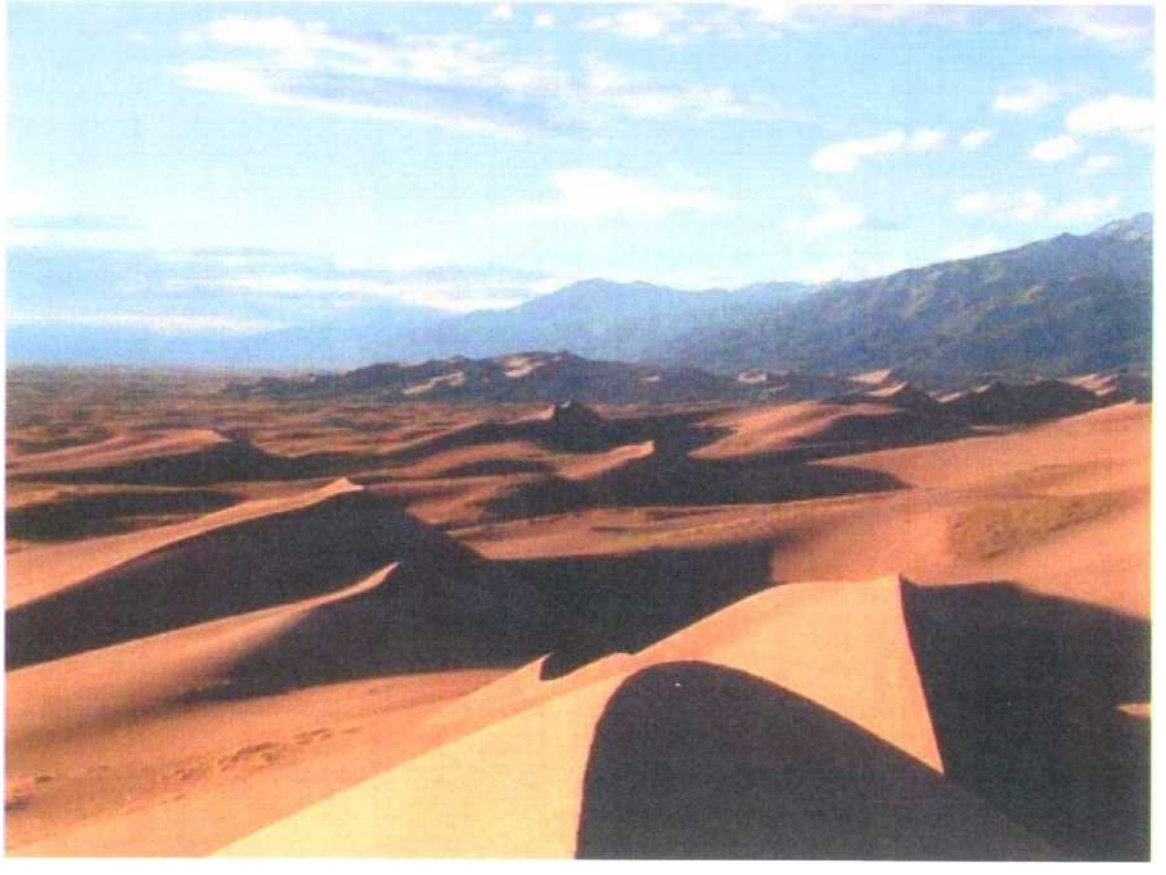
FINAL

2001 AIR EMISSIONS INVENTORY

GREAT SAND DUNES
NATIONAL MONUMENT AND PRESERVE
COLORADO



U.S. NATIONAL PARK SERVICE

FINAL

2001 AIR EMISSIONS **INVENTORY**

GREAT SAND **DUNES**
NATIONAL **MONUMENT** AND **PRESERVE**
COLORADO

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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 Great Sand Dunes National Monument and Preserve (NM & Pres) 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 wildland 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 folined as a result a chemical reaction of NOx and 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
Carbon Dioxide (CO_2)	• Does not directly impair human health • It is a greenhouse gas that traps the earth's heat and contributes to the potential for 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 Great Sand Dunes NM & Pres personnel[1], review of applicable park records, emission calculations, review of applicable state and local air quality regulations, 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

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(FIRE) 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

Great Sand Dunes NM & Pres is located 35 miles northeast of Alamosa in south central Colorado (Figure 1) and consists of 83,958 acres. The park contains the tallest dunes in North America (over 700 feet high) and one of the most complex dune systems in the world that is created by the continuing interaction of wind, sand, and water. The dunes are an internationally significant high-altitude, seasonally cold climate eolian (wind-driven) system that supports nearby creeks demonstrating consistent surge flow, a unique hydrologic phenomenon. The park provides resources that include the combination of massive dunes surrounded by alpine peaks, a desert valley, and creeks flowing on the surface of the sand.

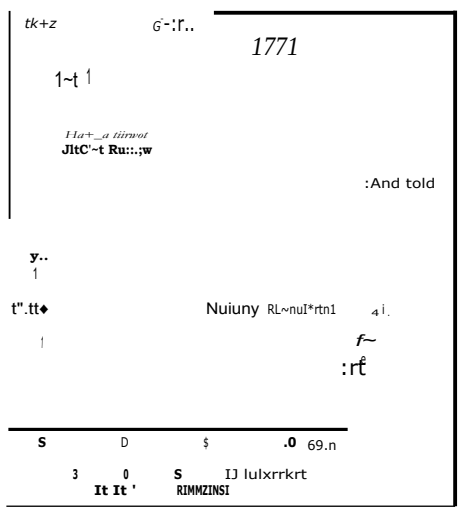


FIGURE 1. GREAT SAND DUNES NATIONAL MONUMENT AND PRESERVE

The park protects 80,000 acres hosting a great diversity of plants and animals, spanning desert to montane life zones. The dunes themselves represent a unique high desert habitat that supports at least six known endemic insect species, including the Great Sand Dunes Tiger Beetle, a species of Darkling Beetle, and an unnamed Flower Beetle. The Great Sand Dunes area contains evidence of ancient people and past human uses, including rare Clovis/Folsom archeological sites and the largest known stand of culturally scarred ponderosa pine in Colorado. Historically, the

Great Sand Dunes were situated along a major historic route into the San Luis Valley; the dunes have been identified as having special importance by people of varied cultures, including Hispanic, American Indian, European, Asian, and others.

On November 22, 2000, the Great Sand Dunes National Park and Preserve Act of 2000 was signed into law. The Act contains several provisions that greatly increase the amount of land managed by the NPS. In particular, the Great Sand Dunes National Preserve was established from 41,646 acres previously managed by the U.S. Forest Service (USFS). The new preserve stretches eastward from the eastern and northern edges of the old monument boundary to the ridgeline of the Sangre de Cristo Mountains. The law also authorized the expansion of boundaries to the west and northwest, doubling NPS acreage to over 107,000 acres. The lands within this boundary include 4,010 acres of Bureau of Land Management land, 36,146 acres owned or leased from the state by The Nature Conservancy (TNC), and several other privately-owned inholdings, including the Baca Ranch.

The bill authorized purchase of these lands from willing sellers, and negotiations are underway. The most critical of these lands is the Baca Ranch, a large property to the northwest. Once purchased, a portion of the Baca Ranch (approximately 31,100 acres) would be managed by the NPS. This acquisition would permit the name of the monument to be changed to "national park." Of the remaining acreage, about 13,500 acres, including the 14,165-foot Kit Carson peak, will be managed by the USFS. The remaining 54,000 acres will become part of the new Baca National Wildlife Refuge managed by the U.S. Fish and Wildlife Service.

