between the Town and District regulations and better protects the community's air quality on those days forecast to exceed 130 micrograms per cubic meter.

- Section 8.30.100 B. This section sets a limit for vehicle miles traveled (VMT) within the town. The current limit is one hundred six thousand six hundred (106,600) VMT on any given day. Proposed development projects and other Town approved activities which affect vehicle trips are evaluated against this limit. Projects, programs, or policies which would cause an exceedence of this limit would have to incorporate higher levels of traffic mitigation or potentially be denied. The revised traffic model for the community incorporates additional roadway segments and revises VMT projections based on updated traffic counts and current modeling technologies. It shows and estimated VMT at General Plan buildout of one hundred seventy nine thousand seven hundred eight (179,708) for the revised model roadway segments. The air quality modeling shows that this overall level of traffic will not cause an exceedence of the NAAQS and is suggested as the VMT limit for the AQMP.

The full text of the amended regulations is found in Appendix C.

7.5 ANTI-BACKSLIDING RULE - CAA SECTION 110(l)

Clean Air Act (CAA) Section 110(l) prohibits the adoption of rule revisions that would interfere with attaining the federal standard or making reasonable further progress toward attainment. This is sometimes referred to as the anti-backsliding rule. The rule changes discussed in Section 7.4 were considered in the growth projections for the anticipated town buildout in the modeling analysis in Sections 8.3 and 8.4. That analysis demonstrated the rule revisions will not interfere with the attainment or maintenance of the PM-10 standard and therefore, would comply with the CAA Section 110(l). The modeling projections demonstrated that the highest design day concentrations would peak out at 100.0 $\mu g/m^3$ and 104.8 $\mu g/m^3$ for the high wood smoke and high road dust days, respectively. This is well below the federal standard of 150 $\mu g/m^3$.

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Figure 7-2. Vehicle Miles Traveled (VMT) Comparison

			Estimated VMT in 1990 Air Quality Management Plan Study		2011 TransCAD Model VMT	
Roadway	**From**	**To**	**Existing (1990)**	**Future (2005)**	**Existing (2009)**	**Future (2030)**
SR203/Main Street	Meridian Blvd	Minaret Road	23,625	27,790	25,331	28,373
Lake Mary Road	Minaret Road	Twin Lakes Parking Lot	5,700	11,215	4,526	4,952
Meridian Blvd	Majestic Pines Road	Highway 203	6,650	25,150	13,115	17,967
Old Mammoth Road	Main Street	Ranch Road	11,900	20,635	13,448	16,839
Old Mammoth Road[1]	Ranch Road	Red Fir Rd	-			
Sherwin Creek (Old Mammoth Road Extension)[2]	Old Mammoth Road	South 0.1 miles	-	350	-	-
Forest Trail	Main Street	Minaret Road	1,500	1,500	1,422	3,220
Canyon Blvd	Lake Mary Road[3]	Canyon Lodge Parking	2,400	4,980	1,175	5,982
Lakeview Blvd	Canyon Lodge Parking	Canyon Blvd (East)	5,000	7,100	3,421	3,378
Kelley/Majestic Pines[4]	Lake Mary Road	Meridian Blvd	750	2,800	1,175	1,489
Majestic Pines Extension	Meridian Blvd	Old Mammoth Road	-	3,000	-	-
SR203/Minaret Road	Main Street	Scenic Loop Road	8,750	16,160	9,608	10,878
Minaret Road	Main Street	Old Mammoth Road	-	26,235	7,364	17,564
		Total	**66,275**	**146,915**	**80,586**	**110,641**

Total VMT of all roadways included in the 2011 TransCAD Model	144,192	179,708
Portion of VMT included on the 1990 Study roadways	56%	62%

Note 1: The segment of Old Mammoth Road from Ranch Road to Red Fir Road did not exist in 1990.

Note 2: The Old Mammoth Road Extension is not included in the TransCAD model.

Note 3: In the 1990 VMT Study, Canyon Blvd is assumed to start at Minaret Road, consistent with its previous alignment.

Note 4: The Majestic Pines Extension is not included in the TransCAD model.

Source: LSC Transportation Consultants, Inc. LSC 2012b

8. Maintenance Demonstration

This section will cover the effects of increased population and visitors on PM-10 emissions on ambient PM-10 concentrations. Receptor modeling results from Chapter 6 will be used with design day concentrations and the projected emissions inventory to determine the future ambient PM-10 concentrations that will result from population and visitation growth. All of the emissions and ambient PM-10 projections are based on the in-town emissions inventory, which is the relevant inventory of sources that most likely contributed to PM-10 concentrations measured at the Gateway Center, where the samples were taken for the receptor modeling analysis discussed in Chapter 6. The results of the receptor modeling analysis were used for the proportional roll-back analysis that was applied for this maintenance demonstration.

8.1 EMISSIONS AND POPULATION GROWTH PROJECTIONS

The 2007 Town of Mammoth Lakes General Plan evaluated population in terms of People at One Time (PAOT). PAOT is the number of people in town on a peak winter Saturday. PAOT is expected to grow from 34,265 in 2007 to 52,000 in 2025. 2025 was considered the build out year by the General Plan. With the slowdown in development as a result of the recent recession, actual growth has been substantially less than forecasted. Nonetheless, the buildout number from the General Plan has been used as the year 2030 projected population in both the RWC and VMT analyses. This provides the required 10-year maintenance period with sufficient lead time to allow for redesignation.

Tables 8-1 and 8-2 show the expected PM-10 emissions to growth with continued implementation of existing controls. Table 8-3 summarizes the peak daily PM-10 emissions for each source category for 1990, 2012, and projections to 2030. Note that the vehicle-related emissions for 2012 are based on VMT for 2009 because traffic counts showed there was little change in the average wintertime traffic volume between 2009 and 2013. In 2012, the average winter traffic count on highway 203 the primary route in and out of the Town was about 10% lower than in 2009. (Caltrans, 2014)

Table 8-1. Peak Roadway Emissions Per Day 2012-2030

		2012		2030	
Emission Factor in g/VMT		**VMT**	**Emissions**	**VMT**	**Emissions**
In-town					
Road Dust	17.49	144,192	2,522 kg	179,708	3,143 kg
Tailpipe,Tire & Brake Wear	0.06	144,192	9 kg	179,708	11 kg
In-Town sub-total			2,531 kg		3,154 kg
Out-of-town					
Road Dust	17.49	53,319	933 kg	66,452	1,162 kg
Tailpipe,Tire & Brake Wear	0.05	53,319	2 kg	66,452	3 kg
Out-of-town sub-total			935 kg		1,165 kg
Planning Area Total			3,466 kg		4,319 kg

Table 8-2. Peak Residential Wood Combustion Emissions Per Day 2012-2030				
	2012		2030	
	Devices	Emissions	Devices	Emissions
Non certified stoves & fireplaces	524	180 kg	64	21 kg
Certified stoves	4,772	662 kg	5,569	779 kg
Pellet stoves	400	8 kg	430	8 kg
Total	5,696	850 kg	6,063	802 kg

Table 8-3 Peak Winter 24-hour PM-10 Emissions for Planning Area (kg/day)			
	1990	2012	2030
Residential Wood Combustion	1,839	850	802
Road Dust & Vehicle Emissions (In-town)	2,413	2,531	3,154
Road Dust & Vehicle Emissions (Out-of-Town)	NA	935	1,165
Industrial Sources	1	8	8
Total	4,253	4,324	5,129

VMT projections for 2030 for the out-of-town emissions from traffic on Highways 203 and US 395 assume traffic will increase in proportion to the in-town VMT increase with buildout projections from the General Plan. This is a fair assumption, since these highways are the primary route into and out of the Town of Mammoth Lakes. A secondary bypass route exists, but it receives relatively little traffic. Out-of-town vehicle emissions are not included in the maintenance demonstration in Chapter 8.3, but are included in the transportation conformity budget for the planning area as discussed in Chapter 10.

PM-10 emissions generated in the Planning Area are primarily from wood smoke from residential wood combustion and resuspended road dust. The attainment emissions inventory for Mammoth Lakes is based on estimated daily PM-10 emissions for 2012. Emission estimates for 2012 are typical of emissions in the Planning Area over the 3-year period (2010-2012) when PM-10 compliance was determined from monitoring evaluations. Table 8-3 shows that total peak daily emissions decreased from 1990 to 2012 and are currently estimated at 3,420 pounds per day.

8.2 DESIGN DAY SELECTION FOR AMBIENT PM-10 FORECAST

For air quality planning purposes the design day concentration is the monitored PM-10 concentration that is used to determine if an area is attainment with the federal standard. For PM-10 it is statistically the fourth highest daily monitored concentration measured over the last three calendar years. Since PM-10 was monitored daily at the Gateway Center during 2010-2012, the fourth highest concentration taken from the last three years is the used as the design concentrations. This design concentration can then be used to forecast ambient PM-10 concentrations and future compliance with the federal PM-10 standard (see Chapter 8.3).

Table 8-4 Four Highest Monitored PM-10 Concentrations At Gateway Center, Mammoth Lakes, CA (2010-2012)					
Year	Number of Samples	1st Hi ($\mu g/m^3$)	2nd Hi ($\mu g/m^3$)	3rd Hi ($\mu g/m^3$)	4th Hi ($\mu g/m^3$)
2010	339	101	100	**99**	89
2011	355	102	81	81	79
2012	330	56	53	51	48

Table 8-4 shows the four highest monitored PM-10 concentrations for the three year period from 2010 through 2012. The fourth highest PM-10 concentration from this period, and therefore the design concentration is 99 $\mu g/m^3$ measured on January 2, 2010. It should be noted that all of the monitor values shown in this table were measured during the winter months from December through March, which is consistent with the highest PM-10 days that the AQMP is intended to mitigate.

8.3 PROPORTIONAL ROLL-BACK METHOD FOR CONTROL STRATEGY ANALYSIS

The effect of PM-10 emissions increases or decreases on the ambient PM-10 concentration can be determined by using a linear rollback method of calculation. This method is based on the assumption that the ambient concentration due to a given source is proportional to the emissions from that source. The emissions are based on sources within the boundaries of the Town because they directly impact PM10 concentrations at the monitor site. It should be noted that the following form of the rollback equation includes background PM-10 concentration. The background concentration for Mammoth Lakes is about 5 $\mu g/m^3$ based on the winter time PM-10 data from Simis Ranch a sparsely populated location near Mono Lake, CA (about 20 miles north of Mammoth Lakes). The data was averaged for calm winter days that would be meteorologically similar to days when high PM-10 levels occur in Mammoth Lakes. The background concentration represents an ambient PM-10 concentration that is due to sources that are not accounted for in the emissions inventory, and will not be reduced by local control measures. These background sources may be regional or global in origin.

$$C_T = \Sigma C_i + C_b = \Sigma[C_{di}\ (E_i/E_{di})] + C_b$$

C_T = Total PM-10 concentration
C_b = Background concentration, 5 $\mu g/m^3$
C_i = PM-10 concentration due to source i
C_{di} = Design day source contribution from source i
E_i = PM-10 emissions from source i
E_{di} = Peak PM-10 emissions from source i

As was described in the 1990 AQMP, Mammoth Lakes' air pollution episodes are characterized by two different scenarios. When temperatures are lower, road dust and cinders are bound up in ice and snow and wood heating demands are higher, wood smoke is the dominant contributor to PM-10. When temperatures are warmer, melting snow and drying pavement releases road dust and wood burning demands are lower, road dust comprises a much higher fraction of PM-10. This leads to air pollution episodes that may be dominated by either wood smoke or road dust. The proportional roll-back analysis tested both cases. The results in Table 6-4 were used to estimate the contributions for the two design day PM10 forecasts. The high wood smoke day is based on the sample collected on 2/9/2008, which had 75% of the PM-10 attributed to residential wood combustion with the remainder coming from road dust. The high road dust day is based on the sample collected on 2/27/2008, which had 39% of the PM-10 attributed to road dust and cinders with the remainder coming from residential wood combustion. Due to the lack of evidence in the CMB analysis and their relatively low emissions as compared to road dust and wood smoke, some emission categories were considered negligible for the purpose of the PM-10 forecast. This included emissions from industrial sources, tail pipes, and brake wear.

To determine the ambient source contributions for the two design day scenarios, use the following peak day 2012 emissions for E_{di}:

E_{di} = 850 kg/day for fireplaces and wood stoves
= 2522 kg/day for In-town road dust and cinders
= negligible for all other sources

For the wood burning dominated design day assume 75% of the design day concentration minus background (example, C_{di} = 0.75 x (99 – 5) = 70.5) is due to fireplaces and woodstoves and the remainder is attributed to road dust and cinders:

C_{di} = 70.5 μg/m^3 for fireplaces and wood stoves
= 18.8 μg/m^3 for road dust and tailpipe

Likewise, for the high road dust and cinders design day, assume 39% is attributable to road dust and cinders and the remainder is due to fireplaces and woodstoves:

C_{di} = 57.3 μg/m^3 for fireplaces and wood stoves
= 36.7 μg/m^3 for road dust and tailpipe
=negligible for all other sources

Effective future emission changes on the ambient contributions can be estimated by using emissions data for 2030 as shown in table 8-3 for the variable E_i.

E_i = 802 kg/day for fireplaces and wood stoves
= 3,143 kg/day for in-town road dust and cinders
= negligible for other sources

8.4 EFFECT OF GROWTH ON PM-10 CONCENTRATIONS

These results show that, with current control measures, growth could result in a 0.4% to a 6.5% increase in worst-case ambient PM-10 concentrations over the next 15 years. Table 8-5 demonstrates that no exceedences of the NAAQS for PM-10 are expected through 2050 with existing control measures. This is also shown in Figure 8.1. Tables 8-6 and 8-7 and Figures 8-2 and 8-3 Show the contributions by source for high residential combustion days and for high road dust contribution days.

Table 8-5. Future PM-10 Concentrations for Residential Wood Combustion and Road Dust Design Days

	2012	2030	2050*
High RWC Design Day	99.0 μg/m^3	100.8 μg/m^3	100.8 μg/m^3
High Road Dust Design Day	99.0 μg/m^3	104.8 μg/m^3	104.8/m^3

*Assumes no growth after buildout in 2030

Figure 8-1 Design Day Projection for High Residential Wood Combustion and Road Dust Days

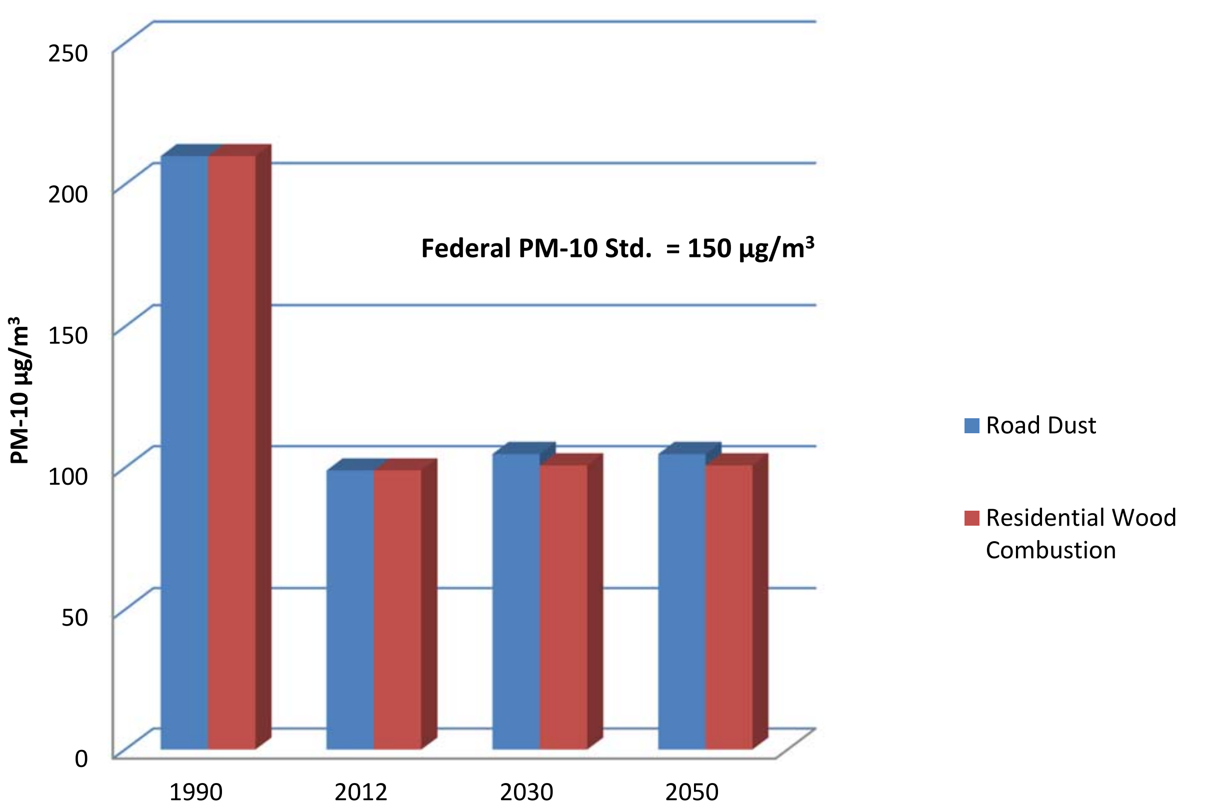


Table 8-6 Forecasted PM-10 Design Day Concentrations by Source for High Residential Wood Combustion Day

Source Category	1990	2012	2030	2050
Background	5 µg/m³	5 µg/m³	5 µg/m³	5 µg/m³
Road Dust	5 µg/m³	23 µg/m³	29 µg/m³	29 µg/m³
Residential Wood Combustion	195 µg/m³	71 µg/m³	66 µg/m³	66 µg/m³
Vehicles*	5 µg/m³	negligible	negligible	negligible
Industrial Sources	negligible	negligible	negligible	negligible
Total	210 µg/m³	99 µg/m³	100 µg/m³	100 µg/m³

