FINAL

2001 AIR EMISSIONS INVENTORY

CHIRICAHUA NATIONAL MONUMENT ARIZONA

U.S. NATIONAL PARK SERVICE

JUNE 2003

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CHIRICAHUA NATIONAL MONUMENT
ARIZONA

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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. In this regard, development of an in-park air emissions inventory for Chiricahua National Monument (NM) serves three functions. 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. Mobile sources may include vehicles operated by visitors, tour operators, and NPS and concessioner 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 NO_x and VOC emissions in the presence of sunlight. It is primarily an issue on the East Coast and Southern California, while particulate matter is more of an issue in the West. 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_S)	• 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
Nitrogen Oxides (NO_x)	• High temperature fuel combustion exhaust product • Can be an irritant to humans and participates in the formation of ozone
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 NO_x 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,)	• 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 January 2003, interviews with Chiricahua NM' personnel, 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) database, USEPA *TANKS 4.0* model, U.S. Forest Service *First Order Fire Effects Model*

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(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, is provided in Appendices A and B.

1.4 PARK DESCRIPTION

Chiricahua NM, located in the far southeastern corner of Arizona, consists of pinnacles, columns, spires and balanced rocks and other rock formations. By far the most noticeable natural features in the monument are the rock pinnacles for which the monument was created to protect. Rising sometimes hundreds of feet into the air, many of these pinnacles are balancing on a small base, seemingly ready to topple over at any time. Rich in diversity, the monument boasts many plant communities, including grasslands, deciduous and evergreen forests, scrublands, and deserts. There are approximately twelve thousand acres of wild, rugged terrain within which the rock formations and a great ecological diversity are protected. The park was created in 1924, and in 1976, Congress designated 87 percent of the monument as Wilderness. This precludes any development and human intervention, thus ensuring the preservation of the geological formations for future generations and the continuation of undisturbed space and habitat for the many unique plants and animals that are found in this special region.

The main road enters the monument at the mouth of Bonita Canyon and runs through the canyon and high slopes to Massai Point located at the eastern end of the monument. All of the developed areas, which are summarized in Table 1, and most of the visitor activity occur along the road. Other than short administrative roads, there are no other roads in the monument. A site map of the monument's location is provided in Figure 1, and a map of the park is depicted in Figure 2. Site plans of the Visitor Center/Park Headquarters, Faraway Ranch, and the Bonita Creek Campgrounds, the only campgrounds in the monument, are depicted in Figures 3, 4, and 5, respectively.

TABLE 1: CHIRICAHUA NM DEVELOPED AREAS

Name/Location	Function/Facilities
Visitor Center/Headquarters	Visitor Center, Restrooms, Headquarters, Maintenance Yard and Shops, and Employee Residences
Faraway Ranch	Ranch House, Guest House, Bunkhouse, Barn, Employee Residence
Bonita Creek	Campgrounds, Employee Residence

The monument also manages the nearby Fort Bowie National Historic Site (NHS), whose location is noted in Figure 1. Fort Bowie is a relatively small site, and visitors must travel on an unpaved, 12-mile county-owned and maintained road to an off-site parking area. Visitor access to the site is by a 1.5-mile trail. There is a small visitor center adjacent to the fort ruins. Also adjacent to the site are two modular homes for NPS employees and maintenance facilities that contain office space, work bays, storage, and a fuel storage tank. Summary information on Fort Bowie NHS is provided in Appendix C.

1.5 AIR QUALITY STATUS

Chiricahua NM is located in Cochise County, AZ, which is in attainment for all national and state ambient air quality standards (NAAQS), including ozone and particulate matter (PM_{10}). Chiricahua NM is designated a Class I airshed under the Clean Air Act, which requires the highest level of air-quality protection. The monument has an air monitoring station that monitors ozone, and the highest hourly reading in 2001 was 0.073 ppm that compares to the NAAQS for ozone of 0.12 ppm. A PM_{10} monitoring station that is located in the town of Douglas approximately 50 miles south of the monument recorded a maximum reading of 55 ptg/m^3 in 2001 that compares to the NAAQS for PM10 of 150 µg/m^3 (24-avaerage). The Arizona Department of Environmental Quality (DEQ), Air Quality Division is the governing authority for regulating air pollution from stationary sources in Arizona.

The monument is in close proximity to Mexico which impacts air quality in the area. For example, smelting and power plants on the other side of the border produce pollutants that can be carried into the monument. There are also plans to build an incinerator and power plants within 50 miles of the monument.