The park contains few visitor services or other developments. There is a Visitor Center located in the southeast area of the park, and park headquarters is located approximately one mile southwest of the Visitor Center. There is one campground at Pinyon Flats approximately a mile north of the Visitor Center, but no additional lodging, food, gasoline, or other services within the park. Table 1 summarizes the facilities that are located at the developed areas.

TABLE 1: GREAT SAND DUNES NM & PRES DEVELOPED AREAS

Area	**Function/Facilities**
Park Headquarters	Superintendent's office, park administrative staff, and employee housing
Visitor Center	Interpretive information, exhibits, bookstore, comfort station
Pinyon Flats	Campground with 88 sites and restrooms

Maps of these three areas are provided at the end of this section.

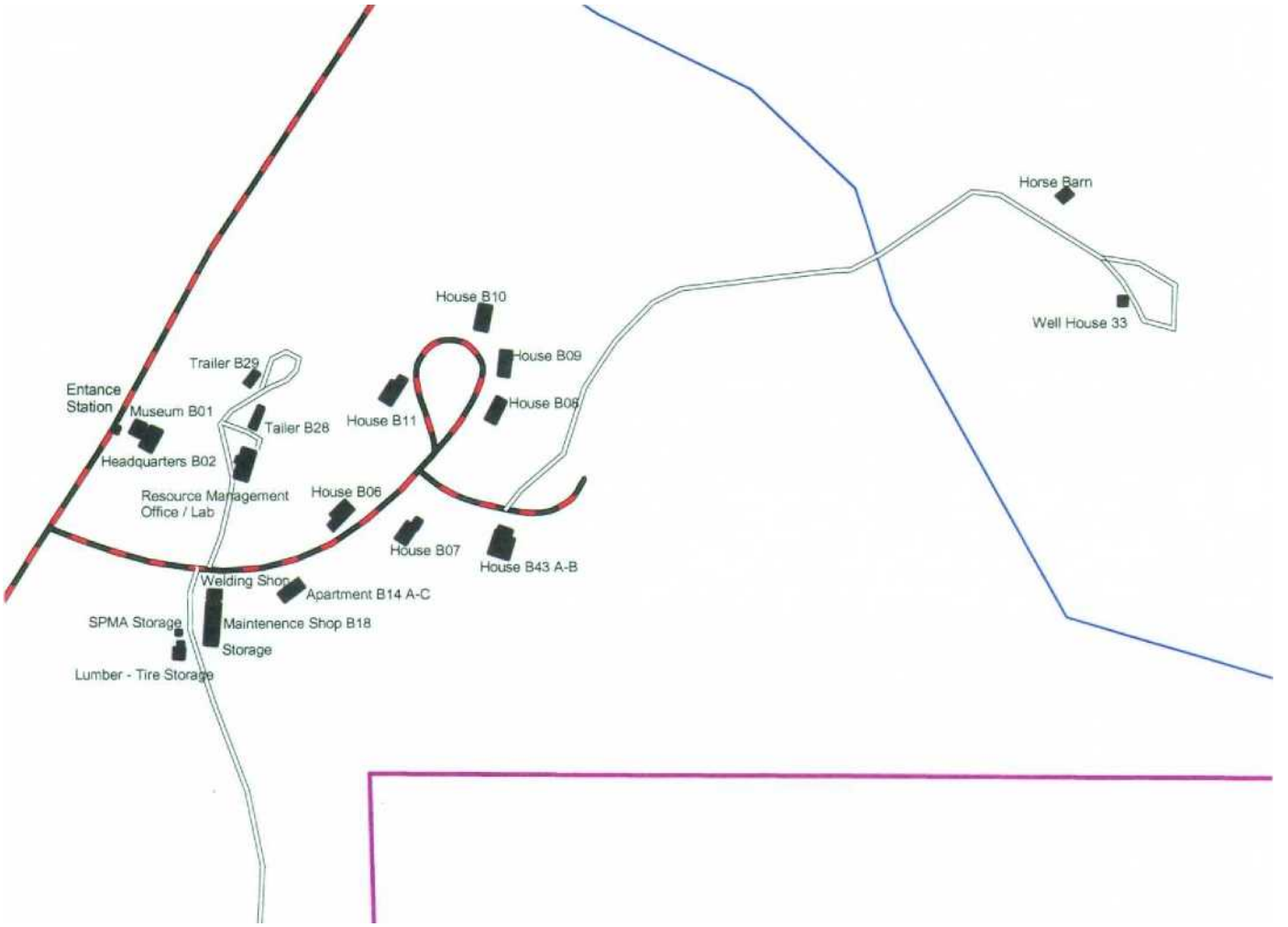
1.5 AIR QUALITY STATUS

The Colorado Depaituient of Public Health and Environment administers the state's air pollution program. The park is located in Alamosa and Saguche Counties, which are classified as attainment for all state and national ambient air quality standards.

The park operates an air monitoring station behind the park headquarters near the entrance station. The park monitors fine 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_{IO} particles for mass. Data indicate that visibility trends at the park have shown improvements over the 1990-1999 time period (NPS 2002).

Great Sand Dunes NM & Pres 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.

