FINAL

2001 AIR EMISSIONS INVENTORY

MESA VERDE NATIONAL PARK
COLORADO

U.S. NATIONAL PARK SERVICE

SEPTEMBER 2003

FINAL

2001 AIR EMISSIONS **INVENTORY**

MESA **VERDE** NATIONAL **PARK**
COLORADO

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SEPTEMBER 2003

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1. INTRODUCTION

1.1 BACKGROUND

In August of 1999, the National Park Service (NPS) embarked on the Natural Resource Challenge, a major effort to substantially improve how the NPS manages the natural resources under its care. As part of Natural Resource Challenge, the NPS Air Resources Division (ARD) was tasked with the responsibility of expanding efforts to monitor and understand air quality and related values in the parks. In addition, the NPS Environmental Leadership policy directs the NPS to manage the parks in a manner "that demonstrates sound environmental stewardship by implementing sustainable practices in all aspects of NPS management...." In order to achieve both of these objectives, it is necessary to gain an understanding of air pollution emissions that result from activities within the park. Development of an in-park air emissions inventory for Mesa Verde National Park (NP) serves three functions in this regard. First, it provides an understanding of the sources and magnitude of in-park emissions and a basis for contrasting them with emissions from the surrounding area. Second, it identifies existing and potential strategies to mitigate in-park air emissions. Finally, it evaluates and ensures the compliance status of the park relative to state and federal air pollution regulations.

1.2 TYPICAL AIR EMISSION SOURCES

Typical air emission sources within NPS units include stationary, area, and mobile sources. Stationary sources can include fossil fuel-fired space and water heating equipment, generators, fuel storage tanks, and wastewater treatment plants. Area sources may include woodstoves, fireplaces, campfires, and prescribed burning and wild fires. Mobile sources may include vehicles operated by visitors and NPS employees and nonroard vehicles and equipment.

The air pollutants that are addressed in this report are summarized in the table below. Of the pollutants noted, ozone is not produced and emitted directly from stationary, area, or mobile sources, but rather it is formed as a result a chemical reaction of nitrogen oxide (NOx) and volatile organic compound (VOC) emissions in the presence of sunlight. Carbon dioxide historically has not been considered a pollutant. However, in recent years, there has been much interest in its contribution to global climate warming since it is considered a greenhouse gas.

AIR POLLUTANTS AND THEIR CHARACTERISTICS

Pollutant	Characteristics
Particulates (PM_{10})	• Mixture of solid particles and liquid droplets; fine particles (less than 2.5 micrometers) produced by fuel combustion, power plants, and diesel buses and trucks • Can aggravate asthma, produce acute respiratory symptoms, including aggravated coughing and difficult or painful breathing, and chronic bronchitis • Impairs visibility
Sulfur Dioxide (SO_2)	• Can cause temporary breathing difficulties for people with asthma • Reacts with other chemicals to form sulfate particles that are major cause of reduced visibility in many parts of the country • Main contributor to formation of acid rain
Nitrogen Oxides (NOx)	• High temperature fuel combustion exhaust product • Can be an irritant to humans and participates in the formation of ozone • Reacts with other pollutants to form nitrate particles that are a significant contributor to visibility reduction in many parts of the country • Contributor to formation of acid rain
Carbon Monoxide (CO)	• Odorless, colorless gas produced by fuel combustion, particularly mobile sources • May cause chest pains and aggravate cardiovascular diseases, such as angina • May affect mental alertness and vision in healthy individuals
Volatile Organic Compounds (VOCs)	• Fuel combustion exhaust product • Consists of a wide variety of carbon-based molecules • Participates in the formation of ozone
Ozone (0_3)	• Not directly emitted by mobile, stationary, or area sources • Formed from complex reactions between NOx and VOC emissions in the presence of sunlight • Occurs regionally due to multiplicity of sources • Can irritate the respiratory system • Can reduce lung function • Can aggravate asthma and increase susceptibility to respiratory infections • Can inflame and damage the lining of the lungs • Damages green leaves and needles
Carbon Dioxide (CO_2)	• Does not directly impair human health • It is a greenhouse gas that traps the earth's heat and contributes to global warming

1.3 INVENTORY METHODOLOGY

The methodology to accomplish the air emissions inventory was outlined in a protocol that was prepared at the initiation of the project (EA Engineering 2001). Tasks consisted of a site survey in March 2003, interviews with Mesa Verde NP personnel[1], review of applicable park records, emission calculations, review of applicable state and local air quality regulations, an assessment of mitigation measures and potential emission reduction initiatives, and report preparation. The data were used in conjunction with a number of manual and computer software computational tools to calculate emissions. Computational tools included U.S. Environmental Protection Agency (USEPA) emission factors such as the Factor Information Retrieval System (FIRE)

[1] George San Miguel, Mesa Verde National Park, Supervisor, Natural Resource Manager (970) 529-5069

database, USEPA *TANKS 4.0* model, U.S. Forest Service *First Order Fire Effects Model (FOFEM) 4.0* model, and USEPA *MOBILE6.2* mobile source emissions model. The year 2001 was selected as the basis for the air emission inventory since data for that year were the most recent available at the park. It should be noted that emissions are expected to vary from year to year due to fluctuations in visitation, prescribed and wildland fires, and other activities. Additional information on emission estimation methodology, including emission factors, are provided in Appendices A and B.

1.4 PARK DESCRIPTION

Mesa Verde NP is located in the high plateau country of southwestern Colorado (Figure 1). The park was established in 1906 to preserve the archeological sites that "Pre-Columbian Indians" built on the mesa tops and in the alcoves of a score of rugged canyons. The park, containing 52,073 acres of Federal land, was designated a World Heritage Site in 1978. Mesa Verde NP, Spanish for "green table", rises high above the surrounding country. For about 1,300 years, agrarian Indians occupied the mesa and surrounding regions. A map of the park is depicted in Figure 2.

There are over four thousand known archeological sites in Mesa Verde NP. Approximately 600 of these are cliff dwellings, and only a few of these sites have been excavated. The culture represented at Mesa Verde NP reflects more than 700 years of history. From approximately A.D. 600 through A.D. 1300, people lived and flourished in communities throughout the area, eventually building elaborate stone villages in the sheltered alcoves of the canyon walls. Today most people call these sheltered villages "cliff dwellings", which represent the last 75 to 100 years of occupation at Mesa Verde NP. In the late 1200s, within the span of one or two generations, they left their homes and moved away.

The archeological sites found in Mesa Verde NP are some of the most notable and best preserved in the U.S. Mesa Verde NP offers visitors a spectacular look into the lives of the Ancestral Pueblo people. Scientists study the ancient dwellings of Mesa Verde NP, in part, by making comparisons between the Ancestral Pueblo people and their contemporary indigenous descendants who still live in the Southwest today. Twenty-four Native American tribes in the southwest have an ancestral affiliation with the sites at Mesa Verde NP.

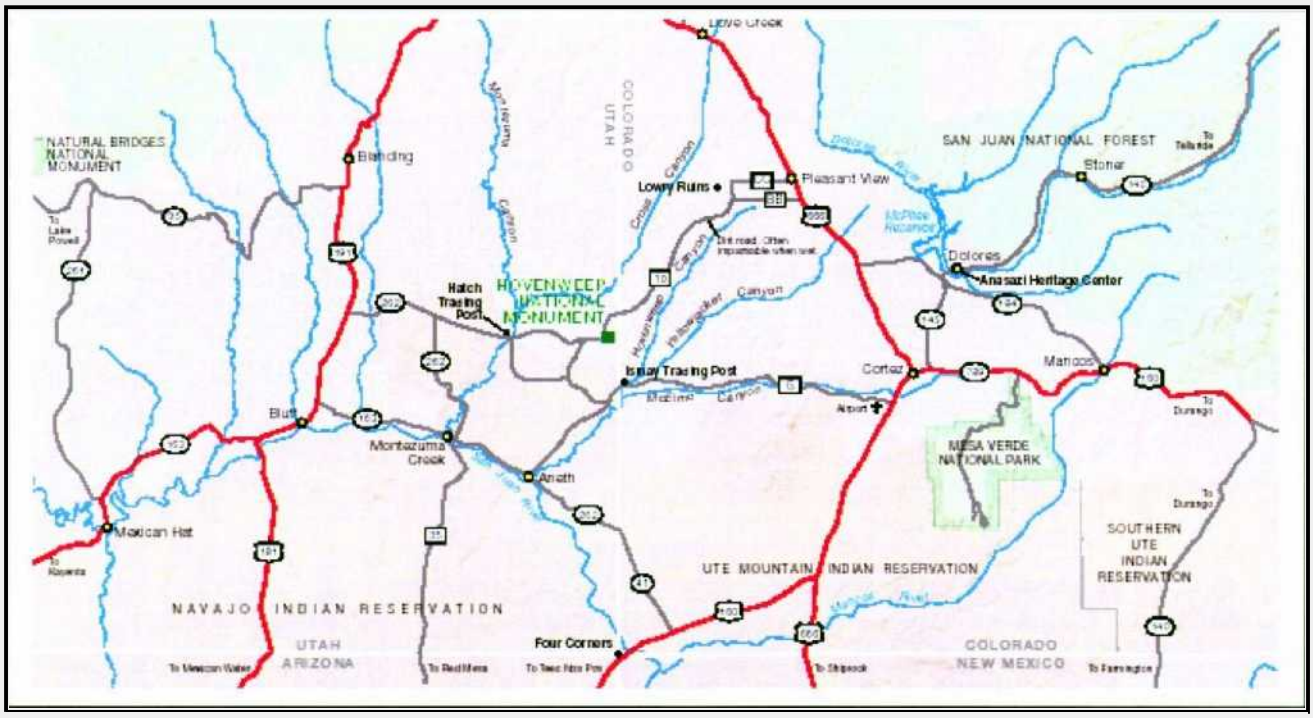


FIGURE 1. MESA VERDE NATIONAL PARK LOCATION

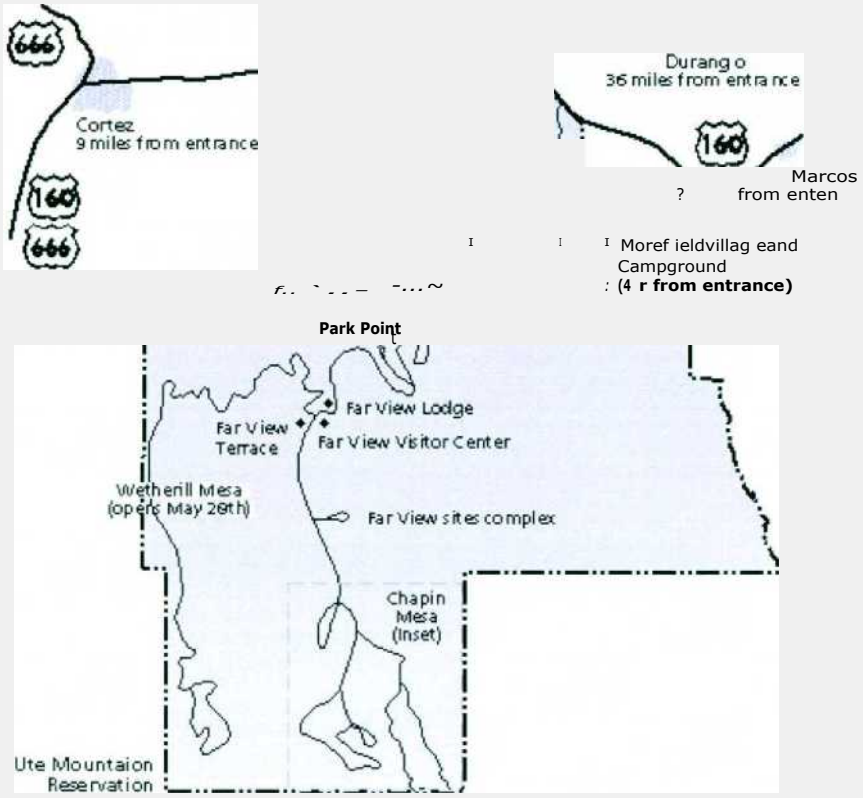


FIGURE 2. **MESA VERDE** NATIONAL PARK

Table 1 summarizes the facilities that are located at the developed areas, and the Figures following this section illustrate the developed areas.

TABLE 1: MESA VERDE NATIONAL PARK DEVELOPED AREAS

Area	Function/Facilities
Entrance Area	Entrance Booth, Employee Trailers, Wastewater Treatment
Chapin Mesa	Archeological Museum, Park Headquarters, Restaurant, Gift Shop, Chief Ranger Office, Post Office, Employee Housing, Library, Fewkes Education Cabin
CCC/Research Area	Fire Cache, Natural Resource Building, Other Research Buildings, GIS/IT
Maintenance Area	Maintenance, Vehicle Refueling, Employee Housing
Far View	Visitor Center, Lodge/Restaurant, Food Court, Gift Shop, Gas Station, Employee Housing, Wastewater Treatment Plant
Morefield Campground	Ranger Station, Grocery Store, Gas Station, Restaurant, Campground, Laundry, Employee Housing
Wetherill	Picnic Area, Snack Bar