Figure 8-2 Design Day Projection for High Residential Wood Combustion Day

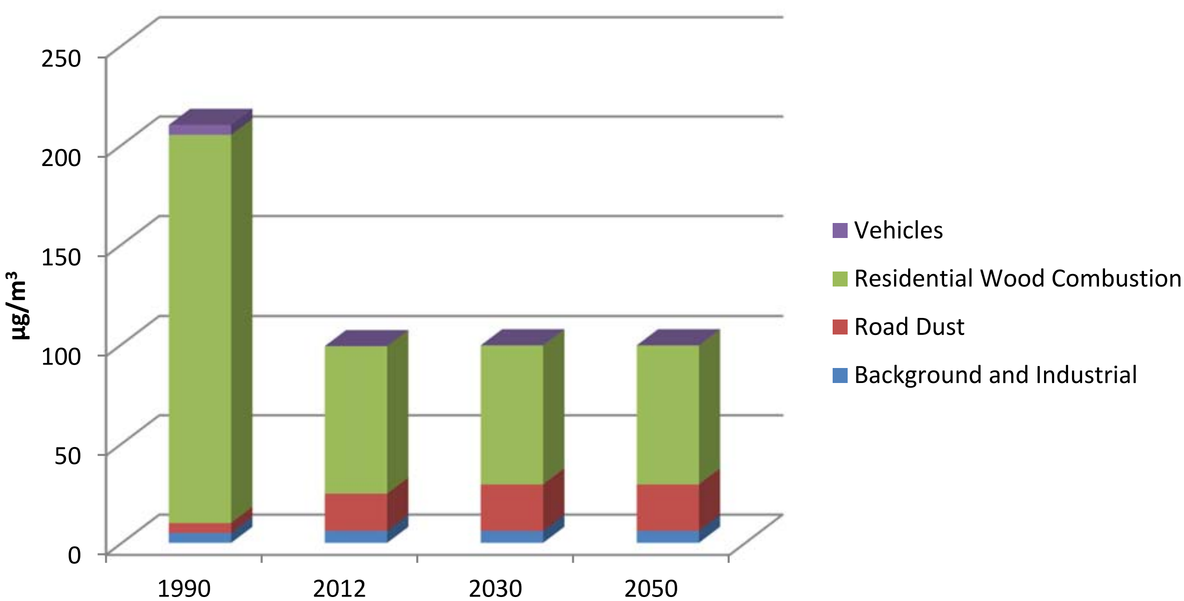
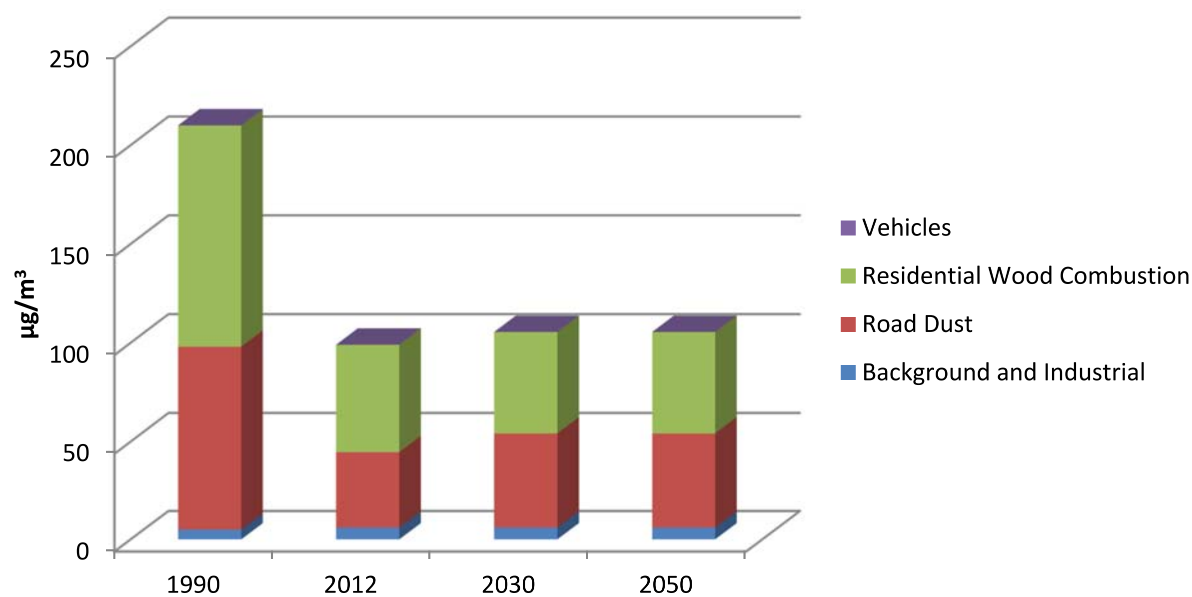


Table 8-7 Forecasted PM-10 Design Day Concentrations by Source for High Road Dust Day				
Source Category	1990	2012	2030	2050
Background	5 µg/m^3	5 µg/m^3	5 µg/m^3	5 µg/m^3
Road Dust	93 µg/m^3	37 µg/m^3	46 µg/m^3	46 µg/m^3
Residential Wood Combustion	112 µg/m^3	57µg/m^3	54 µg/m^3	54 µg/m^3
Vehicles*	negligible	negligible	negligible	negligible
Industrial Sources	negligible	negligible	negligible	negligible
Total	210 µg/m^3	99 µg/m^3	105 µg/m^3	105 µg/m^3

*Vehicle tailpipe and brake wear emission amount to less than 0.3 µg/m^3 except for the 1990 RWC case.

Figure 8-3 Design Day Projection for High Road Dust Day



9. Contingency Plan and Maintenance Measures

9.1 CONTINGENCY PLAN REQUIREMENTS

Section 175A of the Clean Air Act requires that maintenance plans include contingency provisions to assure that any air quality violation of the NAAQS that occurs after the redesignation of the area as attainment is promptly corrected. As per guidance provided by the US EPA, (Calcagni, 1992) the maintenance plan should identify the measures to be adopted and a schedule and procedures for action. This plan takes a two-tiered approach to address contingency measures; 1) to adopt additional measures with this plan to strengthen existing rules and to prevent NAAQS violations, and 2) to commit to adopt additional measures if the standard is violated in the future.

9.1.1 Additional Control Measures Adopted with this Plan

Section 172(c)(9) of the CAA requires that SIPs include contingency measures.

> *Such plan shall provide for the implementation of specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard by the attainment date applicable under this part. Such measures shall be included in the plan revision as contingency measures to take effect in any such case without further action by the State or the Administrator.*

In subsequent NAAQS implementation regulations and SIP approvals/disapprovals published in the Federal Register, the EPA has issued guidance that the contingency measure requirement could be satisfied with already adopted control measures, provided that the controls are above and beyond what is needed to demonstrate attainment with the NAAQS (76 FR 57891). Thus, an already adopted control measure with an implementation date prior to the milestone year or attainment year would obviate the need for an automatic trigger mechanism.

The analysis in this Plan shows that the adopted control measures for the Town of Mammoth Lakes are sufficient to maintain compliance with the NAAQS for PM-10 with a substantial buffer in the event that the measures do not fully achieve the same level of PM-10 reduction going forward that has been achieved to date. The Plan indicates a future design day PM-10 level of 100.8 $\mu g/m^3$ on high residential wood combustion days and 104.8 $\mu g/m^3$ (Table 8-5) on high road dust days. This is 45 $\mu g/m^3$ (30%) lower than the NAAQS of 150 $\mu g/m^3$.

Despite the attainment of the Federal NAAQS, the Town of Mammoth Lakes still exceeds the California 24-hour standard for PM-10. Therefore, this Plan incorporates additional measures to continue to improve the community's air quality.

These measures include amending the Town of Mammoth Lakes Particulate Emissions Regulations to match GBUAPCD Rule 431, requiring all wood burning fireplaces and stoves, whether certified or not, to comply with no-burn days. These additional measures have strengthened the existing rules and were shown by the modeling analysis in Sections 8.3 and 8.4 that the changes will not interfere with attaining or maintaining compliance with the federal standard as required by CAA Section 110(l). Any new facilities in the Planning Area that may emit air pollution will be subject to the District's new source review rules (209-A, 216 and 216-A). Facilities that qualify as a major source under the US EPA federal permitting guidelines will also be subject to federal PSD (Prevention of Significant Deterioration) permitting requirements (40 CFR 51.166 and 52.21).

9.1.2 Commitment for Additional Measures if the Standard is Violated

If a monitored violation of the federal PM-10 standard occurs in the Town of Mammoth Lakes or the surrounding nonattainment area, the Town and the District will investigate the cause of the violation(s). A violation of the standard will be considered to be any exceedance of the PM-10 standard (150 $\mu g/m^3$) that causes the annual average number of exceedances over a three year period to exceed 1.0 days per year; in other words, four or more exceedances in any continuous three year period. The number of exceedances will exclude days that are considered to be exceptional events such as smoke from wildfires, as provided for under the EPA's Exceptional Event Rule. (72 FR 13560)

Within 18 months of the violation, the Town and District will adopt additional control measures needed to meet the PM-10 NAAQS. Depending on the cause of the violation these control measures may include the following:

- Reducing the no burn day trigger threshold from a target of 130 to 100 $\mu g/m^3$, if residential wood smoke is found to be a significant contributor.

- Implementing measures to reduce the use of volcanic cinders or to improve street clean up procedures on roadways during the winter, if road dust is found to be a significant contributor.

9.2 MAINTENANCE MEASURES

CAA Sec 175A and US EPA guidance (Calcagni, 1992) require additional measures in the maintenance plan to track the progress of the plan, and to continue air quality monitoring.

9.2.1 Triennial Progress Reports

The US EPA requires areas to track the progress of maintenance plans. (Calcagni, 1992) This would include updating the emissions inventory, assessing air quality trends and re-evaluating modeling assumptions. The Town and the District will commit to submitting progress reports every third year starting in 2017 to track the progress of the maintenance plan. Progress reports will include an update on PM-10 air quality, a revised peak daily emission inventory for all sources in the planning area, a reassessment of the modeled air quality trend using the modeling assumptions in Section 8.3, and additional information that may be relevant to the air quality program in the Town.

9.2.2 Commitment to Continue PM-10 Monitoring

The District will continue to maintain monitoring network integrity and, with the Town, continue to monitor PM-10 in accordance with 40 CFR Part 58, (1) to verify the attainment status of the area as required by the US EPA (CAA Sec 175A, Calcagni, 1992) and (2) to implement the no burn day program, which relies on daily PM-10 monitoring. Although the intention is to continue monitoring indefinitely in order to implement the no burn day program, the Town and the District will commit to continue ambient PM-10 monitoring for at least 20 years following the redesignation of the area to attainment in order to comply with CAA Sec 175A(b).

9.3 CONTINGENCY AND MAINTENANCE PLAN CONCLUSIONS

The success of the existing control measures demonstrates that PM-10 concentrations have been significantly reduced to a level that contingency measures are not required to maintain compliance with the federal standard. Nonetheless, additional measures have been incorporated into the AQMP to assist in further reductions of PM-10 levels with the goal of improved compliance with the California Ambient Air Quality Standard for PM-10. These additional measures have strengthened the existing rules and as such are consistent with CAA Section 110(l) to avoid adopting measures that would interfere with attainment of the federal standard. The Town and the District will commit to the continuation of the air quality program in the Mammoth Lakes through the implementation of control measures, performing ambient monitoring and providing periodic updates on the progress of the Plan.

10. Transportation Conformity

10.1 BACKGROUND

Transportation conformity is a way to ensure that Federal funding and approval are given to those transportation activities that are consistent with air quality goals. It ensures that these transportation activities do not worsen air quality or interfere with the "purpose" of the SIP, which is to meet the NAAQS. Meeting the NAAQS often requires emissions reductions from mobile sources.

According to the Clean Air Act, transportation plans, programs, and projects cannot:

- Create new NAAQS violations;
- Increase the frequency or severity of existing NAAQS violations; or
- Delay attainment of the NAAQS.

Transportation conformity requirements contained in Great Basin Unified Air Pollution Control District Regulation XII require that federal actions and federally funded transportation projects conform to SIP rules and that they do not interfere with efforts to attain federal air quality standards. Transportation sources were found to contribute to the nonattainment problem in Mammoth Lakes and PM-10 from paved roads. Peak winter-time emissions from road dust and vehicle emissions were estimated at 3,466 kilograms per day in the Mammoth Lakes Planning Area (see Table 8-1). This includes 2,531 kg/day in the Town of Mammoth Lake and 935 kg/day outside of the Town on Highways 203 and US 395. Future PM-10 emission projections for 2030 and beyond is for road dust and vehicle emissions to increase to 3,154 kg/day in the Town and 1,165 kg/day outside of the Town (see Table 8-3).

In terms of transportation plans and transportation improvement programs (TIPs), FHWA/Federal Transit Administration’s joint conformity determination is based on a quantitative demonstration that projected motor vehicle emissions from the planned transportation system do not exceed the motor vehicle emissions budget established in the SIP. If the transportation plan or TIP cannot meet the motor vehicle emissions budget, then changes may be needed to the transportation plan or TIP, or the SIP. If conformity is not determined according to the timeframes established in the regulations, a conformity "lapse" will occur. When conformity lapses, Federal projects may proceed only if they are exempt from transportation conformity (e.g., safety projects), TCMs in an approved SIP, or project phases that have already received funding commitments by FHWA or FTA.

10.2 PLANNING ASSUMPTIONS

Forecasts in this plan are based on the projections in the Town of Mammoth Lakes General Plan. Both growth in VMT and changes in the numbers of residential wood burning appliances assume full build-out of the community at the maximum densities identified in the General Plan. To be consistent with this plan, analyses should be based on projected peak daily wintertime emissions in the Town and average daily wintertime (January-March) emissions on Highways 203 and US 395 outside of the Town, but within the boundaries of the planning area.

Motor Vehicle Emissions Budget

The motor vehicle emissions for in-town traffic is based on the build-out assumptions contained in the Town of Mammoth Lakes General Plan. As set forth in the Mammoth Lakes Vehicle Miles Traveled Analysis (LSC, August, 2012) for the year 2030, traffic volume in Mammoth Lakes will reach 179,708 VMT per day, producing 3,154 kg of PM-10.

Emissions projections for 2030 for out-of-town traffic on Highways 203 and US 395 assume traffic will increase in proportion to the in-town VMT increase with buildout projections from the General Plan. This is a fair assumption, since these highways are the primary route into and out of the Town of Mammoth Lakes. A secondary bypass route exists, but it receives relatively little traffic. For the year 2030 and beyond, average wintertime traffic on these out-of town highways may increase from 53,319 in 2012 to 66,452 vehicle miles travelled per day in 2030, producing 1,165 kg/day of PM-10 emissions.

Combining the in-town and out-of-town future wintertime emissions for 2012 results in an overall motor vehicle emission budget of 3,466 kg per day and for 2030 yields the overall motor vehicle emissions budget for the planning area of 4,319 kg per day. Projects that may result in wintertime emissions in excess of these budgets shall incorporate measures to reduce emissions or revise the AQMP to demonstrate through additional controls or other methods that the increase in emissions will not result in a violation of the NAAQS for PM-10.

11. General Conformity

General conformity is the federal regulatory process for preventing major federal actions or projects from interfering with air quality planning goals. Conformity provisions ensure that federal funding and approval are given only to those activities and projects that are consistent with state air quality implementation plans (SIPs). Conformity with the SIP means that major federal actions will not cause new air quality violations, worsen existing violations, or delay timely attainment of the national ambient air quality standards (NAAQS). Current federal rules require that federal agencies use the emissions inventory from an approved SIP's attainment or maintenance demonstration to support a conformity determination.

General conformity requirements contained in District Regulation XIII require that federal actions and federally funded projects conform to SIP rules and that they do not interfere with efforts to attain federal air quality standards. A conformity determination is currently required for any federally funded (non-transportation) project or action that takes place in a moderate PM-10 nonattainment and maintenance areas that have the potential to exceed a *de minimis* PM-10 emissions threshold of 100 tons per year. In order to maintain the stringency of control requirements in the Mammoth Lakes Planning Area under a maintenance plan, the District will retain the 100 tons of PM-10 per year *de minimis* emissions threshold for triggering a conformity determination as currently required under District Regulation XIII.

12. Redesignation Request

States may ask U.S. EPA to redesignate an area "attainment" if:

- the area has monitored attainment of the air quality standard;
- the area has a fully approved State Implementation Plan;
- U.S. EPA has determined that the improvement in air quality is due to permanent and enforceable reductions in emissions;
- the state has submitted, and U.S. EPA has approved, a maintenance plan for the area; and,
- the area has met all other applicable federal CAA requirements.

As described in Chapter 8, the Town of Mammoth Lakes last exceeded the federal PM-10 24-hour standard in 1994. Attainment of the PM-10 standard is a direct result of the implementation of control measures by the Town of Mammoth Lakes as described in the 1990 Air Quality Management Plan for the Town of Mammoth Lakes.

The daily data collected by the Great Basin Unified Air Pollution Control District in Mammoth Lakes demonstrates that no more than 1.0 exceedances of the NAAQS have occurred over the last three years as is required to demonstrate attainment of the federal standard. In fact, the data show that there have been no exceedances during the last 19 years.

Applying a proportional roll back analysis to the PM-10 present and future emissions this document demonstrates that no more than 1.0 exceedances per year would be expected through the next 20 year planning period and beyond. With continued implementation of the control measures, attainment will be maintained.

The District finds that the Mammoth Lakes PM-10 Planning Area has attained the federal PM-10 standard and requests the California Air Resources Board recommend to the US Environmental Protection Agency that the area be redesignated from nonattainment to attainment with the federal PM-10 standard.

13. References

52 FR 24634. Federal Register, *Revisions to the National Ambient Air Quality Standards for Particulate Matter*, July 1, 1987.

52 FR 29384. Federal Register, August 7, 1987.

62 FR 38652. Federal Register, *National Ambient Air Quality Standards for Particulate Matter*, July 18, 1997.

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Appendix A

Glossary

Glossary

AAQS (Ambient Air Quality Standards): Health and welfare based standards for clean outdoor air that identify the maximum acceptable average concentrations of air pollutants during a specified period of time. (See NAAQS)

Air Pollutants: Amounts of foreign and/or natural substances occurring in the atmosphere that may result in adverse effects on humans, animals, vegetation, and/or materials.