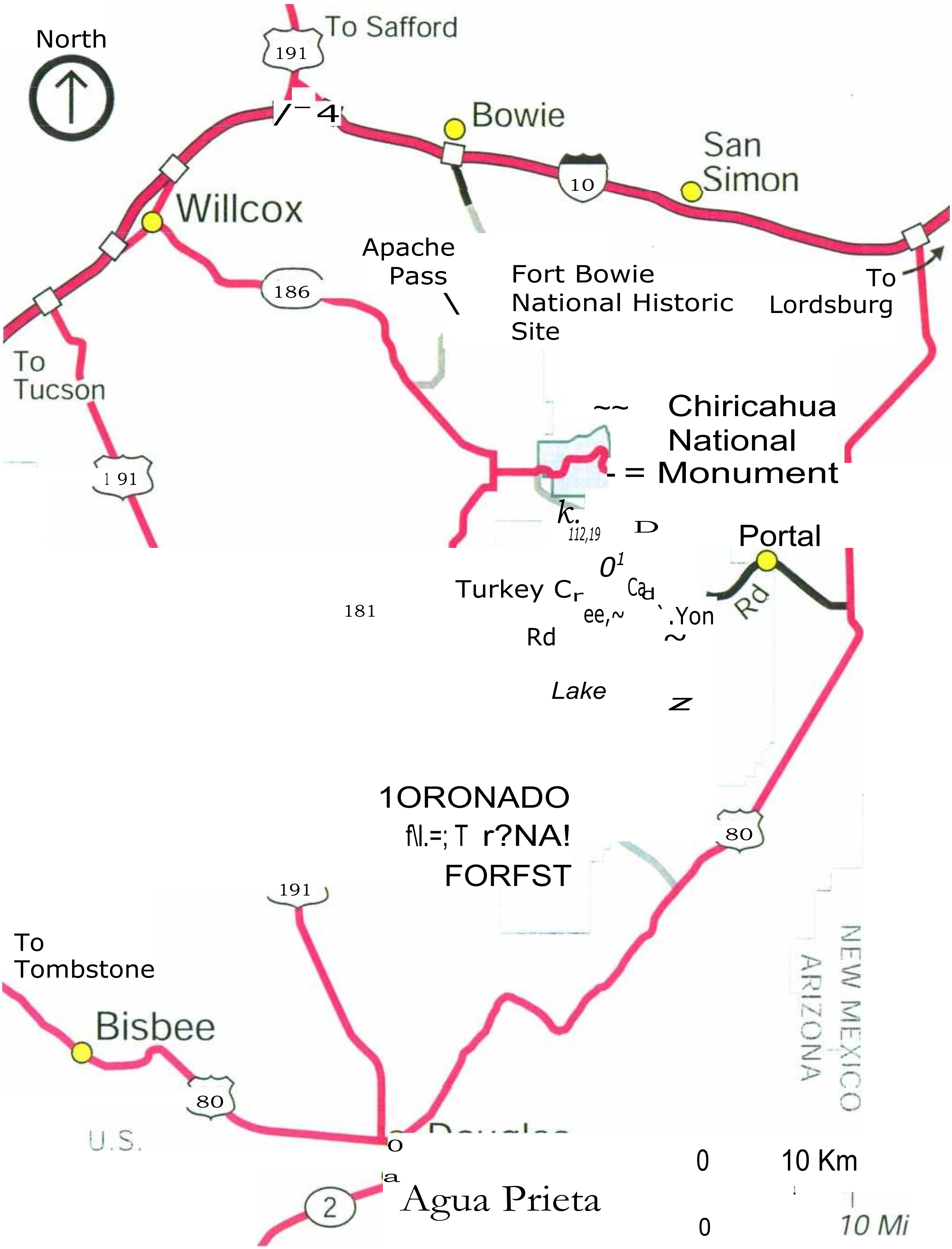


FIGURE 1. CHIRICAHUA NATIONAL MONUMENT LOCATION

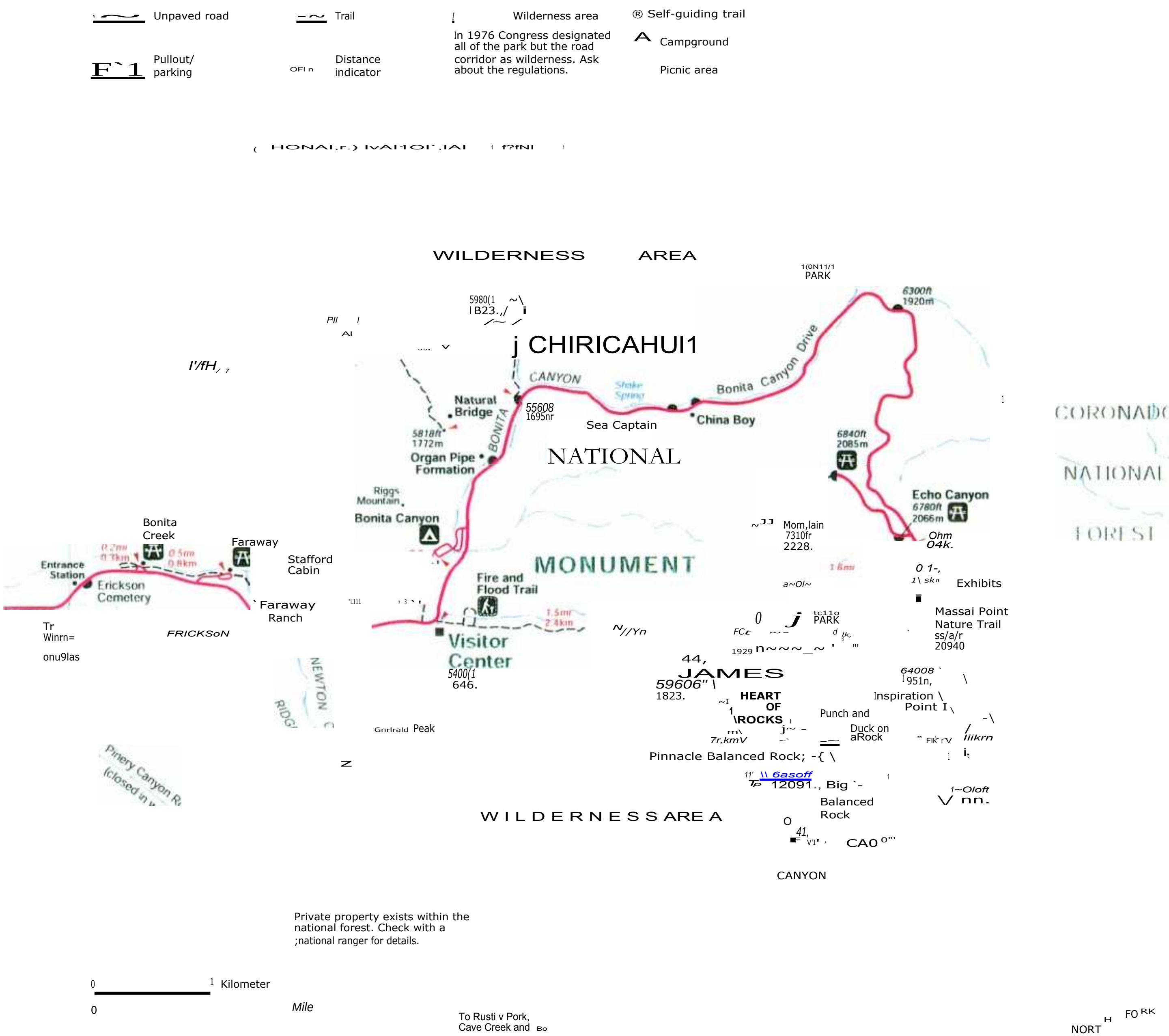
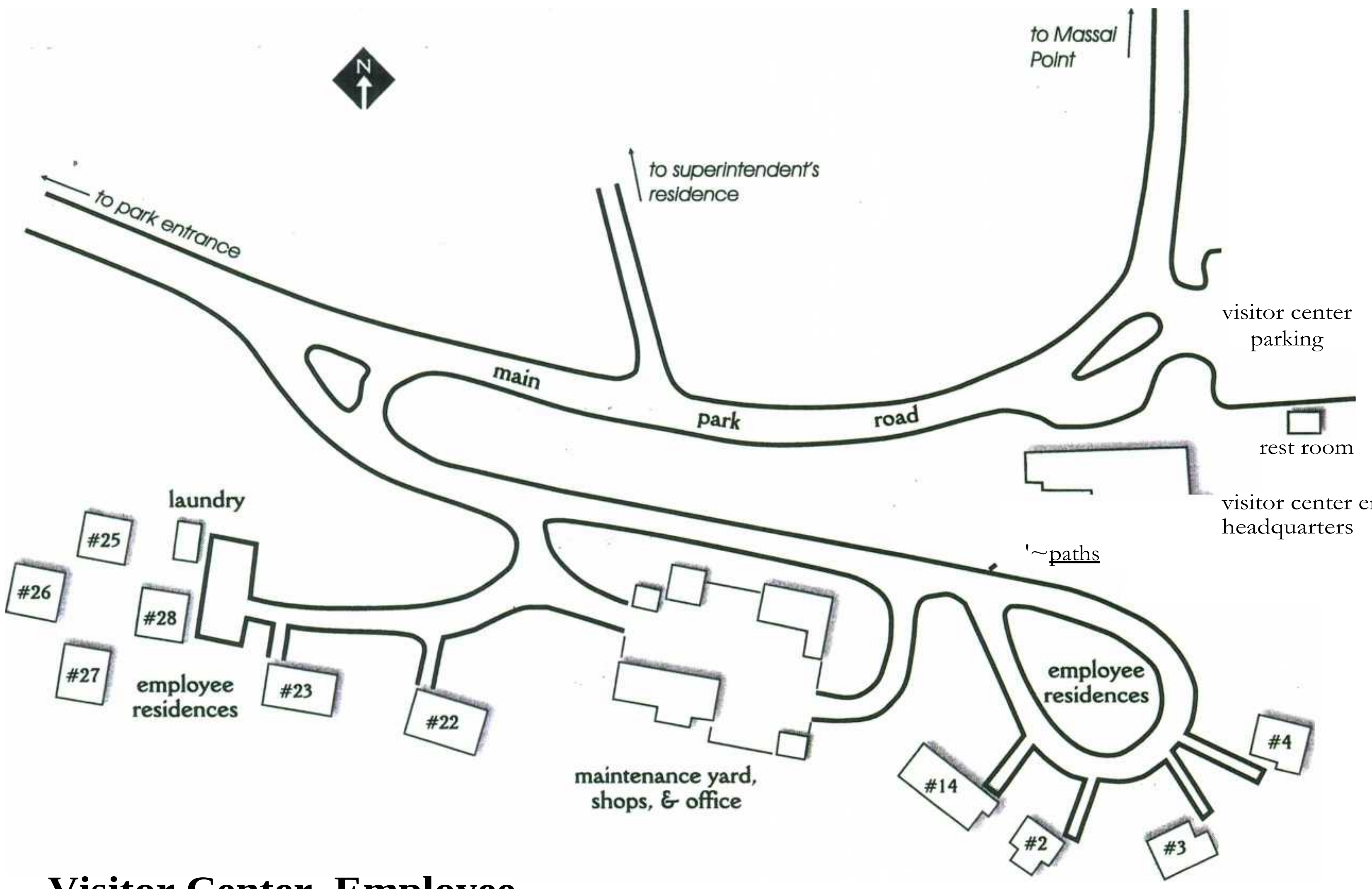


