SECTION 4 - EMISSIONS INVENTORY

EMISSIONS INVENTORY SUMMARY
ANNUAL AVERAGE AND PEAK 24-HOUR EMISSION CALCULATIONS
OTHER POTENTIAL EMISSION SOURCES

4.1 Emissions Inventory Summary

The only significant source of PM-10 emissions in the Mono Basin is from lake shore windblown dust resulting from the erosion of efflorescent salt deposits and some exposed soils and sediments along (1) the northern and eastern shores of Mono Lake, (2) the landbridge between the lake's north shore and Negit Island, and (3) the western shoreline of Paoha Island. Efflorescent salts form as shallow saline ground water rises to the surface of permeable sediments through capillary action and evaporates at the soil surface leaving a highly erodible salt crust. As concluded in the EIR, "Most observers consider the salt deposits to be the major source of suspended particulate matter during significant dust storm events."[20] Other sources of PM-10 have been evaluated to meet the EPA requirement that all potential sources, within the expected control area of the plan, be identified and estimated. As displayed in Table 4-1, the individual and cumulative contribution of other sources to the PM-10 problem in the Mono Basin is insignificant compared to lake shore windblown dust.

Table 4-1

MONO BASIN PLANNING AREA PM-10 EMISSIONS SUMMARY

SOURCE	TONS/YEAR	TONS/DAY
Unpaved Roads	149 (2%)	.42 (<1%)
Vehicle Tail Pipe & Tire Wear	31 (<1%)	.08 (<1%)
Residential Wood Burning	18 (<1%)	0 (0%)
Road Cinders	455 (7%)	0 (0%)
Wildfires & Prescribed Burning	229 (4%)	0 (0%)
Landfill Burning	25 (<1%)	0 (0%)
Lake Shore Windblown Dust	5,665 (86%)	588 (99%)
Total	6,572 (100%)	588.5 (100%)

Annual Average PM-10 Emissions

The annual average PM-10 emissions value for lake shore windblown dust is from a modeled source elevation of 6,375'. 1992 is the year used in the calculation of annual average PM-10 emissions, and the lake level in 1992 was at or near the 6,375' elevation.

An examination of the same emission outputs for the other modeled elevations is summarized in Table 4-2. As can be seen from this table, a rise in the lake level would significantly decrease the annual average PM-10 emissions from the Mono Basin. For example, there is a 76% decrease in emissions if the source elevation is at 6,393'. Nonetheless, at all modeled elevations, lake shore windblown dust remains the predominant emissions source.

Table 4-2

ANNUAL AVERAGE PM-10 EMISSIONS
(Tons/Year)

SOURCES	MODELED ELEVATIONS				
	6,375'	6,377'	6,381'	6,387'	6,393'
Unpaved Roads	149 (2.3%)	149 (2.7%)	149 (4.2%)	149 (6.6%)	149 (9.6%)
Vehicle Tail Pipe & Tire Wear	31 (0.5%)	31 (0.6%)	31 (0.9%)	31 (1.4%)	31 (2.0%)
Residential Wood Burning	18 (0.3%)	18 (0.3%)	18 (0.5%)	18 (0.8%)	18 (1.2%)
Road Cinders	455 (6.9%)	455 (8.2%)	455 (12.9%)	455 (20.1%)	455 (29.2%)
Wildfires & Prescribed Burning	229 (3.5%)	229 (4.1%)	229 (6.5%)	229 (10.1%)	229 (14.7%)
Landfill Burning	25 (0.4%)	25 (0.5%)	25 (0.7%)	25 (1.1%)	25 (1.6%)
Lake Shore Windblown Dust	5,665 (86.2%)	4,634 (83.6%)	2,632 (74.4%)	1,359 (60.0%)	650 (41.7%)
Total	6,572	5,541	3,539	2,266	1,557

1 Ton = 907.2 Kg

Peak 24-Hour PM-10 Emissions

In addition to the annual average emissions inventory, a computer modeled emissions value for a 24-hour "worst case" day has been developed for each possible PM-10 source identified.

As indicated above, lake shore windblown dust is the only significant source of PM-10 emissions in the Mono Basin. The modeling results indicate that the peak 24-hour episode for this emission source is May 8, 1991. This represents the design day (see 4.2 for detail). Normally on May 8th (due to time of year and burn day scheduling), no residential wood burning, road cinders, wildfires/prescribed burning, or landfill burning would be present and ambient emissions from these sources would be unlikely. However, if all sources were to have been present on the design day, the calculated amounts of their respective contribution to emissions are shown in Table 4-3. Lake shore windblown emissions still account for approximately 89% of the total emissions for the design day of May 8, 1991--the 24-hour "worst case" episode.