1.5 AIR **QUALITY STATUS**

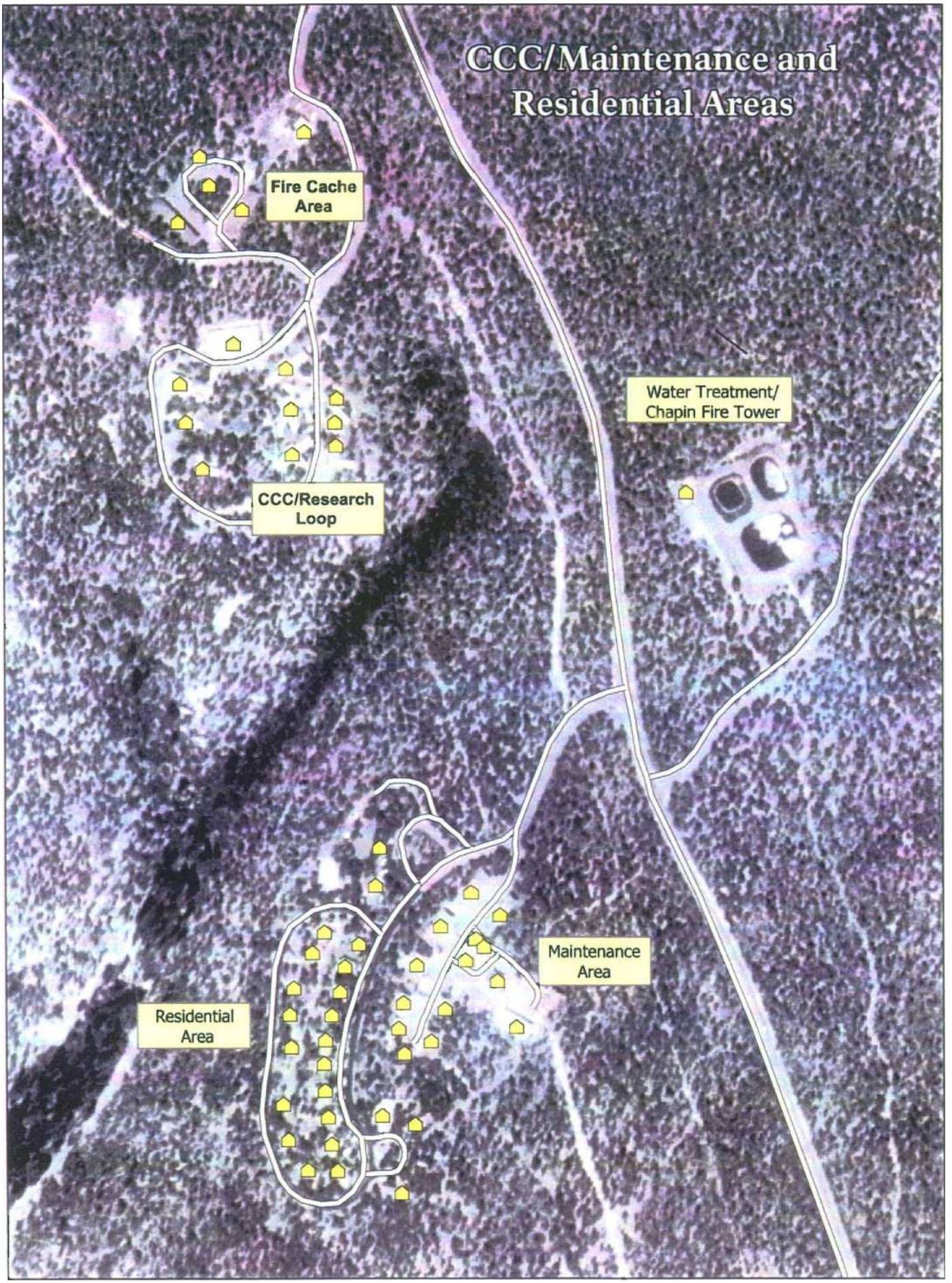
The Colorado Department of Public Health and Environment administers the state's air pollution program. The park is located in Montezuma County, which is classified as attainment for all state and national ambient air quality standards. The park operates an air monitoring station adjacent to the Natural Resources Building in the CCC/Research Area. In addition to ozone, the park monitors acid rain/snow, mercury wet deposition, particulates, and visibility. The latter is part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) particulate monitoring network. The particulate monitoring portion of the IMPROVE program measures the concentration of the fine ($PM_{2.5}$) particles for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrate and of PM_{I0} particles for mass. Data from 1990-1999 indicate that the one-hour average ozone levels have ranged from approximately 0.053 to 0.058 parts per million (ppm), which compares to the standard of 0.12 ppm (NPS 2002). Data from the same ten-year period indicate that the eight-hour average ozone levels have ranged from approximately 0.058 to 0.069 ppm, which compares to the standard of 0.08 ppm.

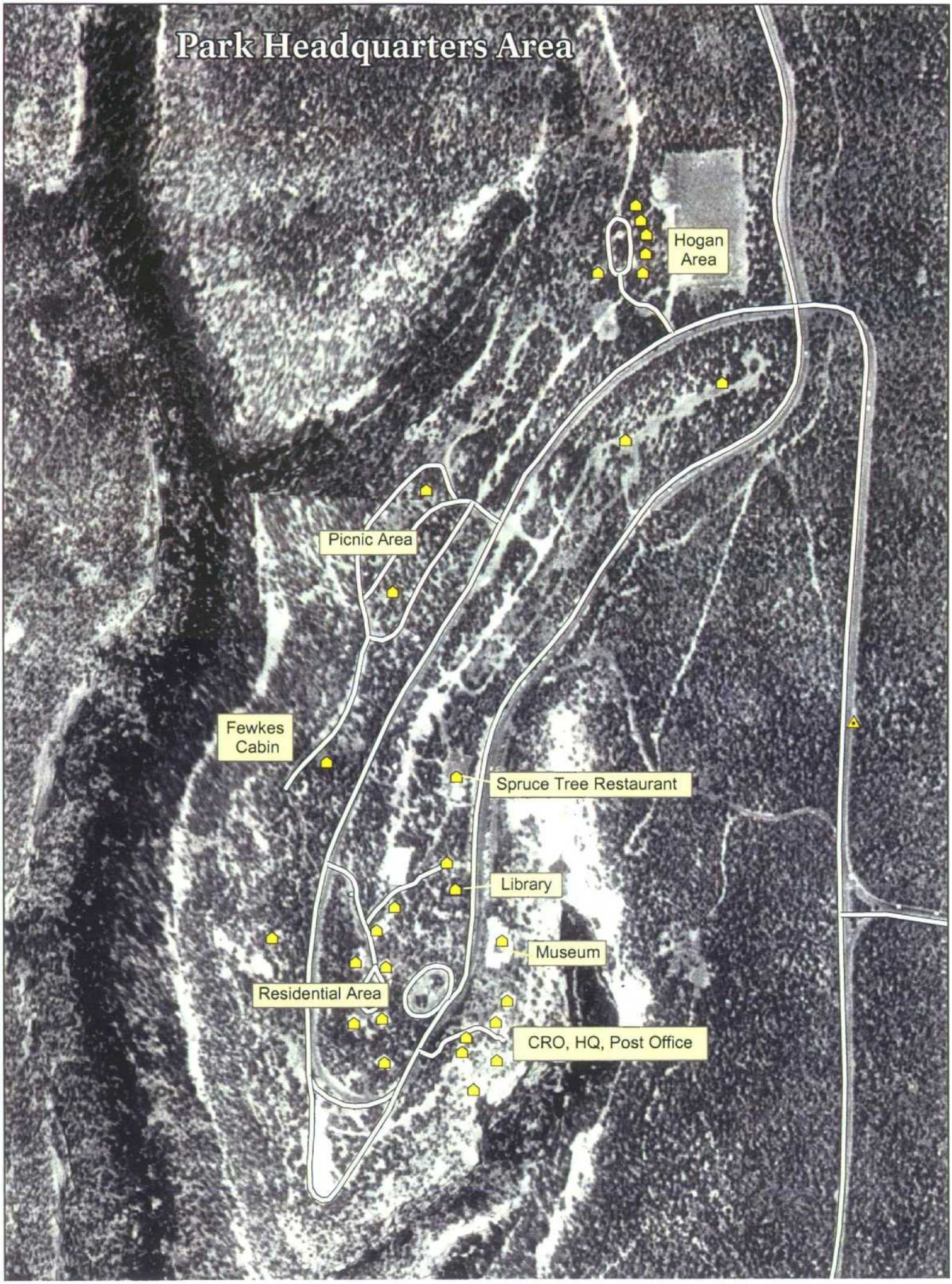
Mesa Verde National Park is a federally-mandated Class I area under the Clean Air Act. As such, air in the Park receives the most stringent protection against increases in air pollution from sources near the park and in further degradation of air quality related values. The Act also sets a further goal of natural visibility conditions, free of human-caused haze. Visibility monitoring at the park indicates that its visibility is as good as or better than other national park units where similar monitoring is conducted (NPS 2002).

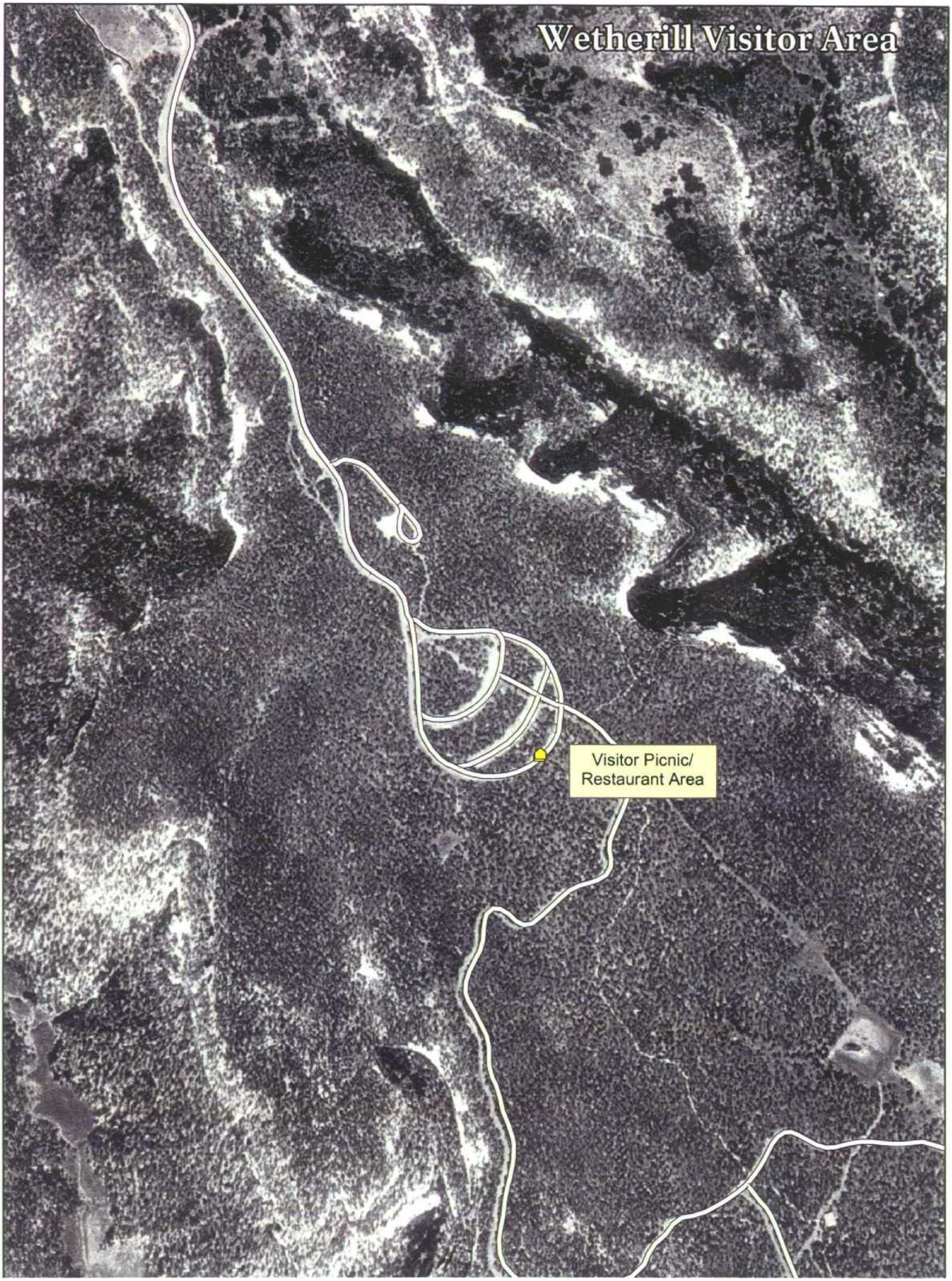
Park Entrance Area
Water Treatment and Residence
Entrance Booth and Trailers

Service Station, Laundry,
Grocery, Ranger Station

Far View Area
Road to Wetherill
Far View
Motel Units
Far View
Lodge
Visitors Center
Residential
Area
Far View
Terrace


CCC/Maintenance and Residential Areas
Fire Cache Area
Water Treatment/ Chapin Fire Tower
CCC/Research Loop
Maintenance Area
Residential Area


Park Headquarters Area
Hogan Area
Picnic Area
Fewkes Cabin
Spruce Tree Restaurant
Library
Museum
Residential Area
CRO, HQ, Post Office


Wetherill Visitor Area
Visitor Picnic/
Restaurant Area

2. STATIONARY AND AREA SOURCE EMISSIONS

This section summarizes emissions from stationary sources at the Park for the year *2001*. The discussion is divided into sections covering emissions from combustion sources, fuel storage sources, and area sources. The following emissions were calculated for each source: particulate matter (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), carbon dioxide (CO_2), and volatile organic compounds (VOCs).

2.1 STATIONARY SOURCES

2.1.1 Space And Water Heating Equipment

There are 74 propane and four No. *2* fuel oil space and heating units in the Park that are operated by the NPS and the concessionaire, Aramark, including 38 employee residential heating units. Criteria emissions were calculated using the appropriate residential emission factors for the fuel types. For example, NOx emissions from the No. *2* oil boiler in the Museum at Headquarters Area was calculated as follows:

$$1{,}027\ gallons/yr\ x\ \frac{18\ lb\ PM}{1{,}000\ gallons} = 21\ lbNOx/yr$$

Actual criteria pollutant emissions from space and water heating equipment are summarized in Table *2*. Potential emissions also were calculated by assuming that the heating units were operated continuously during the year, and these emissions are noted in Table 3.

2.1.2 Generators

There are no stationary generators in use at the park.