FIGURE 2. CHIRICAHUA NATIONAL MONUMENT PARK MAP



Visitor Center, Employee Residences, Maintenance

Chiricahua National Monument - Arizona

U.S. Department of the Interior - National Park Service

145 180,032
Aug 99 IMDE

FIGURE 3

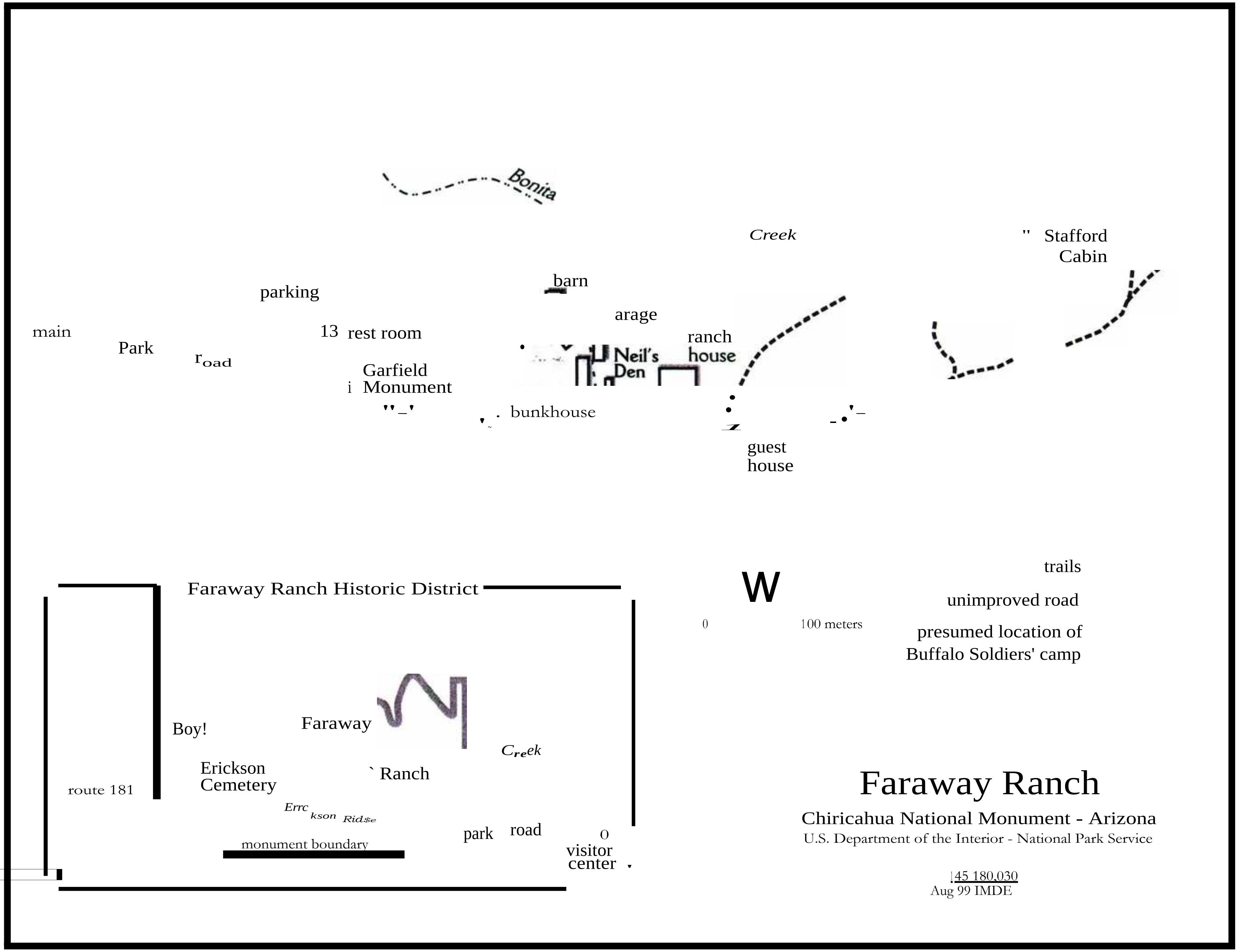

Bonita
Creek
Stafford Cabin
barn
parking
arage
main
Park
road
13 rest room
ranch house
Neil's Den
Garfield Monument
bunkhouse
guest house
W
trails
unimproved road
0
100 meters
presumed location of Buffalo Soldiers' camp
Faraway Ranch Historic District
Boy!
Faraway
Creek
Erickson Cemetery
Ranch
route 181
Errc kson Rid$e
park road
visitor center
monument boundary
Faraway Ranch
Chiricahua National Monument - Arizona
U.S. Department of the Interior - National Park Service
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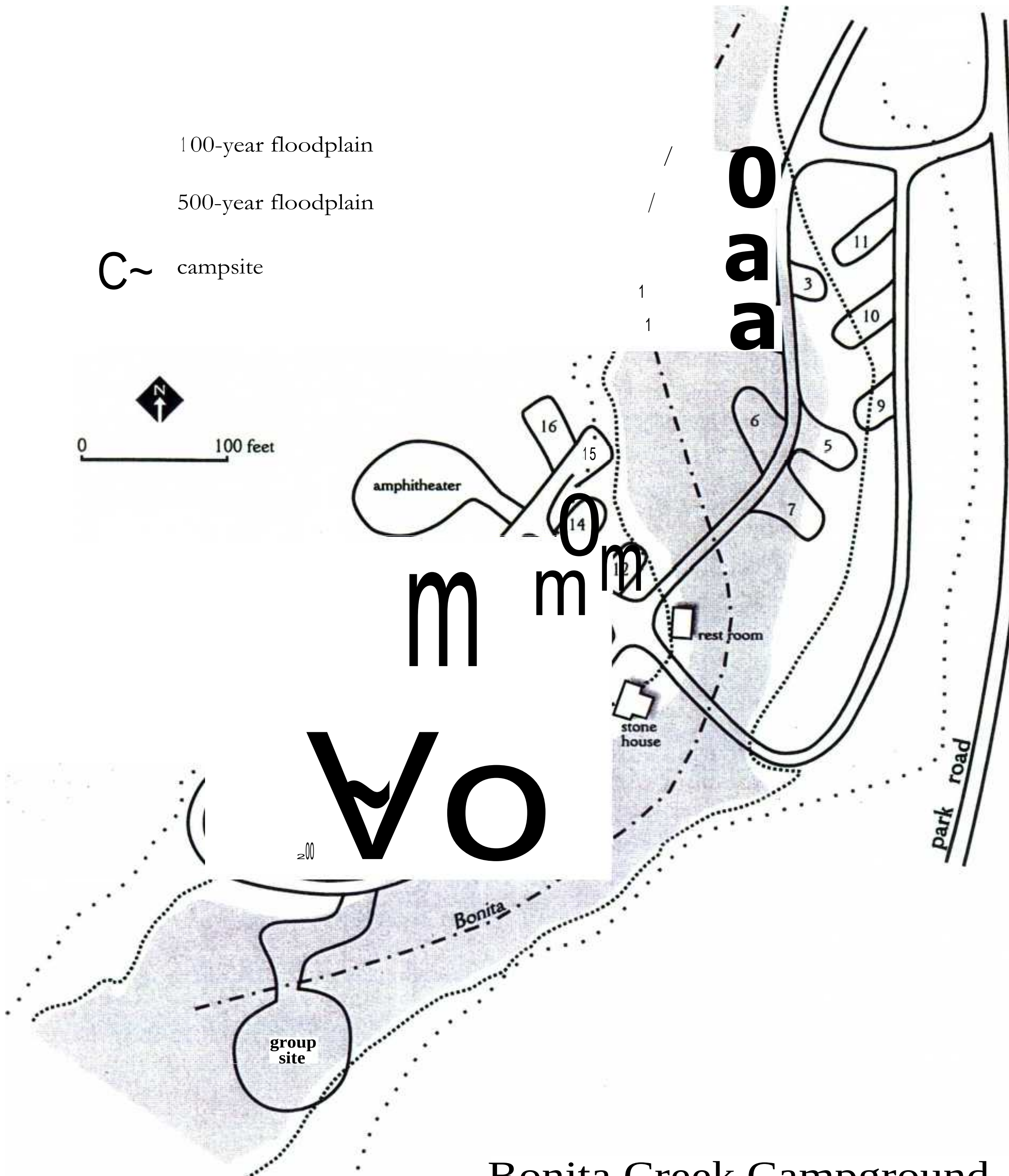
FIGURE 4



Bonita Creek Campground

Chiricahua National Monument • Arizona

U.S. Department of the Interior • National Park Service

145180,031
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FIGURE 5

2. STATIONARY AND AREA SOURCE EMISSIONS

This section summarizes emissions from stationary sources at the Monument 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 (PM10), sulfur dioxide (SO2), nitrogen oxides (NO_X), carbon monoxide (CO), carbon dioxide (C02), and volatile organic compounds (VOCs).