Table 4-3

PEAK 24-HOUR PM-10 EMISSION ESTIMATES
All Potential Sources Calculated

SOURCE	Tons/Day	%
Unpaved Roads	.42	<1%
Vehicle Tail Pipe & Tire Wear	.08	<1%
Residential Wood Burning	.10	<1%
Road Cinders	50	7.6%
Wildfires & Prescribed Burning	10	1.5%
Landfill Burning	12.5	1.9%
Lake Shore Windblown Dust	588	88.9%
Total	661.1	

1 Ton = 907.2 Kg

Table 4-4 shows the peak 24-hour PM-10 emissions contribution by source for May 8, 1991, without residential wood burning, road cinders, wildfires/prescribed burning, and landfill burning.

Table 4-4

PEAK 24-HOUR PM-10 EMISSION ESTIMATES
Design Day Sources Only
May 8, 1991

SOURCE	Tons/Day	%
Unpaved Roads	.42	<1%
Vehicle Tail Pipe & Tire Wear	.08	<1%
Residential Wood Burning	0	0%
Road Cinders	0	0%
Wildfires & Prescribed Burning	0	0%
Landfill Burning	0	0%
Lake Shore Windblown Dust	588	99%
Total	588.5	

1 Ton = 907.2 Kg

4.2 Annual Average and Peak 24-Hour Emission Calculations

This section generally discusses the data sources, methods, and calculations used to estimate the annual average PM-10 emissions and peak 24-hour emissions presented in the above summary. For a detailed presentation of the calculations, refer to Appendix 5 (*Final Mono Lake Air Quality Modeling Study*) and Appendix 6 (Emission Calculations).

It is important to understand the significance of the peak 24-hour emissions value as the basis for the inventory, the modeled predictions, and the demonstration of attainment with the PM-10 Standard. Peak 24-hour emissions are calculated using the same data set as the annual average emission calculations. In nontechnical terms, the calculated peak 24-hour episode represents the design day and can be thought of as the "worst case" air quality conditions which must be remediated to bring the source(s) into compliance with the PM-10 Standard. The design day PM-10 concentration is an essential benchmark used in control measure development and validation of effectiveness. Based upon computer modeling, the 24-hour design day PM-10 concentration for lake shore windblown dust in Mono Basin is 895 $\mu g/m^3$ (at a source elevation of 6,375'). This concentration must be reduced to less than 150 $\mu g/m^3$ to attain the PM-10 Standard and for the planning area to be in compliance with the CAA.

The design day concentration is selected from the sixth highest concentration at the worst air impact site as described in Appendix 5. The design day is May 8, 1991.

Unpaved Roads

There are a total of 422 miles of unpaved roads within the Mono Basin Planning Area. There are 319 miles of roads within the Mono Basin National Forest Scenic Area, of which 287 are unpaved. Outside the scenic area, but within the planning area, are approximately 135 additional miles of unpaved roads.

The soil type is mixed rock, generally granitic in the southwestern, western, and northern portions of the basin. In the southern and eastern portions, the soil is comprised primarily of ash and cinder deposits.

Applying these parameters, the AP-42 methodology for estimating fugitive road dust is used to determine emissions from unpaved roads. The emission factor and equation for the calculations are:

$$\textit{Emissions Factor } e = k(1.7)\,(s/12)\,(S/48)\,(W/2.7)^{0.7}\,(w/4)^{0.5}\,(365-p/365)\ Kg/VKT$$

where:
- k = particle size multiplier
- s = silt content of road surface material (%)
- S = mean vehicle speed (Km/hr)
- W = mean vehicle weight (Mg)
- w = mean number of wheels
- p = number of days with at least 0.254mm (0.01") of precipitation

PM_{10} = *(number of vehicles/year) (VKT) (e)*

where: VKT = [vehicle miles traveled (VMT)] (1.61Km/mile)

The equation yields the following estimates for emissions from unpaved roads:

Annual average PM-10 emissions are 149 Tons.

Peak 24-hour PM-10 emissions are 378 Kg (.42 Tons).

Vehicle Tail Pipe and Tire Wear

Estimated PM-10 emissions from motor vehicle exhaust (gas and diesel) and tire wear are determined using California Air Resources Board data for Mono County. CARB's estimates have been adjusted using traffic counts for the Mono Basin provided by Caltrans.