Ambient Air: The air occurring at a particular time and place outside of structures. Often used interchangeably with "outdoor" air.

APCD (Great Basin Unified Air Pollution Control District): The regional agency with authority to regulate stationary, indirect, and area sources of air pollution (e.g., power plants, highway construction, and housing developments) within Inyo, Mono, and Alpine counties, and governed by a district air pollution control board composed of the elected county supervisors and representatives of cities within the district.

AQMP (Air Quality Management Plan): A Plan prepared by an APCD, for a county or region designated as a nonattainment area, for the purpose of bringing the area into compliance with the requirements of the national and/or California Ambient Air Quality Standards. AQMPs designed to attain national ambient air quality standards are incorporated into the State Implementation Plan (SIP).

Attainment: Compliance with the National and/or California Ambient Air Quality Standards (NAAQS OR CAAQS).

CAA (Federal Clean Air Act): A federal law passed in 1970 and amended in 1977 and 1990 which forms the basis for the national air pollution control effort. Basic elements of the act include national ambient air quality standards for major air pollutants, air toxics standards, acid rain control measures, and enforcement provisions.

California Ambient Air Quality Standard: Standards set by the State of California for the maximum levels of air pollutants which can exist in the outdoor air without unacceptable effects on human health or the public welfare. These are generally more stringent than NAAQS.

CARB (California Air Resources Board): The State's lead air quality agency, consisting of a nine-member Governor-appointed board. It is responsible for attainment and maintenance of the State and federal air quality standards, and is primarily responsible for motor vehicle pollution control. It oversees county and regional air pollution management programs.

Emission Standard: The maximum amount of a pollutant that is allowed to be discharged from a polluting source such as an automobile or chimney.

GBUAPCD: The Great Basin Unified Air Pollution Control District.

Indirect Source: Any facility, building, structure, or installation, or combination thereof, which generates or attracts mobile source activity that results in emissions of any pollutant (or precursor). Examples of indirect sources include employment sites, shopping centers, housing developments, airports, commercial and industrial development, and parking lots and garages.

Maintenance Plan: In general, a plan that details the actions necessary to maintain air quality standards. In particular, the federal Clean Air Act requires maintenance plans for areas that have been redesignated as attainment areas.

Mobile Sources: Moving sources of air pollution such as automobiles, motorcycles, trucks, off-road vehicles, boats and airplanes.

NAAQS (National Ambient Air Quality Standards): Standards set by the federal U.S. EPA for the maximum levels of air pollutants which can exist in the outdoor air without unacceptable effects on human health or the public welfare.

Nonattainment Area: A geographic area identified by the U.S. EPA and/or CARB as not meeting either NAAQS or CAAQS standards for a given pollutant.

PM (Particulate Matter): Solid or liquid particles of soot, dust, smoke, fumes, and aerosols.

PM-10 (Particulate Matter less than 10 microns): A major air pollutant consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and aerosols. The size of the particles (10 microns or smaller, about 0.0004 inches or less) allows them to easily enter the air sacs in the lungs where they may be deposited, resulting in adverse health effects. PM-10 also causes visibility reduction and is a criteria air pollutant.

PM-2.5 (Particulate Matter less than 2.5 microns): A major air pollutant consisting of tiny solid or liquid particles, generally soot and aerosols. The size of the particles (2.5 microns or smaller, about 0.0001 inches or less) allows them to easily enter the air sacs deep in the lungs where they may cause adverse health effects, as noted in several recent studies. PM2.5 also causes visibility reduction,

SIP (State Implementation Plan): A document prepared by each state describing existing air quality conditions and measures which will be taken to attain and maintain national ambient air quality standards (see AQMP).

Smoke: A form of air pollution consisting primarily of particulate matter (i.e., particles). Other components of smoke include gaseous air pollutants such as hydrocarbons, oxides of nitrogen, and carbon monoxide. Sources of smoke may include fossil fuel combustion, agricultural burning, and other combustion processes.

Stationary Sources: Non-mobile sources such as power plants, refineries, and manufacturing facilities which emit air pollutants; can include area sources depending on context.

U.S. EPA (United States Environmental Protection Agency): The federal agency charged with setting policy and guidelines, and carrying out legal mandates for the protection of national interests in environmental resources.

VMT: Total vehicle miles traveled by all or a subset of mobile sources.

Visibility: The distance that atmospheric conditions allow a person to see at a given time and location. Visibility reduction from air pollution is often due to the presence of sulfur and nitrogen oxides, as well as particulate matter.

Appendix B

Residential Wood Burning Survey 2013 Summary

<u>Home Heating Survey Summary Report:</u>

Prepared by: Megan Rybacki, Planning Intern

The home heating survey was sent to over 6,000 out-of-town property owners, 4,500 Town P.O. Box holders and 200 private P.O. boxes. Out of these 10,700 property owners and renters there were 574 respondents to the survey. The variety of respondents whom participated in the survey gives the town an accurate snapshot of data that can be used to analyze the community's home heating habits.

Over 85% of the respondents indicated that they owned property in Mammoth Lakes and 75% of these homeowners purchased their homes after the woodstove ordinance was put into effect in 1990. Of the indicated property owners there were 295 condominiums, 178 single family homes and approximately 44% these property owners consider themselves full time occupants during the winter months of November through March. The remaining 15% of the survey respondents indicated that they were renters and 92% of these renters consider themselves full occupants during the winter months of November-March. The rental residence respondents include 30 condominiums, 28 apartments, 27 single family homes and 1 mobile home.

Only 156 (28%) of the survey respondents indicated that a wood burning appliance was their homes primary source of heat. Out of these primary wood burning responses 50% are operating a wood burning appliance and over 25% are operating a pellet burning appliance. 34 people are operating an EPA phase II appliance, while another 34 are operating an EPA phase I appliance, 24 people are operating a fireplace with an insert, and 13 people are operating a non-compliant woodstove or fireplace. The majority of these respondents are using approximately 1-3 cords of wood per average winter season.

Over 77% of the survey participants are using an alternative home heating device as their primary source of heat, including various propane devices as the most specified appliance.

General findings show that 93% of the respondents are only burning dry wood, however 3 respondents admitted to burning their trash. Other poor burning techniques were revealed in this process. Based on these responses and a significant number of respondents whom indicated interest in becoming educated on the proper techniques of burning, I believe that it would be beneficial for the town to produce educational information on burning wise and specify items that are detrimental to the air quality and their home heating appliance when burned.

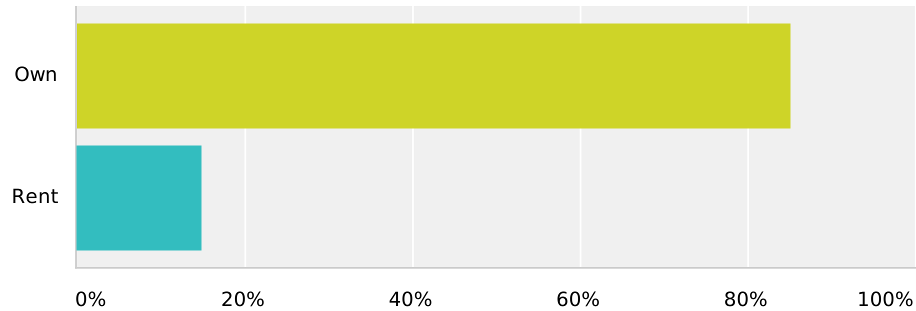
In addition to these findings the Town's cinder "concerns" were validated by many of the respondent's suggestions that the usage and maintenance of cinders used on the town's roadways is a large factor in generating poor air quality. Based on the survey results and the findings that will be identified in the air filter analysis, it could become beneficial for the town to analyze cinder usage and begin to consider other de-icing agents.

Almost 80% of the respondents were aware that the town issues no burning and burning curtailment days. Over 200 full time and part time residents also concluded that they would like to become a part of the Air Quality Notify Me list.

In conclusion of the survey results, gathered changeout data, public outreach strides, and fewer federal air quality regulation compliance issues it is evident that the Town has taken great strides to begin to meet more stringent air quality state regulations. Attached are informative graphs and raw data generated from the survey results.

Q1 Do you own or rent your property in Mammoth?

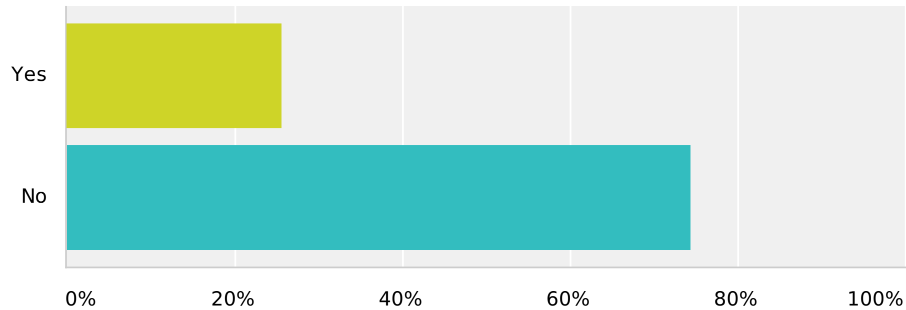
Answered: 572 Skipped: 0



Answer Choices	Responses	
Own	**85.14%**	487
Rent	**14.86%**	85
Total		572

Q2 Have you owned your property since before 1990?

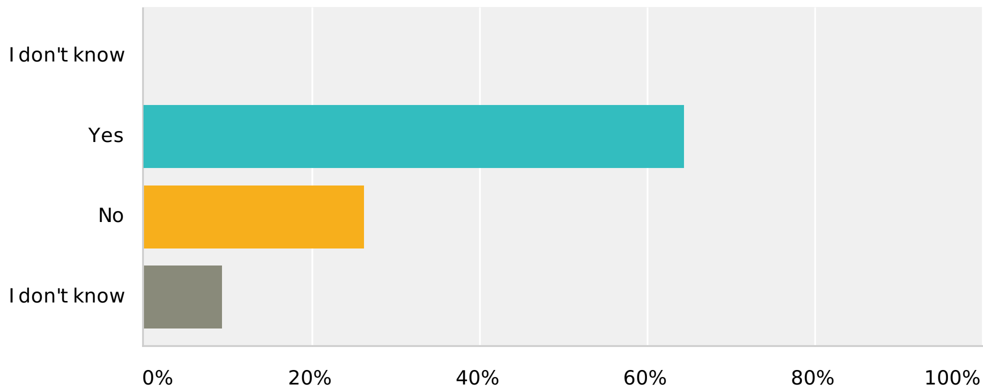
Answered: 484 Skipped: 88



Answer Choices	Responses	
Yes	**25.62%**	124
No	**74.38%**	360
Total		484

Q3 Have you replaced or installed your woodstove or home heating device with a new model after 1990?

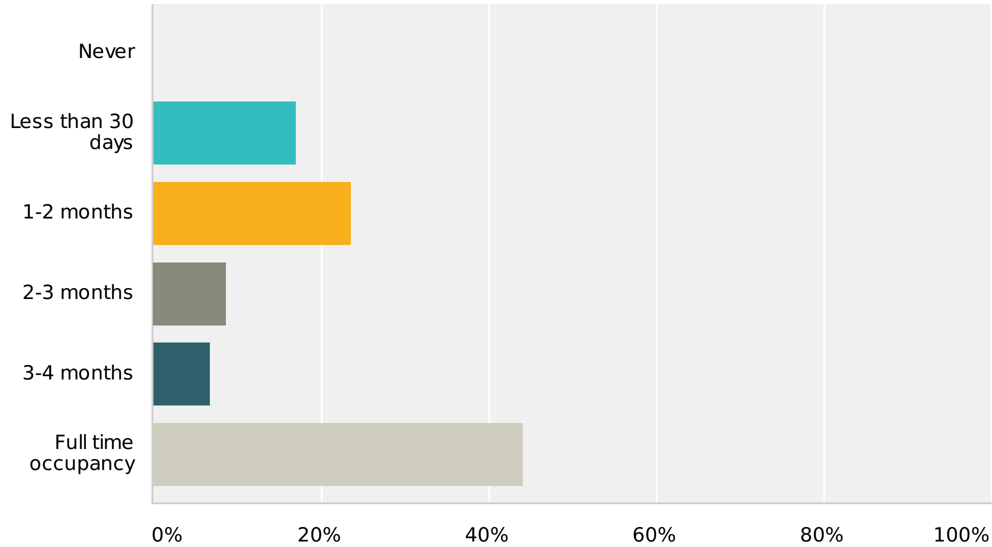
Answered: 484 Skipped: 88



Answer Choices	Responses	
I don't know	**0%**	0
Yes	**64.46%**	312
No	**26.24%**	127
I don't know	**9.30%**	45
Total		484

Q4 How often is your property occupied during November-March?

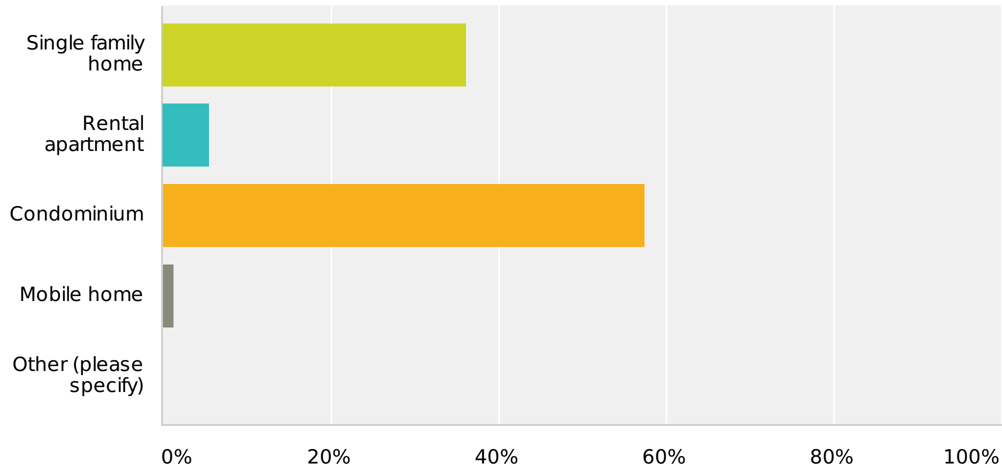
Answered: 565 Skipped: 7



Answer Choices	Responses	
Never	**0%**	0
Less than 30 days	**16.99%**	96
1-2 months	**23.54%**	133
2-3 months	**8.67%**	49
3-4 months	**6.73%**	38
Full time occupancy	**44.07%**	249
Total		565

Q5 What type of residence do you own or rent?

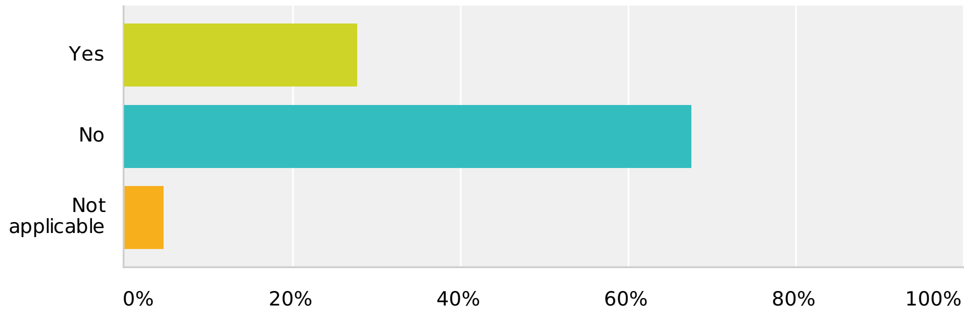
Answered: 564 Skipped: 8



Answer Choices	Responses	
Single family home	**36.17%**	204
Rental apartment	**5.50%**	31
Condominium	**57.45%**	324
Mobile home	**1.24%**	7
Other (please specify)	**0%**	0
Total Respondents: 564		

Q6 Is a pellet or wood burning device your home's primary source of heat?

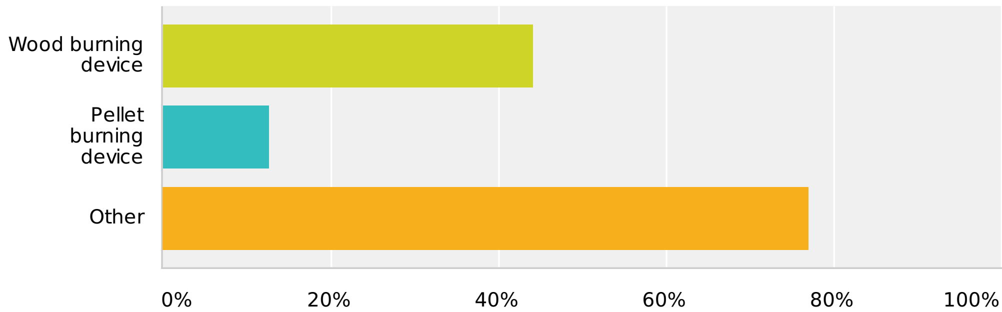
Answered: 562 Skipped: 10



Answer Choices	Responses	
Yes	**27.76%**	156
No	**67.62%**	380
Not applicable	**4.63%**	26
Total		562

Q7 What type of heating device do you use to heat your home? (Please select multiple answers if applicable.)

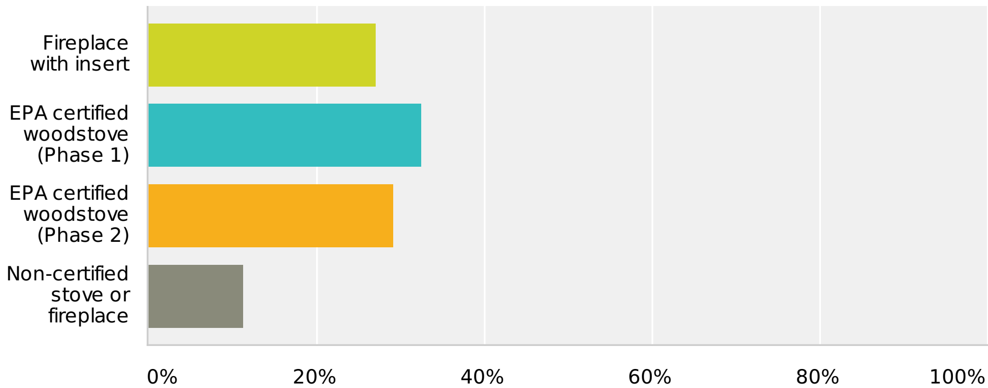
Answered: 562 Skipped: 10



Answer Choices	Responses	
Wood burning device	**44.13%**	248
Pellet burning device	**12.63%**	71
Other	**77.05%**	433
Total Respondents: 562		

Q8 Please identify the type of wood burning appliance you use.