2.1 STATIONARY SOURCES

2.1.1 Space And Water Heating Equipment

There are approximately eight propane heating units in the Monument, and criteria emissions were calculated using the appropriate residential emission factors. For example, NOx emissions from the propane-fired furnace in the Visitor Center/Headquarters building were calculated as follows:

$$1{,}469 \text{ gallons/yr} \times \frac{14 \text{ lb NOx}}{1{,}000 \text{ gallons}} = 21 \text{ lb NOx /yr}$$

Actual criteria pollutant emissions from the heating equipment are summarized in Table 2. Potential emissions for the propane heating equipment 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
CHIRICAHUA NATIONAL MONUMENT HEATING EQUIPMENT

Location	**Fuel**	**Consumption (gal/yr)**	**PM10 (Ibs/yr)**	SO_2 **(lbs/yr)**	NO, **(lbs/yr)**	**CO (Ibs/yr)**	CO_2 **(Ibs/yr)**	VOC **(lbs/yr)**
VC/Headquarters	Propane	*1,469*	*1*	*0*	*21*	*3*	*18,358*	*0*
Maintenance Building	Propane	*451*	*0*	*0*	*6*	*1*	*5,640*	*0*
Residences near Maintenance (8)	Propane	*3,609*	*1*		*51*	*7*	*45,118*	*1*
Faraway Ranch Office	Propane	*451*	*0*	*0*	*6*	*1*	*5,640*	*0*
Faraway Ranch House	Propane	*338*	*0*	*0*	*5*	*1*	*4,230*	*0*
Faraway Ranch Residence	Propane	*451*	*0*	*0*	*6*	*1*	*5,640*	*0*
Seasonal Residences (2)	Kerosene	*650*	*0*	*46*	*12*	*3*	*13,975*	*0*
		Total		*46*	*106*	*6*	*98,600*	*2*

TABLE 3. 2001 POTENTIAL AIR EMISSIONS FROM CHIRICAHUA NATIONAL MONUMENT HEATING EQUIPMENT

Location	Fuel	Consumption (gal/yr)	PM, (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
VC/Headquarters	Propane	18,699	7	0	262	36	233,735	6
Maintenance Building	Propane	5,744	2	0	80	11	71,803	2
Residences near Maintenance (8)	Propane	45,954	18	0	643	87	574,426	14
Faraway Ranch Office	Propane	5,744	2	0	80	11	71,803	2
Faraway Ranch House	Propane	4,308	2	0	60	8	53,852	1
Faraway Ranch Residence	Propane	5,744	2	0	80	11	71,803	2
Seasonal Residences (2)	Kerosene	5,631	2	400	101	28	121,076	4
		Total	7	401	1,308	192	1,198,498	31

2.1.2 Generators

There are no generators at Chiricahua NM.

2.1.3 Fuel Storage Tanks

Chiricahua NM has one gasoline and one diesel fuel aboveground storage tanks in the maintenance yard that service NPS vehicles and other motorized equipment. There are no public automotive service stations in the monument.

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 from the gasoline tank.

TABLE 4: 2001 CHIRICAHUA NM FUEL TANK EMISSIONS

Location	Product	Tank Type	Volume (•al)	Throughput (al/ r)	VOC (Ibs/ r)
Maintenance Yard	Gasoline	AST	1,000	9,170	239

2.1.4 Wastewater Treatment Plants

The only wastewater treatment facilities at the monument are septic tanks.

2.2 AREA SOURCES

2.2.1 Woodstoves/Fireplaces

There are two fireplaces and four woodstoves in the monument. Monument officials were not aware that the fireplaces were even used, but estimated that each woodstove burned a cord per year. The estimated emissions are included in Table 5.

TABLE 5: WOODSTOVE AIR EMISSIONS FROM CHIRICAHUA NM

Location	Number	Fuel Consum ' tion	PM_{10} (lbs/ r)	SO_2 (lbs/ r)	NO_a (lbs/ r)	CO (lbs/ r)	VOC (lbs/ r)
Employee Residences	4	4 cords/yr	137		13	1,034	237

2.2.2 Campfires

There is one campground with 26 sites in the monument that accommodates tent and recreation vehicles (RVs). Park personnel provided estimates of the total number of campers at the NPS operated sites. It was estimated that 40 percent of these were tent campers, with the remainder being RV campers. It was further assumed that only tent campers had campfires. There were an estimated 2.5 campers per campsite and that approximately 50 percent had an evening or morning campfire at each campsite. Assuming that each campfire site consumes approximately 10 lbs of wood, air emissions from campsites in 2001 were calculated and are summarized in Table 6.

TABLE 6: 2001 CHIRICAHUA NM CAMPFIRE EMISSIONS

Location	Campfires	Fuel (tons/ r)	PM,' (lbs/ r)	SO_2 (lbs/yr)	NO, (lbs/ r)	CO (lbs/ r)	CO_2 lbs/ r	VOC (Ibs/ r
Bonita Creek	1,823		315		24	2,303	30,994	2,088

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 burning emissions are considered as anthropogenic emissions.

Over the 1998-2002 time period, there were 15 prescribed burns of pine/oak and grass/shrub that covered approximately 2,100 acres, but only three wildland fires that were less than one-half an acre in size. 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 PM10, PM2.5, CO, CO2, and CH4, which are summarized in Table 7.

TABLE 7: PRESCRIBED BURNING AND WILDLAND FIRE AIR EMISSIONS FROM CHIRICAHUA NM

Type	Acres	PM" (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC' (lbs/yr)
Prescribed Burning						
Pine Grassland	130	25,610	21,710	274,690	1,998,880	1,040
Oak Woodland	290	24,650	20,590	168,780	7,393,260	9,860
Total	420	50,260	42,300	443,470	9,392,140	10,900
Wildland Fires						
Pine Grassland	0.3	59	50	634	4,613	2

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 and they are assumed to be negligible.

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 CHIRICAHUA NM

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 Equipment	3	<0.01	46	0.02	106	0.05	16	<0.01	98,600	49.3		<0.01
Gasoline Storage Tanks	--	--	--		--	--	--	--	--	--	239	0.12
Stationary Sources Subtotal	3	<0.01	46	0.02	106	0.05	16	<0.01	98,600	49.3	241	0.12
Area Sources												
Woodstoves	137	0.07	2	<0.01	13	0.01	1,034	0.52	--	--	237	0.12
Campfires	315	0.16	4	<0.01	24	0.01	2,303	1.15	30,994	15.50	2,088	1.04
Prescribed Burning	50,260	25.13	--	--	--	--	443,470	221.74	9,392,140	4,696	10,900'	5.45
Wildland Fires	59	0.03	--	--	--	--	634	0.32	4,613	2.31	2[1]	<0.01
Area Sources Subtotal	50,771	25.39	6	<0.01	37	0.02	447,441	223.72	9,427,747	4,714	13,227	6.61
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	455	0.23	42	0.02	143	0.07	3,353	1.68	129,594	64.80	2,566	1.28
Totals with Prescribed Burning	50,715	25.36	42	0.02	143	0.07,	446,816	224.41	9,552,728	4,776	13,466	6.73

[1] As methane

3. MOBILE SOURCE EMISSIONS

This section summarizes emissions from mobile sources at Chiricahua NM for 2001. Mobile emission sources include highway and nonroad vehicles.

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

An estimated 74,875 visitors entered the park during the most recent year. Assuming a typical NPS visitor to vehicle ratio of 2.8, an estimated 26,740 visitor vehicles traveled to the park. The only road accessible to the public within the park is an 8-mile scenic paved road that begins at the monument entrance on the west side and ends at the mountain crest and Massai Point on the east side of the park. Assuming that all visitor vehicles traveled this 16-mile roundtrip, these visitors traveled an estimated 427,850 vehicle-miles in the most recent year.

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, PM10 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 VMT data in order to estimate mobile source emissions for VOC (both exhaust and evaporative), NOx, CO, and PM10 (exhaust, brake, and tire) for visitor vehicles. MOBILE6.2 produces exhaust and evaporative emission factors for light duty gasoline vehicles, light duty gasoline trucks, heavy duty gasoline vehicles, light duty diesel vehicles, light duty diesel trucks, heavy duty diesel vehicles, and motorcycles. It also produces a composite emission factor for all vehicles based on the vehicle VMT mix supplied to the model. Inputs to the model include average vehicle speed, vehicle VMT mix, inspection and maintenance (I/M) program infoiination, fuel information, ambient temperature data, elevation, and others. Fugitive PM10 emissions resulting from tire-roadway interaction were based on EPA's road dust emission factors.