The following parameters are used in the emission calculation:

e = CARB emission factor per vehicle type
er = emission rate per vehicle type =
(e) [Mono County vehicle miles traveled/day
(VMT/D) per vehicle type]
Rv = ratio of Mono County VMT/D per vehicle type/
total Mono County VMT/D
VMT/D = (ADT) (m)
ADT = average daily travel/highway
m = number of miles/highway

The equation for estimating emissions from this source is:

PM_{10} = *(VMT/D per vehicle type for Mono Basin) (er)*

Estimates of emissions from vehicle tail pipe and tire wear in the Mono Basin Planning Area are:

Annual average PM-10 emissions are 31 Tons.

Peak 24-hour PM-10 emissions are 76.3 Kg (.08 Tons).

Residential Wood Burning

Emissions from residential wood burning are estimated based on data from a wood use survey conducted by the District in preparing the Air Quality Management Plan for the Town of Mammoth Lakes, California.[21]

Emissions for each wood burning device are calculated using the factors and equation below:

PM_{10} *emissions per device* = *(e)* $(Mass_{wood})$

$Mass_{wood}$ = (number of cords) (800 Kg/cord) Jeffery & Pinion Pine

Emission Factors
e = 8.1 g/kg certified wood stoves
e = 14.0 g/kg fireplaces
e = 15.0 g/kg conventional wood stoves, fireplace inserts

The equation yields the following estimates for emissions from residential wood burning:

Annual average PM-10 emissions are 18 Tons.

Peak 24-hour PM-10 emissions are 0. It is assumed that there would be little to no residential wood burning on the design day of May 8, 1991. Therefore, this source would not significantly contribute to cumulative emissions.

Road Cinders

Road cinders are occasionally used in the winter months to aid in traction when the paved roads are slick due to snow cover. The paved roads within the Mono Basin Planning Area upon which road cinders may be applied are shown below. The automobile frequency counts are included for each listed road. The count is expressed as average daily traffic (ADT) and includes traffic traveling in both directions. The winter ADT count is used in calculating the present estimates.

Highway	Winter Average Frequency Count
US 395 outside Lee Vining	3,980 ADT
US 395 in Lee Vining	5,400 ADT
CA 120 East of US 395	400 ADT
CA 120 West of US 395	2,250 ADT
CA 158 North Junction	610 ADT
CA 158 South Junction	1,450 ADT
CA 167 at US 395	410 ADT
CA 167 at Nevada Border	360 ADT

An estimate of emissions from resuspended road cinders in the Mono Basin is derived using the AP-42 methodology for estimating reentrained road dust emissions for paved roads. The emissions factor for road cinders is based upon the Town of Mammoth Lakes General Plan and a Caltrans study of road cinders used in Mammoth Lakes.

Emissions from resuspended road cinders are calculated using the emission factor and equation below:

Emission Factor $e = 2.28\ (sL/0.5)^{0.8}$ *(grams/VKT)*

where: sL = silt loading before use

$PM_{10} = (e)\ (VKT)\ (n)$

where: n = number of cinder applications/month
VKT = (VMT) (1.61Km/mile)
VMT = (ADT) (m)
m = number of miles/highway
ADT = average daily travel/highway

The following estimates for resuspended road cinders are derived:

Annual average PM-10 emissions are 455 Tons.

Peak 24-hour PM-10 emissions are 0. It is assumed that there would be little to no road cinders used on the design day of May 8, 1991. Therefore, this source would not significantly contribute to cumulative emissions.

Open Burning

PM-10 emissions from open burning occur occasionally in the Mono Basin as a result of wildfires, prescribed burning, and landfill burning of vegetative waste. The Forest Service expects to increase the use of prescribed burning in the Mono Basin as part of a timber management program and as a tool to improve ecosystem health. Prescribed burning will also include natural fires that may be allowed to burn in locations that will not affect populated areas.

The Forest Service has estimated future emissions from open burning in the Mono Basin to be about 214 tons of PM-10 per year for historic wildfires and prescribed natural fires, and 15 tons of PM-10 per year for other prescribed burning activities (McKee, April 1995). Peak daily emissions are estimated at about 10 tons of PM-10 per day from these wildfires and prescribed burning activities, assuming that prescribed burning will not take place simultaneously with large wildfires. Prescribed burning is governed under District Rules 408 through 411 (Appendix 7), and requires that a burn plan be submitted to the District. The plan must show (1) that burning will be conducted on a burn day as defined by the California Air Resources Board, (2) that it will be done in a manner that will minimize smoke, (3) that it will not cause or contribute to a violation of the state or federal ambient air quality standards, and (4) that it will not cause a public nuisance.