GRSA Headquarters/Housing Area



0.05 0.05 0.1 0.15 0.2 0.25 0.3 Miles

Building

Road

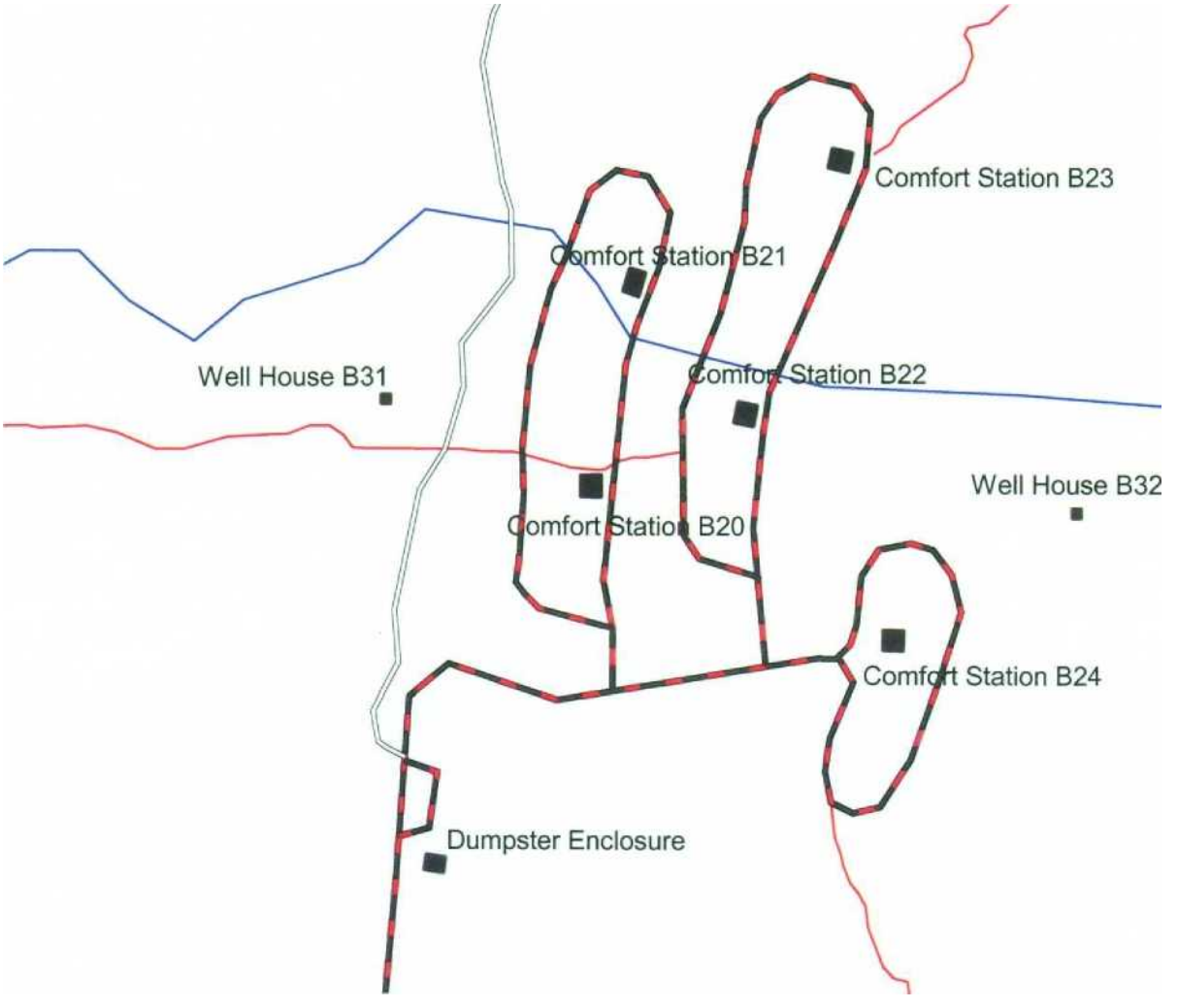
A/ Paved

A/ Unimproved Trail

A/ Boundary Stream

N

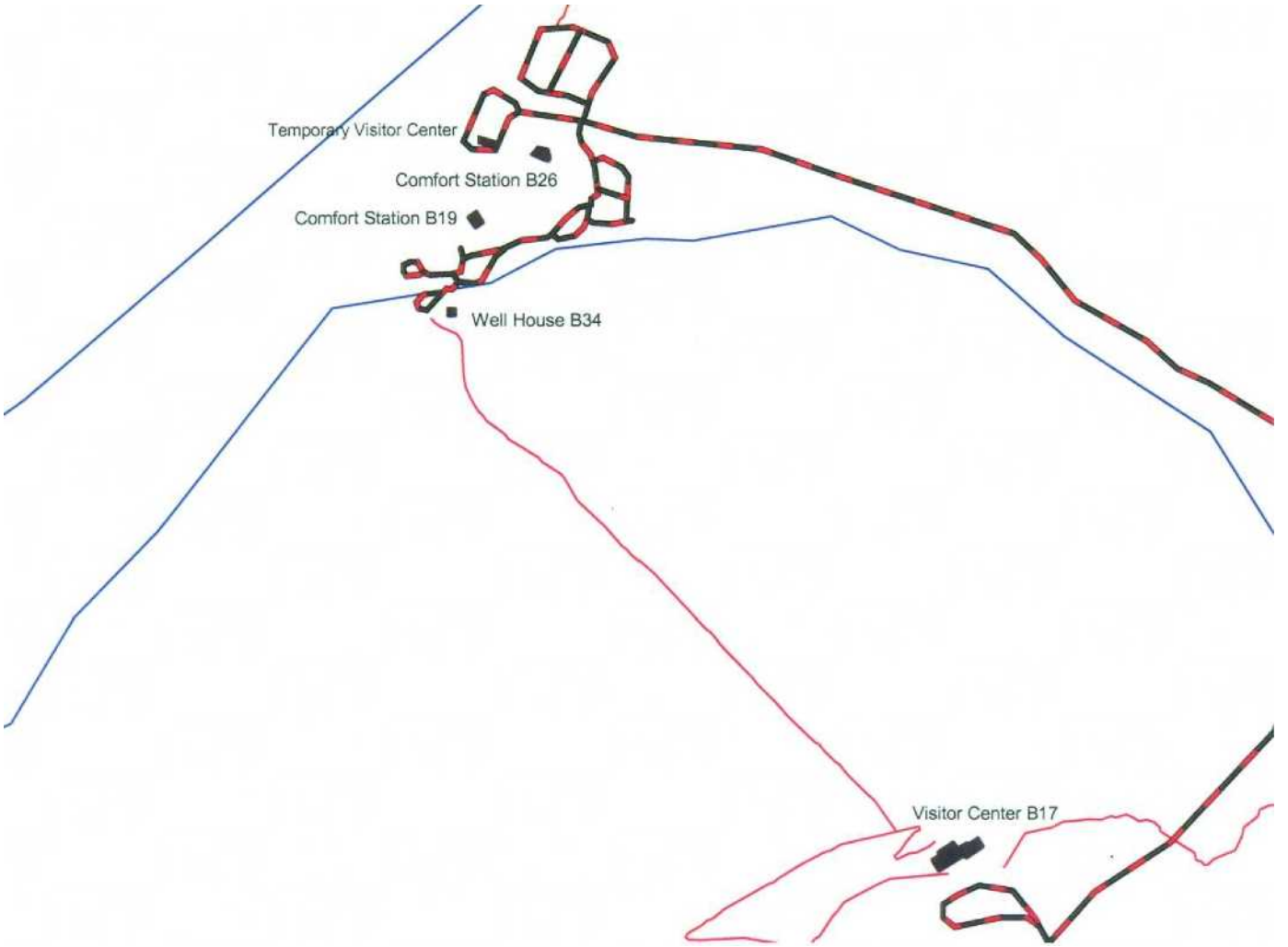
GRSA Campground Area



0.05 0.05 0.1 0.15 0.2 0.25 0.3 0.35 Miles

Building
Road
Paved
Unimproved
Trail
Boundary
Stream

GRSA Visitor Center/Dunes Access Area



0.05 0 0.05 0.1 0.15 0.2 0.25 0.3 Miles

Building
Road
Paved
Unimproved
Trail
Boundary
Stream

N

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), and volatile organic compounds (VOCs).

2.1 STATIONARY **SOURCES**

2.1.1 Space And Water Heating Equipment

There are approximately 24 propane heating units in the Park. Criteria emissions were calculated using the appropriate residential emission factors for the fuel types. For example, NOx emissions from the propane furnace in the Visitor Center was calculated as follows:

$$2{,}343\ gallons/yr \times \frac{14\ lb\ PM}{1{,}000\ gallons} = 33\ lb\ NOx/yr$$

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.

TABLE 2. **2001 ACTUAL AIR EMISSIONS FROM GREAT SAND DUNES NATIONAL MONUMENT AND PRESERVE HEATING EQUIPMENT**

Location	No.	Fuel	Fuel Consumption (gal/yr)	PM_{10} (lbs/yr)	SO_2 (Ibs/yr)	NOx (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)	CO_2 (lbs/yr)
Visitor Center	2	Propane	2,342	1	0	33	5	1	29,275
	1	Propane	1,449	1	0	20	3	0	18,113
Dome Comfort Station	1	Propane	729	0	0	10	1	0	9,113
Campground Comfort Stn	1	Propane	706	0	0	10	1	0	8,825
Resource Mgt Lab	1	Propane	1,360	1	0	19	3	0	17,000
Maintenance Shop	3	Propane	2,214	1	0	31	4	1	27,675
Warehouse	1	Propane	490	0	0	7	1	0	6,125
Welding Shop	1	Propane	490	0	0	7	1	0	6,125
Headquarters	1	Propane	270	0	0	4	1	0	3,375
	1	Propane	770	0	0	11	2	0	9,625
Apt 14a, b, c	3	Propane	940	0	0	13	2	0	11,750
Duplex 43a, b	2	Propane	1,527	1	0	21	3	0	19,088
House 6	1	Propane	845	0	0	12	2	0	10,563
House 7	1	Propane	1,135	0	0	16	2	0	14,188
House 8	1	Propane	520	0	0	7	1	0	6,500
House 9	1	Propane	660	0	0	9	1	0	8,250
House 10	1	Propane	1,090	0	0	15	2	0	13,625
House 11	1	Propane	430	0	0	6	1	0	5,375
		Total	17,967	7	0	252	36	5	224,588