The MOBILE6.2 model is 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 MOBILE5b 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 VMT 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 compared to the general vehicle population. The park-specific mix vehicle types and vehicle age distribution developed by CE-CERT have been applied in the mobile modeling for Chiricahua NM.

In addition to park-specific age distribution, CE-CERT also developed park-specific modeling inputs for driving patterns that 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 national parks. However, since the MOBILE6.2 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 model was 35 mph, fuel volatility was assumed to be Reid vapor pressure (RVP) of 6.8 (summer) and 8.7 (winter), and reformulated gasoline (RFG) was not assumed to be present. Finally, I/M program inputs were not included since there are no UM programs in the areas near the park.

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 CE-CERT, served as the basis for mobile source emission estimates. Additional particulate emissions (or entrained road dust) from vehicles operating on paved roads in Chiricahua NM also were calculated based on VMT. A summary of visitor vehicle emissions is provided in Table 11 at the end of this section.

3.1.2 GSA/NPS Highway Vehicles

Chiricahua NM operates a fleet of highway vehicles that are owned by the NPS or leased from the General Services Administration (GSA). Emission factors that were specific to vehicle classes (e.g., LDGVs) were used to estimate emissions from the NPS and GSA vehicles. Since vehicle mileages were not available, estimates were made based on another southeast park unit whose size is similar to Chiricahua NM. A summary of NPS and GSA vehicles and their estimated annual mileage is provided in Table 9, and emissions are summarized in Table 11 at the end of this section.

TABLE 9: NPS AND GSA ROAD VEHICLES AT CHIRICAHUA NM

Vehicle Type	Number	Annual Usage (mi/yr)
Light Duty Gasoline Vehicles (LDGV)		
Autos	1	10,100
Light Duty Gasoline Trucks (LDGT)		
Pickups	13	53,400
Sport Utility Vehicles	7	28,760
Vans	3	12,330
Suburbans	4	38,000
Total	27	132,490
Heavy Duty Gasoline Vehicles (HDGV)		
Stakebed Truck		4,600
Heavy Duty Diesel' Trucks (HDDT)		
Fire Trucks	5	8,600
Dump Trucks	3	5,160
Buses	1	1,720
Heavy-Duty Trucks	1	1,720
Total	10	17,200
Monument Totall		164,400

3.2 NPS NONROAD VEHICLES

The NPS also owns and operates nonroad motorized equipment that is used to maintain roads and grounds and for other purposes. There are records of the Chiricahua NM equipment inventory, and park officials estimated usage data, which are noted in Table 10. Annual usage and emission factors from the USEPA nonroad emission database were used to calculate annual emissions that are provided in Table 11.

TABLE 9: NPS NONROAD VEHICLES AT CHIRICAHUA NM

Vehicle Type	**Number**	**Annual Usage** (hrs/yr)
Grader	1	60
Backhoe	1	250
Sweepers	1	120
Chainsaws	3	200
Mowers	3	200
Trimmers	2	20
ATVs	3	30

3.3 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 11 summarizes the mobile 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 11: SUMMARY OF 2001 MOBILE SOURCE EMISSIONS AT CHIRICAHUA NM

Activity	Particulates (PM_{10})		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	880[1]	0.44	--	--	4,524	2.26	13,086	6.54	774	0.39
NPS/GSA Road Vehicles	324	0.16	--	--	939	0.47	5,617	2.81	308	0.15
Road Vehicle Emission Subtotal	1,204[1]	0.60	--	--	5,463	2.73	18,703	9.35	1,082	0.54
Nonroad Vehicles										
NPS Nonroad Vehicles		0.041	--		352	0.18	198	0.10	96	0.05
Totals										
	Particulates (PM_{10})		Sulfur Dioxide		Nitrogen Oxides		Carbon Monoxide		VOCs	
	lbs/ r									tons/ r
Totals	1,291	0.65	--	--	5,815	2.91	18,901	9.45	1,178	0.59

[1]Includes exhaust PM_{10} and road dust

4. CHIRICAHUA NM AND REGIONAL EMISSION SUMMARY

4.1 CHIRICAHUA NM SUMMARY

A summary of Chiricahua NM emissions is provided in Table 12.

TABLE 12: ESTIMATED ANNUAL EMISSIONS FROM CHIRICAHUA NM

Source	PM_{10} (tons)	SO_2 (tons)	NO_a (tons)	CO (tons)	VOCs (tons)
Point Sources					
Heating Equipment	<0.01	0.02	0.05	<0.01	<0.01
Gasoline Storage Tanks	--	--	--	--	0.12
Subtotal	<0.01	0.02	0.05	<0.01	0.12
Area Sources					
Woodstoves	0.07	<0.01	0.01	0.52	0.12
Campfires	0.16	<0.01	0.01	1.15	1.04
Prescribed Burning	25.13		--	221.74	5.45
Wildland Fires	0.03	--	--	0.32	<0.01
Subtotal	25.39	<0.01	0.02	223.72	6.61
Mobile Sources					
Road Vehicles	0.60	--	2.73	9.35	0.54
Nonroad Vehicles	0.04	--	0.18	0.10	0.05
Subtotal	0.65	--	2.91	9.45	0.59
Totals					
Totals	26.04	0.02	2.98	233.17	7.32

[1] As methane

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Cochise County and the state of Arizona 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 park emission inventory and those used to generate the NEI. For example, here gasoline storage tanks have been included as stationary sources, while the NEI treats them as area sources. Table 13 provides a comparison of Chiricahua NM emissions with those from the surrounding counties and the state. For all pollutants, Chiricahua NM emissions account for less than 1 percent of the surrounding county point source emissions.

TABLE 13: ESTIMATED ANNUAL EMISSIONS FROM CHIRICAHUA NM, SURROUNDING COUNTY, AND THE STATE OF ARIZONA

Area	PM_{10} (tons/yr)	SO_2 (tons/yr)	NO_x (tons/yr)	CO (tons/yr)	VOC (tons/yr)
Point Sources					
Chiricahua NM Total	<0.01	0.02	0.05	<0.01	0.12
Cochise County	2,273	*6,598*	8,343	3,692	58
Arizona Total	32,013	175,796	173,171	26,577	22,718
Area Sources					
Chiricahua NM Total	25.39	<0.01	0.02	223.72	6.61
Cochise County	4,452	62	1,285	13,960	3,135
Arizona Total	18,226	3,259	51,240	163,548	106,814
Mobile Sources					
Chiricahua NM Total	0.65	--	2.91	9.45	0.59
Cochise County	6,919	415	8,446	39,955	4,625
Arizona Total	13,757	19,231	236,151	1,263,163	137,114

5. COMPLIANCE AND RECOMMENDATIONS

5.1 COMPLIANCE

The Arizona Department of Environmental Quality, Air Quality Division (AQD) is the governing authority for regulating air pollution in the park. Park personnel should coordinate with the agency on permit issues relating to stationary sources, as well as prescribed burning activities. Prior to replacing or adding relatively large heating units, generators, and fuel storage tanks, the appropriate agency should be consulted regarding the need to obtain a permit to construct or a permit to operate such sources. According to Title 18 Chapter 2 of the Arizona Administrative Code, current exemptions to air permits include:

- Fuel burning equipment rated less than 1 million Btu per hour heat input
- Stationary rotating machinery rated less than 325 brake horsepower.

The DAQ has exemptions to open burning regulations that may apply to visitor activities in the park. For example, Article 6 R18-2-602 exempts "fires used only for cooking of food or for providing warmth for human beings or for recreational purposes." Some of these regulations are included in Appendix E of this report.

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.