Answered: 240 Skipped: 332



Answer Choices	Responses	
Fireplace with insert	**27.08%**	65
EPA certified woodstove (Phase 1)	**32.50%**	78
EPA certified woodstove (Phase 2)	**29.17%**	70
Non-certified stove or fireplace	**11.25%**	27
Total		240

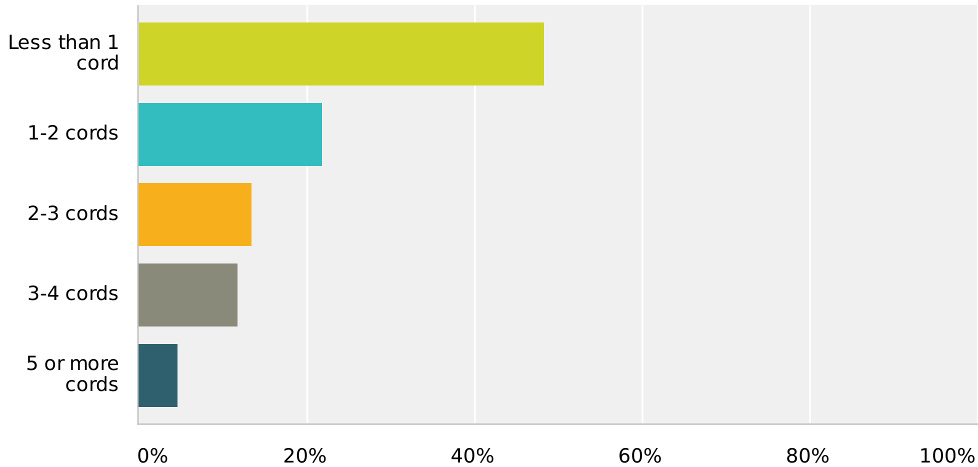
Q9 If you are able, please identify the make and model of your wood burning appliance.

Answered: 107 Skipped: 465

Answer Choices	Responses	
Make:	**97.20%**	104
Model:	**62.62%**	67
Total Respondents: 107		

Q10 How many cords of wood do you burn in an average winter season? (A cord is understood to be 128 cubic ft. of wood or wood stacked to be 4ft x 4ft x 8ft.)

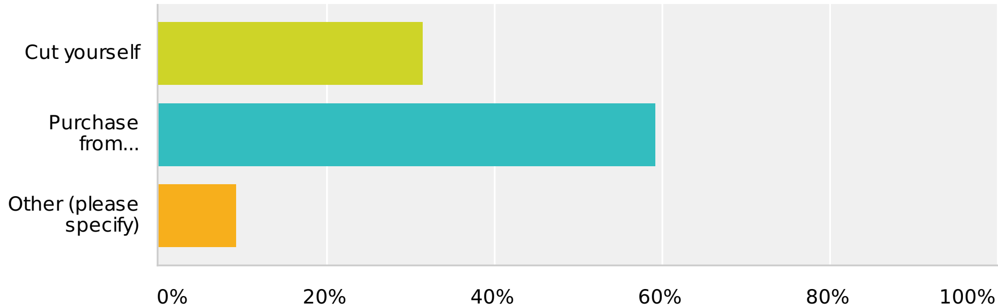
Answered: 238 Skipped: 334



Answer Choices	Responses	
Less than 1 cord	**48.32%**	115
1-2 cords	**21.85%**	52
2-3 cords	**13.45%**	32
3-4 cords	**11.76%**	28
5 or more cords	**4.62%**	11
Total		238

Q11 How do you obtain your firewood?

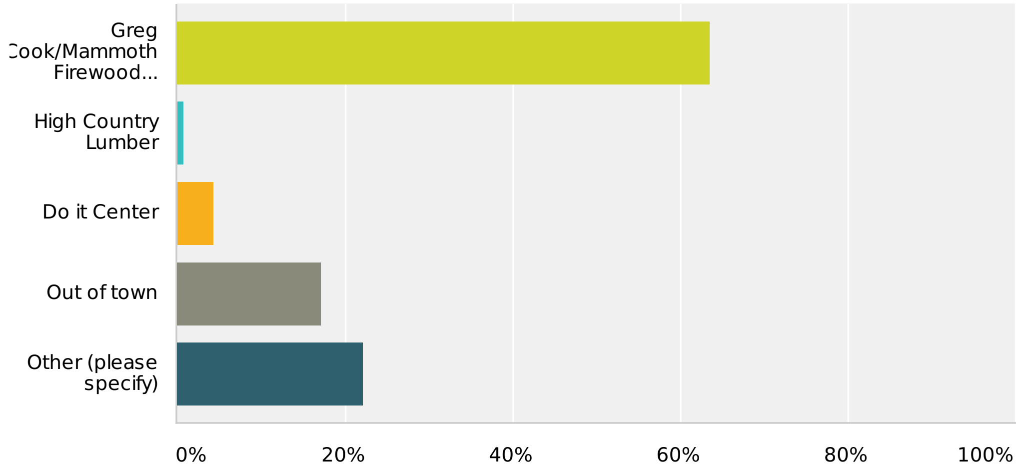
Answered: 238 Skipped: 334



Answer Choices	Responses	
Cut yourself	**31.51%**	75
Purchase from...	**59.24%**	141
Other (please specify)	**9.24%**	22
Total Respondents: 238		

Q12 Where do you purchase your firewood from?

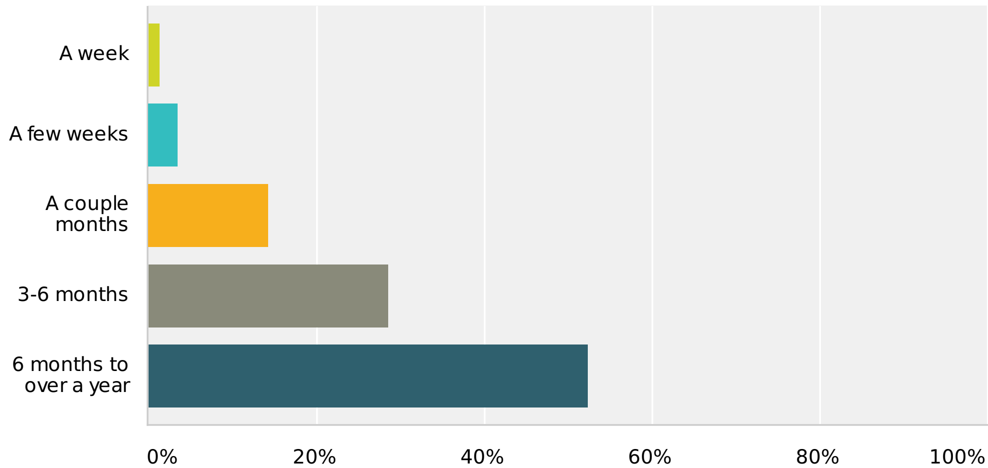
Answered: 140 Skipped: 432



Answer Choices	Responses	
Greg Cook/Mammoth Firewood Company	**63.57%**	89
High Country Lumber	**0.71%**	1
Do it Center	**4.29%**	6
Out of town	**17.14%**	24
Other (please specify)	**22.14%**	31
Total Respondents: 140		

Q13 How long is your wood seasoned before you burn it?

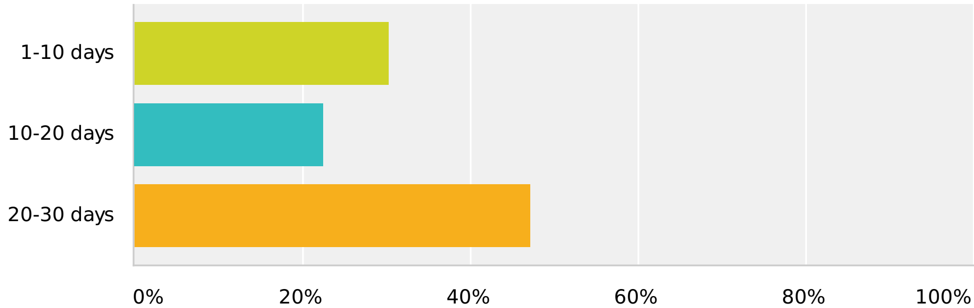
Answered: 231 Skipped: 341



Answer Choices	Responses	
A week	**1.30%**	3
A few weeks	**3.46%**	8
A couple months	**14.29%**	33
3-6 months	**28.57%**	66
6 months to over a year	**52.38%**	121
Total		231

Q14 How many days do you burn wood during a typical winter month?

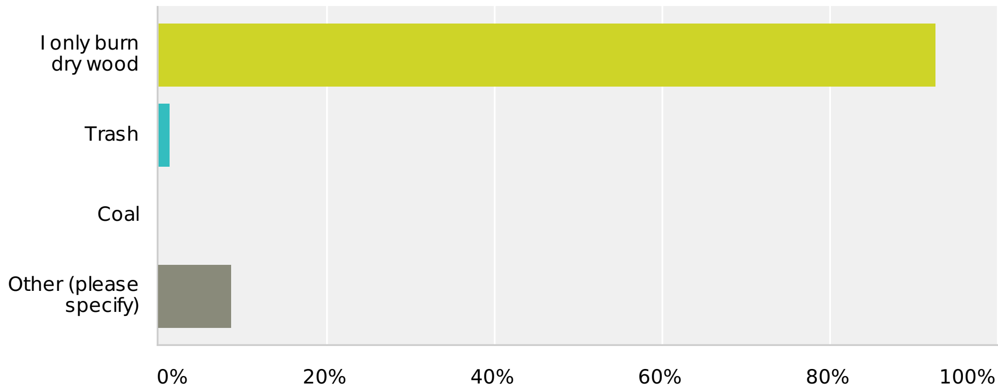
Answered: 231 Skipped: 341



Answer Choices	Responses	
1-10 days	**30.30%**	70
10-20 days	**22.51%**	52
20-30 days	**47.19%**	109
Total		231

Q15 Do you burn anything other than dry wood in your stove?

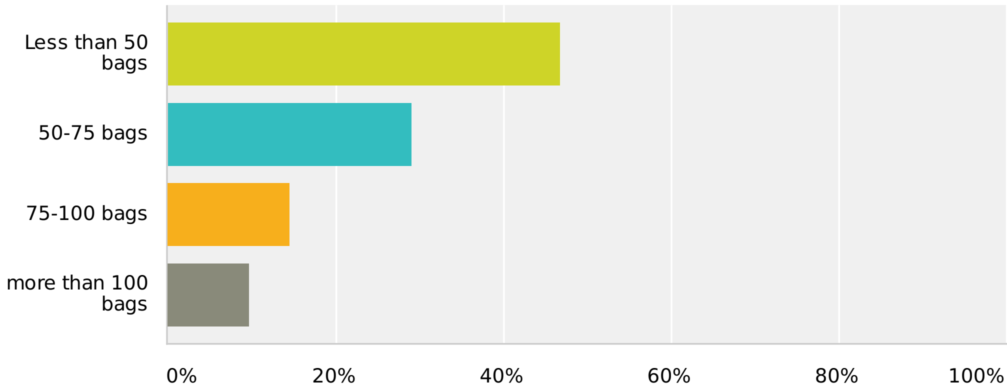
Answered: 231 Skipped: 341



Answer Choices	Responses	
I only burn dry wood	**92.64%**	214
Trash	**1.30%**	3
Coal	**0%**	0
Other (please specify)	**8.66%**	20
Total Respondents: 231		

Q16 How many bags of pellets do you use in an average winter season? (A pallet of pellets equals 1 ton and there are 50 bags in a ton. One bag is equal to 40lbs.)

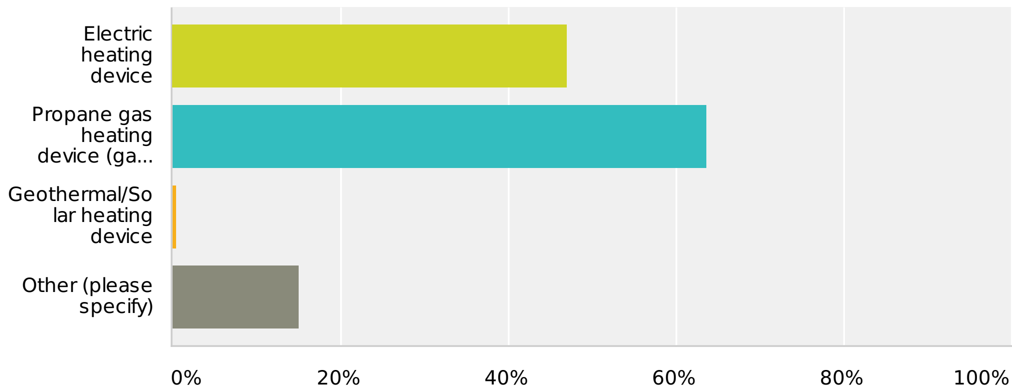
Answered: 62 Skipped: 510



Answer Choices	Responses	
Less than 50 bags	**46.77%**	29
50-75 bags	**29.03%**	18
75-100 bags	**14.52%**	9
more than 100 bags	**9.68%**	6
Total		62

Q17 Please specify your alternative heat source. (Please select all choices that apply.)

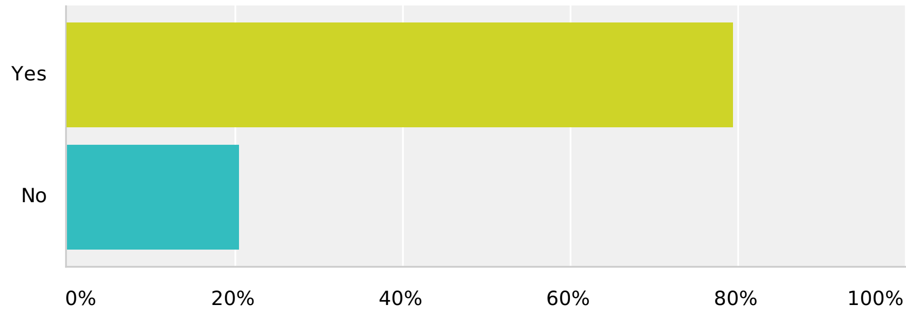
Answered: 253 Skipped: 319



Answer Choices	Responses	
Electric heating device	**47.04%**	119
Propane gas heating device (gas fireplace, insert, logs, etc,.)	**63.64%**	161
Geothermal/Solar heating device	**0.40%**	1
Other (please specify)	**15.02%**	38
Total Respondents: 253		

Q18 Are you aware that the town calls no burn days when the air quality is forecasted to be poor?

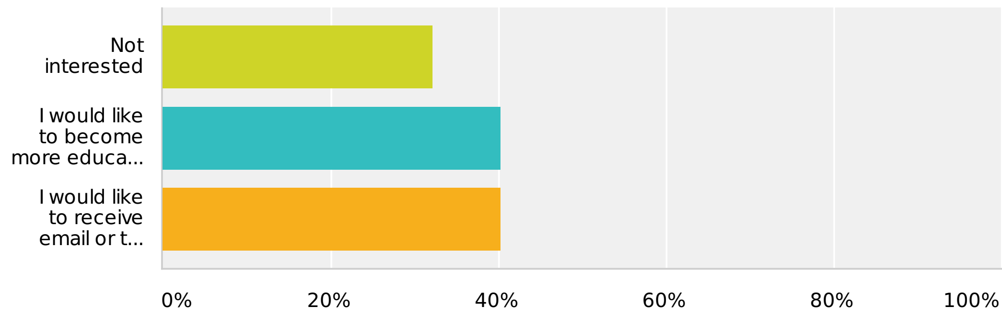
Answered: 541 Skipped: 31



Answer Choices	Responses	
Yes	**79.48%**	430
No	**20.52%**	111
Total		541

Q19 Would you be interested in improving the air quality in Mammoth Lakes?

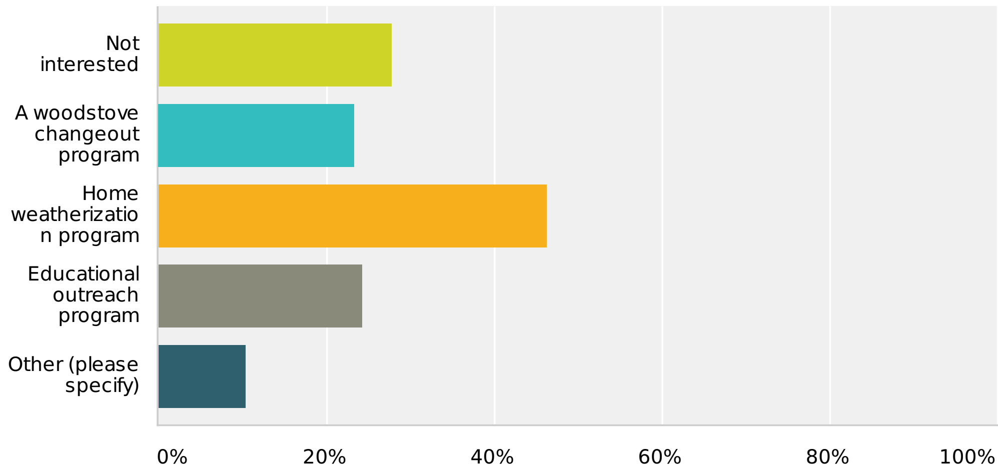
Answered: 541 Skipped: 31



Answer Choices	Responses	
Not interested	**32.16%**	174
I would like to become more educated in proper burning techniques.	**40.30%**	218
I would like to receive email or text updates on burning restrictions and no burn days.	**40.30%**	218
Total Respondents: 541		

Q20 If the town developed a program to reduce emissions I would be interested in participating in the following choices...