TABLE 3. **2001** POTENTIAL AIR EMISSIONS FROM
GREAT SAND DUNES NATIONAL MONUMENT AND PRESERVE HEATING EQUIPMENT

Location	No.	Fuel	Fuel Consumption (gallyr)	PM10 (lbs/yr)	SO_2 (lbs/yr)	NOx (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)	CO_2 (lbs/yr)
Visitor Center	2	Propane	15,318	6	0	214	31	5	191,475
	1	Propane	7,659	3	0	107	15	2	95,738
Dome Comfort Station	1	Propane	3,830	2	0	54	8	1	47,869
Campground Comfort Stn	1	Propane	7,180	3	0	101	14	2	89,754
Resource Mgt Lab	1	Propane	15,701	6	0	220	31	5	196,262
Maintenance Shop	3	Propane	12,925	5	0	181	26	4	161,557
Warehouse	1	Propane	2,872	1	0	40	6	1	35,902
Welding Shop	1	Propane	2,872	1	0	40	6	1	35,902
Headquarters	1	Propane	3,351	1	0	47	7	1	41,885
	1	Propane	9,574	4	0	134	19	3	119,672
Apt 14a, b, c	3	Propane	18,669	7	0	261	37	6	233,361
Duplex 43a, b	2	Propane	14,361	6	0	201	29	4	179,508
House 6	1	Propane	8,616	3	0	121	17	3	107,705
House 7	1	Propane	8,616	3	0	121	17	3	107,705
House 8	1	Propane	7,659	3	0	107	15	2	95,738
House 9	1	Propane	7,659	3	0	107	15	2	95,738
House 10	1	Propane	7,659	3	0	107	15	2	95,738
House 11	1	Propane	8,616	3	0	121	17	3	107,705
		Total	163,137	65	1	2,284	326	49	2,039,213

2.1.2 Generators

There are no stationary generators in the Park.

2.1.3 **Fuel Storage Tanks**

Great Sand Dunes NM & Pres has one gasoline underground storage tank and one diesel fuel underground storage tank at the Maintenance Shop that service NPS vehicles and other motorized equipment. There are no public automotive service stations in the park.

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** GREAT SAND DUNES NM & PRES FUEL TANK EMISSIONS

Location	**Product**	**Tank Type**	**Volume** (gal)	**Throughput (gal/yr)**	**VOC (lbs/yr)**
Maintenance Shop	Gasoline	UST	2,000	5,600	24

2.1.4 Wastewater Treatment Plants

Wastewater is discharged to septic tanks.

2.2 AREA SOURCES

2.2.1 Woodstoves

Two employee housing units are equipped with woodstoves, and park officials estimated that the average wood consumption was two-and-a-half cords by each a year. Emissions from these woodstoves are summarized in Table 5.

TABLE 5: WOODSTOVE AIR EMISSIONS FROM GREAT SAND DUNES NM & **PRES**

Location	**Number**	**Fuel Consumption**	**PM_{10} (lbs/yr)**	SO_2 (lbs/yr)	**NOr** (lbs/yr)	**CO (Ibs/yr)**	**VOC (Ibs/yr)**
Woodstoves							
Employee Residences		5 cords/yr	304		23	2,217	2,009

2.2.2 Campfires

There is one campground with 88 sites at Pinyon Flats that is approximately one-half mile north of the Visitor Center. Park data indicate that there were 37,800 campers in 2001. Assuming that

there were five campers per site 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 GREAT SAND DUNES NM & PRES CAMPFIRE EMISSIONS

Location	Campfires	Fuel (tons/yr)	PM_{10} (lbs/yr)	SO_2 (Ibs/yr)	NOx (Ibs/yr)	CO (lbs/yr)	VOC (Ibs/yr)
Pinyon Flats	7,560	57	1,962	23	147	14,322	12,984

2.2.3 Wildland Fires and Prescribed Burning

Wildland fires are ignited naturally, usually by lightening, and they are typically suppressed. 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.

In 2000, a very large wildland fire started off-site, but moved through the Headquarters area up to the campground amphitheater where an employee residence was destroyed. For the last three years, the park has conducted prescribed burning on about 30 acres each year.

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, CO_2, and CH_4 that are summarized in Table 7.

TABLE 7: WILDFIRE AND PRESCRIBED BURNING AIR EMISSIONS FROM GREAT SAND DUNES NM & PRES

Fuel Type	Acres	PM_{10} (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CO (Ibs/yr)	CO_2 (lbs/yr)	VOC' (Ibs/yr)
Wildland Fires						
Grass and Shrubs	2,900	31,900	26,100	162,400	11,637,700	11,600
Aspen	26	5,356	4,524	58,188	379,756	2,678
Pinyon Juniper	131	27,510	23,318	295,929	2,113,161	13,755
Total	3,057	64,766	53,942	516,517	14,130,617	28,033
Prescribed Burns						
Ponderosa Pine Shrub	30	5,880	4,980	63,360	449,520	2,940

' As methane

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 GREAT SAND DUNES NM & **PRES**

Activity	Particulates (PMpa)		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs		Carbon Dioxide	
	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 Equipment	7	<0.01	0	0	252	0.13	36	0.02	5	<0.01	224,588	112.29
Gasoline Storage Tanks									24	0.01	--	--
Stationary Sources Subtotal	7	<0.01	0	0	252	0.13	36	0.02	29	0.01	224,588	112.29
Area Sources												
Woodstoves	304	0.15	4	<0.01	23	0.01	2,217	1.11	2,009	1.00	--	--
Campfires	1,962	0.98	23	0.01	147	0.07	14,322	7.16	12,984	6.49	--	--
Prescribed Burning	5,880	2.94	--	--		--	63,360	31.68	2,940 [1]	1.47 [1]	449,520	224.76
Wildland Fires	64,766	32.38	--	--	--	-	516,517	258.26	28,033 [1]	14.02 [1]	14,130,617	7,065
Area Sources Total	72,912	36.46	27	0.01	170	0.09	596,416	298.21	45,966	22.98	14,580,137	7,290
Totals												
	Particulates (PM_{10})		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs		Carbon Dioxide	
Totals without Prescribed Burning	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr	lbs/yr	tons/yr
and Wildland Fires	2,273	1.14	27	0.01	422	0.21	16,575	8.29	15,022	7.51	224,588	112.29
Totals with Prescribed Burning	8,153	4.08	27	0.01	422	0.21	79,935	39.97	17,962	8.98	674,108	337.05

As methane

3. MOBILE SOURCE EMISSIONS

This section summarizes emissions from mobile sources at Great Sand Dunes NM & Pres 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_X), carbon monoxide (CO), and volatile organic compounds (VOCs).

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

Park data provided an estimated number of vehicles that entered the park from the southern entrance, which is the park's only entrance. Of the 83,000 vehicles that traveled to the Visitor Center and Pinyon Flats campground, only about one thousand traveled the unpaved, four-wheel drive vehicle Medano Pass Primitive Road to the Rio Grande National Forest.

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 information, 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.

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 particular, 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 UM 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 and unpaved roads in Great Sand Dunes NM & Pres also were calculated based on VMT. A summary of visitor vehicle emissions is provided in Table 10.

3.1.2 NPS Vehicles

Great Sand Dunes 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 9, and emissions are provided in Table 10.