There are no significant air quality issues at this relatively small park unit. According to park officials, new quarry located between Chiricahua NM and Fort Bowie NHS generates noticeable fugitive dust at times and operates heavy vehicles on some unpaved roads outside but near the monument. The park has some interest in investigating a possible commercial shuttle bus operation for visitors from the town of Wilcox, a gateway community located directly off Interstate 10 approximately 35 miles due west of the monument. This would reduce emissions associated with visitor 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]	So·[b]	NO,.(c)	CO	VOC[d]
Residential Furnace[e]	0.4	142S	18	5	0.713
Boilers < 100 Million Btu/hr (Commercial/Institutional Combust.()	2	142S	20	5	0.34
Boilers < 100 Million Btu/hr (Industrial Boilers[g])	2	142S	20		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°)	SO_2	NO_X[c]	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,. 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 (Ib/1,000 dal fuel burned)				
	PM(a)	SO2(b)	NO_X(e)	CO	VOC(d)
Commercial Boilers(O	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,,	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	SOX(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,,(`)	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-I.					

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.
(I) 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 CHIRICAHUA NATIONAL MONUMENT

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (lbs/yr)	SO, (Ibs/yr)	NO, (lbs/yr)	CO (lbs/yr)	CO, (lbs/yr)	VOC (Ibs/yr)
Furnace	VC/Headquarters	Propane	1	195,313	195,313	1,469	1	0	21	3	18,358	0
Furnace	Maintenance Building	Propane	1	60,000	60,000	451	0	0	6	1	5,640	0
Furnace	Residences near Maintenmace	Propane	8	60,000	480,000	3,609	1	0	51	7	45,118	1
Furnace	Faraway Ranch Office	Propane	1	60,000	60,000	451	0	0	6	1	5,640	0
Furnace	Faraway Ranch House	Propane	1	45,000	45,000	338	0	0	5	1	4,230	0
Furnace	Faraway Ranch Residence	Propane	1	60,000	60,000	451	0	0	6	1	5,640	0
		Propane Totals	13		900,313	6,770	3	0	95	13	84,625	
Furnace	Seasonal Residences	Kerosene	2	45,000	90,000	650	0	46	12	3	13,975	011
		Monument Totals	15				3	46	106	16	98,600	211

		Emission Factors (Ibs/1,000 gal)					
Emission Factors from AP-42, Tables 1.5-1 for commercial boilers, S = 0.18 grains/100 cu ft	Propane	0.4	0.1 *S	14	1.9	12,500	0.3
Emission Factors from AP-42, Tables 1.3-1 and 1.3-3 for furnaces <300,000 Btu/hr S = 0.5 percent	Kerosene	0.4	142S	18	5	21,500	0.713

Formula = Consumption (gal/yr) * Emission Factor (lb/1,000 gal)

2001 POTENTIAL CRITERIA EMISSIONS FROM HEATING UNITS AT CHIRICAHUA NATIONAL MONUMENT

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (lbs/yr)	SO, (lbs/yr)	NO, (lbs/yr)	CO (lbs/yr)	CO, (lbs/yr)	VOC (lbs/yr)
Furnace	VC/Headquarters	Propane	1	195,313	195,313	18,699	7	0	262	36	233,735	6
Furnace	Maintenance Building	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
Furnace	Residences near Maintenmac	Propane	8	60,000	480,000	45,954	18	1	643	87	574,426	14
Furnace	Faraway Ranch Office	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
Furnace	Faraway Ranch House	Propane	1	45,000	45,000	4,308	2	0	60	8	53,852	1
Furnace	Faraway Ranch Residence	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
		Propane Totals	13		900,313	86,194	34	2	1,207	164	1,077,424	26
Furnace	Seasonal Residences	Kerosene	2	45,000	90,000	5,631	2	400	101	28	121,076	4
		Monument Totals	15				37	401	1308	192	1,198,499	30

Emission Factors (lbs/1,000 gal)

	Fuel	PM	SO,	NO,	CO	CO,	VOC
Emission Factors from AP-42, Tables 1.5-1 for commercial boilers, S = 0.18 grains/ 100 cu ft	Propane	0.4	0.1"S	14	1.9	**12,500**	**0.3**
Emission Factors from AP-42, Tables 1.3-1 and 1.3-3 for furnaces <300,000 Btu/hr S = 0.5 percer	Kerosene	0.4	**142S**	18	5	**21,500**	0.713

Formula = Consumption (gal/yr) * Emission Factor (lb/1,000 gal)

2001 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT FORT BOWIE NATIONAL HISTORIC HOUSE

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (lbs/yr)	SO, (lbs/yr)	NO, (lbs/yr)	CO (lbs/yr)	CO, (lbs/yr)	VOC (lbs/yr)
Furnace	Residences	Propane	2	60,000	120,000	380	0	0	5	1	4,750	0

Emission Factors (lbs/1,000 gal)	PM	SO,	NO,	CO	CO,	VOC
Propane	0.4	0.005	14	1.9	12,500	0.3

2001 POTENTIAL CRITERIA EMISSIONS FROM HEATING UNITS AT CHIRICAHUA NATIONAL MONUMENT

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (lbs/yr)	SO_2 (lbs/yr)	NO_x (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Furnace	VC/Headquarters	Propane	1	195,313	195,313	18,699	7	0	262	36	233,735	6
Furnace	Maintenance Building	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
Furnace	Residences near Maintenmac	Propane	8	60,000	480,000	45,954	18	0	643	87	574,426	14
Furnace	Faraway Ranch Office	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
Furnace	Faraway Ranch House	Propane	1	45,000	45,000	4,308	2	0	60	8	53,852	1
Furnace	Faraway Ranch Residence	Propane	1	60,000	60,000	5,744	2	0	80	11	71,803	2
		Propane Totals	13		900,313	86,194	34	0	1,207	164	1,077,424	26
Furnace	Seasonal Residences	Kerosene	2	45,000	90,000	5,631	2	40	101	28	121,076	4
		Monument Totals	15				37	40	1308	192	1,198,499	30

Emission Factors (lbs/1,000 gal)

	PM	SO_2	NO_x	CO	CO_2	VOC
Propane	0.4	0.005	14	1.9	12,500	0.3
Kerosene	0.4	7.1	18	5	21,500	0.713

2001 ACTUAL EMISSIONS FROM WOODSTOVES AT CHIRICAHUA NATIONAL MONUMENT

Location	Number	Cords	tons/yr	PM (lbs/yr)	SO, (lbs/yr)	NO_X (lbs/yr)	CO (lbs/yr)	CO, (lbs/yr)	VOC (lbs/yr)
Rattlesnake Springs Residences	4	1	4.48	137	2	13	1,034	ND	237
				tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
				0.07	0.00	0.01	0.52	ND	0.12
				Emission Factors (lbs/ton)					
				30.6	0.4	2.8	230.8	**ND**	53.0

2001 ACTUAL EMISSIONS FROM CAMPFIRES AT CHIRICAHUA NM

Location	Campers	Camps'	Fires/Yr[2]	Tons/Yr[3]	PM (lbs/yr)	SO_2 (lbs/yr)	NO,, (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Bonita Creek	9,116	3,646	1,823	9	315	4	24	2,303	30,994	2,088
					tons/yr	tons/yr	tons/yr	tons/yr		tons/yr
					0.16	0.00	0.01	1.15	15.50	1.04

Assumptions:

' There were an estimated 2.5 campers per campsite

[2] Fifty percent of camp sites have either an evening or morning campfire

[3] Assumes 10 lbs wood per fire

	PM	SO_2	NO,,	CO	CO_2	VOC
Emission Factor (lbs/ton)	34.60	0.40	2.60	252.60	3,400	229.00

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

Identification

User Identification:	Chiricahua NM
City:	Tucson
State:	Arizona
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	1,00 gallon white AST

Tank Dimensions

Shell Length (ft):	6.00
Diameter (ft):	5.25
Volume (gallons):	1,000.00
Turnovers:	9.17
Net Throughput (gal/yr):	9,170.00
Is Tank Heated (y/n):	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: Tucson, Arizona (Avg Atmospheric Pressure = 13.41 psia)

Chiricahua NM
NPS

Horizontal Tank
Tucson, Arizona

TANKS 4.0
Emissions Report - Detail 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 7)	All	70.84	63.74	77.95	68.42	4.3263	3.7583	4.9616	68.0000			92.00	Option 4: RVP=7, ASTM Slope=3

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)