TABLE 2. 2001 ACTUAL AIR EMISSIONS FROM MESA VERDE NATIONAL PARK HEATING EQUIPMENT

Location	No.	Fuel	Fuel Consumption	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NOx (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
National Park Service									
Museum	1	No. 2 Fuel Oil	1,067	2	76	21	5	22,933	0
Chief Rangers Office	1		1,067	2	76	21	5	22,933	0
Park Headquarters	1		1,067	2	76	21	5	22,933	0
Library	1	Propane	1,173	0	0	16	2	14,659	0
Hogan	2		2,345	1	0	33	5	29,318	1
Electric Shop	1		1,173	0	0	16	2	14,659	0
Warehouse	1		1,173	0	0	16	2	14,659	0
Auto Shop	1		1,173	0	0	16	2	14,659	0
Carpenter Shop	1		1,173	0	0	16	2	14,659	0
Lumber Shed	1		1,173	0	0	16	2	14,659	0
Snow Blast Shed	1		1,173	0	0	16	2	14,659	0
Fire Cache	1		1,173	0	0	16	2	14,659	0
Wastewater Treatment Plant	1		1,173	0	0	16	2	14,659	0
Residences	1		1,173	0	0	16	2	14,659	0
Recreational Hall	1		1,173	0	0	16	2	14,659	0
Research Laboratory	1		1,173	0	0	16	2	14,659	0
Visitor Center	1		1,173	0	0	16	2	14,659	0
Stabilization Shed	1		1,173	0	0	16	2	14,659	0
Water Treatment Plant	1		1,173	0	0	16	2	14,659	0
Barracks	3		3,518	1	0	49	7	43,977	1
Equipment Shed	2		2,345	1	0	33	5	29,318	1
Employee Residences	38		23,060	9	0	323	46	288,250	7
			NPS Totals	26	228	748	114	679,550	16
Aramark Parks & Resorts									
Laundry	1	No. 2 Fuel Oil	1,500	3	11	30	8	32,250	1
Lodge	1	Propane	3,750	2	0	53	8	46,875	1
Terrace	1		3,000	1	0	42	6	37,500	1
Terrace	2		1,000	0	0	14	2	12,500	0
Lodge	2		3,500	1	0	49	7	43,750	1
Terrace	2		2,500	1	0	35	5	31,250	1
Spruce Tree	2		4,000	2	0	56	8	50,000	1
Spruce Tree	1		500	0	0	7	1	6,250	0
Trailer 5	1		500	0	0	7	1	6,250	0
Dorm 9	2		2,000	1	0	28	4	25,000	1
			Concessionaire Totals	11	11	321	49	291,625	7
			Park Totals	37	239	1,069	163	971,175	22

TABLE 3. 2001 POTENTIAL AIR EMISSIONS FROM MESA VERDE NATIONAL PARK HEATING EQUIPMENT

Location	No.	Fuel	Fuel Consumption	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
National Park Service									
Museum	1	No. 2 Fuel Oil	7,821	16	555	156	39	168,161	3
Chief Rangers Office	1		7,821	16	555	156	39	168,161	3
Park Headquarters	1		7,821	16	555	156	39	168,161	3
Library	1	Propane	7,659	3	0	107	15	95,738	2
Hogan	2		15,318	6	0	214	31	191,475	5
Electric Shop	1		7,659	3	0	107	15	95,738	2
Warehouse	1		7,659	3	0	107	15	95,738	2
Auto Shop	1		7,659	3	0	107	15	95,738	2
Carpenter Shop	1		7,659	3	0	107	15	95,738	2
Lumber Shed	1		7,659	3	0	107	15	95,738	2
Snow Blast Shed	1		7,659	3	0	107	15	95,738	2
Fire Cache	1		7,659	3	0	107	15	95,738	2
Wastewater Treatment Plant	1		7,659	3	0	107	15	95,738	2
Residences	1		7,659	3	0	107	15	95,738	2
Recreational Hall	1		7,659	3	0	107	15	95,738	2
Research Laboratory	1		7,659	3	0	107	15	95,738	2
Visitor Center	1		7,659	3	0	107	15	95,738	2
Stabilization Shed	1		7,659	3	0	107	15	95,738	2
Water Treatment Plant	1		7,659	3	0	107	15	95,738	2
Barracks	3		22,977	9	0	322	46	287,213	7
Equipment Shed	2		15,318	6	0	214	31	191,475	5
Employee Residences	38		145,521	58	3	2,037	291	1,819,016	44
			NPS Totals	173	1,672	4,866	745	4,429,728	102
Aramark Parks & Resorts									
Laundry	1	No. 2 Fuel Oil	67,577	135	4,798	1,352	338	1,452,909	23
Lodge	1	Propane	50,262	20	1	704	101	628,279	15
Terrace	1		38,295	15	1	536	77	478,689	11
Terrace	2		29,487	12	01	413	59	368,590	9
Lodge	2		138,820	56	2	1,943	278	1,735,246	42
Terrace	2		38,295	15	1	536	77	478,689	11
Spruce Tree	2		57,443	23	1	804	115	718,033	17
Spruce Tree	1		7,180	3	0	101	14	89,754	2
Trailer 5	1		3,638	1	0	51	7	45,475	1
Dorm 9	2		38,276	15	1	536	77	478,449	11
			Concessionaire Totals	296	4,805	6,975	1,141	6,474,112	143
			Park Totals	468	6,477	11,841	1,887	10,903,840	246

2.1.3 Fuel Storage Tanks

Mesa Verde NP has one gasoline aboveground storage tank (AST) and the concessionaire, Aramark, has two gasoline ASTs and one underground storage tank (UST). The Aramark gasoline facility at Morefield Village is open to the public during the summer season.

There are two basic types of VOC emissions from storage tanks: working losses and standing losses. Working losses are composed of both withdrawal and refilling loss emissions. Withdrawal loss emissions result from the vaporization of liquid fuel residue on the inner surface of tank walls as the liquid levels in the tank are decreased and air is drawn into the tank. Refilling losses refer to fuel vapor releases to the air during the process of refilling the tank as the liquid level in the tank increases and pressurizes the vapor space. Standing losses describe those tank emissions from the vaporization of the liquid fuel in storage due to changes in ambient temperatures. VOC losses are also a direct function of the annual product throughput or turnovers. Emissions from diesel tanks are extremely small since the volatility of diesel fuel is extremely low compared to gasoline. VOC emissions from the NPS fuel storage tanks were calculated using the USEPA *TANKS* software program. *TANKS* is based on the emission estimation procedures from Chapter 7 of EPA's Compilation of Air Pollutant Emission Factors (AP-42) and uses chemical, meteorological, and other data to generate emission estimates for different types of storage tanks. Table 4 summarizes the calculated emissions.

TABLE 4: 2001 MESA VERDE NP FUEL TANK EMISSIONS

Location	Product	Tank Type	Volume (gal)	Throughput (gal/yr)	VOC (lbs/yr)
Maintenance	Gasoline	AST	6,000	24,800	881
Morefield Village	Gasoline	UST	6,000	45,700	200
Far View Lodge	Gasoline	AST	500	1,232	190
Wetherill	Gasoline	AST	500	2,200	91
				Total	1,362

2.1.4 Wastewater Treatment Plant

There is a tertiary wastewater treatment plant near the maintenance are that processing approximately 25,000 gallons per day. Using a VOC emission factor of 8.9 lbs VOC per million gallons of influent treated, the estimated VOC emissions are approximately 80 lbs/year.

2.2 AREA SOURCES

2.2.1 Woodstoves

Twenty employee housing units are equipped with woodstoves, but park officials estimated that only eight are used and that the average wood consumption was two cords a year each. Emissions from these woodstoves are summarized in Table 5.

TABLE 5: WOODSTOVE AIR EMISSIONS FROM MESA VERDE NP

Location	Number	Fuel Consumption	PM_{10} (lbs/yr)	SO_2 (Ibs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	VOC (Ibs/yr)
Employee Residences	8	16 cords/yr	972	11	73	7,093	6,430

2.2.2 Campfires

There is one campground in Morefield Village. Assuming that 90 percent of campsites had a morning or evening campfire and that each campfire site consumes approximately 15 lbs of wood, air emissions from campsites in 2001 were calculated and are summarized in Table 6.

TABLE 6: 2001 MESA VERDE NP CAMPFIRE EMISSIONS

Location	Campfires	Fuel (tons/yr)	PM_{10} (Ibs/yr)	SO_2 (Ibs/yr)	NO_X (Ibs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Morefield Village	18,747	141	4,865	56	366	35,516	32,198

2.2.3 Wildland Fires and Prescribed Burning

Wildland fires are ignited naturally, usually by lightening and are typically suppressed, while prescribed fires are ignited intentionally in order to achieve fire management objectives. Prescribed burning is a land treatment process to accomplish natural resource management objectives, including reducing the potential for destructive wildfires, eliminating excessive fuel buildup, controlling insects and disease, improving wildlife habitat and forage production, maintaining natural succession of plant communities, and restoring natural processes. Only prescribed burnings for ecological restoration are considered as anthropogenic emissions.

The First Order Fire Effects Model (FOFEM) was used to estimate emissions. FOFEM is a computer program developed by the Intermountain Fire Sciences Lab, U.S. Forest Service to predict the effects of prescribed fire and wildfire in forests and rangelands throughout the U.S. In

particular, it quantifies emissions of PM_{10}, $PM_{2,5}$, CO, $C0_2$, and CH_4.

By their very nature, wildland fires vary significantly from year to year within most parks, particularly western parks. For example, wildland fires in Mesa Verde NP varied from a low of two acres in 1999 to over 20,000 acres in 2000. In addition to wildland fires, there have been several prescribed fires within the park. Table 7 summarizes the emissions from these fires for the years 1999 to 2001.

TABLE 7: WILDLAND FIRE AND PRESCRIBED BURNING AIR EMISSIONS FROM MESA VERDE NP

Year	Acres	PM_{10} (lb s)	$PM_{2.5}$ (Ibs)	CO (Ibs)	CO_2 (Ibs)	VOC[1] (Ibs)
Wildland Fires						
1999	2	222	187	2,317	20,706	109
2000	20,061	1,186,380	987,693	11,675,514	146,970,531	562,620
2001	4	444	374	4,634	41.412	218
Prescribed Burnin						
1999	25	300	225	1,450	114,375	100
2001	48	576	432	2,784	219,600	192

As methane

In addition to wildland fires and prescribed burning, the park also began pile burns in 2002. During that year, they burned approximately 138,000 cubic feet of Pinyon-Juniper vegetation, and at he time of the site visit in 2003, they had burned 120,000 cubic feet to date.

2.2.4 Miscellaneous Area Sources

Miscellaneous area sources include food preparation, degreasers, paints and other surface coatings, lighter fluid consumption, consumer solvents, and propane use by visitors in recreational vehicles. However, there are no data on the consumption of these materials.

2.3 SUMMARY OF STATIONARY AND AREA SOURCE EMISSIONS

Table 8 summarizes the stationary and area source emissions calculated above in a format that allows comparison between the various sources as well as providing totals for each pollutant or pollutant category under consideration.

TABLE **8:** SUMMARY **OF 2001 STATIONARY AND AREA SOURCE EMISSIONS** AT MESA VERDE **NP**

Activity	Particulates (PM_{10})		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		Carbon Dioxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Stationary Sources												
Heating E.uipment	37	0.02	34	0.02	1,069	0.53	163	0.08	971,175	486	22	0.01
Gasoline Storage Tanks											1,362	0.68
Wastewater Treatment Plant											80	0.04
Stationary Sources Subtotal	37	0.02	34	0.02	1,069	0.53	163	0.08	971,175	486	1,464	0.73
Area Sources												
Woodstoves	972	0.49	11	<0.01	73	0.04	7,093	3.55	--	--	6,430	3.22
Campfires	4,865	2.43	56	0.03	366	0.18	35,516	17.76	--	--	32,198	16.10
Prescribed Burning	576	0.29	--	--	--	--	2,784	1.39	219,600	109.80	192[1]	0.10[1]
Area Sources Total	6,413	3.21	67	0.03	439	0.22	45,393	22.70	219,600	109.80	38,820	19.41
Totals												
	Particulates (PM_{10})		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		Carbon Dioxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Totals without Prescribed Burning	5,874	2.94	101	0.05	1,508	0.75	42,772	21.39	971,175	486	40,092	20.05
Totals with Prescribed Burning	6,450	3.23	101	0.05	1,508	0.75	45,556	22.78	1,190,775	595	40,284	20.14

[1] As methane

3. MOBILE SOURCE EMISSIONS

This section summarizes emissions from mobile sources at Mesa Verde NP for 2001. Mobile emission sources include highway and nonroad vehicles. The following emissions were calculated for each source: particulate matter (PM_{10}), nitrogen oxides (NO,), carbon monoxide (CO), and volatile organic compounds (VOCs).

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

The number of visitor vehicles operating in NPS units is often correlated to the number of annual visitors to the park unit, and estimated visitors to Mesa Verde NP in 2001 were estimated to be 537,474. Table 9 summarizes the approximate number of vehicles entering the park and estimated roundtrip distances traveled by these vehicles. It was assumed that all visitor vehicles drove to the Chapin Mesa area. Visitation data indicate that the majority of these also traversed the Mesa Top Loop drive that is adjacent to the Chapin Mesa area and that a much smaller number visited the Wetherill Mesa area. Approximately 1,250 buses also entered the park and were assumed to travel to the Chapin Mesa area. The concessionaire, Aramark, also operates a tram to the west end of Wetherhill and tour buses in other parts of the park. Data on these vehicles also are provided in Table 9.

TABLE 9: MESA VERDE NP ANNUAL VISITOR VEHICLE SUMMARY

Area Visited	Visitation	No. Vehicles[1]	MilesNehicle	Vehicle Miles Traveled
Chapin Mesa	537,474	255,940	42	10,749,480
Mesa Top Loop	407,545	194,070	9	1,746,630
Wetherill Mesa	8,421	4,010	24	96,240
			Visitor Vehicle Totals	12,592,350
			Wetherhill Trams	60,480
			Tour Buses	26,800

[1] Assumes 2.1 visitors per vehicle

The majority of mobile source emissions can be categorized as either exhaust or evaporative emissions. Exhaust emissions are related to the combustion of fuel in the engine and include VOC, NOx, CO, and PM_{10}. Exhaust emissions are dependent on a number of factors, including engine load, engine design and age, combustion efficiency, emissions equipment such as catalytic converters, and other factors. Evaporative emissions, which can occur while the vehicle is

running or at rest, are related to the volatilization of fuel from vapor expansion, leaks and seepage, and fuel tank vapor displacement. Evaporative emissions are primarily dependent on daily temperature cycles and fuel volatility. In addition to vehicle exhaust, PM_{10} emissions also result from brake and tire wear, as well as the re-entrainment of dust from paved and unpaved roads (referred to as fugitive dust).

Emission factors produced by the USEPA MOBILE6.2 model were used in conjunction with vehicle miles traveled (VMT) data in order to estimate mobile source emissions for VOC (both exhaust and evaporative), NOx, and CO. Similarly, emission factors produced by the PARTS model were used in conjunction with VMT data to estimate PM_{10} emissions. MOBILE6.2 produces exhaust and evaporative emission factors for the following classes of vehicles: light duty gasoline vehicles (LDGV), light duty gasoline trucks 1 (LDGTI), light duty gasoline trucks 2 (LDGT2), heavy duty gasoline vehicles (HDGV), light duty diesel vehicles (LDDV), light duty diesel trucks (LDDT), heavy duty diesel vehicles (HDDV), and motorcycles. It also produces a composite emission factor for all vehicles based on the vehicle class mix supplied to the model. Inputs to the model include average vehicle speed, vehicle VMT mix, annual mileage accumulation rates and registration distributions by age, inspection and maintenance (UM) program info' ination, fuel information, ambient temperature data, and others.

Both the MOBILE6.2 and PARTS models are typically used to support planning and modeling efforts in urban or regional areas, and include default inputs suited for these applications. Therefore, it is suitable for applications over large, regional transportation networks. Application of the MOBILE6.2 model required the utilization of unique inputs that were representative of mobile source activity within the park. In particular, it was necessary to utilize unique inputs for the visitor vehicle class mix and the vehicle age distribution.

The Center for Environmental Research and Technology within the College of Engineering at the University of California's Riverside Campus (CE-CERT) established park-specific vehicle fleet characterizations in developing air emission inventories for Zion National Park (CE-CERT, 2001). CE-CERT found that the distribution of vehicle ages in the park reflected a larger fraction of newer vehicles than the overall model default vehicle age distribution. Using the VMT data noted earlier in Table 10, the VMT by vehicle class for summer and winter travel also are provided in Table 11.