TABLE 9: NPS ROAD VEHICLES AT GREAT SAND DUNES NM & PRES

Vehicle Type	Number	Annual Usage (mi/yr)
Light-Duty Gasoline Vehicles	3	9,500
Light-Duty Gasoline Trucks	19	90,300
Medium-Duty Gasoline Trucks	1	2,745
Heavy Duty Diesel Trucks	2	2,325
Total	25	104,870

3.2 NONROAD **VEHICLES**

The NPS also owns and operates some nonroad motorized equipment that is used to maintain roads and grounds and for other purposes. These include a backhoe, tractor, all-terrain vehicle, and a forklift. However, the last two vehicles are rarely used. Emissions from the backhoe and tractor are included in the nonroad category in Table 10.

3.3 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 10 summarizes the mobile source emissions for road and nonroad vehicles and equipment operating in Great Sand Dunes NM & Pres in 2001.

TABLE 10: SUMMARY OF 2001 MOBILE SOURCE EMISSIONS AT GREAT SAND DUNES NM & PRES

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	13,292[1]	6.65	--	--	2,264	1.13	32,130	16.07	1,616	0.81
Tour Buses	192[1]	0.10	--	--	12	0.01	5	<0.01	<0	<0.01
NPS Road Vehicles	202'	0.10	--	--	363	0.18	4,600	2.30	224	0.11
Vehicle Emission Subtotal	13,686	6.84	--	--	2,639	1.32	36,735	18.37	1,840	0.92
Nonroad Vehicles										
NPS Nonroad Vehicles	391	0.021	--	--	20	0.01	44	0.02	42	0.02
Totals										
Totals	Particulates (PM,o)		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
	13,725	6.86	--		2,659	1.33	36,780	18.39	1,882	0.94

[1] Includes exhaust, brake, and tire PM10 and road dust

4. GREAT SAND DUNES NM AND PRES AND REGIONAL AIR EMISSIONS

4.1 GREAT SAND DUNES NM AND PRES SUMMARY

A summary of Great Sand Dunes NP emissions is provided in Table 11.

TABLE 11: ESTIMATED ANNUAL EMISSIONS FROM GREAT SAND DUNES NM AND PRES

Source	PM_{10} (tons)	SO_2 (tons)	NOx (tons)	CO (tons)	VOCs (tons)
Point Sources					
Heating Equipment	<0.01	<0.01	0.13	0.02	<0.01
Gasoline Storage Tanks	--	--	--	--	0.01
Subtotal	<0.01	<0.01	0.13	0.02	0.01
Area Sources					
Woodstoves	0.15	<0.01	0.01	1.11	1.00
Campfires	0.98	0.01	0.07	7.16	6.94
Prescribed Burning	2.94	--	--	31.68	1.47 [1]
Subtotal	4.08	<0.01	0.08	39.95	9.41
Mobile Sources					
Road Vehicles	6.84	--	1.32	18.37	0.92
Nonroad Vehicles	0.02	--	0.01	0.02	0.02
Subtotal	6.86	--	1.33	18.39	0.94
Totals					
Totals	10.94	0.01	1.54	58.34	10.35

[1] As methane

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Alamosa and Saguche Counties 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 NEI. For example, gasoline storage tanks have been included as stationary sources for the park, while the NEI treats them as area sources. Table 12 provides a comparison of the park emissions with those from the surrounding counties and the State of Colorado.

TABLE *12:* ESTIMATED ANNUAL EMISSIONS FROM GREAT SAND DUNES NM AND PRES, SURROUNDING COUNTIES, AND THE STATE OF COLORADO

Area	PM_{10} (tons/yr)	SO_2 (tons/yr)	NOx (tons/yr)	CO (tons/yr)	VOC (tons/yr)
Point Sources					
Great Sand Dunes NM & Pres Totals	<0.01	<0.01	0.13	0.02	0.01
Alamosa County	10	0	13	3	18
Saguache County	58	0	0	0	3
Surrounding Counties Totals	68	0	13	3	21
Colorado Totals	19,979	103,922	118,526	36,563	37,408
Area Sources					
Great Sand Dunes NM &Pres Totals	4.08	<0.01	0.08	39.95	9.41
Alamosa County	1,752	12	62	849	681
Saguache County	2,258	6	83	2,346	390
Surrounding Counties Totals	4,010	18	145	3,195	1,071
Colorado Totals	217,805	4,177	53,695	185,809	120,432
Mobile Sources					
Great Sand Dunes NM & Pres Totals	6.86	--	1.33	18.39	0.94
Alamosa County	1,725	92	1,142	5,419	512
Saguache County	1,277	71	762	2,427	259
Surrounding Counties Totals	3,002	163	1,904	7,846	771
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

Great Sand Dunes NM & Pres is located in Alamosa and Saguache Counties, CO, which are 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.

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 Alamosa and Saguache Counties 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

Based on a review of the Preserve's facilities and operations, the park is in compliance with all state air quality regulations.

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:

- Photovoltaic-powered radio repeater
- Photovoltaic-powered flume data recorder
- Visitor Center solar trombwalls
- Motion detectors in Visitor Center restrooms
- Ranger electric bicycle for campground patrols
- Composting toilets in backcountry
- Recycling program

The park should continue to pursue such measures as the opportunities arise. These may include the installation of motion detectors in the Headquarters and Resource Management buildings, retrofit of energy efficient lighting fixtures, and acquisition of energy efficient and less polluting vehicles.

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'	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]	SOP[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!)	2	1425	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' fuel burned)				
	PM[10]	SO_2	NO_x[f]	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)[l]	7.6	0.6	190	84	5.5
-Controlled-Low NO, 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 gal fuel burned)				
	PM[a]	50 [b]	NO_x[c]	CO	VOC[d]
Commercial Boilers[f]	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 (Ib/hp-hr)				
	PM	SO_K	NO,	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_X	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-I.					

FIREPLACE EMISSION FACTORS

Fuel Type	Emission Factor (lb/ton)				
	PM[0]	SO,	NO_X[]	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[a]	SO_X	NO_X[c]	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 GREAT SAND DUNES NM & PRES

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (Ibs/yr)	SO_2 (Ibs/yr)	NOx (Ibs/yr)	CO (Ibs/yr)	CO_2 (Ibs/yr)	VOC (Ibs/yr)	
National Park Service													
Furnace	Visitor Center	Propane	2	80,000	160,000	2,342	1	0	33	5	29,275		1
Boiler	Visitor Center	Propane	1	80,000	80,000	1,449	1	0	20	3	18,113		0
Furnace	Dome Comfort Station	Propane	1	40,000	40,000	729	0	0	10	1	9,113		0
Furnace	Campground CS	Propane	1	75,000	75,000	706	0	0	10	1	8,825		0
Boiler	Resource Mgt Lab	Propane	1	164,000	164,000	1,360	1	0	19	3	17,000		0
Furnace	Maintenance Shop	Propane	3	45,000	135,000	2,214	1	0	31	4	27,675		1
Radiant l leatcr	Warehouse	Propane	1	30,000	30,000	490	0	0	7	1	6,125		0
Radiant Heater	Welding Shop	Propane	1	30,000	30,000	490	0	0	7	1	6,125		0
Furnace	leadquarters	Propane	1	35,000	35,000	270	0	0	4	1	3,375		0
Furnace	Headquarters	Propane	1	100,000	100,000	770	0	0	11	2	9,625		0
Furnace	Apt 14a, b, c	Propane	3	65,000	195,000	940	0	0	13	2	11,750		0
Furnace	Duplex 43a, b	Propane	2	75,000	150,000	1,527	1	0	21	3	19,088		0
Furnace	House 6	Propane	1	90,000	90,000	845	0	0	12	2	10,563		0
Furace	House 7	Propane	1	90,000	90,000	1,135	0	0	16	2	14,188		0
Furnace	House 8	Propane	1	80,000	80,000	520	0	0	7	1	6,500		0
Furnace	1-louse 9	Propane	1	80,000	80,000	660	0	0	9	1	8,250		0
Furnace	House 10	Propane	1	80,000	80,000	1,090	0	0	15	2	13,625		0
Furnace	1-louse 11	Propane	1	90,000	90,000	430	0	0	6	1	5,375		0
		Totals	24			17,967	7	0	252	36	224,588		5
Emission Factors from AP-42, Tables 1.5-I for commercial boilers, S=.05							0.4	0.01	14.00	1.90	12,500	0.30	
Formula = Consumption (gal/yr) * Emission Factor (lb/1,000 gal)													