Burning of vegetative waste at Mono County's Pumice Valley Landfill, located three miles east of US 395 on CA 120, is permitted under District Rule 412 (Appendix 7). Burning is conducted on burn days under a plan approved by the District and the California Air Resources Board (Morgester, 1993). This activity is expected to occur twice per year and PM-10 emissions are estimated at about 12.5 tons per day (e.g., 25 tons of PM-10 per year).

PM-10 emissions from open burning are not expected to occur on high wind days associated with the wind blown dust at Mono Lake. High winds pose an obvious safety hazard for prescribed burning operations. It is noted in the PM-10 Comments in Sampling Data from Monitoring Sites (Appendix 4) when forest fires or brush fires have been present during an observation period. On those days when forest or brush fires were present, PM-10 levels were well below the Standard.

Lake Shore Windblown Dust

The windblown PM-10 emissions are estimated using empirically-derived wind erosion data from wind tunnel tests performed by the District in 1990 at Mono Lake. Using hourly average wind speed data, the amount of PM-10 emissions can be estimated using the following equation:

$$q_a = 2.6 \times 10^{-5} \exp(0.11u)$$

where: q_a is the area source PM_{10} emission factor or vertical flux ($g/m^2/sec$), and u is wind speed in miles per hour (mph) at a 10 meter height.

$q_a = 0$ if the wind speed is below the threshold wind speed of 16 mph.

From this equation, the hourly PM-10 emissions are estimated for the dispersion model. Emissions from the exposed source areas are changed each hour with the changing wind speed and are changed again as the source area sizes vary with the lake level. (Also see Section 5 on Dispersion Modeling)

Table 4-5

ANNUAL AVERAGE PM-10 EMISSIONS
Dust Season Only
(Tons/Year)

YEAR	MODELED ELEVATIONS				
	6,375'	6,377'	6,381'	6,387'	6,393'
1988	6,745	5,518	3,134	1,618	774
1989	4,098	3,354	1,905	983	471
1990	4,042	3,307	1,878	970	464
1991	5,375	4,397	2,497	1,290	616
1992	5,665	4,634	2,632	1,359	650
AVERAGE	5,165	4,242	2,410	1,244	595

Annual average PM-10 emissions are 5,665 Tons (as presented in the Emissions Inventory Summary). Table 4-5 above contains modeled emission estimates for different lake levels or source elevations for the years 1988-1992.

The annual average emission values appearing in Table 8 of Appendix 5 are expressed in Mg/Year. PM-10 emission tonnage in Table 4-5 is derived using the following conversion equation:

(Emission Ton/yr) = (Emission Mg/yr) (1,000 Kg/Mg) (1 Ton/907.2 Kg)

Peak 24-hour PM-10 emissions are 588 Tons/Day (as presented in the Emissions Inventory Summary). This is for a lake level of 6,375'. Table 4-6 below shows peak 24-hour emission estimates for different lake levels or source elevations. Data is extracted from Table 7, Appendix 5.

Table 4-6

PEAK 24-HOUR PM-10 EMISSIONS
Dispersion Modeling Results
Design Day: May 8, 1991
(Tons/Day)

MODELED ELEVATIONS				
6,375'	6,377'	6,381	6,387'	6,393'
588	480	273	141	67

1 Ton = 907.2 Kg

4.3 Other Potential Emission Sources

Prediversion Exposed Lake Bed

The relatively flat west side of Paoha Island is a frequent dust storm emission source area. Lake bed silts, clays, and diatomaceous sediments occur on Paoha Island. Lake bed silts with occasional clayey layers--deposited by the prehistoric Lake Russell--are exposed in streamcuts and probably underlie many of the surface sands in this area. Diatomaceous sediments are microscopic silica shells formed by some types of aquatic algae. Although these sedimentary materials can be transported long distances through wind erosion, they are not considered a significant source of PM-10.

Pumice Sands

Pumice sands are readily apparent along much of the east shore of Mono Lake. The material has a high void ratio and low particle density. As a result, pumice sands are subject to wind erosion, but they are not a significant source of PM-10 emissions.