In addition to VMT mix and age distribution, CE-CERT also established park-specific modeling inputs for driving pattern characterization. CE-CERT found that park driving patterns differ

significantly from the default driving patterns typically used in mobile modeling, such as the Federal Test Procedure (FTP). In particularly, they found that the FTP reflects both higher speeds and a wider range of speeds than observed in the parks. However, since the MOBILE5b model is not designed to readily incorporate unique driving pattern data, the default driving cycle remains the basis for the mobile source emission estimates provided here.

Other important mobile modeling inputs that can significantly affect mobile emission factors are the average speed, fuel characteristics, and UM program parameters. The average speed input to the mobile models was assumed to be 35 mph. The fuel volatility was assumed to be RVP 13.6 (winter) and 8.8 (summer), and reformulated gasoline was not assumed to be present. Finally, inspection/maintenance (UM) program inputs were not included since there are no I/M programs in this part of Colorado.

In order to account for seasonal differences in mobile emissions, separate MOBILE6.2 runs were performed to produce emission factors for winter and summer. A composite emission factor for each season, reflecting a park specific VMT mix adapted from the CE-CERT data, served as the basis for mobile source emission estimates. Additional particulate emissions (or entrained road dust) from vehicles operating on paved roads in Mesa Verde NP also were calculated based on VMT. A summary of visitor vehicle emissions is provided in Table 11.

3.1.2 NPS Vehicles

Mesa Verde NP operates a fleet of highway vehicles that are owned by the NPS. A summary of NPS vehicles and their estimated annual mileage is provided in Table 10, and emissions are provided in Table 11. The concessionaire also operates a fleet of approximately 20 vehicles, excluding the trams and tour buses. Since no mileage data were available for these vehicles, mileages were estimated proportionately to the NPS vehicles.

TABLE 10: NPS ROAD VEHICLES AT MESA VERDE NP

Vehicle Type	Annual Usage (milyr)
Light-Duty Gasoline Vehicles	21,284
Light-Duty Pickups	166,632
Heavy Duty Diesel Trucks	57,917
Total	245,833

3.2 NONROAD VEHICLES

The NPS also owns and operates nonroad motorized equipment that is used to maintain roads and grounds and for other purposes. Data were not available on the types of nonroad vehicles and equipment, although total operating hours of approximately 1900 hours were estimated. In order to calculate annual emissions that are summarized in Table 11, it was assumed that these vehicles were similar to those operated by other park units.

3.3 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 11 summarizes the mobile source emissions for road and nonroad vehicles and equipment operating in Mesa Verde NP in 2000.

TABLE 11: SUMMARY OF **2000 MOBILE** SOURCE EMISSIONS AT MESA VERDE NP

Activity	Particulates (PM10)		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
Road Vehicles										
Visitor Vehicles	24,211 [1]	12.11	--	--	33,936	16.97	477,603	238.80	28,645	14.32
Visitor Tour Buses	131 [1]	0.07	--	--	1,930	0.97	755	0.38	58	0.03
Concessionaire Trams	123 [1]	0.06	--	--	494	0.25	3,476	1.74	132	0.07
Concessionaire Tour Buses	67 [1]	0.03	45	0.02	985	0.49	386	0.19	29	0.01
NPS Road Vehicles	504 [1]	0.25	--	--	2,619	1.31	8,885	4.44	500	0.25
Concessionaire Road Vehicles	249 [1]	0.12	--	--	339	0.17	5,568	2.78	300	0.15
Vehicle Emission Subtotal	25,285	12.64	45	0.02	40,303	20.15	496,673	248.34	29,664	14.83
Nonroad Vehicles										
NPS Nonroad Vehicles	198	0.101	--	--	5181	0.26 ~	3441	0.17 ~	2261	0.11
Totals										
Totals	Particulates (PM10)		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
	25,483	12.74	45	0.02	40,821	20.41	497,017	248.51	29,890	14.95

[1] Includes exhaust, brake, and tire PM~o and road dust

4. MESA **VERDE NP AND REGIONAL** AIR **EMISSIONS**

4.1 MESA **VERDE NP SUMMARY**

A summary of Mesa Verde NP emissions is provided in Table 12.

TABLE 12: ESTIMATED ANNUAL EMISSIONS FROM MESA VERDE NP

Source	PM_{10} (tons)	SO_2 (tons)	NO_X (tons)	CO (tons)	VOCs (tons)
Point Sources					
Heating Equipment	0.02	0.12	0.53	0.08	0.01
Gasoline Storage Tanks	--	--		--	0.68
Wastewater Treatment Plant	--	--	--	--	0.04
Subtotal	0.02	0.12	0.53	0.08	0.73
Area Sources					
Woodstoves	0.49	<0.01	0.04	3.55	3.22
Campfires	2.43	0.03	0.18	17.76	16.10
Prescribed Burning	0.29	--	--	1.39	0.10[1]
Subtotal	3.21	0.03	0.22	22.70	19.41
Mobile Sources					
Road Vehicles	12.64	--	20.15	248.34	14.83
Nonroad Vehicles	0.10	--	0.26	0.17	0.11
Subtotal	12.74	--	20.41	248.51	14.95
Totals					
Totals	15.97	0.15	21.16	271.29	35.09

[1] As methane

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Montezuma County and the state of Colorado were obtained from the 1999 National Emission Inventory (NEI) maintained by USEPA. It is important to note that differences may exist between the methodologies used to generate the preserve emission inventory and those used to generate the NET. For example, gasoline storage tanks have been included as stationary sources for the Park, while the NEI treats them as area sources. Table 13 provides a comparison of the Park emissions with those from the surrounding county and the State of Colorado.

TABLE 13: ESTIMATED ANNUAL EMISSIONS FROM MESA VERDE NP, SURROUNDING COUNTIES, AND THE STATE OF COLORADO

Area	PM~p (tons/yr)	SO_2 (tons/yr)	NO_X (tons/yr)	CO (tons/yr)	VOC (tons/yr)
	Point Sources				
Mesa Verde NP Totals	0.02	0.12	0.53	0.08	<0.01
Montezuma County	40	47	473	204	232
Colorado Totals	19,979	103,922	118,526	36,563	37,408
	Area Sources				
Mesa Verde NP Totals	3.21	0.03	0.22	22.70	19.41
Montezuma County	1,556	27	292	3,432	908
Colorado Totals	217,805	4,177	53,695	185,809	120,432
	Mobile Sources				
Mesa Verde NP Totals	12.74	--	20.41	248.51	14.95
Montezuma County	3,191	117	1,626	10,129	1,345
Colorado Totals	183,131	19,243	244,978	1,245,011	123,773

5. COMPLIANCE AND RECOMMENDATIONS

This section discusses air emission related issues relating to the park and associated recommendations that may be considered to mitigate those issues.

5.1 COMPLIANCE

Mesa Verde NP is located in Montezuma County, CO, which is in attainment for all national and state ambient air quality standards (AAQS). The Colorado Department of Public Health and Environment administers the state's air pollution program. Park personnel should coordinate with the agency on permit issues relating to stationary sources, as well as prescribed burning activities. According to the Colorado Air Quality Control Commission Regulation No. 9, which is provided in Appendix D, open burning, under certain conditions, is allowed for fires used for noncommercial cooking of food for human consumption, or for instructional, training, or recreational purposes without a permit. However, since prescribed burning is not specifically exempt from the requirement to obtain a permit, presumably a permit must be obtained from the Colorado Department of Health and Environment to conduct prescribed burning.

Unlike some counties in Colorado, such as Denver and Boulder, there are no limitations on the use of wood burning stoves and other wood burning appliances. A construction permit for new or modified air pollution sources in Montezuma County is required only for a facility with actual emissions that exceed:

- PM_{10} - 5 tons/year
- Sulfur dioxide - 10 tons/year
- Nitrogen oxides - 10 tons/year
- Carbon monoxide - 10 tons/year
- Volatile organic compounds - 5 tons/year

Since the park has no source that exceeds the above threshold, it does not require permits for any of its equipment.

5.2 RECOMMENDATIONS

Actions to promote sustainable development in the design, retrofit, and construction of park facilities have associated air quality benefits. These include actions that reduce or replace consumption of conventional fossil fuels and/or reduce the consumption of other resources.

Reductions in potable and non-potable water consumption also achieve concurrent reductions in energy consumption and associated air emissions. Acquisition of energy efficient appliances whenever possible also is an incremental energy saving measure that has associated air quality benefits.

The park has undertaken a number of energy conservation and substitution initiatives. These include:

- Solar hot water assist units on six employee residences
- Waterless urinals in public restrooms
- Low-flow showers and toilets in employee residences
- Two photovoltaic-powered radio repeaters
- Recycling program.

The few woodstoves in employee residences are estimated to be the largest non-mobile sources of emissions in the park. If these are replaced, they should be replaced with units that meet the USEPA New Source Performance Standards for residential woodstoves. Based on laboratory testing, EPA has estimated that cleaner stove could reduce PM 10 emissions by at least 70 percent, and as much as 90 percent (USEPA 1990). The park has phased out its No. 2 fuel oil heaters and has only three remaining units that are planned for replacement with a cleaner burning propane heater.

The park does not utilize alternative fuels, and there are no near-term plans to implement them. Based on the park's relatively isolated location and the lack of other nearby relatively large vehicle fleets, the best opportunity to implement an alternative fuel would be if a nearby fuel supplier could be found to provide a biodiesel blend such as B20. This is a fuel that has been adopted by a number of western parks to reduce vehicle emissions.

6. REFERENCES

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APPENDIX A

FUEL DATA AND EMISSION FACTORS

FUEL DATA

Fuel	Heating Value	Sulfur Content
No. 2 Distillate Fuel Oil/Diesel	140,000 Btu/gal	0.05% by weight
Natural Gas	1,050 Btu/ft^3	2,000 grains/10^6 ft^3
Propane	91,500 Btu/gal	0.18 grains/100 ft^3

STATIONARY SOURCE EMISSION FACTORS - BOILERS/HEATING UNITS

DISTILLATE OIL (DF-2) - CRITERIA POLLUTANTS					
Combustor Type	Emission Factor (lb/1,000 gal fuel burned)				
	PM[a]	SOz~[b]	NO_X[c]	CO	VOC[d]
Residential Furnace[e]	0.4	142S	18	5	0.713
Boilers < 100 Million Btu/hr (Commercial/Institutional Combust.~[0])	2	142S	20	5	0.34
Boilers < 100 Million Btu/hr (Industrial Boilers[g])	2	142S	20	5	0.2
Boilers > 100 Million Btu/hr (Utility Boilers[h])	2	157S	24	5	--
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Tables 1.3-1 and 1.3-3.					

NATURAL GAS - CRITERIA POLLUTANTS					
Combustor Type (MMBtu/hr Heat Input)	Emission Factor (lb/10^6 ft^3 fuel burned)				
	PM[U>]	SO_2	NO,,[6]	CO	VOC
Residential Furnaces (<0.3)					
-Uncontrolled	7.6	0.6	94	40	5.5
Tangential-Fired Boilers (All Sizes)					
-Uncontrolled	7.6	0.6	170	24	5.5
-Controlled-Flue gas recirculation	7.6	0.6	76	98	5.5
Small Boilers (<100)					
-Uncontrolled	7.6	0.6	100	84	5.5
-Controlled-Low NO, burners	7.6	0.6	50	84	5.5
-Controlled-Low NO., burners/Flue gas recirculation	7.6	0.6	32	84	5.5
Large Wall-Fired Boilers (>100)					
-Uncontrolled (Pre-NSPS)[k]	7.6	0.6	280	84	5.5
-Uncontrolled (Post-NSPS)[k]	7.6	0.6	190	84	5.5
-Controlled-Low NO_X burners	7.6	0.6	140	84	5.5
-Controlled-Flue gas recirculation	7.6	0.6	100	84	5.5
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Tables 1.4-1 and 1.4-2.					

STATIONARY SOURCE EMISSION FACTORS - BOILERS/HEATING UNITS (Continued)

PROPANE (LPG) - CRITERIA POLLUTANTS					
Combustor Type	Emission Factor (lb/1,000 al fuel burned)				
	PM[a]	SO_2	NO_X[c]	CO	VOC[d]
Commercial Boilers[0	0.4	0.10S	14	1.9	0.3
Industrial Boilers[g]	0.6	0.10S	19	3.2	0.3
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.5-1.					

STATIONARY SOURCE EMISSION FACTORS - GENERATORS

For generators rated at less than or equal to 448 kW (600 hp):

Fuel Type	Emission Factor (lb/hp-hr)				
	PM	SO_X	NO_X	CO	VOC
DF-2	2.20 E-03	2.05 E-03	0.031	6.68 E-03	2.51 E-03
Gasoline	7.21 E-04	5.91 E-04	0.011	0.439	0.022
Natural Gas/Propane	1.54 E-04	7.52 E-03(S)	3.53 E-03	8.6 E-04	1.92 E-04
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 3.3-1 and 3.1-1					

For generators rated at greater than 448 kW (600 hp):

Fuel Type	Emission Factor (lb/hp-hr)				
	PM	SO_x[b]	NO,	CO	VOC
DF-2	0.0007	(8.09 E-03)S	0.024	5.5 E-03	6.4 E-04
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 3.4-1.					

FIREPLACE EMISSION FACTORS

Fuel Type	Emission Factor (lb/ton)				
	PM°	SO,	NO_X cc>	CO	VOC
Wood	34.6	0.4	2.6	252.6	229.0
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.9-1.					

WOODSTOVE EMISSION FACTORS

Stove Type	Emission Factor (lb/ton)				
	PM°	SO_X	NO_X cc)	CO	VOC
Conventional	30.6	0.4	2.8	230.8	53
Noncatalytic	19.6	0.4	--	140.8	12
Catalytic	20.4	0.4	2.0	104.4	15
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.10-1.					

STATIONARY SOURCE EMISSION FACTORS - SURFACE COATING OPERATIONS

Surface Coating Type	VOC Emission Factor (lb/gal)
Paint: Solvent Base	5.6
Paint: Water Base	1.3
Enamel: General	3.5
Lacquer: General	6.1
Primer: General	6.6
Varnish/Shellac: General	3.3
Thinner: General	7.36
Adhesive: General	4.4
Source: *Calculation Methods for Criteria Air Pollutant Emission Inventories*, AL/OE-TR-1994-0049, July 1994. Armstrong Laboratory.	