2001 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT GREAT SAND DUNES NM & **PRES**

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (lbs/yr)	SO_2 (lbs/yr)	NOx (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
National Park Service												
Furnace	Visitor Center	Propane	2	80,000	160,000	15,318	6	0	214	31	191,475	5
Boiler	Visitor Center	Propane	1	80,000	80,000	7,659	3	0	107	15	95,738	2
Furnace	Done Comfort Station	Propane	1	40,000	40,000	3,830	2	0	54	8	47,869	1
Furnace	Campground CS	Propane	1	75,000	75,000	7,180	3	0	101	14	89,754	2
Boiler	Resource Mgt Lab	Propane	1	164,000	164,000	15,701	6	0	220	31	196,262	5
Furnace	Maintenance Shop	Propane	3	45,000	135,000	12,925	5	0	181	26	161,557	4
Radiant Heater	Warehouse	Propane	1	30,000	30,000	2,872	1	0	40	6	35,902	1
Radiant Heater	Welding Shop	Propane	1	30,000	30,000	2,872	1	0	40	6	35,902	1
Furnace	Headquarters	Propane	1	35,000	35,000	3,351	1	0	47	7	41,885	1
Furnace	Headquarters	Propane	1	100,000	100,000	9,574	4	0	134	19	119,672	3
Furnace	Apt 14a, b, c	Propane	3	65,000	195,000	18,669	7	0	261	37	233,361	6
Furnace	Duplex 43a, b	Propane	2	75,000	150,000	14,361	6	0	201	29	179,508	4
Furnace	House 6	Propane	1	90,000	90,000	8,616	3	0	121	17	107,705	3
Furnace	House 7	Propane	1	90,000	90,000	8,616	3	0	121	17	107,705	3
Furnace	House 8	Propane	1	80,000	80,000	7,659	3	0	107	15	95,738	2
Furnace	House 9	Propane	1	80,000	80,000	7,659	3	0	107	15	95,738	2
Furnace	House 10	Propane	1	80,000	80,000	7,659	3	0	107	15	95,738	2
Furnace	House 11	Propane	1	90,000	90,000	8,616	3	0	121	17	107,705	3
			24		1,704,000	163,137	65	1	2,284	326	2,039,213	49
Emission Factors from AP-42, Tables 1.5-I for commercial boilers, S=.05							0.4	0.01	14.00	1.90	12,500	0.30
Formula = Consumption (gal/yr) * Emission Factor (lb/1,000 gal)												

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

Identification

User Identification:	Great Sand Dunes NM
City:	Alamosa
State:	Colorado
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	2000 Gasoline UST

Tank Dimensions

Shell Length (ft):	12.00
Diameter (ft):	5.30
Volume (gallons):	2,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	5,600.00
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 4.0

Emissions Report - Summary Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F)			Liquid Bulk Temp.	Vapor Pressures (psia)			Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
						Avg.	Min.	Max.					
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 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
GasolineitypAL	24.46	0.00	24.46

2001 ACTUAL EMISSIONS FROM WOODSTOVES AT GREAT SAND DUNES NM & PRES

Woodstoves

Location	Number	Cords	tons/yr	PM (lbs/yr)	SO_2 (Ibs/yr)	NOx (lbs/yr)	CO (lbs/yr)	VOC (Ibs/yr)
Emplyee Residences	2	2.5	8.78	304	4	23	2,217	2,009

(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
0.15	0.00	0.01	1.11	1.00

2001 ACTUAL EMISSIONS FROM CAMPFIRES AT GREAT SAND DUNES NM & PRES

Location	Camp Sites	Fires/Yr	Tons/Yr	PM (lbs/yr)	SO_2 (lbs/yr)	NO, (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Pinyon Flats	88	7,560	57	1,962	23	147	14,322	12,984
	88	7,560	57	1,962	23	147	14,322	12,984
			tons/yr	0.98	0.01	0.07	7.16	6.49

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

TITLE: Results of FOFEM model execution on date: 6/3/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 612 - Sagebrush - Grass
Fuel Type: Natural
Fuel Reference: FOFEM 461

FUEL CONSUMPTION TABLE

Fuel Component Name	Preburn Load (t/acre)	Consumed Load (t/acre)	Postburn Load (t/acre)	Percent Reduced (o)	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	0.45	0.45	0.00	100.0	22	
Shrubs	1.26	0.63	0.63	50.0	232	
Crown foliage	0.00	0.00	0.00	0.0	37	
Crown branchwood	0.00	0.00	0.00	0.0	38	
Total Fuels	1.78	1.15	0.63	64.6		

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	7	4	11
PM 2.5	6	3	9
CH 4	2	2	4
CO	14	42	56
CO 2	3841	172	4013

	Consumption tons/acre	Duration hour:min:sec
Flaming:	1.08	00:01:00
Smoldering:	0.07	00:01:00
Total:	1.15	

TITLE: Results of FOFEM model execution on date: 6/3/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SAF 016 - Aspen
Fuel Type: Natural
Fuel Reference: FOFEM 561

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	0.90	0.90	0.00	100.0	999	
Wood (0-1/4 inch)	0.20	0.20	0.00	100.0	999	
Wood (1/4-1 inch)	0.80	0,80	0.00	100.0	999	25.0
Wood (1-3 inch)	1.00	0.43	0.57	42.9	999	
Wood (3+ inch) Sound	2.70	0.20	2.50	7.5	999	20.0
3->6	0.67	0.11	0.57	0.2		
6->9	0.67	0.05	0.62	0.1		
9->20	0.67	0.03	0.65	0.0		
20->	0.67	0.01	0.66	0.0		
Wood (3+ inch) Rotten	0.30	0.06	0.24	19.4	999	20.0
3->6	0.08	0.03	0.05	0.4		
6->9	0.08	0.02	0.06	0.2		
9->20	0.08	0.01	0.07	0.1		
20->	0.08	0.00	0.07	0.1		
Duff	5.00	2.05	2.95	41.1	2	100.0
Herbaceous	0.30	0.30	0.00	100.0	22	
Shrubs	0.50	0.30	0.20	60.0	23	
Crown foliage	0.00	0.00	0.00	0.0	37	
Crown branchwood	0.00	0.00	0.00	0.0	38	
Total Fuels	11.70	5.24	6.46	44.8		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	0.5	0.1	0.4	28.1	6
Min 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 inconsistancy in the 'Percent Reduced' shown on this report.
Duff (tons/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	10	196	206
PM 2.5	8	166	174
CH 4	2	101	103
CO	20	2218	2238
CO 2	5577	9029	14606

	Consumption tons/acre	Duration hour:min:sec
Flaming:	1.57	00:01:00
Smoldering:	3.68	00:21:45

~TITLE: JResults ~of ~FOFEM model execution on date: 6/3/2003 - - - - - - - - - - - -

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 412 - Juniper - Pinyon Woodland (also SRM 504, SAF 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 (o)	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->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	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	0.00	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
Min 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 inconsistancy in the 'Percent Reduced' shown on this report.
Duff (tons/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
Flaming:	1.98	00:01:00
Smoldering:	3.70	00:29:00