Annual Emission Calculations	
Standing Losses (lb):	174.7629
Vapor Space Volume (cu ft):	82.7294
Vapor Density (lb/cu ft):	0.0517
Vapor Space Expansion Factor:	0.1794
Vented Vapor Saturation Factor:	0.6243
Tank Vapor Space Volume	
Vapor Space Volume (cu ft):	82.7294
Tank Diameter (ft):	5.2500
Effective Diameter (ft):	6.3346
Vapor Space Outage (ft):	2.6250
Tank Shell Length (ft):	6.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0517
Vapor Molecular Weight (lb/lb-mole):	68.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	4.3263
Daily Avg. Liquid Surface Temp. (deg. R):	530.5126
Daily Average Ambient Temp. (deg. F):	68.4042
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	528.0942
Tank Paint Solar Absorptance (Shell):	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	1,807.3021
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.1794
Daily Vapor Temperature Range (deg. R):	28.4208
Daily Vapor Pressure Range (psia):	1.2034
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	4.3263
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	3.7583
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	4.9616
Daily Avg. Liquid Surface Temp. (deg R):	530.5126
Daily Min. Liquid Surface Temp. (deg R):	523.4074
Daily Max. Liquid Surface Temp. (deg R):	537.6178
Daily Ambient Temp. Range (deg. R):	27.5250
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.6243
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	4.3263
Vapor Space Outage (ft):	2.6250
Working Losses (lb):	64.2306
Vapor Molecular Weight (lb/lb-mole):	68.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	4.3263
Annual Net Throughput (gal/yr.):	9,170.0000
Annual Turnovers:	9.1700
Turnover Factor:	1.0000
Tank Diameter (ft):	5.2500

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)- (Continued)

Working Loss Product Factor:	1.0000
Total Losses (lb):	238.9935

TANKS 4.0
Emissions Report - Detail Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 7)	64.23	174.76	238.99

~TITLE 'Results ~of FOFEM model execution on date: 1/21/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 110 - Ponderosa Pine Grasslands
Fuel Type: Natural
Fuel Reference: FOFEM 011

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	1.40	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	0.50	0.45	0.05	90.0	221	
Shrubs	0.10	0.06	0.04	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	5.39	14.81	26.7		

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 (o)	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	185	197
PM 2.5	10	157	167
CH_4	3	95	98
CO	25	2088	2113
CO_2	6875	8501	15376

	Consumption tons/acre	Duration hour:min:sec
Flaming:	1.93	00:01:00
Smoldering:	3.46	00:22:15

TITLE: Results of FOFEM model execution on date: 1/21/2003

FUEL CONSUMPTION CALCULATIONS

Region: Interior West
Cover Type: SAF/SRM - SRM 509 - Oak - Juniper and Mahogany - Oak Woodland
Fuel Type: Natural
Fuel Reference: FOFEM 331

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	0.50	0.50	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	2.00	0.82	1.18	41.1	2	100.0
Herbaceous	0.10	0.10	0.00	100.0	22	
Shrubs	10.00	6.00	4.00	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	12.60	7.42	5.18	58.9		

FIRE EFFECTS ON FOREST FLOOR COMPONENTS

Forest Floor Component	Preburn Condition	Amount Consumed	Postburn Condition	Percent Reduced	Equation Number
Duff Depth (in)	0.2	0.0	0.2	4.5	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	41	44	85
PM 2.5	34	37	71
CH_4	11	23	34
CO	86	496	582
CO_2	23475	2019	25494

	Consumption tons/acre	Duration hour:min:sec
Flaming:	6.60	00:01:00
Smoldering:	0.82	00:06:30

2001 FIRES EMISSIONS AT **CHIRICAHUA NATIONAL MONUMENT**

Prescribed Burning

Fuel Type	Acres	PM_{10} (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CH_4 (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)
Pine Grassland	130	25,610	21,710	1,040	274,690	1,998,880
Oak Woodland	290	24,650	20,590	9,860	168,780	7,393,260
Totals	420	50,260	42,300	10,900	443,470	9,392,140

		tons/yr				
Totals		25.13	21.15	5.45	221.74	4,696

Emission Factors

	PM_{10} (lbs/acre)	$PM_{2.5}$ (lbs/acre)	CH_4 (lbs/acre)	CO (lbs/acre)	CO_2 (lbs/acre)
Pine Grassland	197	167	8	2,113	15,376
Oak Woodland	85	71	34	582	25,494

Wildland Fires

Fuel Type	Acres	PM_{10} (lbs/yr)	$PM_{2.5}$ (lbs/yr)	CH_4 (lbs/yr)	CO (lbs/yr)	CO_2 (lbs/yr)
Pine Grassland	0.3	59	50	2	634	4,613

```
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Chiricahua NM Winter Conditions.
* File 1, Run 1, Scenario 27.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  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:   30.0 (F)
```

Maximum Temperature: 56.0 (F)
Absolute Humidity: 75. grains/lb
Nominal Fuel RVP: 8.7 psi
Weathered RVP: 8.7 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):

	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Composite VOC :	0.730	0.962	0.865	0.921	0.822	0.433	0.439	0.509	2.61	0.825
Composite CO	15.28	20.03	18.04	19.18	25.34	1.308	0.931	6.582	24.22	16.356
Composite NOX :	0.792	1.135	1.326	1.216	3.786	1.267	1.212	16.834	1.12	1.214

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):

	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
Composite VOC :	0.903	0.979	0.843	0.915	2.424	0.391
Composite CO	19.37	20.24	17.93	18.27	6.522	0.795
Composite NOX :	0.892	1.210	1.197	1.611	2.555	1.180

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGVS	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):