(a) PM = Filterable Particulate Matter.
(b) These factors must be multiplied by the fuel sulfur content (for example, if the sulfur content is 0.05%, then S equals 0.05).
(c) Expressed as NO_2.
(d) Emission factors given in AP-42 are actually for non-methane total organic compounds (NMTOC) which includes all VOCs and all exempted organic compounds (such as ethane, toxics and HAPs, aldehydes and semivolatile compounds) as measured by EPA reference methods.
(e) Unit Rating <300,000 Btu/hr.
(f) Unit Rating 3300,000 Btu/hr, but <10,000,000 Btu/hr.
(g) Unit Rating 310,000,000 Btu/hr, but <100,000,000 Btu/hr.
(h) Unit Rating 3100,000,000 Btu/hr.
(i) POM = Particulate POM only.
(j) PM = Filterable Particulate Matter + Condensible Particulate Matter.
(k) NSPS = New Source Performance Standard as defined in 40 CFR 60 Subparts D and Db. Post-NSPS units are boilers with greater than 250 MMBtu/hr of heat input that commenced construction, modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction, modification, or reconstruction after June 19, 1984.
(l) Emission factors are given on a fuel input basis (lb/MMBtu). To convert to a power output basis (lb/hp-hr), use an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr.

APPENDIX B

EMISSION CALCULATIONS

2001 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT MESA VERDE NATIONAL PARK

Emission Source	Location	Facilities	Fuel	Number of c,,,.ces	Capacity (Btu%hr)		Consumption trab'vr)	PM (lbs/vr)	SO, (lhs/vrl	NOa tlhetvrt	CO tlhr/vr1	CO. (lbs/vr)	VOC (lhs/vr)
			Yational Park Service										
Boiler	Headquarters Area	Museum	No. 2 rues 011		125,000		1,067	2	76	21	5	22,933	0
Furnace	Headquarters Area	Chief Rangers Office	No. 2 Fuel Oil	1	125,000	125,000	1,067	2	76	21	5	22,933	0
Boiler	Headquarters Area	Park Headquarters	No. 2 Fuel Oil	1	125,00(1	125,(100	1,067	2	76	21	5	22,933	0
			Totals	3	375,000		3100	6	227	64	16	68,800	I
Emission Factors from AP-12, Tables 1,3-I and 1.3-3 for residential furnaces (<300,000 Btu/hr) S = 0.5 percent					-			0.4	1425	18.0	5.0	21,5(10	((.7
Emission Factors from AP-12, Tables 1.3-I and 1.3-3 for furnaces (>300,000 Btu/hr) S = (1.5 percent								2.0	1425	20.0	5.0	21,50(1	((.3
Formula = Consumption (gal/y.11 • Emission Factor (lb/1,000 gal)													
Boiler	Headquarters Area	Library	Propane	I	80,000	80,(100	1,173	(1	1)	16	2	14,659	11
Heater	Headquarters Area	Hogan	Propane	2	80,000	160,000	2.745	I	0	33	5	29,318	I
Furnace	Maintenance	Electric Shop	Propane	1	80,000	80,018)	1,173	11	0	16	2	14,659	0
Furnace	Maintenance	Warehouse	Propane	I	80,00(1	80,000	1,173	0	0	16	2	14,659	0
Heater	Maintenance	Auto Shop	Propane	1	80,(100	80,000	1,173	(1	(I	16	2	14,659	0
Boiler	Maintenance	Carpenter Shop	Propane	I	80,00(1	80,000	1,173	(I	0	16	2	14,659	0
Furnace	Maintenance	Lumber Shed	Propane	1	80,000	8(1,000	1,173	0	0	16	2	14,659	0
Furnace	Maintenance	Snow Blast Shed	Propane	1	60,008	8(1,00(1	1,173	0	U	16	2	14,659	0
Furnace	CCC	Fire Cache	Propane	1	80,000	80,000	1,173	0	0	16	2	14,659	0
Furnace	Chapin	Wastewater Treatment Plant	Propane	I	80,000	80,000	1,173	0	0	16	2	14,659	(I
Heater	Morefeld	Residences	Propane	1	80,000	80,00(1	1,173	0	0	16	2	14,659	0
Furnace	CCC	Recreational Hall	Propane	1	80,000	80,0(10	1,173	0	0	16	2	14,659	(I
Furnace	CCC	Research Laboratory	Propane	I	80,(10(1	80,0(10	1,173	0	0	16	2	14,659	0
Boiler	Far View	Visitor Center	Propane	I	80,000	80,000	1,173	0	0	16	2	14,659	0
Furnace	CCC	Stabilization Shed	Propane	1	80,000	80,000	1,173	(1	0	16	2	14,659	0
Furnace	Jackson Lake	Water Treatment Plant	Propane	I	8(1,000	80,00(1	1,173	0	0	16	2	14,659	0
Furnace	CCC	Barracks	Propane	3	80,000	24(1,000	3,518	1	0	49	7	43,977	I
Heater	Maintenance	Equipment Shed	Propane	2	80,000	160,000	2,345	1	0	33	5	29.318	I
			Subtotal	22		1,760,0(10	25,8011	10	0	361	52	322,5011	8
Furnaces	Parkwide	Employee Residences	Propane				23,060	9	0	323	46	288,250	7
			Totals					20	1	684	98	61(1,750	15
Emission Factors from AP-42, Tables 1.5-I for commercial boilers, S=(1.18 grains/10(1 cu ft								((.4	(LA'S	14.0(1	1.90	12,50(1	(130
Fommla = Consumption (ga'yr) • Emission Factor (lb/1,000 gal)													
			Total National Park Service Pleating Units					26	228	748	114	679,55(1	161

Emission Source	Location	Facilities	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (caVs+)	PM (hi¹ ^'	SO. (lbs/•-'	NOa pbsh~)	CO (11,0~)	CO. Ohs/vs)	VOC pbs¹vr)
			raruerk Parks & Resorts										
Boiler	Morefeld	Laundry	No. 2 Fuel Oil		1,080,000	1,080,000	1, 510		t t	30	6	32,250	
			Subtotal	I		1,080,000	1.580	3	11	30	8	32,25(1	1
Emission Factors from AP-42, Tables 1.3-1 and t 3-3 for furnaces (>300,000 Btu/hr) S = 0.5 percent								2.0	I42S	2(1.0	5.0	21,50(1	0.3
Formula = Consumption (gaVyr) Emission Factor (lb/1,000 gal)													
Boiler	Far View	Lodge	Propane	1	525,00(1	525,0(10	3,75(1	2	0	53	8	46,875	
Furnace	For View	Terrace	Propane	1	400,(1(10	400,000	3,000	I	0	42	6	37,5(1(1	
Furnace	Far View	Terrace	Propane	2	154,(1(10	308,000	1,0(11)	0	0	14	2	12,500	0
Water Heater	Far View	Lodge	Propane	2	725,0(1(1	1,450,000	3,5(10	1	0	49	7	43,75(1	1
Water Heater	Far View	Terrace	Propane	2	200,000	400,000	2,500	I	0	35	5	31,250	I
Furnace	Chapin	Spruce Tree	Propane	2	300,000	60(1,00(1	4,00(1	2	0	56	8	50,(100	I
Water Heater	Chapin	Spruce Tree	Propane	1	75,00(1	75,00(1	500	0	0	7	I	6,250	(1
Water Heater		Trailers	Propane	I	38,000	38,(100	500	0	0	7	1	6,250	(I
Water Hurter		Donn9	Propane	2	199,9(10	399,500	2,0(10	1	0	28	4	25,(10(1	I
			Subtotal	14		4,195,80(1	2475(1	8	0	291	42	259,375	6
Emission Factors from AP-42, Tables 1.5-1 for commercial boilers, S=0.18 grains/100 cu 0								0.4	(I.I•S	14.00	1.90	12,50(1	((.3O
Fomntla = Consumption (gaVyr) Emission Factor (lb/1,000 gal)													
			Total Aramark Parks & Resorts Heating Units	15			lbs/yr	I I	I I	321	49	291,625	7-
			Park Totals	15			lbs/yr	37	239	1,069	163	971,175	22
							tons/yr	4(12	(1.12	0.53	0.08	486	Q01

2001 POTENTIAL CRITERIA EMISSIONS FROM HEATING UNITS AT MESA VERDE NATIONAL PARK

Emission Source	Location	Facilities	Fuel	Number of Sources	Capacity (Btulhr)		Consumptio (gal/yr)	PM (lbs/yr)	SO, (lbs/yr)	NO_6 (lbs/vr)	CO !lhshr^s	CO, nti~r,^'	VOC rlud.,r1
---	--		--		National Park Service								
Boiler	Headquarters Area	Museum	Ivo.2 Fuel Oil	i	(25,000	125,000	7,821	16	555	156	39	1 00 ,101	
Furnace	Headquarters Area	Chief Rangers Office	No. 2 Fuel Oil	I	125,(1(10	125,(100	7,821	16	555	156	39	168.161	3
Boiler	Headquarters Area	Park Headquarte rs	No. 2 Fuel Oil	I	125,(100	125.0(10	7,821	16	555	156	39	168,161	3
			Totals	3	375,000		23,464	47	1.666	469	117	504,482	8
Emission Factors from AP-42, Tables 1,3-1 and L3-3 for residential furnaces (<300,000 Btu/hr) S = (1.5 percent								0,4	142S	18.0	5.0	21,500	0.7
Emission Factors from AP-42, Tables 1.3-1 and 1.3-3 for furnaces (>300,000 Btu/hr) S = 0.5 percent								2.0	142S	20.(1	5.0	21,500	0.3
Formula = Consumption (goFyr) * Emission Factor (lb/ 1,000 gal)													
Boiler	Headquarters Area	Library	Propane	1	8(1,000	80,000	7,659	3	0	1(17	15	95,738	2
Heater	Headquarters Area	Hogan	Propane	2	811,000	16(1,000	15,318	6	(1	214	31	191,475	5
Furnace	Maintenance	Electric Shop	Propane	1	8(1,(100	80,0(10	7,659	3	0	107	15	95,738	2
Furnace	Maintenance	Warehouse	Propane	I	80,(100	8(1,000	7,659	3	0	107	IS	95,738	2
Heater	Maintenance	Auto Shop	Propane	I	80,1100	80,0(10	7,659	3	0	I07	15	95,738	2
Boiler	Maintenance	Carpenter Shop	Propane	I	80,000	80,000	7,659	3	0	1(17	15	95,738	2
Furnace	Maintenance	Lumber Shed	Propane	1	8(1,000	80,000	7,659	3	0	1(17	15	95,738	2
Furnace	Maintenance	Snow Blast Shed	Propane	I	80,000	80,000	7,659	3	(1	107	15	95,738	2
Furnace	CCC	Fire Cache	Propane	t	80.000	80,000	7,659	3	0	I07	IS	95,738	2
Furnace	Chapin	Wastewater Treatment Plant	Propane	I	80,000	80,000	7,659	.3	0	107	IS	95,738	2
Heater	Morefield	Residences	Propane	I	80,000	80,000	7,659	3	0	107	IS	95,738	2
Fumace	CCC	Recreational Hall	Propane	1	80,000	80,000	7,659	3	0	107	15	95,738	2
Furnace	CCC	Research Laboratory	Propane	i	80,000	80,000	7,659	3	0	1(17	15	95,738	2
Boiler	Far View	Visitor Center	Propane	I	80,00(1	80,000	7,659	3	0	107	15	95,738	2
Fumace	CCC	Stabilization Shed	Propane	I	80,0(10	8(1,000	7,659	3	0	107	15	95,738	2
Furnace	Jackson Lake	Water Treatment Plant	Propane	1	80,(100	80,000	7,659	3	0	107	15	95,738	2
Furnace	CCC	Barracks	Propane	3	80,000	24(1,000	22,977	9	0	322	46	287,213	7
Heater	Maintenance	Equipment Shed	Propane	2	8(1,0(10	160,000	15,318	6	0	214	31	191,475	5
			Subtotal	22		1,76(1,000	168,498	67	3	2,359	337	2,106,230	51
Furnaces	Parkwide	Employee Residences	Propane	38	4)1.(100	1,520,(1110	145,521	58	3	2,(137	291	1,819,016	44
			Totals	6(1			314,020	126	6	4,396	628	3,925,246	94
Emission Factors from AP-42, Tables 1.5-I for commercial boilers, S = 0.18 grains/100 cu ft								0.4	(1.1"S	14.0(1	1.90	12,500	0.311
Fomula = Consumption (gaEyr) * Emission Factor (lb/1,00(1 gal)													
Total National Park Service Heating Units								173	1,672	4,866	745	4,429,728	1(121

Emission Source	Location	Faeilitia	Fuel	Number of Sources	Capacity (Btu/hr)		Consumptio (gaUvn)	PM (lb_/}r)	SO, (lbsrvr)	$NO_{,)}$ (lbs/vr)	CO (lbs/yr)	CO, rlbe/vr)	VOC (lbs/se)
				A remark P1.0		u «o							
Boiler	Ivtorcheld	Laundry	No. 2 FFuel uel Oil		1, 80, (10		67,577	1 5	4, 96	1,352	338	1,452,909	– 2)
Emission Factors from AP-42, Tables 13-I and 13-3 for furnaces (>300,000 Bln/hr) S = 0.5 percent								2.0	1425	20.0	5.0	21,50(1	11.3
Formula = Consumption (gallyr) * Emission Factor (lb/l,000 gal)													
Boiler	Far View	Lodge	Propane	1	525,0(10	525,000	50,262	20	I	704	101	628,279	15
Furnace	Far View	Terrace	Propane	I	400,1)00	400,0(10	38,295	15	1	536	77	478,689	11
Furnace	Far Viosv	Terrace	Propane	2	154,000	308,000	29,487	I?	I	413	59	368,590	9
Water Heater	Far View	Lodge	Propane	2	725,000	1,450,000	138,820	56	2	1,943	278	1,735,246	42
Water Heater	Far View	Terrace	Propane	2	200,000	400,000	38,295	15	1	536	77	478,689	II
Furnace	Chapin	Spruce Tree	Propane	2	300,0(10	600,000	57,443	23	I	804	115	718,033	17
Water Heater	Chapin	Spruce Tree	Propane	I	75,000	75,(100	7,180	3	0	101	14	89,754	2
Water Heater		Trailer5	Propane	I	38,000	38,000	3,638	I	0	51	7	45,475	I
Water Heater		Dorm 9	Propane	2	199.900	399,800	38,276	I5	I	536	77	478,449	II
			Subtotal	(4		4,195,800	401,696	161	7	5,624	803	5,021.203	121
Emission Factors from AP-42, Tables 1.5-1 for commercial boilers, S = I8 groins/I OU cu 0								0.4	0.1 *S	14.00	1.90	12,500	0.31)
Formula = Consumption (gal/yr) * Emission Factor (lb/ 1,000 gal)													
Total Aeomark Parks & Resorts Heating Units				I5			lbs/yr	296	4,805	6,975	1,141	6,474,112	1431
			Park Totals	15			lbs'yr	468	6,477	11,841	1,887	10,903,840	246
							tons/yr	0.23	3.24	5.92	0.94	5,452	(1.12