TITLE: Results of FOFEM model execution on date: 6/3/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 109 - Ponderosa Pine Shrublands
Fuel Type: Natural
Fuel Reference: FOEM 011

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	1.40	1.40	0.00	100.0	999	
Wood (0-1/4 inch)	0.07	0.07	0.00	100.0	999	
Wood (1/4-1 inch)	0.63	0.63	0.00	100.0	999	25.0
Wood (1-3 inch)	0.80	0.32	0.48	39.4	999	
Wood (3+ inch) Sound	4.50	0.32	4.18	7.1	999	20.0
3->6	1.12	0.17	0.95	0.2		
6->9	1.12	0.09	1.04	0.1		
9->20	1.12	0.04	1.08	0.0		
20->	1.12	0.02	1.11	0.0		
Wood (3+ inch) Rotten	0.50	0.10	0.40	19.1	999	20.0
3->6	0.12	0.05	0.08	0.4		
6->9	0.12	0.03	0.10	0.2		
9->20	0.12	0.01	0.11	0.1		
20->	0.12	0.01	0.12	0.1		
Duff	5.00	2.05	2.95	41.1	2	100.0
Herbaceous	0.10	0.10	0.00	100.0	22	
Shrubs	0.50	0.30	0.20	60.0	23	
Crown foliage	6.00	0.00	6.00	0.0	37	
Crown branchwood	0.70	0.00	0.70	0.0	38	
Total Fuels	20.20	5.28	14.92	26.2		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	0.6	0.2	0.4	30.8	6
Min 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 inconsistancy in the 'Percent Reduced' shown on this report.
Duff (tons/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	11	185	196
PM 2.5	9	157	166
CH 4	3	95	98
CO	24	2088	2112
CO 2	6483	8501	14984

	Consumption tons/acre	Duration hour:min:sec
Flaming:	1.82	00:01:00
Smoldering:	3.46	00:22:15

2001 WILDFIRE EMISSIONS AT GREAT SAND DUNES NM & PRES

Fire	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)
	Grass and Shrubs	2,900	31,900	26,100	11,600	162,400	11,637,700	16.0	13.1	5.8	81.2	5,818.9
Sand	Aspen	26	5,356	4,524	2,678	58,188	379,756	2.7	2.3	1.3	29.1	189.9
	Pinyon Juniper	131	27,510	23,318	13,755	295,929	2,113,161	13.8	11.7	6.9	148.0	1,056.6
	Totals	3,057	64,766	53,942	28,033	516,517	14,130,617	32.4	27.0	14.0	258.3	7,065.3
	Emission Factors (lbs/acre)											
	Grass		11	9	4	56	4013					
	Aspen		206	174	103	2,238	14,606					
	Pinyon Juniper		210	178	105	2,259	16,131					

PRESCRIBED BURNING EMISSIONS AT GREAT SAND DUNES NM & PRES

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_{25} (tons/yr)	CH_4 (tons/yr)	CO (tons/yr)	CO_2 (tons/yr)
Ponderosa Pine Shrub	30	5,880	4,980	2,940	63,360	449,520	2.9	2.5	1.5	31.7	224.8
Emission Factors (lbs/acre)											
Ponderosa Pine Shrub		196	166	98	2,112	14,984					

```
* ##################################
* Great Sand Dunes NM Winter Conditions.
* File 1, Run 1, Scenario 15.
* # # # #     #   #  #  #  #  #  #  #  #  #  #
  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:    9.3 (F)
```

Maximum Temperature: 34.9 (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 :	0.857	1.188	1.075	1.140	0.979	0.433	0.439	0.509	2.60	0.969
Composite CO	21.15	27.84	24.89	26.59	28.74	1.308	0.931	6.582	27.79	22.406
Composite NOX :	0.899	1.309	1.525	1.401	3.946	1.267	1.212	16.834	1.27	1.339

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 :	1.112	1.212	1.046	1.140	2.424	0.391
Composite CO	27.10	28.07	24.77	25.18	6.522	0.795
Composite NOX :	1.029	1.394	1.377	1.852	2.555	1.180

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 :	0.979	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	28.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.946	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 :      0.378      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
-------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Great Sand Dunes NM Summer Conditions.
* File 1, Run 1, Scenario 16.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #
  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:	50.3	(F)
Maximum Temperature:	80.6	(F)
Absolute Humidity:	75.	grains/lb
Nominal Fuel RVP:	8.8	psi
Weathered RVP:	8.8	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 :	0.700	0.873	0.869	0.871	0.813	0.405	0.461	0.490	3.02	0.803
Composite CO	11.88	14.94	14.49	14.75	22.37	1.277	0.945	6.500	22.55	12.824
Composite NOX :	0.735	1.017	1.287	1.132	3.613	1.170	1.239	16.586	0.98	1.143

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 :	0.831	0.885	0.850	0.910	2.512	0.418
Composite CO	14.53	15.07	14.40	14.69	6.775	0.824
Composite NOX :	0.806	1.082	1.160	1.570	2.574	1.212

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 :	0.813	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	22.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.613	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 :	0.374	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

# #
Great Sand Dunes NM Winter Conditions.
File 1, Run 1, Scenario 15.
# # # # # # # # # # # # # # # # # # # # # # #

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
SO2:	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:	------	------	------	_____

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:	------	------	------	------	------	------	-----	

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):

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

If # #

a Great Sand Dunes NM Summer Conditions.
File 1, Run 1, Scenario 16.
# #

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				
GASPM:	0.0046	0.0046	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:	0.0095	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		
SO2:	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:	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	0.0506	0.0506	0.0506	0.0506	0.0505	0.0000
ECARBON:								
OCARBON:								
SO4:	0.0120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Exhaust PM:	0.0643	0.0523	0.0506	0.0506	0.0506	0.0506	0.0505	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:	0.0848	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	0.0000	0.0000	0.0000	0.0000	0.0000
Idle Emissions (g/hr)								
PM Idle:								

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):	
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 GREAT SAND DUNES NM & PRES VISITOR VEHICLES

Paved Road

Total Visitors	Visitor Vehicles	Southern Border to Visitor Center	Total Visitor VMT	Tour Buses	Total Bus VMT
537,474	82,913	5	829,130	32	320

Unpaved Road

	Visitor Vehicles	Medano Pass 4-Wheel Drive	Total Visitor VMT	Tour Buses	Total Bus VMT
	1,055	5	10,550	32	320

2001 GREAT SAND **DUNES** NM & **PRES VISITOR VEHICLE EMISSIONS**

Paved **Road** Visitor Annual VMT	**Unpaved Road** Annual VMT
829,130	19,600

Emission Factors (g/mi) - All Vehicles

	NOx	CO	VOC	PM,o (Paved) Exhaust, Brake, **and** Tire	Fugitive	Total	PM_{10} **(Unpaved)** Exhaust, Brake, and Tire	Fugitive	Total
Summer	1.143	12.824	0.803	0.0338	0.84	0.8738	0.0338	271.25	271.2838
Winter	1.339	22.406	0.969	0.0341	0.84	0.8741	0.0341	271.25	271.2841
Average	1.241	17.615	0.886			0.874			271.284

Emissions (tonslyr) - All Vehicles

NOx	CO	VOC	Paved PM_{10}	Unpaved PM_{10}	Total PM_{10}
1.13	16.07	0.81	0.80	5.85	6.65

Emissions (lbs/yr) - All Vehicles

NOx	CO	VOC	Paved PM10	**Unpaved** PM_{10}	Total PM_{10}
2,264	32,131	1,616	1,594	11,698	13,292