Answered: 540 Skipped: 32



Answer Choices	Responses	
Not interested	**27.78%**	150
A woodstove changeout program	**23.33%**	126
Home weatherization program	**46.30%**	250
Educational outreach program	**24.26%**	131
Other (please specify)	**10.37%**	56
Total Respondents: 540		

Q21 Thank you for completing the home heating survey. Enter the following information for a chance to win a Von's gift card! (Please enter physical address and include unit number to ensure that the Town does not receive duplicate entries. Please provide your name for your chance to win $150 gift card to Von's.)

Answered: 490 Skipped: 82

Answer Choices	Responses	
Name:	**100%**	490
Company:	**0%**	0
Address:	**100%**	490
Address 2:	**61.22%**	300
City/Town:	**0%**	0
State:	**0%**	0
ZIP:	**0%**	0
Country:	**0%**	0
Email Address:	**97.76%**	479
Phone Number:	**100%**	490
Total Respondents: 490		

Appendix C

Town of Mammoth Lakes Municipal Code Chapter 8.30 (Revised)

Town of Mammoth Lakes
Municipal Code
Chapter 8.30
Particulate Emissions Regulations

Sections:

8.30.010 - Purpose.

The purpose of this chapter is to improve and maintain the level of air quality of the town so as to protect and enhance the health of its citizens by controlling the emissions of particulate matter into the air of the community of Mammoth Lakes.

8.30.020 - Definitions.

For the purpose of this chapter:

A. "EPA" means the United States Environmental Protection Agency.

B. "EPA-certified appliance" means any wood or other solid fuel burning appliance for space or water heating or cooking that meets the Phase II performance and emission standards of the Environmental Protection Agency. Phase II requirements are 4.1 grams per hour particulate emission for catalytic appliances and 7.5 grams per hour for noncatalytic appliances. Pellet fueled wood heaters and EPA Phase II qualified fireplaces and fireplace retrofit devices shall be considered as meeting Phase II requirements. All other solid fuel burning appliances shall be considered noncertified.

C. “Opacity” means the amount of light obscured by particulate matter in the air as may be measured using EPA Method 9 (40 CFR 60, App. A).

D. "Pellet fueled wood heater" means any heater designed to heat the interior of a building that operates on pelletized wood and has an automatic feed.

E. "Permanently inoperable" means modified in such a way that the appliance can no longer function as a solid fuel appliance or easily be remodified to function as a solid fuel appliance. Permanent conversion to other fuels, such as gas, is permitted.

F. "Solid fuel burning appliance, heater or device" means any fireplace, wood burning heater or coal stove or structure that burns wood, coal or any other nongaseous or nonliquid fuels, or any similar device burning any solid fuel used for aesthetic, water heating, or space heating purposes.

8.30.030 - Standards for regulation of solid fuel burning appliances.

A. No solid fuel burning appliance shall be permitted to be installed within the town unless the appliance is certified as meeting the emission requirements of the U.S. Environmental Protection Agency (EPA) for Phase II certification.

B. The restrictions of this section shall apply to all solid fuel burning appliances including unregulated fireplaces.

C. For the purposes of enforcing this chapter, the Town shall keep a record of all certified appliances installed in Mammoth Lakes in accordance with this chapter and of properties which have been determined to conform to the requirements of this chapter.

8.30.040 - Limitations on number of appliances.

A. Single Family Dwellings. No more than one EPA-certified appliance may be installed in any new single family detached dwelling. Existing properties with one or more existing solid fuel burning appliances may not install additional solid fuel burning appliances. One pellet fueled wood heater per dwelling shall be allowed in addition to the one EPA-certified appliance.

B. Multi-Unit Residential Developments. No solid fuel burning appliance may be installed in any new multi-unit residential development; however, one pellet fueled wood heater per dwelling may be installed in a multi-unit residential development.

C. Commercial or Lodging Developments. No solid fuel burning appliance shall be installed in any new commercial or lodging development project.

D. Solid fuel burning appliances shall not be considered to be the primary form of heat in any new construction.

E. No new and replacement appliances shall be installed without first obtaining a building permit from the Town. All installations shall require an inspection and approval by the building division prior to operation.

F. Verification of compliance shall be certified by an inspector of the Town’s building division.

8.30.050 - Replacement of noncertified appliances upon sale of property.

A. Prior to the completion of the sale or transfer of a majority interest in any developed real property within the town, all existing noncertified solid fuel burning appliances shall be replaced, removed, or rendered permanently inoperable. If the buyer assumes responsibility for appliance replacement or removal in writing on a form approved by the Community and Economic Development Director, the deadline for such action shall be extended to 60 calendar days from the date of completion of the sale or transfer. The buyer shall contact the building division no later than 60 calendar days from the date of completion of sale to schedule an inspection.

B. The building division shall inspect the appliance(s) in question to assure that they meet the requirements of this chapter. Within five working days from the date of the inspection, the building division shall issue a written certification of compliance or noncompliance for the affected property. If the inspection reveals that the subject property does not comply with the requirements of this chapter, all noncomplying solid fuel burning appliances shall be replaced, removed, or rendered permanently inoperable. In this event, reinspection shall be required prior to certification of compliance.

C. No building permit shall be issued for an increase in habitable area of a structure that has not complied with the requirements of this section.

D. Existing appliances certified as meeting EPA Phase I requirements or Oregon Department of Environmental Quality requirements are not subject to the replacement requirements.

E. Pursuant to Section 1102.6(a) of the California Civil Code, sellers of residential real property shall disclose to purchasers of such property the provisions of this chapter. This disclosure obligation shall be satisfied by providing to each purchaser a “Local Option Real Estate Transfer Disclosure Statement” specified by the Town and by providing a copy of this chapter.

F. If developed real property is to be sold which does not contain a solid fuel burning appliance, a form approved by the building division, containing the notarized signatures of the seller, the buyer, and the listing real estate agent attesting to the absence of any fuel device, may be accepted in lieu of an inspection. A written exemption shall be issued by the building division.

G. No appliance(s) removed under the provisions of this section may be replaced except as provided by this chapter.

H. This section shall not be applicable to National Forest permittees located west of Old Mammoth Road in Sections 4 and 9 of Township 4 S., Range 27 E., MDBM, or National Forest permittees located above 8,500 feet elevation above sea level.

8.30.060 - Opacity limits.

No person shall cause or permit emissions from a solid fuel burning appliance to be readily visible, for a period or periods aggregating more than three minutes in any one-hour period. Emissions created during a 15 minute start-up period are exempt from this regulation. Readily visible emissions means smoke easily seen when viewed against any contrasting background including, but not limited to native conifers or a blue sky and may be equated with an opacity limit of 20 percent or greater as designated by the shade No. 1 on the Ringelmann Chart.

8.30.070 - Prohibited fuels.

Burning of any fuels or materials other than the following fuels within the town shall be in violation of this chapter:

A. Untreated wood;

B. Uncolored paper, including newspaper; and

C. Manufactured logs, pellets, and similar manufactured fuels.

8.30.080 - Mandatory curtailment.

A. The Town Manager shall appoint an air quality manager. The duty of the air quality manager shall be to determine when curtailment of solid fuel combustion in the town is necessary, notify the community that curtailment is required, and make such other determinations as are necessary to carry out the objectives of this chapter.

B. Determination that curtailment is required shall be made when PM-10 levels have reached 130 micrograms/m3 or when adverse meteorological conditions are predicted to persist. Should it be determined that 130 micrograms/m3 is not a low enough threshold to prevent the Town from violating the National Ambient Air Quality Standard for 24 hours (NAAQS, 24 hours), that threshold may be lowered by resolution of the Town Council.

C. Upon the determination that curtailment is required, the air quality manager shall contact all radio stations and television stations in Mammoth Lakes and have them broadcast that it is required that there be no wood or other solid fuel burning. The air quality manager shall also record a notice on a telephone line dedicated to this purpose and post a notice in the Town offices. The air quality manager may utilize additional methods of communication to effectively inform Mammoth Lakes' residents and visitors of burning restrictions. Upon such notice, all wood and other solid fuel combustion shall cease.

D. All dwelling units being rented on a transient basis which contain a solid fuel burning appliance shall post, in a conspicuous location near the appliance, a notice indicating that no-burn days may be called and informing the tenants about sources of information on no-burn days.

E. All persons renting units which contain a solid fuel burning appliance shall inform their tenants that solid fuel burning may be prohibited on certain days and that the person signing the rental agreement shall be responsible for assuring that the no-burn requirements are obeyed during the rental period identified on the rental agreement.

F. For residences where a solid fuel burning appliance is the sole means of heat, these curtailment regulations do not apply. For a residence to be considered as having solid fuel as its sole source of heat, the owner must apply to the building division for an exemption and the department must inspect the residence and certify that no other adequate source of heat is available to the structure. Adequate source shall mean that the alternate source of heat cannot produce sufficient heat for the residence without causing a hazard. A written exemption will then be granted. Where an adequate alternate source of heat is determined to have been removed from the structure in violation of the building codes, a sole source exemption shall not be issued. Sole source exemptions shall not be granted for nonresidential uses.

G. Pellet fueled heaters shall not be subject to the provisions of this section.

H. This section shall not apply to National Forest permittees located west of Old Mammoth Road, in Sections 4 and 9 of Township 4 S., Range 27 E., MDBM, or National Forest permittees located above 8,500 feet elevation above sea level.

8.30.090 - Pollution reduction education programs.

The Town Manager or his/her designee is directed to undertake such public education programs as are reasonably calculated to reduce particulate air pollution within the town, including particulate emissions from sources other than solid fuel burning appliances. In addition to the notification measures listed in Section 8.30.080.C, the public education programs shall include additional measures to inform the public of burning curtailment requirements.

8.30.100 - Road dust reduction measures.

A. The Public Works Director shall implement a vacuum street sweeping program to reduce PM-10 emissions resulting from excessive accumulations of cinders and dirt.

B. The Town shall, in its review of proposed development projects, incorporate measures which reduce projected total vehicle miles traveled. Examples of such measures include, but are not limited to, circulation system improvements, mass transit facilities, private shuttles, and design and location of facilities to encourage pedestrian circulation. The goal of the Town's review shall be to limit peak vehicle miles traveled to

179,708 on any given day on the roadway segments evaluated in the Mammoth Lakes Vehicle Miles Traveled Analysis (LSC, August, 2012).

8.30.110 - Fees.

A fee shall be charged for the inspection and permitting services of the Town. The fee shall be established in the Town master fee schedule.

8.30.120 - Penalties.

A. It is illegal to violate any requirements of this chapter. Any owner of any property which is in violation of the requirements of this chapter shall be guilty of an infraction. Any person operating a solid fuel burning appliance in violation of this chapter is guilty of an infraction. The third violation by the same person within a 12 month period shall constitute a misdemeanor. Prosecution of any violation of Subsection 8.30.080.E, relating to exemptions from curtailment, may be against the property owner, the occupant, or both.

B. Violation of any portion of this chapter may result in assessment of civil penalties against the property and against an individual person or persons in accordance with Chapter 1.12, General Penalty.

C. Each and every day a violation exists is a new and separate violation. Right to appeal, hearings, and collection of civil penalties shall be pursuant to the procedures set forth in Chapter 8.20, Nuisances.

D. Nothing in this section shall prevent the Town from pursuing criminal penalties or using any other means legally available to it in addressing violations of this chapter.

E. Whenever necessary to make an inspection to enforce any of the provisions of this code, or whenever the air quality manager or his/her authorized representative has reasonable cause to believe that there exists in any building or upon any premises any condition which violates the provisions of this chapter, the air quality manager or authorized representative may enter such building or premises at all reasonable times to inspect the same or to perform any duty imposed upon the air quality manager by this code; provided, that if such building or premises be occupied, he/she shall present proper credentials and request entry; and if such building or premises be unoccupied, he/she shall first make a reasonable effort to locate the owner or other persons having charge or control of the building or premises and request entry. If such entry is refused, or if the owner or person having charge or control of the building or premises cannot be contacted, the air quality manager or authorized representative shall have recourse to every remedy provided by law to secure entry.

Appendix D

VMT Estimates for Days of Air Quality Monitoring – 2003 to 2011 (LSC, 2013)

TRANSPORTATION CONSULTANTS, INC.

TRANSPORTATION PLANNING AND TRAFFIC ENGINEERING CONSULTANTS

2690 Lake Forest Road, Suite C
Post Office Box 5875
Tahoe City, California 96145
(530) 583-4053 FAX: (530) 583-5966
info@lsctahoe.com
www.lsctrans.com

MEMORANDUM

To: Jen Daugherty, Associate Planner, Town of Mammoth Lakes

From: Gordon Shaw, PE, AICP, LSC Transportation Consultants, Inc.

Date: April 25, 2013

RE: VMT Estimates for Days of Air Quality Monitoring – 2003 to 2011

Per your request, LSC Transportation Consultants, Inc. has conducted an analysis to estimate Vehicle-Miles of Travel (VMT) in the Mammoth Lakes area on days that air quality filter samples were collected between 2003 and 2011. The goal of this work is to provide the Town and the Great Basin Unified Air Pollution Control District with data needed to evaluate observed air quality against vehicle travel in the area.

LSC has developed a detailed, state-of-the-practice computerized model of traffic activity in the Mammoth Lakes area (most recently updated in 2011). This model, based on the TransCAD software, provides estimates of traffic volumes on every roadway in the area, based on a detailed calibration of existing land uses with existing observed traffic counts. In addition to providing a means of forecasting traffic volumes based on future changes in land uses, this model provides an estimate of total VMT for existing conditions.

The model is calibrated to reflect a single design period, specifically the average winter Saturday. The VMT associated with this design period is estimated to be 114,192. As the model only provides a VMT estimate for a single day, it is not possible to use regression analysis to develop a forecasting methodology of VMT dependent on other observable factors. Instead, the model structure and information on overall mobility patterns in Mammoth Lakes was used to develop an estimation methodology.

Table A presents available data for the various days on which air quality samples were collected. This includes the following:

- Daily traffic count data collected by Caltrans along SR 203 (Main Street) at three locations (just west of US 395, just west of Old Mammoth Road, and just east of Minaret Road).

- Daily skier figures.

- Daily sewage flows.

All three of these data sets have a correlation with total VMT. The single best indicator of VMT is the total traffic volume observed at the three count locations, as it is a direct measure of vehicle travel.

Differences in total VMT throughout the entire street network, however, is not simply a direct function of traffic volumes observed on SR 203, as a relatively high proportion of traffic on the state highway is generated by visitors when compared with other roadways serving residential neighborhoods. Estimating VMT on various days is improved by considering a "base" VMT generated by residents (which is relatively constant, at least over the busy winter ski season when the air quality samples were collected) and a more variable VMT component generated by visitors.

The TransCAD model provides estimates of the overall proportion of VMT generated by residents versus visitors. Specifically, the vehicle trip generation of the various residential and lodging categories can be used to estimate that 53 percent of VMT is associated with visitors and 47 percent with residents.

In considering how resident VMT varies on the various air sample days, two factors were addressed:

- As the model design day is for an average winter Saturday, it does not reflect work trips of residents that work typical Monday to Friday work weeks. An air sample day that is a typical workday would therefore have additional resident-generated VMT associated with work trips (all other factors being equal) that is not reflected in the model estimate. US Census economic data (as presented in the American Factfinder website) was reviewed to establish that 10.5 percent of Mammoth Lakes jobs are in classifications that have typical work weeks (such as office jobs), while the large majority are employed in classifications such as retail and dining that have peak employment on the design day. Furthermore, the traffic model indicates that approximately 20 percent of resident-generated travel is associated with work trips. This indicates that, all else being equal, a day during the typical work week would generate 2 percent more resident VMT than the average winter Saturday design day.

- As the model estimate is based on 2010 data, it reflects the population of Mammoth Lakes in 2010. Earlier sample days should reflect that population has grown over time, and thus the resident-generated VMT can be assumed to have grown. A review of US Census data (collected near the end of the ski season) indicates a 2000 Mammoth Lakes population of 7,093 and a 2010 population of 8,234, corresponding to a 1.4 percent annual average growth in population.

This information was used to estimate VMT for the various sample days as follows:

1. The model design day value of total traffic counts shown in Table A (31,547) was factored by 0.47 to estimate the proportion associated with resident trips (14,827).

2. As shown in Table B, the day-of-week and annual population growth factors were applied to estimate the total traffic counts generated by residents.

3. Visitor-related total traffic counts were calculated by subtracting resident-related volumes from the total Caltrans counts (as presented in Table A).

4. Resident VMT was calculated by factoring the total resident VMT on the model design day (53,670) by the ratio of the estimated resident total traffic count on the specific air

sample day to the resident total traffic count on the model design day.

5. Similarly, visitor VMT was calculated by factoring the total resident VMT on the model design day (60,522) by the ratio of the estimated visitor total traffic count on the specific air sample day to the visitor total traffic count on the model design day. In reviewing the results, however, the estimate for 2/17/2003 stood out as an "outlier" with high traffic volumes (the highest of any of the sample days) but low skier activity (the lowest of the dataset) and low sewer flow (second lowest of the data set). This specific date was the end of the three-day Presidents Day weekend. A review of the directional traffic counts indicates that there was a high exiting (eastbound) volumes at US 395, consistent with skiers leaving at the end of the long weekend. As the skier visit data indicates that a low proportion of these visitors were not skiing, it is reasonable to assume that they left relatively early in the day and thus were not making multiple trips through the community. A reduction factor of 0.33 was applied, based upon the relative proportion of skier visits on the day in question compared with the skier visit value on the design day and assuming that visitors departing the area early have half the VMT impact per observed vehicle than is typical.