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	MEVE AST
City:	Alamosa
State:	Colorado
Company:	
Type of Tank:	Horizontal Tank
Description:	6,000 Gallon Gasoline AST

Tank Dimensions

Shell Length (ft):	16.00
Diameter (ft):	8.00
Volume (gallons):	6,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	24,800.00
Is Tank Heated (yin):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Alamosa, Colorado (Avg Atmospheric Pressure = 11.19 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	43.33	34.96	51.69	41.10	2.8651	2.3894	3.4152	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	115.04	766.06	881.10

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	MEVE Aramark
City:	Alamosa
State:	Colorado
Company:	Aramark
Type of Tank:	Horizontal Tank
Description:	6000 UST

Tank Dimensions

Shell Length (ft):	16.00
Diameter (ft):	8.00
Volume (gallons):	6,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	45,700.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	Y

Paint Characteristics

Shell Color/Shade:	
Shell Condition:	

Breather Vent Settings

Vacuum Settings (psig):	0.00
Pressure Settings (psig):	0.00

Meteorological Data used in Emissions Calculations: Alamosa, Colorado (Avg Atmospheric Pressure = 11.19 psia)

TANKS 4R
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	40.52	40.52	40.52	40.08	2.6973	2.6973	2.6973	68.0000			92.00	Option 4. RVP=8, ASTM Slope=3

TANKS 4M
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	199.58	0.00	199.58

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	MEVE Aramark1
City:	Alamosa
State:	Colorado
Company:	Aramark
Type of Tank:	Horizontal Tank
Description:	500 Gallon AST at Wetherill

Tank Dimensions

Shell Length (ft):	5.50
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	0.00
Net Throughput (gal/yr):	2,202.00
Is Tank Heated (yin):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Alamosa, Colorado (Avg Atmospheric Pressure = 11.19 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	43.33	34.96	51.69	41.10	2.8651	2.3894	3.4152	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4M
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	10.21	81.17	91.38

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Aramark2
City:	Alamosa
State:	Colorado
Company:	Aramark
Type of Tank:	Horizontal Tank
Description:	500 gallon AST at Far View lodge

Tank Dimensions

Shell Length (ft):	5.50
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	0.00
Net Throughput (gal/yr):	1,232.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Alamosa, Colorado (Avg Atmospheric Pressure = 11.19 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 8)	All	51.76	37.44	66.07	44.16	3.4201	2.5231	4.5598	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 8)	6.82	183.02	189.84

2000 ACTUAL EMISSIONS FROM WOODSTOVES AT MESA VERDE NATIONAL PARK

Woodstoves

Location	Number	Cords	tons/yr	PM (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Emplyee Residences	8	2	28.08	972	11	73	7,093	6,430
				(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
				0.49	0.01	0.04	3.55	3.22

2001 ACTUAL EMISSIONS FROM CAMPFIRES AT MESA VERDE NATIONAL PARK

Location	Camps	Fires/Yr	Tons/Yr	PM (Ibs/yr)	SO_2 (lbs/yr)	NO. (lbs/yr)	CO (Ibs/yr)	VOC (Ibs/yr)
Morefield Village	20,830	18,747	141	4,865	56	366	35,516	32,198
	20,830	18,747	141	4,865	56	366	35,516	32,198
			tons/yr	2.43	0.03	0.18	17.76	16.10

Assumption: Ninety percent of camp sites have either an evening or morning campfire

_TITLE: Results of TFOFEM **modelNexecution_on_date:** 4/14/2003 -

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 412 - Juniper - Pinyon **Woodland** **(also** SRM **504, SAP 239)**
Fuel Type: Natural
Fuel Reference: FOFEM 381

FUEL **CONSUMPTION** TABLE

Fuel Component Name	Preburn Load (t/acre)	**Consumed** Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number	Moisture
Litter	1.00	1.00	0.00	100.0	999	
Wood (0-1/4 inch)	0.00	0.00	0.00	0.0	**999**	
Wood (1/4-1 inch)	0.00	0.00	0.00	**0.0**	**999**	25.0
Wood (1-3 inch)	0.00	0.00	0.00	0.0	999	
Wood (3+ inch) Sound	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	**0.00**	0.00	0.0		
20->	0.00	0.00	0.00	**0.0**		
Wood (3+ inch) Rotten	0.00	0.00	0.00	0.0	**999**	20.0
3->5	0.00	0.00	0.00	0.0		
6-y9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20-}	**0.00**	0.00	0.00	0.0		
Duff	9.00	3.70	5.30	41.1	2	100.0
Herbaceous	0.20	0.20	0.00	100.0	22	
Shrubs	1.30	0.78	0.52	60.0	23	
Crown foliage	0.00	0.04	0.00	0.0	37	
Crown branchwood	0.00	**0.00**	0.00	**0.0**	38	
Total Fuels	11.50	5.68	5.82	49.4		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	**0.4**	**0.1**	0.3	**24,2**	6
Miii Soil Exp (%)	.0	21.9	21.9	21.9	10

Note!
'Duff' (tons/acre) and 'Duff Depth (in)' burned are computed using different equations, sometimes this may cause an i.nconsistancy in the 'Percent **Reduced' shown on this report.**
Duff (tens/acre) consumed is best suited for predicting smoke production, while Duff Depth (in) may be better related to fire severity and soil heating

	Emissions -- **lbs/acre** flaming	smoldering	total
PM 10 -	12	198	210
PM 2.5	**10**	168	178
CH 4	3	102	**105**
CO	**26**	2233	**2259**
CO 2	7043	**9088**	16131

	Consumption tons/acre	**Duration** hour:min:sec
Flamin g:	1,98	00:01;00
Smoldering:	3,70	00:29:00

TITLE: Results of FOFEM model execution on date: 4/14/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 729 - Mesquite (low shrub cover)
Fuel Type: Natural
Fuel Reference: FOFEM 501

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load **(t/acre)**	Postburn Load (t/acre)	Percent Reduced (%)	Equation Reference Number	Moisture
Litter	0.07	0.07	0.00	100.0	999	
Wood (0-1/4 inch)	0.00	0.00	0.00	0.0	**999**	
Wood (1/4-1 inch)	0.00	0.00	0.00	0.0	**999**	25.0
Wood (1-3 inch)	0.00	0.00	0.00	0.0	999	
Wood (3+ inch) Sound	0.00	0.00	0.00	0.0	999	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Wood (3+ inch) Rotten	0.00	0.00	0.00	0.0	**999**	20.0
3->6	0.00	0.00	0.00	0.0		
6->9	0.00	0.00	0.00	0.0		
9->20	0.00	0.00	0.00	0.0		
20->	0.00	0.00	0.00	0.0		
Duff	0.00	0.00	0.00	0.0	2	100.0
Herbaceous	0.23	0.23	0.00	100.0	22	
Shrubs	1.26	1.01	0.25	80.0	231	
Crown foliage	0.00	0.00	0.00	0.0	37	
Crown branchwood	0.00	0.00	0.00	0.0	38	
Total Fuels	1.56	1.31	0.25	83.8		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	0.0	0.0	0.0	0.0	6
Min Soil Exp (%)	.0	21.9	21.9	21.9	10

	Emissions -- lbs/acre flaming	smoldering	total
PM 10	8	4	12
PM 2.5	6	3	9
CH 4	2	2	4
CO	16	42	58
CO 2	4403	172	4575

	Consumption tons/acre	Duration hour:min:sec
Flaming:	1.24	00:01:00
Smoldering:	0.07	00:01:00
Total:	1.31	

2001 WILDFIRE EMISSIONS AT MESA VERDE NATIONAL PARK

Year	Fuel Type	Acres	PM_{10} (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CH_4 (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)	CH_4 (tons/yr)	CO (tons/yr)	CO_2 (tons/yr)
	Mountain Shrub	1	12	9	4	58	4,575	0.0	0.0	0.0	0.0	2.3
1999	Pinyon Juniper	1	210	178	105	2,259	16,131	0.1	0.1	0.1	1.1	8.1
	Totals	2	222	187	109	2,317	20,706	0.1	0.1	0.1	1.2	10.4
	Mountain Shrub	15,285	183,420	137,565	61,140	886,530	69,928,875	92	69	31	443	34,964
2000	Pinyon Juniper	4,776	1,002,960	850,128	501,480	10,788,984	77,041,656	501	425	251	5,394	38,521
	Totals	20,061	1,186,380	987,693	562,620	11,675,514	146,970,531	593	494	281	5,838	73,485
	Mountain Shrub	2	24	18	8	116	9,150	0	0	0	0	5
2001	Pinyon Juniper	2	420	356	210	4,518	32,262	0	0	0	2	16
	Totais	4	444	374	218	4,634	41,412	0	0	0	2	21
	Mountain Shrub	284	3,408	2,556	1,136	16,472	1,299,300	2	1	1	8	650
2002	Pinyon Juniper	2,319	486,990	412,782	243,495	5,238,621	37,407,789	243	206	122	2,619	18,704
	Totals	2,603	490,398	415,338	244,631	5,255,093	38,707,089	245	208	122	2,628	19,354
	Emission Factors (lbs/acre)											
	Mountain Shrub		12	9	4	58	4,575					
	Pinyon Juniper		210	178	105	2,259	16,131					

PRESCRIBED BURNING EMISSIONS AT MESA VERDE NATIONAL PARK

	Fuel Type	Acres	PM_{10} (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CH_4 (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)	CH_4 (tons/yr)	CO (tons/yr)	CO_2 (tons/yr)
1999	Mountain Shrub	25	300	225	100	1,450	114,375	0.2	0.1	0.1	0.7	57.2
2001	Mountain Shrub	48	576	432	192	2,784	219,600					

```
####     ##################
Mesa Verde NP Winter Conditions.
File 1, Run 1, Scenario 13.
# # # # # # # # # # # # # # # # # # # # # # #   # #
M584 Warning:
          The user supplied area wide average speed of 35.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways,
          freeway ramps, arterial/collector and local roadways
          for all hours of the day and all vehicle types.

Reading PM Gas Carbon ZML Levels
from the external data file PMGZML.CSV

Reading PM Gas Carbon DR1 Levels
from the external data file PMGDR1.CSV

Reading PM Gas Carbon DR2 Levels
,from the external data file PMGDR2.CSV

Reading PM Diesel Zero Mile Levels
from the external data file PMDZML.CSV

Reading the First PM Deterioration Rates
from the external data file PMDDR1.CSV

Reading the Second PM Deterioration Rates
from the external data file PMDDR2.CSV

        User supplied gasoline sulfur content = 300.0 ppm.

M616 Comment:
             User has supplied post-1999 sulfur levels.
M 48 Warning:
            there are no sales for vehicle class HDGV8b

                  Calendar Year:   2001
                          Month:   Jan.
                       Altitude:   High
            Minimum Temperature:   12.0 (F)
```

```
Maximum Temperature:   56.0  (F)
  Absolute Humidity:    75.  grains/lb
   Nominal Fuel RVP:   13.6 psi
       Weathered RVP:   13.6 psi
 Fuel Sulfur Content:   299.  ppm

 Exhaust  I/M Program:   No
    Evap  I/M Program:   No
         ATP Program:   No
    Reformulated Gas:   No
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.911	1.170	1.047	1.118	1.002	0.433	0.439	0.509	3.24	1.019
Composite CO	18.46	24.25	21.90	23.25	27.92	1.308	0.931	6.582	25.96	19.648
Composite NOX :	0.833	1.201	1.402	1.287	3.796	1.267	1.212	16.834	1.17	1.261

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016
Composite Emission Factors (g/mi):						
Composite VOC :	1.101	1.191	1.021	1.106	2.424	0.391
Composite CO	23.48	24.48	21.78	22.17	6.522	0.795
Composite NOX :	0.944	1.280	1.266	1.703	2.555	1.180

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Composite Emission Factors (g/mi):								
Composite VOC :	1.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	27.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.796	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8E

```
          VMT Mix:     0.0020     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

Composite Emission Factors  (g/mi):
    Composite VOC :      0.378      0.000      0.000      0.000      0.000      0.000      0.000      0.000
    Composite CO         1.942      0.000      0.000      0.000      0.000      0.000      0.000      0.000
    Composite NOX :      4.150      0.000      0.000      0.000      0.000      0.000      0.000      0.000


 # # # # # # # # # # # # # # # # # # # # # # # # # # #
 Mesa Verde NP Summer Conditions.
 File 1, Run 1, Scenario 14.
 # # # # # # # # # # # # # # # # # # # # # # # # # # #
 M584 Warning:
           The user supplied area wide average speed of 35.0
           will be used for all hours of the day. 100% of VMT
           has been assigned to a fixed combination of freeways,
           freeway ramps, arterial/collector and local roadways
           for all hours of the day and all vehicle types.

 Reading PM Gas Carbon ZML Levels
 from the external data file PMGZML.CSV

 Reading PM Gas Carbon DR1 Levels
 from the external data file PMGDR1.CSV

 Reading PM Gas Carbon DR2 Levels
 from the external data file PMGDR2.CSV

 Reading PM Diesel Zero Mile Levels
 from the external data file PMDZML.CSV

 Reading the First PM Deterioration Rates
 from the external data file PMDDR1.CSV

 Reading the Second PM Deterioration Rates
 from the external data file PMDDR2.CSV

         User supplied gasoline sulfur content = 300.0 ppm.