Volcanic Rock

Sands derived from most of the volcanic rocks in the Mono Basin have a variable density and low quartz content. Volcanic rocks south of Mono Lake are predominantly rhyolitic ash and include obsidian domes and pumice fields. Volcanic rocks on Negit Island are andesitic lavas. Black Point is a basalt cinder cone. These sources of sand are highly resistant to erosion by the wind and are not considered to contribute significantly to PM-10 emissions.

Industrial Sources

1. Permitted Industrial Facilities

The following industrial sources of PM-10 emissions meet the standards for air quality compliance as per the EPA guidelines and have been permitted by the District to operate in the Mono Basin. Permits are on file at the District office.

Company Name	Type of Operation
Hunewill Ready Mix Co.	Sand and Gravel Concrete Batch Plant Asphalt Plant
Marzano & Sons	Sand and Gravel Concrete Batch Plant

2. Non-Permitted Industrial Facilities

The following industrial sources are identified as operating within the Mono Basin and are not required to be permitted by the District.

Company Name	Type of Operation
McCune's Sand & Gravel	Trucking
United States Pumice Co.	Block Pumice Mine Pumice Storage Yard
Construction Specialty	Trucking Road Cinder Mine
June Mountain Ski Area	Ski Area
Southern California Edison	Electric Generating and Distributing
High Sierra Shrimp Plant	Tropical Fish Food Factory
Logging Companies	Timber Harvesting from Inyo National Forest

Agriculture

Livestock production is the dominant agricultural activity within Mono Basin. Sheep and cattle are grazed within the basin during summer months. Due to harsh winters, few livestock remain in the basin year round. Most grazing occurs on land leased from the Los Angeles Department of Water and Power or through use permits issued by the U.S Forest Service or the Bureau of Land Management. Four sheep companies and one cattle company use most of the grazing lands within the Mono Basin.

As per Rule 405 of the Rules and Regulations of the District, agricultural operations associated with livestock production are exempt from Rule 400. This means that such operations are not required to have a permit or to control the discharge of fugitive dust. However, it is estimated that the amount of fugitive dust generated by grazing is negligible.

Home Construction

The population of the Mono Basin Planning Area is approximately 2,600 people and there are a relatively small number of homes. Information from the Mono County Building Department indicates that the following building permits were issued in 1992.

Location	Number of Building Permits
June Lake	39
Lee Vining	9
Mono City	3
Homes along Highway 167	2
Lundy Canyon	2

These permits were issued for new home construction as well as improvements on existing homes. The small number of permits issued indicates that the impact on air quality in the Mono Basin due to home construction is minimal. There are no large home tracks being constructed where substantial areas of disturbed earth are exposed and subject to wind erosion.

Recreational

The Mono Basin provides opportunities for a wide range of recreational activities. The most common are: hiking, cross country and downhill skiing, snowmobiling, off road vehicle travel and motor-cross, boating and fishing, horseback riding, target shooting, sightseeing, photography, and birding. Developed recreational facilities include several interpretive sites and a County Park, where organized community activities occur. The County Park provides a picnic area, playground equipment, and a boardwalk to the lake shore for birding and close views of the tufa. There are no camping facilities within the Mono Basin National Forest Scenic Area, though many campgrounds exist in the mountain regions surrounding Mono Lake.

There is no evidence that any of these activities produce significant contributing sources of PM-10 emissions.

Commercial

In addition to businesses in the communities of Lee Vining and June Lake, there are several lodges, horse packing concessions, and boating and fishing concessions that operate on many of the freshwater, alpine lakes up-stream from Mono Lake. Similar to recreational activities, the comparatively small scale of commercial business activities does not produce significant contributing sources of PM-10 emissions.

Government Agencies

The following governmental agencies have authority within Mono Basin:

Name of Agency	Activities
U.S. Forest Service	Regulation and Management of National Forests
Bureau of Land Management	Regulation and Management of all BLM Public Land
Bonneville Power Administration	Maintains Power Lines in Jurisdiction
California Department of Transportation	Maintains all Federal and State Highways
California Department of Fish and Game	Regulation and Management of Fishing and Hunting
Mono County Public Works	Maintains Land Fill
Mono County Road Department	Maintains all County Roads
Mono County Public Utility Districts	Maintains Water and Sewer Services in June Lake, Mono City, and Lee Vining
Los Angeles Department of Water and Power	Maintains Reservoirs and Aqueduct System

The physical activities of these governmental agencies do not produce significant contributing sources of PM-10 emissions.