6. Adding the resident VMT and the visitor VMT results in the total estimated VMT, as shown in Table B and Figure A.

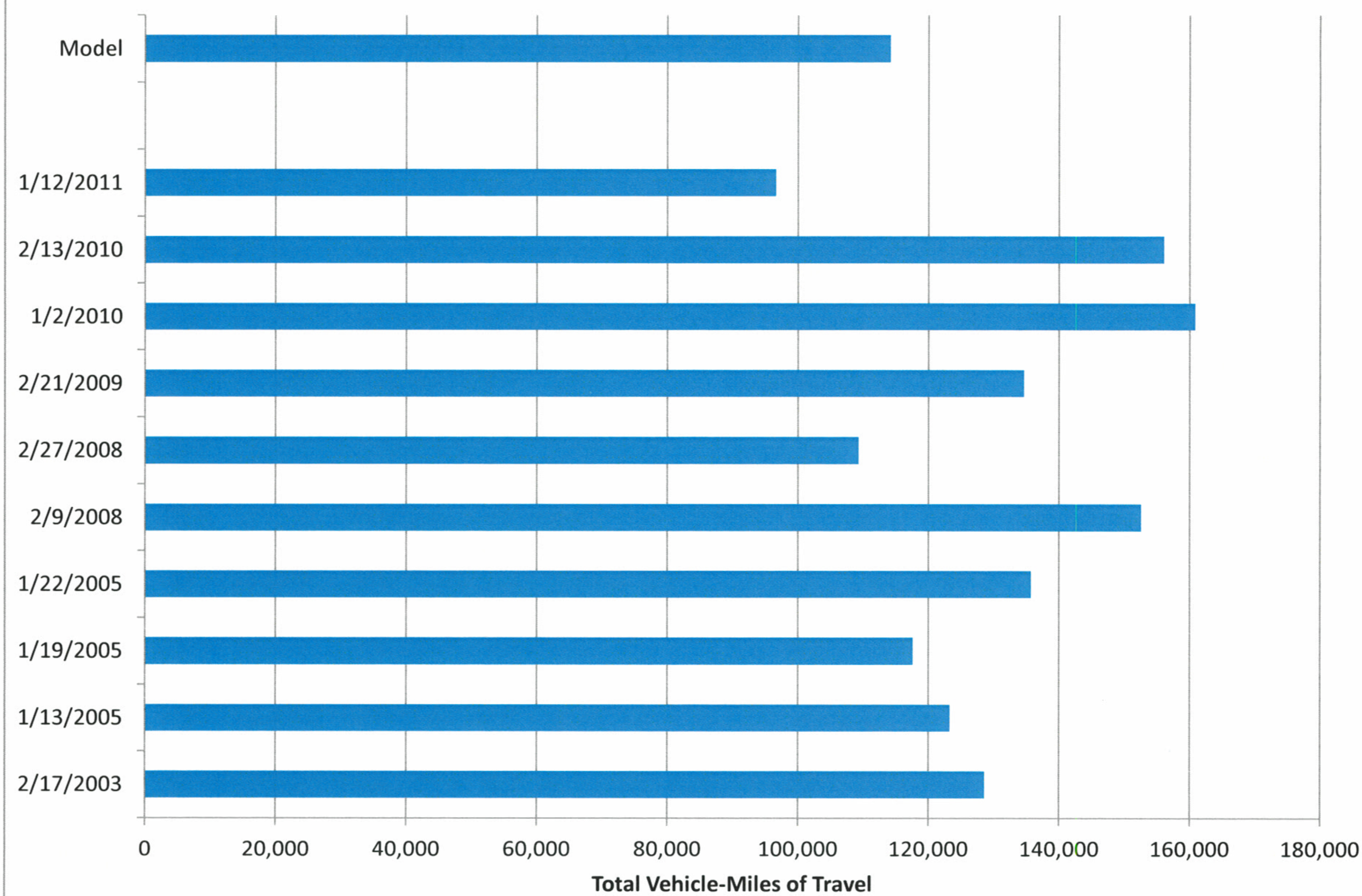
TABLE A: Available Input Data

Date	Daily 2-Way Traffic Volume on SR 203					
	Just West of Old Mammoth Road	Just East of Minaret Road	Just West of US 395	Sum	Skier visits	Flow KGPD
2/17/2003	18,808	15,261	12,259	46,328	4,224	1,374
1/13/2005	15,682	10,430	7,950	34,062	5,795	1,607
1/19/2005	14,777	10,620	7,103	32,500	4,312	1,362
1/22/2005	16,019	13,599	7,881	37,499	15,152	2,052
2/9/2008	17,841	14,945	9,371	42,157	15,980	2,039
2/27/2008	13,604	9,458	7,138	30,200	4,237	1,263
2/21/2009	15,457	13,742	8,000	37,199	14,522	2,019
1/2/2010	17,892	15,909	10,640	44,441	14,851	2,118
2/13/2010	18,096	16,080	8,940	43,116	19,676	2,523
1/12/2011	11,956	8,809	5,935	26,700	4,983	966
Typical Winter Saturday (Model)	13,080	11,455	7,012	31,547	12,276	

TABLE B: VMT Estimates on Air Sample Days

	Resident Factors		Total Count Volume		Model VMT Estimate		
Date	Day of Week Factor	Year Factor	Resident Volume Estimate	Visitor Volume Estimate	Resident	Visitor	Total
2/17/2003	1.00	0.90	13,389	32,939	48,464	80,128	128,593
1/13/2005	1.02	0.93	14,086	19,976	50,987	72,309	123,296
1/19/2005	1.02	0.93	14,086	18,414	50,987	66,655	117,642
1/22/2005	1.00	0.93	13,800	23,699	49,952	85,786	135,737
2/9/2008	1.00	0.97	14,416	27,741	52,183	100,414	152,597
2/27/2008	1.00	0.97	14,416	15,784	52,183	57,134	109,317
2/21/2009	1.00	0.99	14,622	22,577	52,927	81,725	134,651
1/2/2010	1.00	1.00	14,827	29,614	53,670	107,195	160,866
2/13/2010	1.00	1.00	14,827	28,289	53,670	102,399	156,070
1/12/2011	1.02	1.01	15,344	11,356	55,542	41,105	96,647
Typical Winter Saturday (Model)			14,827	16,720	53,670	60,522	114,192

Figure A: Estimated Mammoth Lakes VMT on Air Sample Days



Appendix E

Mammoth Lakes
Vehicle Miles Traveled Analysis
(LSC, 2012)

LSC TRANSPORTATION CONSULTANTS, INC.

TRANSPORTATION PLANNING AND
TRAFFIC ENGINEERING CONSULTANTS

2690 Lake Forest Road, Suite C
Post Office Box 5875
Tahoe City, California 96145
(530) 583-4053 • FAX: 583-5966
www.lsctahoe.com • info@lsctahoe.com

TECHNICAL MEMORANDUM

DATE: August 3, 2012

TO: Ellen Clark, Town of Mammoth Lakes

FROM: Sara Hawley, PE and Leslie Suen, EIT, LSC Transportation Consultants, Inc.

SUBJECT: Mammoth Lakes Vehicle Miles Traveled Analysis

As requested, LSC Transportation Consultants, Inc. has completed the analysis of Vehicle Miles Traveled (VMT) for the Town of Mammoth Lakes for use in the preparation of a Greenhouse Gas (GHG) inventory and an update to the 1990 Air Quality Management Plan. This memo presents the townwide VMT by roadway speed, as well as a limited analysis of VMT for external trips.

VMT by Travel Speed

Using the 2011 Town of Mammoth Lakes TransCAD Travel Model, VMT was calculated and grouped into speed classes based on the 85^{th}-percentile roadway speed, as shown in Table 1. VMT is calculated by multiplying the length of a roadway segment by the volume on that roadway. A map of the roadway speeds for all the roads in the model can be found in Appendix A, attached. Also shown in Appendix A are all the roadways included in the VMT analysis, which total approximately 240 roadways with 1,037 segments. The model reflect a typical winter Saturday, which will subsequently be called a ‘peak day’ throughout this report. Peak day conditions for both existing 2009 and future 2030 (reflecting build out of the general plan) scenarios were taken directly from the model. As indicated, a total of approximately 144,192 VMT are estimated to be generated in Mammoth over the course of an existing peak winter day, and approximately 179,708 VMT are estimated to be generated on a peak day in the future. This indicates a 25 percent increase by the time that buildout of the General Plan occurs (estimated at the year 2030).

In order to estimate annual average day conditions, peak day VMT was factored using Caltrans data along State Route (SR) 203. Specifically, daily traffic volumes at six locations on SR 203 within the Town of Mammoth Lakes were reviewed. As shown in Table 2, the percent decrease between peak month average daily traffic (Peak Month ADT) and annual average daily traffic (AADT) ranges from approximately 17 percent to 29 percent. The weighted average percent decrease is calculated to be about 23 percent. This reduction was applied to the model’s peak day VMT results, in order to estimate the VMT on an annual average day. As shown on the right side of Table 1, a total of approximately 111,287 VMT are estimated to be generated in

Mammoth over the course of an existing annual average day, and approximately 138,698 VMT are estimated to be generated on an average day in the future.

In 1990 a similar VMT study was completed in combination with the *Air Quality Management Plan for the Town of Mammoth Lakes* (November 30, 1990). The methodology used in the 1990 study and this VMT study are similar. Both studies are based on a travel demand model that assumes full buildout of the Town's General Plan in the future. Both studies include all of the Town's major roadways. The main difference is the extent of the roadways analyzed in each study. The 1990 study had a total of 10.9 miles of roadways on 8 different roads (with 17 segments) for the existing year 1990 VMT, while the future year 2005 had a total of 15.8 miles of roadways on 10 different roads (with 31 segments). In contrast, this study's VMT analysis included 93.1 miles of roadways on 420 different roads (with 1,037 segments) for both the existing and future analysis years. The higher number of miles of roadways included in this VMT analysis produces higher VMT estimates than the 1990 study. Additional comparison between the two studies can be found in the attached memo *Mammoth Lakes Vehicle Miles Traveled Analysis – Comparison with 1990 Study* (LSC, September 10, 2012).

External VMT

LSC reviewed information provided in the existing model at the two external points representing trips to/from Highway 395 - one on SR 203 east of Meridian Boulevard and one on Mammoth Scenic Loop north of town. Nearly all (approximately 97 percent) of the trips that enter and exit the model area use SR 203 to the east. A total of 8,880 vehicles are estimated to pass through the external points over the course of a peak day (total in both directions). Of the total number of trips generated in the Mammoth Lakes model area, about 15 percent are external trips, meaning they have either an origin or destination outside the model area. It should be noted that as the peak day of traffic activity is a winter Saturday, these figures do not reflect the many recreational trips occurring on a Friday or Sunday.

<u>Trip Types</u>

External trips can be broken down into the following five model trip types:

- home-based work
- home-based shopping
- home-based recreation
- home-based other
- other to other (example: work to shopping)

The large majority of the external trips (approximately 88 percent) are home-based recreation trips, such as a trip made by a person staying in Bishop and skiing in Mammoth Lakes, or staying in Mammoth and going elsewhere for recreation. The remaining 12 percent of trips are equally distributed among the other trip types, with approximately 3 percent of each trip type, as shown in Table 3.

Future external trips were also obtained from the model, and they are presented in Table 4. Again, the majority (85 percent) of the future external trips are generated by home-based recreation trips.

<u>Residents vs Visitors</u>

Trips going through the external points in the model were reviewed with respect to trips made by residents versus visitors. A precise breakdown cannot be provided based on available data. However, it is assumed that the majority of the external trips on a peak winter day are made by visitors, given that most of the external trips are "home-based recreation" trips, which is a trip type primarily associated with visitors. It is also expected that the majority of home-based shopping trips are made by visitors. The remaining trip types (home-based work, home-based other, and other to other) are not assumed to be made by visitors.

Similarly, the split of residents versus visitors for internal trips cannot be provided based on available data. However, a general breakdown can be made based on the number of resident dwelling units and visitor dwelling units. In the TransCAD model, there are about 5,600 existing resident dwelling units and 5,000 visitor dwelling units (which include single-family vacation homes and lodging units). As the trip generation rate in the model is slightly higher for residential units, the total number of trips generated by residents is nearly equal to the total trips generated by visitors. Furthermore, the trip lengths for internal trips made by residents and visitors are assumed to be similar. Therefore, the resident/visitor split for VMT internal to Mammoth Lakes is estimated to be roughly a 50/50 split.

Residence Locations of Commuters

Data from the US Census 2010 indicates that more than half (approximately 57 percent) of persons who work in Mammoth Lakes also reside in Mammoth Lakes. About 12 percent of persons employed in Mammoth Lakes live in Bishop, California, with the remaining 31 percent residing in various locations throughout the Eastern Sierra. Of the workers commuting to Mammoth Lakes from external points, about 58 percent are estimated to reside in points to the north of Mammoth along US 395 and 42 percent are estimated to live to the south. Detailed percentages for each town in the Eastern Sierra are shown in Figure 1. Note the census data includes the Mammoth Yosemite Airport within the Mammoth Lakes analysis area.

Of all workers residing in Mammoth Lakes, almost all (approximately 96 percent) are employed in Mammoth Lakes. In other words, very few persons living in Mammoth Lakes leave the community to go to work.

Residence Locations of Visitors

The residence locations of visitors traveling to Mammoth Lakes from more remote destinations was reviewed, based upon data provided in the *Town of Mammoth Lakes Winter Survey* (Leisure Trends Group, 2007). Based on this survey, and shown in Figure 2 the home regions of all visitors to Mammoth include:

- Greater Los Angeles Area – 29%
- Outside California – 17%
- Orange County – 16%
- San Diego County – 14%
- Central Valley and Northern California – 13%
- Central Coast – 11%

The top home states for the 17 percent of visitors from outside California are Nevada, Maryland, Texas, Washington, Idaho, Arizona, Oregon and Utah (each state representing four percent or less of all visitors).

Trips to/from Mammoth Yosemite Airport

According to the 2007 Winter Survey, almost all respondents arrived via private automobile and no respondents reported flying to the Mammoth Yosemite Airport. This is unsurprising since commercial air service was not available at this time, but has since become available. Many hotels in Mammoth provide a free shuttle service to and from the airport in connection with flight times, and rental cars and taxi service are available at the airport. While it is difficult to quantify exactly how many trips from various locations may have shifted from driving to flying since air service started, it is probable that at least a small portion of previous driving trips are now made by air. However, this shift is likely to be accompanied by a certain number of new airport-related trips including employee and passenger trips to and from Mammoth, and new visitors. Overall, the net change to VMT associated with airport-related trips is likely negligible relative to total daily trip volumes.

Estimate of Total External VMT

In order to determine the total VMT associated with activity in the Town of Mammoth Lakes, the VMT of the external part of the external trips (i.e. outside of the model area) needs to be considered. In VMT analyses for communities with high levels of visitor/tourism activity, some portion of the trip length that occurs outside the model area is typically allocated to the study community. For example, in recent VMT analyses conducted in Shasta County and in the Lake Tahoe area, 50 percent of the external VMT were allocated to the study area. For the purposes of this analysis, 100 percent of the external VMT is allocated to Mammoth Lakes.

To estimate the external VMT, the approximate mileage between Mammoth and each of the external locations shown in Figures 1 and 2 was estimated for each trip type. Of the home-based recreation trips, about 10 percent are assumed to be made to/from the Bishop area, reflecting that some visitors stay overnight at locations near Mammoth as a part of their trip, and that visitors staying in Mammoth will recreate in locations outside of the town itself. The remainder is allocated proportionately to the various points of visitor origin indicated in the 2007 survey. Multiplying the mileage by the number of external trips for each trip type yields the external VMT by trip type, as shown in Table 5.

Note all external VMT was calculated based on the TransCAD traffic model which estimates a busy winter Saturday, which when the highest traffic volumes occur in Mammoth Lakes but may not be when the peak external trips occur. A general estimation can be made of average annual daily VMT by reducing the peak VMT by 23 percent, which is the same percent internal VMT was reduced, as shown in Table 5.

Total Yearly VMT

Total VMT for one year is estimated based on the assumption that visitors' home regions are similar in the summer and winter, as indicated in the *Town of Mammoth Lakes Winter Survey* (Leisure Trends Group, 2007) and *Town of Mammoth Lakes Summer Survey* (Leisure Trends Group, 2008). Adding the existing internal annual average VMT (111,287) to the external annual average VMT (1,730,000) yields a total of about 1,841,000 VMT per annual average day. Multiplying this total by 365 days per year yields about 672 million existing VMT per year. A similar calculation can be done for future VMT, which results in a total of about 705 million VMT per year in 2030.

Table 1: Town of Mammoth Lakes Vehicle Miles Traveled Per Day

Roadway Speed (miles per hour)	Daily Vehicle Miles Traveled			
	Peak Day		Annual Average Day	
	Existing	Future	Existing	Future
25 or less	22,066	31,452	17,030	24,274
30	2,288	3,053	1,766	2,356
35	n/a	n/a	n/a	n/a
40	28,421	37,623	21,935	29,037
45	6,383	9,937	4,926	7,669
50	72,510	83,935	55,963	64,781
55	12,524	13,708	9,666	10,580
All	**144,192**	**179,708**	**111,287**	**138,698**

Note: In the Mammoth Lakes TransCAD model no roadways have a 35 mph speed.
Note: Includes VMT within Mammoth Lakes associated with internal and external trips.
Source: LSC Transportation Consultants, Inc.

Table 2: Daily Traffic Volumes on Highway 203 in Mammoth Lakes

Highway	Post Mile	Location	Peak Month Daily Traffic	Annual Average Daily Traffic	Percent Decrease to Convert Peak Month to Annual Average Day
203	2.35	MAINTENANCE SUBSTATION	4,500	3,750	17%
203	4.49	MAMMOTH, FOREST TRAIL	4,500	3,650	19%
203	4.78	LAKE MARY /MINARET RD	12,100	9,700	20%
203	5.75	OLD MAMMOTH RD	16,700	13,250	21%
203	6.87	MERIDIAN BLVD	9,600	6,850	29%
203	8.56	JCT. RTE. 395	11,100	7,950	28%
				Weighted Average	**23%**

Source: California Department of Transportation http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

Table 3: Existing Peak Day Daily Vehicle Trips at External Points
(Total in Both Directions)

External Points	Trip Type: Home Based Recreation	Home Based Shopping	Home Based Work	Home Based Other	Other to Other	Total
Highway 203 East (TAZ 700)	7,565	235	268	269	257	8,594
Mammoth Scenic Loop (TAZ 701)	257	7	7	8	8	287
Total Daily Traffic	**7,822**	**242**	**275**	**277**	**264**	**8,880**
Percent of Total	88%	3%	3%	3%	3%	100%

TAZ = Traffic Analysis Zone
Source: LSC Transportation Consultants, Inc.