 M616 Comment:
              User has supplied post-1999 sulfur levels.
```

M 48 Warning:
there are no sales for vehicle class HDGV8b

Calendar Year:	2001
Month:	July
Altitude:	High
Minimum Temperature:	47.0 (F)
Maximum Temperature:	101.0 (F)
Absolute Humidity:	75. grains/lb
Nominal Fuel RVP:	8.8 psi
Weathered RVP:	8.2 psi
Fuel Sulfur Content:	299. ppm
Exhaust I/M Program:	No
Evap I/M Program:	No
ATP Program:	No
Reformulated Gas:	No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.900	1.045	1.002	1.027	0.981	0.405	0.461	0.490	5.42	1.049
Composite CO	13.84	16.76	16.27	16.55	24.33	1.277	0.945	6.500	29.13	14.832
Composite NOX :	0.787	1.059	1.342	1.179	3.635	1.170	1.239	16.586	0.89	1.189

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016
Composite Emission Factors (g/mi):						
Composite VOC :	1.003	1.058	0.983	1.044	2.512	0.418
Composite CO	16.40	16.87	16.17	16.47	6.775	0.824
Composite NOX :	0.840	1.126	1.210	1.635	2.574	1.212

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8E
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.981	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	24.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.635	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	1.957	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite NOX :	4.078	0.000	0.000	0.000	0.000	0.000	0.000	0.000

# #
Mesa Verde NP Winter Conditions.
File 1, Run 1, Scenario 13.
# #

Calendar Year: 2001
Month: Jan.
Gasoline Fuel Sulfur Content: 299. ppm
Diesel Fuel Sulfur Content: 500. ppm
Particle Size Cutoff: 10.00 Microns
Reformulated Gas: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0042	0.0047	0.0044	0.0046	0.0523	------	------	------	0.0205	0.0050
ECARBON:	------	------	------	------	------	0.1244	0.0488	0.1250	------	0.0024
OCARBON:	------	------	------	------	------	0.0351	0.0703	0.0997	------	0.0019
SO4:	0.0028	0.0049	0.0047	0.0048	0.0118	0.0049	0.0106	0.0540	0.0010	0.0043
Total Exhaust PM:	0.0071	0.0096	0.0091	0.0094	0.0640	0.1644	0.1297	0.2786	0.0215	0.0136
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0115	0.0040	0.0080
Total PM:	0.0276	0.0302	0.0297	0.0300	0.0846	0.1849	0.1503	0.3027	0.0380	0.0341
SO2:	0.0684	0.0804	0.1134	0.0944	0.1603	0.0939	0.2028	0.7715	0.0328	0.0872
NH3:	0.1016	0.1005	0.1015	0.1009	0.0451	0.0068	0.0068	0.0270	0.0113	0.0970
Idle Emissions (g/hr)										
PM Idle:	------	------	------	------	------	------	------	1.0557	------	0.0190

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016
Composite Emission Factors (g/mi):						
Lead:	0.0000	0.0000	0.0000	0.0000	------	------
GASPM:	0.0047	0.0047	0.0044	0.0044	------	------
ECARBON:	------	------	------	------	0.1498	0.0464
OCARBON:	------	------	------	------	0.2156	0.0668

SO4:	0.0049	0.0049	0.0047	0.0047	0.0062	0.0107
Total Exhaust PM:	0.0096	0.0096	0.0091	0.0091	0.3717	0.1238
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Total PM:	0.0302	0.0302	0.0297	0.0297	0.3922	0.1444
802:	0.0804	0.0804	0.1134	0.1134	0.1196	0.2049
NH3:	0.1005	0.1005	0.1015	0.1015	0.0068	0.0068
Idle Emissions (g/hr)						
PM Idle:	------	------	------	------	------	------

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Composite Emission Factors (g/mi):								
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0523	0.0523	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
ECARBON:	------	------	------	------	------	------	------	
OCARBON:	------	------	------	------	------	------	------	
SO4:	0.0118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.0640	0.0523	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total PM:	0.0846	0.0523	0.0503	0.0504	0.0503	0.0503	0.0503	0.0000
SO2:	0.1603	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0451	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	------	------	------	------	------	------		

Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Composite Emission Factors (g/mi):								
Lead:	- - - - - - - - - -	------	------	------	------	------	------	------
GASPM:	------	------	------	------	------	------	------	------
ECARBON:	0.0514	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OCARBON:	0.0535	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO4:	0.0172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.1221	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Total PM:	0.1426	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO2:	0.2452	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	1.0617	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

#   #   #   # # # # # #   # # # # # # # # # #
Mesa Verde NP Summer Conditions.
File 1, Run 1, Scenario 14.
# #

Calendar Year: 2001
Month: July
Gasoline Fuel Sulfur Content: 299. ppm
Diesel Fuel Sulfur Content: 500. ppm
Particle Size Cutoff: 10.00 Microns
Reformulated Gas: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.7002	0.1410	0.1044		0.0060	0.0008	0.0016	0.0180	0.0280	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0042	0.0046	0.0044	0.0045	0.0523	------	------	------	0.0205	0.0050
ECARBON:						0.1192	0.0485	0.1160	------	0.0023
OCARBON:	______	______	______	______	------	0.0336	0.0698	0.0926	------	0.0018
SO4:	0.0028	0.0049	0.0047	0.0048	0.0120	0.0049	0.0106	0.0540	0.0010	0.0042
Total Exhaust PM:	0.0070	0.0095	0.0091	0.0093	0.0643	0.1576	0.1289	0.2626	0.0215	0.0133
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0116	0.0040	0.0080
Total PM:	0.0276	0.0300	0.0297	0.0299	0.0848	0.1782	0.1494	0.2867	0.0380	0.0338
SO2:	0.0684	0.0804	0.1134	0.0944	0.1601	0.0929	0.2031	0.7714	0.0328	0.0872
NH3:	0.1016	0.1007	0.1015	0.1010	0.0451	0.0068	0.0068	0.0270	0.0113	0.0970
Idle Emissions (g/hr)										
PM Idle:								1.0472	------	0.0189

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0330	0.1080	0.0719	0.0325	0.0000	0.0016

Composite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	' - -	------
GA3PM:	0.0046	0.0046	0.0044	0.0044	------	[illegible]
ECARBON:	------	------	------	------	0.1498	0.0464
OCARBON:	------	------	------	------	0.2156	0.0668
S04:	0.0049	0.0049	0.0047	0.0047	0.0062	0.0107
Total Exhaust PM:	0.0095	0.0095	0.0091	0.0091	0.3717	0.1238
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Total PM:	0.0300	0.0300	0.0297	0.0297	0.3922	0.1444
302:	0.0804	0.0804	0.1134	0.1134	0.1196	0.2049
NH3:	0.1007	0.1007	0.1015	0.1015	0.0068	0.0068
Idle Emissions (g/hr)						
PM Idle:	------	------	------	------	------	------

Veh. Type:	oo5v2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
\nMr Mix:	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Compooite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0523	0.0523	0.0506	0.0506	0.0506	0.0506	0.0505	0.0000
ECARBON:	------	------	------	------	------	------	------	------
oCARBmn:	-'----	------	------	------	------	------	------	------
S04:	0.0120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust em:	0.0643	0.0523	0.0506	0.0506	0.0506	0.0586	0.0505	0.0000
Brake:	0.0125	0.0000	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total PM:	0.08*8	0.0523	0.0506	0.0506	0.0506	0.0506	0.0505	0.0000
SO2:	0.1601	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0451	0.0000	0.0000	0.0800	0.0000	0.8800	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	------	------	------	------	------	------	------	------
vMz Mix:	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Conpmoite Emission Factors (g/mi):

Lead:

GASPM:

ECARBON:	0.0503	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
OCARBON:	0.0523	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO4:	0.0171	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.1198	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Brake:	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tire:	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total PM:	0.1403	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO2:	0.2450	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NH3:	0.0270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:	1.0504	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

2001 MESA VERDE NATIONAL PARK VISITOR VEHICLE EMISSIONS

Paved Road Annual VMT
12,592,350

Emission Factors (g/mi) - All Vehicles

	NOx	CO	**VOC**	PM_{t0} **(Paved)** Exhaust, **Brake,** and Tire	Fugitive	Total
Summer	1.189	14.832	1.049	0.0338	0.84	0.8738
Winter	1.261	19.648	1.019	0.0341	0.84	0.8741
Average	1.225	17.240	1.034			0.874

Emissions (tons/yr) - All Vehicles

NOx	**CO**	**VOC**	**Paved PM_{10}**
16.97	238.80	14.32	12.11

Emissions (lbslyr) - All Vehicles

NOx	**CO**	**VOC**	**Paved PM_{10}**
33,936	477,603	28,645	24,211

Bus
Annual VMT
52,500

Emission Factors (g/mi) - Buses

	NOx	CO	VOC	PM_{10} (Paved) Exhaust, Brake, and Tire	Fugitive	Total
Summer	16.586	6.500	0.490	0.2867	0.84	1.1267
Winter	16.834	6.582	0.509	0.3027	0.84	1.1427
Average	16.710	6.541	0.500			1.135

Emissions (tons/yr) - Buses

NOx	CO	VOC	Paved PM_{10}
0.97	0.38	0.03	0.07

Emissions (lbs/yr) - Buses

NOx	**CO**	VOC	**Paved** PM_{10}
1,930	755	58	131

MESA VERDE NP CONCESSIONAIRE BUS EMISSIONS

Tram VMT
60,480

Emission Factors (glmi) - Gasoline Buses

	NOx	CO	VOC	PM10 (Paved) Exhaust, Brake, and Tire	PM10 (Paved) Fugitive	PM10 (Paved) Total
Summer	3.635	24.330	0.981	0.0848	0.84	0.9248
Winter	3.796	27.920	1.002	0.0846	0.84	0.9246
Average	3.716	26.125	0.992			0.925

Emissions (tons/yr) - All Vehicles

NOx	CO	VOC	Paved PM_{10}
0.25	1.74	0.07	0.06

Emissions (lbs/yr) -All Vehicles

NOx	CO	VOC	Paved PM_{10}
494	3,476	132	123

Tour Bus VMT
26,800

Emission Factors (glmi) - Tour Buses

	NOx	CO	VOC	PM_{10} (Paved) Exhaust, Brake, and Tire	PM_{10} (Paved) Fugitive	PM_{10} (Paved) Total	SO_2
Summer	16.586	6.500	0.490	0.2867	0.84	1.1267	0.7714
Winter	16.834	6.582	0.509	0.3027	0.84	1.1427	0.7715
Average	16.710	6.541	0.500			1.135	0.7715

Emissions (tons/yr) - Buses

NOx	CO	VOC	Paved PM_{10}	SO_2
0.49	0.19	0.01	0.03	0.02

Emissions (lbslyr) - Buses

NOx	CO	VOC	Paved PM_{10}	SO_2
985	386	29	67	45

MESA VERDE NATIONAL PARK NPS AND **GSA VEHICLES**

	LDGV	LDGT	LDDT	HDDV	Total
Total Miles	21,284	166,632	0	57,917	245,833

Emission Factors (glmi) - **LDGV**

				PM_{10}		
	NOx	CO	VOC	Exhaust, **Brake, and Tire**	Fugitive	Total
Summer	0.7870	13.8400	0.9000	0.0276	0.8400	0.8676
Winter	0.8330	18.4600	0.9110	0.0276	0.8400	0.8676
Average	0.8100	16.1500	0.9055			0.8676

Emissions (tonslyr) - **LDGV**

NOx	CO	**VOC**	PM_{10}
0.02	0.38	0.02	0.02

Emission Factors (glmi) - LDGT

				PM_{10}		
	NOx	**CO**	VOC	**Exhaust, Brake, and** Tire	Fugitive	Total
Summer	1.179	16.550	1.027	0.030	0.840	0.870
Winter	1.287	23.250	1.118	0.030	0.840	0.870
Average	1.233	19.900	1.073			0.870

Emissions (tonslyr) - LDGT

NOx	CO	VOC	PM1o
0.23	3.65	0.20	0.16

Emission Factors (glmi) - LDDT

				PM_{10}		
	NOx	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	1.239	0.945	0.461	0.149	0.840	0.989
Winter	1.212	0.931	0.439	0.150	0.840	0.990
Average	1.226	0.938	0.450			0.990

Emissions (tonslyr) - HDGV

NOx	CO	VOC	PM_{10}
0.00	0.00	0.00	0.00

Emission Factors (glmi) - HDDV

				PM_{10}		
	NOx	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	16.586	6.500	0.490	0.287	0.840	1.127
Winter	16.834	6.582	0.509	0.303	0.840	1.143
Average	16.710	6.541	0.500			1.135

Emissions (tonslyr) - HDDV

NOx	CO	VOC	PM1o
1.06	0.42	0.03	0.07

Emissions (tonslyr) - Total

NOx	CO	VOC	PM_{10}
1.31	4.44	0.25	0.25

Emissions (lbslyr) - Total

NOx	CO	VOC	PM_{10}
2,619	8,885	499	504

MEVE ARAMARK VEHICLES

	LDGV	LDGT	LDDT	HDDV	Total
Total Miles	15,000	115,000	0	0	130,000

Emission Factors (glmi) - LDGV

	NOx	CO	VOC	PM_{10} Exhaust, **Brake, and Tire**	PM_{10} Fugitive	PM_{10} Total
Summer	0.7870	13.8400	0.9000	0.0276	0.8400	0.8676
Winter	0.8330	18.4600	0.9110	0.0276	0.8400	0.8676
Average	0.8100	16.1500	0.9055			0.8676

Emissions (tonslyr) - **LDGV**

NOx	CO	**VOC**	PM_{10}
0.01	0.27	0.01	0.01

Emission Factors (glmi) - LDGT

	NOx	CO	VOC	PM_{10} Exhaust, Brake, **and** Tire	PM_{10} Fugitive	PM_{10} Total
Summer	1.179	16.550	1.027	0.030	0.840	0.870
Winter	1.287	23.250	1.118	0.030	0.840	0.870
Average	1.233	19.900	1.073			0.870

Emissions (tonslyr) - LDGT

NO.	CO	VOC	PM_{10}
0.16	2.52	0.14	0.11

Emission Factors (glmi) - LOOT

	NOx	CO	VOC	PM_{10} Exhaust, Brake, **and** Tire	PM_{10} Fugitive	PM_{10} Total
Summer	1.239	0.945	0.461	0.149	0.840	0.989
Winter	1.212	0.931	0.439	0.150	0.840	0.990
Average	1.226	0.938	0.450			0.990

Emissions (tonslyr) - HDGV

NOx	CO	VOC	PM_{10}
0.00	0.00	0.00	0.00

Emission Factors (glmi) - HDDV

	NOx	CO	VOC	PM_{10} Exhaust, Brake, **and** Tire	PM_{10} Fugitive	PM_{10} Total
Summer	16.586	6.500	0.490	0.287	0.840	1.127
Winter	16.834	6.582	0.509	0.303	0.840	1.143
Average	16.710	6.541	0.500			1.135

Emissions (tonslyr) - HDDV

NOx	CO	VOC	PMio
0.00	0.00	0.00	0.00

Emissions (tonslyr) - Total

NOx	CO	VOC	PM.o
0.17	2.78	0.15	0.12

Emissions (Ibslyr) - Total

NOx	CO	VOC	PM.o
339	5,568	301	249

2001 MESA VERDE NP NONROAD VEHICLE EMISSIONS

	Emission Factors (gm/hp-hr)							Emissions (lbs/yr)			
Vehicle	PM	Nox	CO	VOC	hp	load	hrs/yr	PM	Nox	CO	VOC
Utility Vehicle	2.04	1.03	2.31	2.19	15	0.55	700	25.9	13.1	29.3	27.8
Tractors	2.04	1.03	2.31	2.19	42.35	0.68	600	77.5	39.2	87.8	83.2
									0.0	0.0	
Backhoe	2.04	1.03	2.31	2.19	77	0.55	200	38.0	19.2	43.0	40.8