Bus Annual VMT
320

Emission Factors (g/mi) - Buses

	NOx	CO	VOC	PM_{10} (Paved) Exhaust, Brake, and Tire	Fugitive	Total	PM_{10} (Unpaved) Exhaust, Brake, and Tire	Fugitive	Total
Summer	16.586	6.500	0.490	0.2867	0.84	1.1267	0.0338	271.25	271.2838
Winter	16.834	6.582	0.509	0.3027	0.84	1.1427	0.0341	271.25	271.2841
Average	16.710	6.541	0.500			1.135			271.284

Emissions (tonslyr) - Buses

NOx	CO	VOC	Paved PM_{10}	**Unpaved** PM_{10}	Total PM_{10}
0.01	0.00	0.00	0.00	0.10	0.10

Emissions (lbs/yr) - Buses

NOx	CO	VOC	Paved PM10	Unpaved PM_{10}	Total PM10
12	5	0	1	191	192

GREAT SAND DUNES NM & PRES NPS AND GSA VEHICLES

	LDGV	LDGT	MDGT	HDDV	Total
Total Miles	9,500	90,300	2,745	2,325	104,870

Emission Factors (glmi) - **LDGV**

	NOx	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	0.7350	11.8800	0.7000	0.0276	0.8400	0.8676
Winter	0.8990	21.1500	0.8570	0.0276	0.8400	0.8676
Average	0.8170	16.5150	0.7785			0.8676

Emissions (tonslyr) - **LDGV**

NOx	CO	**VOC**	PM_{10}
0.01	0.17	0.01	0.01

Emission Factors (glmi) - LDGT

	NOx	CO	VOC	PM_{10} **Exhaust, Brake, and** Tire	PM_{10} Fugitive	PM_{10} Total
Summer	1.132	14.750	0.871	0.0297	0.8400	0.8697
Winter	1.401	26.590	1.140	0.0300	0.8400	0.8700
Average	1.267	20.670	1.006			0.8699

Emissions (tonslyr) - LDGT

NOx	CO	VOC	PM_{10}
0.13	2.05	0.10	0.09

Emission Factors (g/mi) - MDGT

	NOx	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	1.287	14.490	0.869	0.030	0.840	0.870
Winter	1.525	24.890	1.075	0.030	0.840	0.870
Average	1.406	19.690	0.972			0.870

Emissions (tonslyr) - HDGV

NOx	CO	VOC	PM_{10}
0.00	0.06	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	0.2867	0.8400	1.1267
Winter	16.834	6.582	0.509	0.3027	0.8400	1.1427
Average	16.710	6.541	0.500			1.1347

Emissions (tonslyr) - HDDV

NOx	CO	VOC	PM_{10}
0.04	0.02	0.00	0.00

Emissions (tonslyr) - Total

NOx	CO	VOC	PM_{10}
0.18	2.30	0.11	0.10

Emissions (lbs/yr) - Total

NOx	CO	VOC	PM_{10}
363	4,604	224	202

2001 GREAT SAND DUNES NM & PRES NONROAD VEHICLE EMISSIONS

Vehicle	Emission Factors (gm/hp-hr) PM	Nox	CO	VOC	hp	load	hrs/yr	Emissions (lbs/yr) PM	Nox	CO	VOC
Tractors	2.04	1.03	2.31	2.19	42.35	0.68	15	1.9	1.0	2.2	2.1
									0.0	0.0	
Backhoe	2.04	1.03	2.31	2.19	77	0.55	195	37.1	18.7	42.0	39.8
						Totals:	(lbs/yr)	39	20	44	42
							(tons/yr)	0.02	0.01	0.02	0.02

APPENDIX C

PUBLIC USE DATA

Monthly Public Use Report

Printed on 01/20/2003

GREAT SAND DUNES NM			12/2001	1470
	December 2001			
	Recreational	Non-Recreational	Total	Calendar Year-To-Date
Visits	2,554	35	2,589	277,991
Visitor Hours	7,290	35	7,325	1,746,803
				Fiscal YTD
Total Fiscal YTD Visitor Days				8,095

Recreation O/N stays	Current Month	Year-To-Date	
Concessioner Lodging	0	0	**NPS Campgrounds**
Concessioner Campgrounds	0	0	**Tents** 92
NPS Campgrounds	155	37,831	**R/V's** 63
			Total 155
NPS Backcountry	3	1,982	
NPS Miscellaneous	0	6,453	
Non Recreation O/N stays	0	0	
Total Overnight stays	158	46,266	

	This Month	Same Month Last Year	Percent Change
Total Rec	2,554	2,260	13.04 %
Total NonRec	35	35	0.00 %
Total Visits	2,589	2,295	12.84 %
Total YTD	277,991	261,260	6.40 %

Special Use Data	This Month	Year-To-Date
MEDANO PASS VEHICLES	0	341
CONCESSION VEHICLES	0	93
MEDANO PASS VISITORS	0	1,040
CONCESSION VISITORS THIS MONTH	0	1,055

Great Sand Dunes
National Monument and Preserve

Historical Visitation Records

2001	277,993	**1990**	272,136	**1979**	162,546
2000	260,789	**1989**	266,321		
1999	286,745	**1988**	274,286		
1998	279,768	**1987**	225,937		
1997	309,855	**1986**	221,449		
1996	309,283	**1985**	182,713		
1995	232,663	**1984**	141,833		
1994	312,225	**1983**	150,177		
1993	294,282	**1982**	175,273		
1992	290,654	**1981**	172,505		
1991	295,070	**1980**	142,427		

This information comes from the National Park Service Public Use Statistics Office

Return to HOME PAGE PirklsItt **Return to PARK NET**

Good morning, Mr. Bunch.

Here are your answers to the requests you made 3/25.

PPV

Month	PPV
JAN	2.1
FEB	2.6
MAR	2.9
APR	2.4
MAY	2.9
JUN	3.1
JUL	3.2
AUG	3.2
SEP	2.6
OCT	2.5
NOV	2.4
DEC	2.1
Average	2.67

Car Count: 2002

Month	Car Count
JAN	1505
FEB	1660
MAR	4614
APR	4620
MAY	11997
JUN	13215
JUL	13964
AUG	12534
SEP	9014
OCT	5876
NOV	2209
DEC	1705
	Year Total: 82,913

Commercial Tours

Year	Number of Tours
2002	32 (26 buses; 6 vans)

Public Use Statistics Office

Park Visitation Report

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ParkNet National Park Service

NatureNet National Park Service

10-157 Reporting National Park Service

GREAT SAND DUNES NM

Month	Year	Recreation Visits	Non-Recreation Visits	Total Visits	Concessioner Lodging	Concessioner Campgrounds	Tent Campers	RV Campers	Total RV/Tent Campers	Back-countr Campe
January	2002	2,543	35	2,578	0	01	831	33	116	
February	2002	3,453	35	3,488	0	01	73	23	96	
March	2002	12,754	351	12,789	0	0	947	317]	1,264	
April	2002	10,882	35	10,917		01	1,346	726	2,072	
May1	2002	37,122	45	37,167	0	01	3,201	2,043	5,244	2i
June	2002	40,553	45	40,598	0	01	3,9571	2,036	5,993	1
July	2002	43,769	451	43,814	0	0	3,4321	1,472	4,904	3i
August	2002	39,205	451	39,250	0	0	3,798	2,231	6,029	2
September	2002	22,976	45	23,021	0		2,267	1,706	3,973	
October	2002	13,991	35	14,026	0	01	1,426	1,155	2,581	
November	2002	4,614	35	4,649	0	0	320	96	416	
December	2002	2,914	35	2,949	0	0	76	53	129	
Totals:		234,776	470	235,246	0	0	20,926	11,891	32,817	1,4

New Park Visitation Report

Return to HomeReports_P_age

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 their ordinance for the previous heating 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 III 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 VII.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 II.A.
4. an approved pellet burning fireplace insert.