Table 4: Future Peak Day Daily Vehicle Trips at External Points
(Total in Both Directions)

External Points	Trip Type: Home Based Recreation	Home Based Shopping	Home Based Work	Home Based Other	Other to Other	Total
Highway 203 East (TAZ 700)	7,798	280	382	372	366	9,198
Mammoth Scenic Loop (TAZ 701)	248	8	10	12	10	288
Total Daily Traffic	**8,046**	**288**	**392**	**384**	**376**	**9,486**
Percent of Total	85%	3%	4%	4%	4%	100%

TAZ = Traffic Analysis Zone

Source: LSC Transportation Consultants, Inc.

Table 5: External Vehicle Miles Traveled Per Day

	Daily Vehicle Miles Traveled			
	Peak Day		Annual Average Day	
Trip Type	Existing	Future	Existing	Future
Home Based Recreation	2,199,000	2,262,000	1,697,000	1,746,000
Home Based Shopping	10,000	12,000	8,000	9,000
Home Based Work	12,000	17,000	9,000	13,000
Home Based Other	11,000	16,000	8,000	12,000
Other to Other	11,000	15,000	8,000	12,000
Total	**2,243,000**	**2,322,000**	**1,730,000**	**1,792,000**

Note: Only includes miles associated with the external portion (i.e. outside the model area) of the trips.

Source: LSC Transportation Consultants, Inc.

Appendix F

Mammoth Lakes
Vehicle Miles Traveled Analysis
Comparison with 1990 Study
(LSC, 2012)

TRANSPORTATION CONSULTANTS, INC.

TRANSPORTATION PLANNING AND
TRAFFIC ENGINEERING CONSULTANTS

2690 Lake Forest Road, Suite C
Post Office Box 5875
Tahoe City, California 96145
(530) 583-4053 • FAX: 583-5966
www.lsctahoe.com • info@lsctahoe.com

TECHNICAL MEMORANDUM

DATE: September 10, 2012

TO: Ellen Clark, Town of Mammoth Lakes

FROM: Sara Hawley, PE and Leslie Suen, EIT, LSC Transportation Consultants, Inc.

SUBJECT: Mammoth Lakes Vehicle Miles Traveled Analysis – Comparison with 1990 Study

As requested, LSC Transportation Consultants, Inc. has completed an additional analysis of Vehicle Miles Traveled (VMT) for the Town of Mammoth Lakes to compare the 2012 VMT analysis to the previous 1990 Air Quality Management Plan (AQMP) VMT Study. First, the VMT on each roadway in the 1990 study was estimated, and the results are listed in Table A. As discussed in the 2012 VMT analysis memorandum, there are more miles of roadway included in the current TransCAD model than in the 1990 study. The VMT in the current TransCAD model was estimated for only those roadway segments included in the 1990 study. As shown in the right columns in Table A, a total of approximately 80,586 existing VMT and 110,641 future VMT are estimated on those roadways included in the 1990 study. Of the total existing VMT in the current TransCAD model network (144,192), about 56 percent are reflected on the roadways included in the 1990 study. Similarly, of the total future VMT in the current model (179,708), about 62 percent occur on roadways included on the 1990 study. The remaining VMT occurs on the smaller roads that were not included in the 1990 study. Note that these figures are based on peak-day conditions, consistent with the 1990 study.

The following findings are made regarding the VMT on the roadways included in the 1990 Study:

- Overall, the VMT in Mammoth Lakes has increased from approximately 66,275 in 1990 to approximately 80,856 in 2009. This equates to a total increase of approximately 22 percent over 19 years.

- In 1990, the future forecast indicated that the existing VMT would increase by more than double (approximately 222 percent) by 2005. Given that the VMT in 2009 was only slightly higher than the VMT in 1990, this high rate of growth has not occurred.

- The future (2005) VMT forecasts made in 1990 are much higher than the future (2030) forecasts in the current TransCAD model, reflecting that the growth rate has decreased since 1990 and future development is expected to occur at a slower rate. Based on the current TransCAD model, VMT on the roadways included in the 1990 study is expected to increase by a total of 37 percent from 2009 to 2030.

Table A: Vehicle Miles Traveled (VMT) Comparison

Roadway	From	To	Estimated VMT in 1990 Air Quality Management Plan Study: Existing (1990)	Estimated VMT in 1990 Air Quality Management Plan Study: Future (2005)	2011 TransCAD Model VMT: Existing (2009)	2011 TransCAD Model VMT: Future (2030)
SR203/Main Street	Meridian Blvd	Minaret Road	23,625	27,790	25,331	28,373
Lake Mary Road	Minaret Road	Twin Lakes Parking Lot	5,700	11,215	4,526	4,952
Meridian Blvd	Majestic Pines Road	Highway 203	6,650	25,150	13,115	17,967
Old Mammoth Road	Main Street	Ranch Road	11,900	20,635	13,448	16,839
Old Mammoth Road[1]	Ranch Road	Red Fir Rd	-			
Sherwin Creek (Old Mammoth Road Extension)[2]	Old Mammoth Road	South 0.1 miles	-	350	-	-
Forest Trail	Main Street	Minaret Road	1,500	1,500	1,422	3,220
Canyon Blvd	Lake Mary Road[3]	Canyon Lodge Parking	2,400	4,980	1,175	5,982
Lakeview Blvd	Canyon Lodge Parking	Canyon Blvd (East)	5,000	7,100	3,421	3,378
Kelley/Majestic Pines[4]	Lake Mary Road	Meridian Blvd	750	2,800	1,175	1,489
Majestic Pines Extension	Meridian Blvd	Old Mammoth Road	-	3,000	-	-
SR203/Minaret Road	Main Street	Scenic Loop Road	8,750	16,160	9,608	10,878
Minaret Road	Main Street	Old Mammoth Road	-	26,235	7,364	17,564
		Total	**66,275**	**146,915**	**80,586**	**110,641**

Total VMT of all roadways included in the 2011 TransCAD Model	144,192	179,708
Portion of VMT included on the 1990 Study roadways	56%	62%

Note 1: The segment of Old Mammoth Road from Ranch Road to Red Fir Road did not exist in 1990.

Note 2: The Old Mammoth Road Extension is not included in the TransCAD model.

Note 3: In the 1990 VMT Study, Canyon Blvd is assumed to start at Minaret Road, consistent with its previous alignment.

Note 4: The Majestic Pines Extension is not included in the TransCAD model.

Source: LSC Transportation Consultants, Inc.

Appendix G

Chemical Analysis of PM10 and PM2.5 Filters from Mammoth Lakes (DRI, 2013)

Chemical Analysis of PM10 and PM2.5 filters from Mammoth Lakes

Final Report

Prepared by:

Mark C. Green

Division of Atmospheric Sciences

Desert Research Institute

2215 Raggio Parkway

Reno, NV 89512

Prepared for the Town of Mammoth Lakes

May 21, 2013

Chemical Analysis of PM10 and PM2.5 filters from Mammoth Lakes

Introduction

A study was conducted to try to gain understanding regarding source contributions to high PM10 values recorded at the Mammoth Lakes Gateway air quality monitoring site.

DRI proposed to analyze fifteen PM10 and five PM2.5 filters (dates and concentrations shown in Tables 1 and 2) for elements and ions. The fifteen PM10 filters included the nine highest and 11th highest PM10 filter concentration days since 2001, eight of which were since the start of 2008. The other five PM10 filters are days for which high PM10 and/or PM2.5 concentrations were measured and both PM10 and PM2.5 filters are available for each day. Three of these five days had the highest PM10 for days with PM2.5 filters also. The other two days had high PM2.5 and high PM2.5 to PM10 ratios (indicative of large relative wood smoke impact). Because the road dust is expected to be mostly in the larger sizes and wood smoke is mostly in the small sizes (PM2.5) analyzing both PM10 and PM2.5 for a few days will be informative and will provide supporting evidence for our estimates based on the PM10 data.

The samples proposed to be analyzed are listed below.

Table 1. Dates with only PM10 filters:

Date	PM10 concentration
12/21/2001	134.2
2/13/2002	129.3
1/1/2008	85.9
2/9/2008	96.7
2/27/2008	95.5
2/21/2009	117.6
1/2/2010	101.3
1/29/2010	104.0
2/13/2010	92.0
1/12/2011	127.6

Table 2. Dates with PM10 and PM2.5 filters:

Date	PM10	PM2.5
3/14/2001	55.0	35.2
12/17/2003	74.6	33.5
1/13/2005	39.3	27.0
1/19/2005	85.1	25.2
1/22/2005	77.8	27.4

Filters for the three days in 2001 and 2002 were not provided to DRI for analysis. Chemical analysis of filters was done on the remaining samples listed above, and included twelve PM10 filters and four PM2.5 filters.

The chemical analysis included X-ray fluorescence (XRF, giving most elements), ion chromatography (anion and cations), and light absorption. The XRF analysis provides the road dust elements, ion chromatography the contributions from sulfate and nitrate, and ammonium (associated with nitrate and sulfate). The light absorption measurement is a good indicator of elemental carbon (EC) (diesel exhaust and wood smoke primarily). What the analysis cannot do that is important is organic carbon (OC), because the Teflon filters that have been collected cannot provide that. Organic carbon was estimated as a residual.

Chemical analysis results

Total PM_{10} concentrations and component concentrations by date are shown in Table 3.

Table 3. PM10 concentrations and measured or reconstructed major species concentrations by date. The residual is calculated as the total PM10 concentration – (soil+SO4+NO3+NH4+sea salt+ EC). It was assumed that all unaccounted for mass is organic mass (OM) and the ratio of organic mass to organic carbon is 1.8.

Date	conc stp	soil	SO4	NO3	NH4	seasalt	EC	residual	OC
12/17/03	74.6	22.3	0.32	0.64	0.02	0.30	9.1	41.9	23.3
01/13/05	39.3	5.5	0.28	0.40	0.02	0.07	10.2	22.8	12.7
01/19/05	85.1	34.1	0.33	0.49	0.02	0.25	9.0	40.9	22.7
01/22/05	77.8	28.9	0.27	0.40	0.00	0.28	8.3	39.7	22.0
01/01/08	85.9	44.3	0.60	0.69	0.03	0.37	9.8	30.2	16.8
02/09/08	96.7	25.2	0.30	0.38	0.02	0.20	6.8	63.8	35.4
02/27/08	95.5	44.6	0.40	0.38	0.05	0.11	7.5	42.5	23.6
02/21/09	117.6	51.6	0.79	0.80	0.05	1.12	7.6	55.6	30.9
01/02/10	101.3	44.6	0.29	0.48	0.00	2.68	7.6	45.6	25.4
01/29/10	104.0	47.3	0.36	0.54	0.04	0.68	6.7	48.4	26.9
02/13/10	92.0	41.2	1.10	0.50	0.23	0.34	7.9	40.7	22.6
01/12/11	127.6	4.3	0.16	0.16	0.00	0.07	5.4	117.4	65.2

Because only Teflon filters were available, OC and EC could not be analyzed. Reconstructed mass calculations (using the IMPROVE protocol, Pitchford et al., 2007) showed that for most days, reconstructed mass was far less than measured mass. This is expected when there is a significant contribution from carbonaceous aerosol as with residential wood combustion, and other ambient sources of carbon, such as in road dust.

Elemental carbon was estimated from filter light absorption (Chow et al., 2010) as $EC=(b_{abs})/10$ where b_{abs} is filter light absorption in inverse megameters (Mm^{-1}) and EC concentration is in $\mu g/m^3$. EC concentration was then added to the reconstructed mass. The residual of measured mass – reconstructed mass was assumed to be organic mass (OM), which was assumed to be 1.8 times OC (as used in the IMPROVE algorithm). Thus OC is the residual/1.8.

From Table 3 it can be readily seen that OC, EC, and soil are the only significant contributors to PM10 concentrations. The nitrate is expected to be biased low as it tends to volatilize off the filter, especially after exposure to x-rays in a vacuum as occurs during the XRF analysis prior to analyzing for nitrate with ion chromatography. It should be noted here that the PM10 concentration of 127.6 µg/m^3 on 1/12/2011 is probably in error. The soil and EC concentrations are not consistent with such a high mass concentration and the TEOM FDMS data for the day was only 27.7 µg/m^3. The TEOM FDMS and filter PM10 were usually close in magnitude.

Table 4 shows the same information as Table 3 for the $PM_{2.5}$ samples.

Table 4. $PM_{2.5}$ concentrations and measured or reconstructed major species concentrations by date. To be comparable to the PM10 data, the concentrations have been adjusted to standard temperature and pressure as defined by EPA (25°C, 760mm Hg).

Date	conc stp	soil	SO4	NO3	NH4	seasalt	EC	residual	OC
12/17/03	40.6	1.19	0.24	0.45	0.03	0.12	7.8	30.8	17.1
1/13/05	32.7	0.50	0.24	0.39	0.03	0.04	10.2	21.4	11.9
1/19/05	30.5	1.89	0.26	0.28	0.03	0.07	8.8	19.2	10.7
1/22/05	33.2	1.60	0.21	0.29	0.02	0.08	8.3	22.7	12.6

For $PM_{2.5}$, most of the mass is EC and residual (assumed OM). Table 5 shows the percentage of each chemical component that was in the fine mode ($PM_{2.5}$) for the four days with both PM_{10} and $PM_{2.5}$ chemically speciated data.

Table 5. Percent of each chemical component that is in the fine mode.

	PM10 stp	soil	SO4	NO3	NH4	seasalt	EC	OC
12/17/03	54.4	5.3	76.4	70.3	144.8	40.1	85.1	73.4
1/13/05	83.2	9.0	86.9	97.8	158.6	60.0	99.8	93.5
1/19/05	35.9	5.5	78.1	57.5	133.1	29.3	97.9	46.9
1/22/05	42.7	5.5	75.1	70.8		27.4	100.7	57.1

As expected most of the sulfate, nitrate, and EC are in the fine mode and most of the soil is in the coarse mode. For 12/17/03 and 1/13/05 most of the OC is in the fine mode as would be expected with wood smoke. For 1/19/05 and 1/22/05 only about half to a little more than half of the estimated OC is in the fine mode. It should be noted that the fine/coarse mode OC split is highly uncertain because OC in both size ranges was estimated from a residual.

Diurnal patterns in PM10 concentrations

Consideration of diurnal patterns in PM_{10} concentrations may provide insight into likely sources of high PM10. Hourly PM10 concentrations for chemical analysis days in 2009 and 2010 are shown in Figure 1. This period had hourly measurements using the TEOM FDMS monitor which gives values similar to the filter based concentration measurements (Table 6). All days had morning and evening peaks although the timing of the peaks varied.

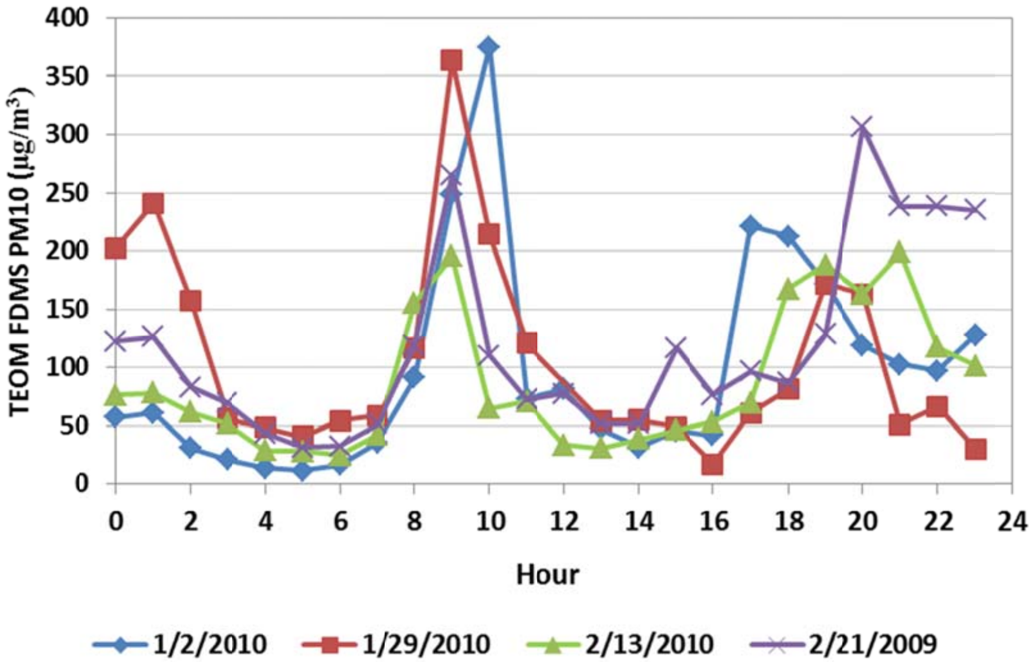


Figure 1. TEOM FDMS hourly concentrations for 1/2/2010, 1/29/2010,2/13/2010 and 2/21/2009.

Table 6. Comparison of filter PM10 and TEOM PM10 for days with chemical speciation. For days before 2009 a standard TEOM was used. From 2009 and after, a TEOM FDMS was used.

Date	Filter	TEOM	TEOM/Filter
12/17/2003	74.6	60.4	0.81
1/13/2005	39.3	29.2	0.74
1/19/2005	85.1	46	0.54
1/22/2005	77.8	40.1	0.52
2/21/2009	117.6	116.2	0.99
1/2/2010	101.3	97.3	0.96
1/29/2010	104	107.6	1.03
2/13/2010	92	87	0.95
1/12/2011	127.6	26.8	0.21

Figure 2 gives hourly PM10 concentrations for days in 2003 and 2005 with chemical speciation measurements. These were measured using a standard TEOM which heats the sample to 50°C which drives off most of the volatile compounds including much of the organic material in wood smoke and ammonium nitrate. During these days, the TEOM PM10 was much less than the filter-based PM10 as shown in Table 6.