Bobcat	2.04	1.03	2.31	2.19	15	0.55	200	7.4	3.7	8.4	7.9
Grader	1.06	9.6	3.8	1.43	172	0.61	200	48.9	443.2	175.4	66.0
						Totals:	(lbs/yr)	198	518	344	226
							(tons/yr)	0.10	0.26	0.17	0.11

APPENDIX C

PUBLIC USE DATA

Monthly Public Use Report

Printed on 01/20/2003

MESA VERDE NP			12/2001	1490
December 2001				
	Recreational	Non-Recreational	Total	Calendar Year-To-Date
Visits	5,597	408	6,005	537,474
Visitor Hours	25,187	408	25,595	4,128,450
				Fiscal YTD
Total Fiscal YTD Visitor Days				31,110

Recreation O/N stays	Current Month	Year-To-Date	
Concessioner Lodging	0	46,818	NPS Campgrounds
Concessioner Campgrounds	0	0	Tents 0 RN's 0
NPS Campgrounds	0	51,616	Total 0
NPS Backcountry	0	0	
NPS Miscellaneous	0	1,236	
Non Recreation O/N stays	0	0	
Total Overnight stays	0	99,670	

	This Month	Same Month Last Year	Percent Change
Total Rec	5,597	6,746	-17.03 %
Total NonRec	408	761	-46.39 %
Total Visits	6,005	7,507	-20.01 %
Total YTD	537,474	471,084	14.09 %

Form 10-157
(Rev. 3/77)

U.S. DEPARTMENT OF INTERIOR

MONTHLY PUBLIC USE REPORT

PARK	MONTH YEAR	PARK CODE
MESA VERDE NATIONAL PARK	12/2001	11490'

	CURRENT-MONTH			YEAR-TO-DATE
	Recreational	Nonrecreational	Total	
VISITS	55971	4081	60051	537474

	CURRENT-MONTH			YEAR-TO-DATE
	Recreational	Nonrecreational	Total	
VISITOR HOURS	251871	4081	255951	4128450

	CURRENT MONTH	YEAR-TO-DATE
RECREATION O/N STAYS		
CONCESSIONER LODGING	01	46818
CONCESSIONER CAMPGROUNDS		
NPS CAMPGROUNDS	01	51616
NPS BACKCOUNTRY	01	0
NPS MISCELLANEOUS	01	1236
NON RECREATION O/N STAYS	0	0
TOTAL OVERNIGHT STAYS	01	99670

NPS CAMPGROUNDS

TENTS	0
IR/VS	0
TOTAL	0

VISITOR-HOUR APPENDIX

SEE WORKSHEET

SPECIAL USE DATA	THIS MONTH	YEAR-TO DATE		THIS MONTH	YEAR-TO DATE
PARK POINT	30781	26215911	WETHERILL MESA	01	8421
FAR VIEW RUINS	39181	346420''			
MESA TOP LOOP	44781	407545''			
CLIFF PALACE	01	39102611	n. BUSES	SI	1251

~~REMARKS: THIS MONTH~~		~~SAME MO LAST YEAR~~			
TOTAL VISITS	6005	TOTAL VISITS	75071	%CHANGE	-20.0'
YTD VISITS	5374741	YTD VISITS	471084'	%CHANGE'	14.11
CG USE YTD	996701	CG YTD USE	823861	%CHANGE'	21.01

SIGNATURE	TITLE	DATE
CHARLES PETERSON	CHIEF RANGER	01/08/02

Charles Peterson

~rMESA VERDE NATIONAL PARK WORKSHEET- VER=4.03

ENTER REPORTING
MONTH/YEAR >*12/20011

ENTER THE TRAFFIC COUNT FROM THE MAIN ENTRANCE * 30301

ENTER THE NUMBER OF NON-RECREATION VEHICLES * 2721

	rBUSES	rPASSn
ENTER THE NUMBER OF BUSES/BUS PASSENGERS	* 51	* 701
ENTER THE NUMBER OF TENT/RV CAMP SITES OCCUPIED	rTENTS * 01	-RV' S * 01

ENTER THE NUMBER OF OVERNIGHT STAYS AT FAR VIEW LODGE * 01

ENTER THE TRAFFIC COUNT AT WETHERILL * 0

ENTER YES IF THE FOLLOWING ROADS WERE OPEN FOR THE ENTIRE MONTH OR A PARTIAL MONTH, IF CLOSED ENTIRE MONTH ENTER NO.

PARK POINT	(Y OR N)	IF CLOSED PARTIAL MONTH # DAYS OPEN	01
FAR VIEW RUINS	(Y OR N)	IF CLOSED PARTIAL MONTH # DAYS OPEN	01
MESA TOP LOOP	(Y OR N)	IF CLOSED PARTIAL MONTH # DAYS OPEN	01
CLIFF PALACE	(Y OR N) INI	IF CLOSED PARTIAL MONTH # DAYS OPEN	01
WETHERILL	(Y OR N)	IF CLOSED PARTIAL MONTH # DAYS OPEN	01

PRESS>-{ F10 TO SAVE=I

PERSONS-PER-VEHICLE MULTIPLIER 12.41 NONREPORTABLE 4501

REC AUTOMOBILE VISITORS	55271
BUS VISITORS	701
OVERNIGHT STAYS	01

TOTAL RECREATION VISITS	55971	TOTAL NONRECREATION VISITS	4081
TOTAL RECREATION HOURS	251871	TOTAL NONRECREATION HOURS	4081

CONTROL#00108 LAST # 107 CLY 96'

Public Use 1980-2007

YEAR	MONTH January	February	March	April	May	June	July	August	September	October	November	December	TOTAL	DIFFERENCE
1980	1,488	1,152	3,411	10,747	49,804	98,701	131,609	133,424	68,558	30,879	7,245	3,808	542,806	
1981	3,424	1,808	3,200	12,104	65,443	108,301	141,882	130,318	77,007	35,166	7,378	2,816	590,828	8.8%
1982	1,200	1,872	5,552	13,090	57,751	117,150	146,716	141,005	73,581	32,393	9,010	3,648	604,950	2.4%
1983	3,584	3,200	7,680	14,620	65,574	108,195	141,833	130,249	79,709	38,707	8,364	2,400	604,115	-0.1%
1984	2,528	3,078	8,663	14,269	47,117	92,120	117,588	120,858	72,038	26,087	7,636	4,883	516,865	-14.4%
1985	5,346	4,628	10,218	20,971	65,951	117,501	155,297	139,039	82,706	36,328	11,246	7,060	656,291	27.0%
1986	7,497	4,799	16,430	20,449	66,006	111,035	154,908	147,714	81,426	33,974	7,980	6,670	658,888	0.4%
1987	4,386	4,441	9,726	23,938	75,867	125,223	165,166	156,573	101,517	45,013	12,266	4,450	728,566	10.6%
1988	3,753	5,577	14,533	26,583	79,298	128,602	172,929	164,245	108,421	52,549	10,617	5,076	772,183	6.0%
1989	2,990	3,401	14,593	21,683	57,557	111,661	128,270	134,791	70,471	37,899	10,457	6,272	600,045	-22.3%
1990	3,926	4,232	12,856	25,531	56,647	111 215	142,952	136,791	69788	33,157	9583	4,801	611,479	1.9%
1991	3,885	6,001	12,317	22,225	61,574	96,769	173,774	158,191	80,823	45,855	11434	5,227	678,0_75	10.9%
1992	5,090	6,545	14,614	31,207	67,353	136,273	172,012	158,503	86,893	48,508	10,097	4,925	742,020	9.4%
1993	3,768	4,666	13,283	28,575	64,748	113,462	150,932	142,614	79,541	48,728	10,015	5,724	666,056	-10.2%
a 1994	6,126	3,947	18,802	26,196	66,517	119,260	159,407	147,527	83,579	51,733	9,798	6,752	699,644	5.0%
b 1995	4,938	6,710	16,568	27,605	64,167	109,197	171,053	137,981	82,474	46,707	10,452	2,981	680,833	-2.7%
c 1996	4,486	5,373	16,284	29,373	67,113	114,588	152,711	106,638	74,899	44,533	10,785_	6,150	632,933	-7.0%
1997	4,427	4,771	16,547	25,781	61,288	116,398	148,967	135,008	77.691	42,539	9,477	5,702	648,596	2.5%
d 1998	4,905	4,666	13,526	25,886	62,091	109,226	137.955	123,132	80,306	45,949	8,482	7,386	623,510	-3.9%
1999	6,103	6,552	19,502	24,474	63,487	115,0.43	143 ; ^3	130,354	82,142	45,062	12,219	7,802	656,023	5.2%
e f 2000	5,923	5,832	14,087	26,313	57,157	98,175	77,946	64,221	64,411	38,861	10,651	7,507	471,084	-28.2%
2001	6,897	6,567	15,411	27,053	53,173	94,178	116,882	101,748	58,631	38,928	12,001	6,005	537,474	14.1%
g 2002	5,807	6,441	13,820	22,724	56,739	82,169	78,058	53,380	49,901	34,797	9,478	6,347	419,661	-21.9%
2003	5,529	4,849												-15.3%
2004														
2005														
2006	a - Due to a change in computations, 1994 totals include the non-recreation figures.									e- Park closed due to Bircher fire.				
2007	b - Due to a congressional shutdown, the park was closed 11/14-19 and 12/16/95 - 1/6/96									f- Park closed due to Pony fire.				
2008	c - The park was closed 8/18-28 due to the Chapin 5 fire.									g- Park closed due to Long Mesa 02 Fire, July 29 - Aug 9, 2002				
2009	d- Traffic counter failure in December 1998.													

APPENDIX D

SELECTED COLORADO AIR QUALITY REGULATIONS

Colorado Air Quality Control Commission Regulation No. 9:
Open Burning, Prescribed Fire, and Permitting.

Scope

This regulation applies to all open burning activity throughout the state.

II. Definitions

The following definitions apply for the purposes of this Regulation No. 9.

A. Agricultural Open Burning

The open burning of cover vegetation for the purpose of preparing the soil for crop production, weed control, maintenance of water conveyance structures related to agricultural operations, and other agricultural cultivation purposes.

B. Broadcast Burn

A broadcast burn is the controlled application of fire to wildland fuels in their natural or modified state over a predetermined area. Broadcast burns do not include the burning of wildland fuels that have been concentrated in piles by manual or mechanical methods.

C. Class I Area and Mandatory Federal Class I Area

A class I area is an area listed in Regulation No. 3, Part B, section V.A.

D. Fuel Treatment

Manipulation, including combustion, or removal of wildland fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control of wildfire.

E. Land Manager

Any federal, state, local or private person or entity that administers, directs, oversees or controls the use of public or private land, including the application of fire to the land.

F. Local Agency

A local air pollution control authority to which the division has delegated authority to issue general open burning permits.

wildland fires ignited by military munitions.

S. Wildfire

Any fire that is not intended for use for grassland or forest management, regardless of whether the fire is ignited by natural or human means.

T. Wildlands

An area where development is generally limited to roads, railroads, power lines and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in ten years), is not fallow, and is not in the United States Department of Agriculture Conservation Reserve Program. The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands or protective plant cover.

U. Wildland Fuels

Combustible vegetative materials located on wildlands that can be consumed by fire, including naturally occurring live and dead vegetation, such as grass, leaves, ground litter, plants, shrubs, and trees, as well as excessive buildups of these materials resulting from resource management and other land use activities, as well as from natural plant growth and succession.

III. Open Burning Permit Requirements

A. No person shall conduct any open burning activity not exempted from this regulation without first obtaining an open burning permit from the division or from a local agency. No person shall burn or allow the burning of rubbish, wastepaper, wood, vegetative material, or any other flammable material on any open premises, or on any public street, alley, or other land adjacent to such premises without first obtaining an open burning permit from the division or local agency.

B. The following activities are exempt from the requirement to obtain an open burning permit:

1. noncommercial burning of private household trash in particulate matter (PM 10) attainment areas unless local ordinances or rules prohibit such burning;

2. fires used for noncommercial cooking of food for human consumption, or for instructional, training or recreational purposes;

3. safety flares used to signal danger to the public;

duct design, combustion function and probable emissions performance.

V. ENFORCEMENT

A. The Division may enter and inspect the property or premises of any manufacturer, or dealer, for the purpose of investigating any actual, suspected, or potential violation of this regulation; and may, at reasonable times, have access to and copy any document, inspect any wood stove, wood stove component, pellet stove, masonry heater or testing equipment, or test the emissions of any wood stove, pellet stove or masonry heater possessed by any manufacturer, or dealer, for the purpose of ascertaining compliance or noncompliance with this regulation.

B. The Division shall also enforce the provisions of this regulation through all means authorized by Part 1 of Title 25, C.R.S.

VI. LIST OF APPROVED SOLID FUEL APPLIANCES

The Division shall request each dealer to make available to consumers a list of certified wood stoves, exempt, approved pellet stoves and approved masonry heaters to be compiled by the Division.

VII. HIGH POLLUTION DAYS

A. Applicability

Limitations on the use of wood burning stoves, pellet stoves, masonry heaters and fireplaces shall be applicable only in those portions of the counties of Adams, Arapahoe, Boulder, Denver, Douglas, and Jefferson which are located in the AIR program area, as such area is defined in Section 42-4-307(8), C.R.S. but not including those areas above seven thousand feet elevation.

B. Provisions of this section may be enforced by the appropriate local agency. Local agencies are encouraged to develop suitable enforcement programs and enter into an agreement with the State to promote more effective enforcement of this regulation. Approval of a wood stove, pellet stove or masonry heater model pursuant to this regualtion does not constitute authorization not to comply with requirements of any local ordinance or

resolution relating to the installation or use of any wood-burning appliance,

C. This section shall not apply within any municipality which had an ordinance mandating restricted use of wood burning stoves, pellet stoves, masonry heaters and fireplaces on high pollution days in effect on January 1, 1990.

1. All such exempt areas shall be required to submit a yearly report to the commission no later than June 30, which provides information concerning the enforcement actions pursuant to theft ordinance for the previous healing season.

D. Prohibitions of use

No person shall operate a wood burning stove, pellet stove, masonry heater or fireplace during a high pollution day. A burn-down time shall be allowed for the burn-down of existing fires prior to the initiation of enforcement action.

E. Exemptions

1. Persons utilizing their wood burning stove, pellet stove, masonry heater or fireplace as a primary source of heat.

2. Persons operating a Phase Ili certified wood burning stove.

3. Persons operating an approved pellet stove.

4. Persons operating an approved masonry heater.

VIII. REQUIREMENTS FOR INSTALLATION OF FIREPLACES

A. On and after the effective date of this regulation no person shall install any fire place in any dwelling in the area defined in Section Vfl.A. unless it is one of the following:

1. a gas appliance.
2. an electric device.
3. a fireplace insert that meets the requirements set forth in Section ILA.
4. an approved pellet burning fireplace insert.