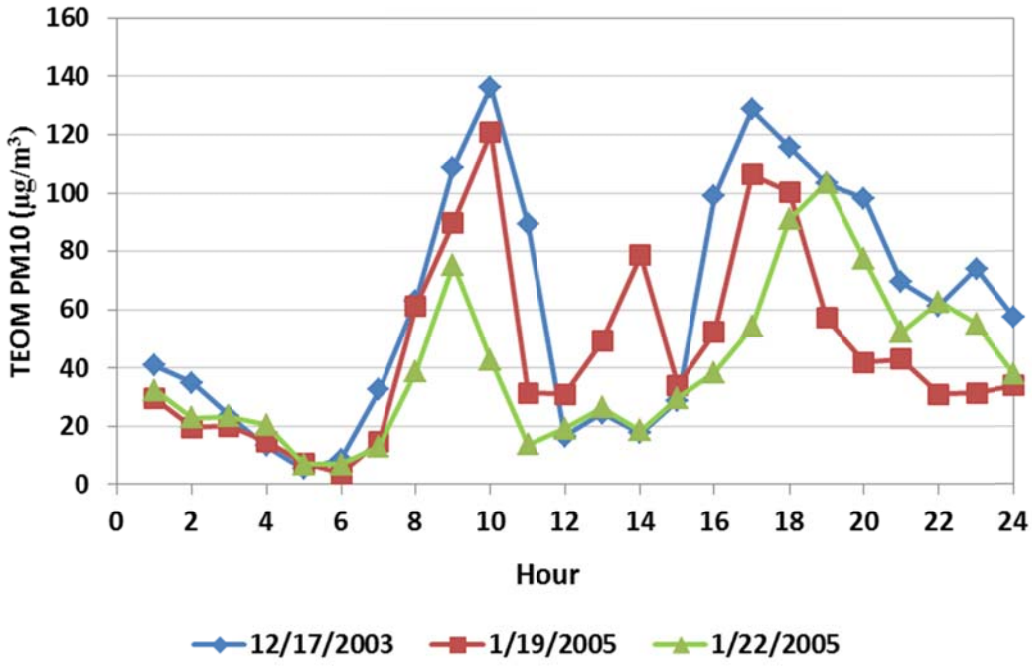


Figure 2. TEOM hourly PM10 concentrations for 12/17/2003, 1/19/2005, and 1/22/2005.

Figure 3 shows average TEOM PM10 by hour of day for winter months (December, January, and February) for the 2001-2008 and 2009-2012 periods. This essentially corresponds to the time frame with standard TEOM (2001-2008) and the period with TEOM FDMS (2009-2012). The concentrations are similar and diurnal patterns both show morning and evening peaks. The latter period shows somewhat higher concentrations overnight (from about 9pm to 8 am). This is expected because the standard TEOM volatilizes a portion of the wood smoke. The morning peaks are of very similar concentration both periods, suggesting that this peak is almost entirely traffic related (e.g. road dust) and that concentrations have changed little over time. It is possible however that volatile compounds (e.g. wood smoke) also contribute to the morning peak and the levels have decreased by an amount equal to the volatile component of the wood smoke lost by the standard TEOM, thus masking any trend in time. We can also note that the earlier evening peak in PM10 seen gives the same concentrations for both time periods until after 9pm when the 2009-2012 period shows higher values likely due to less volatilization of wood smoke from the sample. This suggests that the influence of wood smoke relative to road dust increases during late evening to morning and that the earlier rise in PM10 may be driven mainly by road dust.

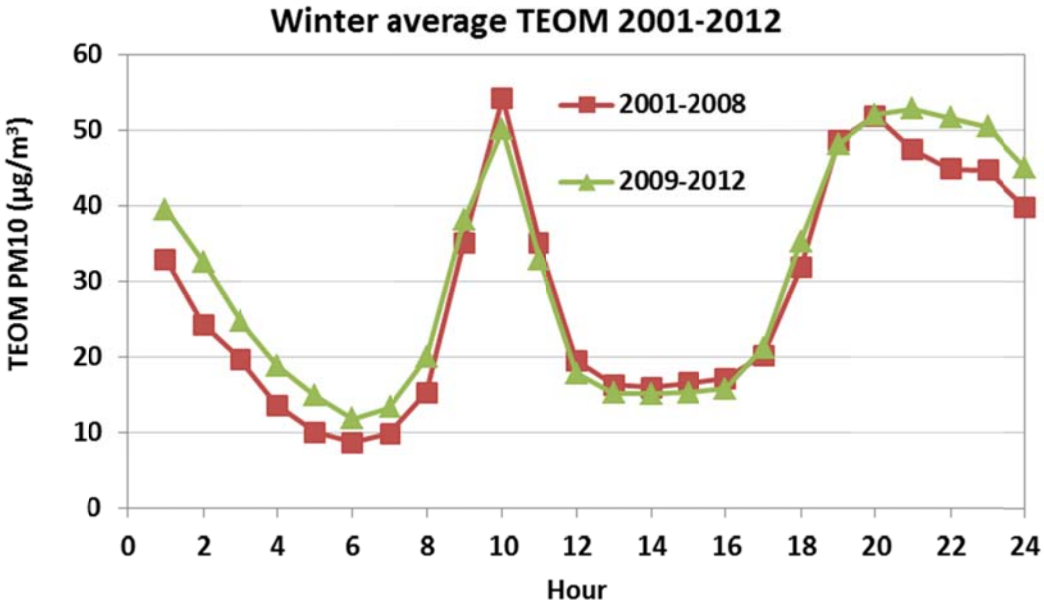


Figure 3. Average PM_{10} by hour of day for winter months (December, January, and February) for the 2001-2008 and 2009-2012 periods. The 2009-2012 period had TEOM FDMS; the 2001-2008 period mostly was standard TEOM.

Methodology for CMB 8 runs for Mammoth Lakes PM10 and PM2.5

Chemical mass balance (CMB) version 8 (USEPA) was used to estimate source contributions to PM10 and PM2.5 for days with chemically speciated data. CMB analysis done in support of the 1990 Air Quality Management Plan (AQMP, Ono et al, 1990) for Mammoth Lakes showed most of the PM10 was due to road dust and residential wood combustion (RWC). One of the goals of the current study is to try to determine if the relative contribution of RWC and road dust has changed since the1990 report.

Source profiles used for CMB

PM10 analysis

Source profiles were taken from the 1990 AQMP. Profiles for Mammoth Lakes woodstoves and fireplaces were used plus road dust and cinders. When running CMB it was found that significant collinearity occurred between the wood stove and fireplace sources, giving high uncertainty to wood stove contributions (sometimes significantly negative). CMB was run again not using the wood stove source, just fireplaces, cinders, and road dust. This gave much improved results. It was attempted to improve results by averaging the wood stove and fireplace profiles, but the quality of the results deteriorated. A weighted average of 3 parts fireplace to 1 part wood stove profile was also tried and results were not as good as simply using the fireplace profile.

PM2.5 analysis

The PM2.5 analysis had collinearity problems between wood stove and fireplace and between road dust and cinders. The analysis with the best results used fireplaces and road dust source profiles only.

Fitting species

CMB results can vary significantly based on the choice of fitting species selected. In the initial run, all species measured with available source analysis were used. This gave poor results. Species that were noted from the ambient data to represent the mix of sources were added and subtracted in a trial and error method until the best results were obtained. Attention was paid to squared correlation coefficient, the Chi square statistic and percent of mass explained performance measures (Watson, 2004). The fitting species included: soluble Cl, ammonium, soluble K, total K, Na, Al, Si, S, Ca, Ti, Fe, EC, OC, Ba, Sr, and Zn.

CMB results

Results for the best fitting CMB analysis are shown in Table 7. Recommended performance measures (Watson, 2004) are % mass accounted for 100±20%, R-squared>0.80, and Chi-squared < 4.0. For the PM10 results (discounting the 1/12/2010 sample), 10/11 cases have % mass 100±20%, all cases have R-squared>0.80, and 5/11 meet the Chi-squared <4.0 criteria. For the PM2.5 results, three out of four met the mass criteria and all four met the R-squared and chi-squared criteria.

Table 7. CMB attribution results and performance statistics.

DATE	SIZE	conc stp	FP	RD	CIND	SUM	% mass	R^2	Chi^2
12/17/03	10	74.6	53.0	9.6	10.2	72.8	97.5	0.94	3.70
01/13/05	10	39.3	31.1	3.6	1.7	36.5	92.7	0.92	3.76
01/19/05	10	85.1	51.8	18.1	11.5	81.3	95.5	0.93	4.39
01/22/05	10	77.8	47.5	16.9	8.7	73.0	93.8	0.94	3.70
01/01/08	10	85.9	53.4	24.6	14.8	92.9	108.1	0.93	4.73
02/09/08	10	96.7	68.0	10.2	13.8	92.0	95.1	0.94	3.35
02/27/08	10	95.5	52.6	26.1	12.7	91.3	95.6	0.90	6.40
02/21/09	10	117.6	91.7	26.6	21.0	139.3	118.5	0.94	3.89
01/02/10	10	101.3	100.4	23.2	19.0	142.6	140.8	0.90	6.88
01/29/10	10	104.0	65.8	24.5	16.8	107.1	103.0	0.93	4.52
02/13/10	10	92.0	68.9	25.9	13.9	108.7	118.2	0.91	6.09
01/12/11	10	127.6	43.9	2.2	1.8	47.9	37.5	0.82	8.77
12/17/03	2.5	40.6	28.6	1.5		30.0	74.0	0.96	0.90
01/13/05	2.5	32.7	27.5	0.6		28.1	86.0	0.81	3.90
01/19/05	2.5	30.5	28.1	2.2		30.3	99.3	0.89	2.73
01/22/05	2.5	33.2	27.6	1.9		29.5	89.0	0.92	2.00

The percent of each sample attributed to each source is shown in table 8. On average, residential wood combustion contributed about 2/3 of the PM10, while traffic (road dust + cinders) contributed about 1/3, according to the CMB results.

Table 8. Percent of each sample attributed to fireplaces, road dust, and cinders. January 12, 2011 not included as this date had an apparent mass problem as discussed earlier. January 13, 20o5 was not included in the PM10 list because it had low PM10 concentrations and thus does not represent a high PM10 day.

DATE	SIZE	conc stp	FP%	RD%	CIND%
12/17/03	10	74.6	72.9	13.2	14.0
01/19/05	10	85.1	85.3	10.0	4.7
01/22/05	10	77.8	63.7	22.2	14.1
01/01/08	10	85.9	65.0	23.1	11.8
02/09/08	10	96.7	57.5	26.5	16.0
02/27/08	10	95.5	73.9	11.1	15.0
02/21/09	10	117.6	57.5	28.5	13.9
01/02/10	10	101.3	65.8	19.1	15.1
01/29/10	10	104.0	70.4	16.3	13.3
02/13/10	10	92.0	61.4	22.9	15.7
12/17/03	2.5	40.6	28.6	4.5	
01/13/05	2.5	32.7	95.2	4.8	
01/19/05	2.5	30.5	97.7	2.3	
01/22/05	2.5	33.2	92.6	7.4	
Average PM10		93.1	67.4	19.3	13.4
Average PM2.5		34.3	78.5	4.7	

For the winter 1987-1988 study (Ono et al, 1990), on average, fireplaces contributed 75% of the PM10 and road dust 25%. Table 9 compares the results of the 1987-88 study to this study. Three of the days in the 1987-88 study showed wood smoke contributing >95% of the PM10; the current study shows no high PM10 days with greater than 75% of the PM10 contributed from wood smoke.

Furthermore, the peak contributions of road dust and residential wood combustion to PM10 appear to have diminished. For the 1987-88 study average contributions to PM10 from road dust and fireplaces for the three highest impact days were 72 and 107 $\mu g/m^3$, respectively. For the 2008-2010 period these fell to 56 and 72 $\mu g/m^3$. This represents a 32% drop in road dust concentrations and 33% drop in residential wood combustion concentrations on high impact days.

Table 9. CMB percent contributions to PM10 by road dust (RD) and residential wood combustion (RWC) for the winter 1987-88 study and this study (2003-2011). Road dust and cinders contributions are combined into RD .

Date	Conc	RD%	RWC%
12/26/1987	125.9	2.3	97.7
12/30/1987	132.8	1.3	98.7
12/31/1987	142.8	2.5	97.5
1/1/1988	117.4	10.3	89.7
1/22/1988	143.8	33.7	66.3
1/23/1988	157.8	41.2	58.8
2/3/1988	104.3	31.5	68.5
2/5/1988	148.2	33.8	66.2
2/6/1988	160	31.2	68.8
2/13/1988	137.6	38.8	61.2
2/14/1988	144	45.2	54.8
2/19/1988	148.5	28.7	71.3
12/17/03	74.6	25.3	74.7
01/19/05	85.1	33.7	66.3
01/22/05	77.8	32.5	67.5
01/01/08	85.9	39.5	60.5
02/09/08	96.7	24.3	75.7
02/27/08	95.5	39.4	60.6
02/21/09	117.6	32.0	68.0
01/02/10	101.3	27.7	72.3
01/29/10	104.0	36.0	64.0
02/13/10	92.0	33.8	66.2
1987-88 study average		25.0	75.0
This study average		32.4	67.6

A simple alternative method for estimating source attributions

Another estimate of crustal type sources (road dust and cinders) as percent of total PM was made by computing reconstructed fine soil (IMPROVE equation) and adding estimated associated carbonaceous aerosol mass (EC + 1.8*OC). Cinders have essentially no carbon, but road dust is about 10% OC and about 1% EC. As an upper limit it was assumed that OC and EC are proportional to the reconstructed soil at the same ratio as in road dust and this is added to the reconstructed soil calculation. The results (Table 10) show a higher average contribution from road dust and cinders (about 49%) than the CMB analysis (about 35%). Note: this method assumes organic and elemental carbon at the same abundance as in road dust and may be expected be an overestimate of carbon in road dust + cinders as cinders have essentially no carbon. It may thus represent an upper limit to the road dust and cinder contribution to PM10.

Table 10. Comparison of contribution of crustal elements from mass reconstruction calculations (soil+rd C) and CMB analysis (rd+cind).

date	soil+rd C	rd+cind%
12/17/03	35.9	27.1
01/19/05	48.2	36.3
01/22/05	44.7	35.0
01/01/08	62.0	42.5
02/09/08	31.3	26.1
02/27/08	56.2	42.5
02/21/09	52.8	34.2
01/02/10	52.9	29.6
01/29/10	54.7	38.6
02/13/10	53.9	36.6
average	49.3	34.8

Analysis of days with both PM10 and PM2.5 speciated data

Four days have both PM10 and PM2.5 speciated data. For these days, by subtraction of the PM2.5 attribution from the PM10 attribution we can get a value for PM coarse (PM10-PM2.5) attribution. These results are shown in Table 11.

Table 11. CMB attribution (μg/m^3) to wood smoke (FP) and road dust (rd+cind) by size fraction for four days with chemically speciated PM2.5 and PM10.

DATE	SIZE	stp conc	FP	rd+cind
12/17/03	10	74.6	53.0	19.7
12/17/03	2.5	40.6	28.6	1.5
12/17/03	coarse	34.0	24.5	18.3
1/13/05	10	39.3	31.1	5.4
1/13/05	2.5	32.7	27.5	0.6
1/13/05	coarse	6.6	3.6	4.7
1/19/05	10	85.1	51.8	29.5
1/19/05	2.5	30.5	28.1	2.2
1/19/05	coarse	54.6	23.7	27.3
1/22/05	10	77.8	47.5	25.5
1/22/05	2.5	33.2	27.6	1.9
1/22/05	coarse	44.6	19.8	23.6
average	10	69.2	45.8	20.0
	2.5	34.3	27.9	1.6
	coarse	34.9	17.9	18.5

Table 11 shows that over 90% of the PM10 mass attributed to road dust and cinders is in the coarse mode, as would be expected. However, on average for these days only a little more than 60% of the wood smoke (FP) is attribute to the fine mode, with about 40% in the coarse mode. This is somewhat unexpected, as a large majority of wood smoke is expected to be in the fine mode. The result is also contrary to the 1987-88 study which found the vast majority of the wood smoke impact in the fine mode. The attribution in the current study was largely a result of having a large residual in the reconstructed mass due to the inability to measure carbon on Teflon filters. The main question regards the “missing mass” which was assumed to be organic mass. If it is organic mass then what is it from if not wood smoke? Some would be associated with road dust, but not the levels needed. Some also would be from motor vehicles, but again this would almost all be expected to be in the fine mode. It is possible the reconstructed soil equation used is not appropriate for the local conditions and this would affect the residual used to estimate organic carbon. There could also be some water accounting for the missing mass, but concentration of hygroscopic compounds such as sulfate and nitrate are low and mainly in the fine mode, so this would not be expected to account for much. Because the wood smoke is present along with road dust, the road dust may become coated with wood smoke, thus causing a significant fraction of the wood smoke associated organic mass to be in the coarse mode.

Summary and conclusions

The question of the relative contributions of wood smoke and road dust to PM10 in Mammoth Lakes was considered. Teflon filters from high PM10 days between 2003 and 2011 were subjected to chemical analysis with XRF, ion chromatography, and filter light absorption. Four days analyzed also had PM2.5 filters that underwent chemical analysis. A major limitation was the inability to measure carbon on the filters. The filter light absorption provided a reasonable estimate of elemental carbon and the unexplained mass (on average 58% of PM10 and 68% of PM2.5) was assumed to be organic mass (OC*1.8). Estimates of contribution of wood smoke and road dust were made using Chemical mass balance (CMB) and a simple method based on abundance of crustal elements in the samples. For PM10 CMB showed an average of 32% due to road dust and 68% due to residential wood combustion. This compares to 25% from road dust and 75% from residential wood combustion for the winter 1987-88 study. The CMB maximum contributions (average of 3 highest days) to PM10 from road dust and residential wood combustion dropped by about 1/3 for each source category between 1987-1988 and 2008-2010.

A simpler method using reconstructed soil from the IMPROVE equation and adding organic mass and elemental carbon in the ratio found in Mammoth Lakes road dust gave an average of 49% contribution of road dust to PM10. There is likely some impact from other sources such as vehicle exhaust to the PM10 although these impacts are expected to be small in comparison to wood smoke and road dust. The relative contribution of wood smoke may have decreased since the 1990 AQMP was produced. The extent of any such decrease cannot be reliably determined with the data available. Additional measurements, chemical analysis and data analysis would be necessary to gain more confidence in the results.

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