	HDGV2B	HDGV3	HDGV4	HDGVS	HDGV6	HDGV7	HDGV8A	HDGV8B
Composite VOC :	0.822	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.786	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
-----------------------------------------------------------------------------------------------------------------------
```

• #
• Chiricahua NM Summer Conditions.
• File 1, Run 1, Scenario 28.
• # # # # # # # # # # # # # # # # # # #

M584 Warning:
The user supplied area wide average speed of 35.0
will be used for all hours of the day. 1000 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:	60.0 (F)
Maximum Temperature:	89.0 (F)
Absolute Humidity:	75. grains/lb
Nominal Fuel RVP:	6.8 psi
Weathered RVP:	6.6 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 :	0.658	0.810	0.814	0.812	0.748	0.405	0.461	0.490	2.80	0.753
Composite CO	11.70	14.38	14.11	14.26	21.49	1.277	0.945	6.500	24.55	12.631
Composite NOX :	0.741	1.004	1.271	1.118	3.669	1.170	1.239	16.586	0.92	1.142

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 :	0.771	0.822	0.797	0.853	2.512	0.418
Composite CO	13.99	14.50	14.02	14.30	6.775	0.824
Composite NOX :	0.796	1.067	1.146	1.549	2.574	1.212

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGVS	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 :	0.748	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Composite CO	21.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Composite NOX :	3.669	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

# #
Chiricahua NM Winter Conditions.
File 1, Run 1, Scenario 27.
# #

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

S04:	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
S02:	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	HDGVS	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:	------	------	------	------	------	------	------	
S04:	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
S02:	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
S04:	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

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- #
- Chiricahua NM Summer Conditions.
- File 1, Run 1, Scenario 28.
- #

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):

						-----	------	------
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
S04:	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
S02:	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

CHIRICAHUA NATIONAL MONUMENT VISITOR VEHICLE EMISSIONS

Annual VMT
427,850

Emission Factors (g/mi) -All Vehicles

	NO_X	CO	VOC	PM_{10} Exhaust, Brake, and Tire	PM_{10} Fugitive	PM_{10} Total
Summer	4.690	12.171	0.783	0.0938	0.84	0.9338
Winter	4.923	15.633	0.861	0.0950	0.84	0.9350
Average	4.807	13.902	0.822			0.934

Emissions (tons/yr) - All Vehicles

NO_x	CO	VOC	PM_{10}
2.26	6.54	0.39	0.44

Emissions (lbs/yr) -All Vehicles

NO_X	CO	VOC	PM_{10}
4,524	13,086	774	880

CHIRICAHUA NATIONAL MONUMENT NPS AND GSA VEHICLES

	LDGV	LDGT	HDGV	HDDV	Total
Total Miles	10,100	132,490	4,600	17,200	164,390

Emission Factors (g/mi) - LDGV

				PM_{10}		
	NOx	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	0.7390	11.6200	0.6510	0.0276	0.8400	0.8676
Winter	0.7890	15.1800	0.7220	0.0276	0.8400	0.8676
Average	0.7640	13.4000	0.6865			0.8676

Emissions (tons/yr) - LDGV

NO_x	CO	VOC	PM"
0.01	0.15	0.01	0.01

Emission Factors (g/mi) - LDGT

				PM"		
	NO_x	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	1.090	14.290	0.810	0.030	0.840	0.870
Winter	1.197	19.390	0.930	0.030	0.840	0.870
Average	1.144	16.840	0.870			0.870

Emissions (tonslyr) - LDGT

NO_x	CO	VOC	PM_{10}
0.17	2.45	0.13	0.13

Emission Factors (g/mi) - HDGV

				PM_{10}		
	NO_x	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	3.717	22.140	0.769	0.085	0.840	0.925
Winter	3.844	26.110	0.843	0.084	0.840	0.924
Average	3.781	24.125	0.806			0.924

Emissions (tons/yr) - HDGV

NOx	CO	VOC	PM,
0.02	0.12	0.00	0.00

Emission Factors (glmi) - HDDV

				PM_{10}		
	NO_x	CO	VOC	Exhaust, Brake, and Tire	Fugitive	Total
Summer	14.245	4.397	0.806	0.261	0.840	1.101
Winter	14.858	4.431	0.810	0.261	0.840	1.101
Average	14.552	4.414	0.808			1.101

Emissions (tonslyr) - HDDV

NOx	CO	VOC	PM_{10}
0.28	0.08	0.02	0.02

Emissions (tons/yr) - Total

NO_x	CO	VOC	PM_{10}
0.47	2.81	0.15	0.16

Emissions (lbs/yr) - Total

NO_x	CO	VOC	PM_{10}
939	5,617	308	324

2001 CHIRICAHUA NM NONROAD VEHICLE EMISSIONS

Vehicle	No.	Emission Factors (gm/hp-hr) PM	Nox	CO	VOC	hp	load	hrs/yr	Emissions (lbs/yr) PM	NO_x	CO	VOC
Honda ATV	3	2.04	1.03	2.31	2.19	18	0.55	30	4.0	2.0	4.5	4.3
Backhoe	1	2.04	1.03	2.31	2.19	70	0.55	250	43.2	21.8	48.9	46.4
Riding Mower	3	1.11	10.3	4.8	1.3	18	0.55	200	14.5	134.6	62.7	17.0
Grader	1	1.06	9.6	3.8	1.43	200	0.61	60	17.1	154.6	61.2	23.0
Sweeper	1	1.7	14	6.06	1.46	15	0.68	120	4.6	37.7	16.3	3.9
Trimmer	2	3.99	0.9	4.8	1.3	1.2	0.55	300	3.5	0.8	4.2	1
							Totals:	(lbs/yr)	87	352	198	96
								(tons/yr)	0.04	0.18	0.10	0.05

APPENDIX C

FORT BOWIE NATIONAL HISTORIC SITE, AZ

FORT BOWIE NATIONAL HISTORIC SITE, AZ

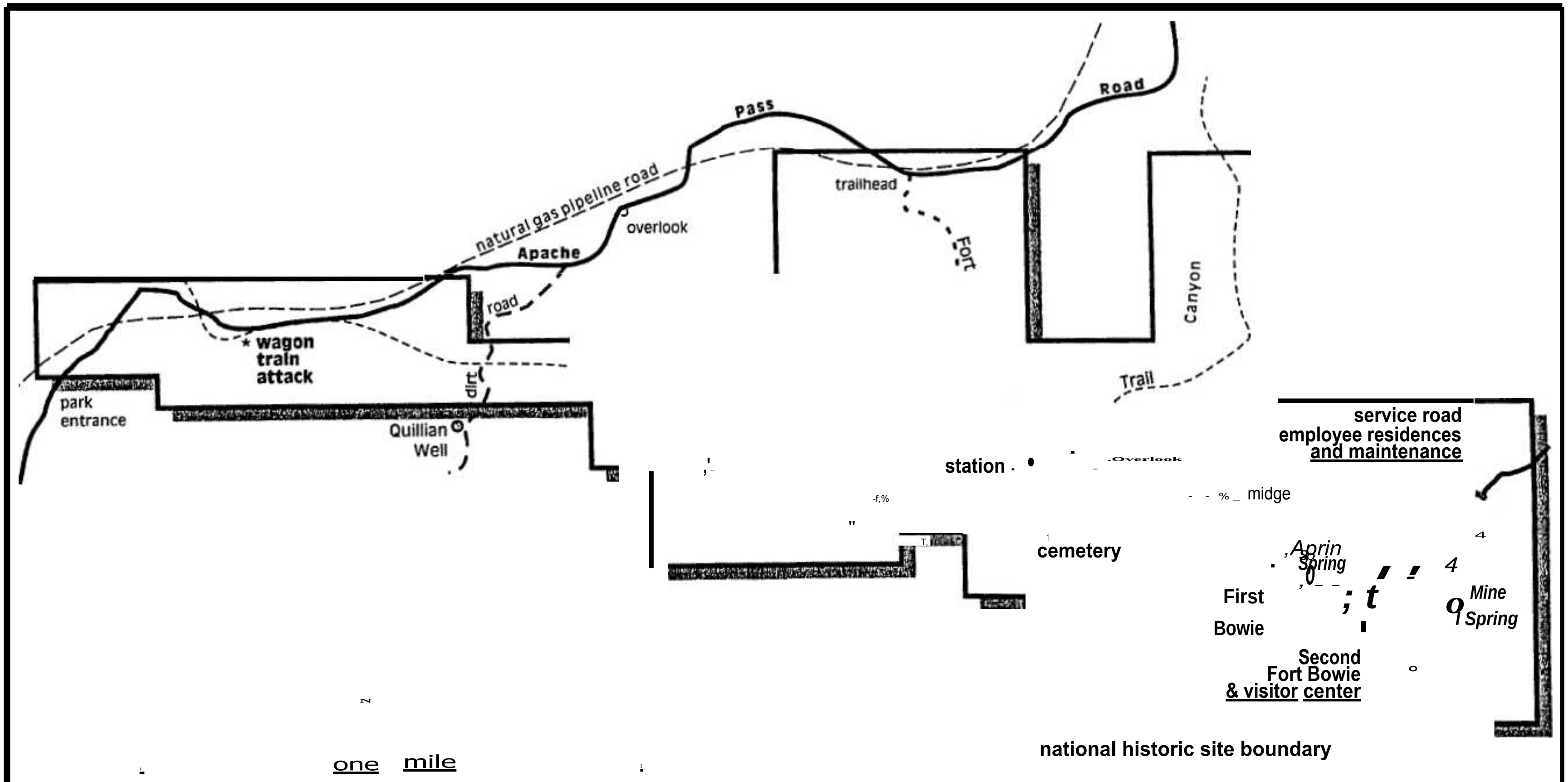
<u>Description:</u> Fort Bowie NHS commemorates in its 1,000 acres the story of the conflict between the Chiricahua Apaches and the United States military. For more than 30 years, Fort Bowie and Apache Pass were the focal point of military operations eventually culminating in the surrender of Geronimo in 1886 and the banishment of the Chiricahua Apaches to Florida and Alabama. It was the site of the Bascom Affair, a wagon train massacre, and the battle of Apache Pass, where a large force of Chiricahua Apaches under Mangus Colorados and Cochise fought the California Volunteers. The remains of Fort Bowie NHS today include adobe walls of various post buildings and the ruins of a Butterfield Stage Station. It stands as a monument to the endurance of U.S. soldiers in paving the way for westward settlement and the taming of the western frontier. It also serves to provide an understanding of the "clash of cultures," one a young emerging nation in pursuit of its "manifest destiny," the other a valiant hunter/gatherer society fighting to preserve its existence. Apache resistance was finally crushed at Fort Bowie, and the result was the end of the Indian wars in the United States.

<u>Visitation:</u> 8,290 in CY 2002

<u>Air Emission Sources:</u>

2001 ACTUAL AIR EMISSIONS FROM FORT BOWIE NHS

Location	**Fuel**	**Consumption** (gal/yr)	**PM,0 (lbs/yr)**	SO_2 **(lbs/yr)**	NO_x **(Ibs/yr)**	**CO (Ibs/yr)**	CO_2 **(Ibs/yr)**	**VOC (Ibs/yr)**
Residences (2)	Propane	380	0	0	5	1	4,750	0
Maintenance Fuel Tank	Gasoline	1,413		--	--	--	--	142
		Total			5	1	4,750	142



Existing Conditions

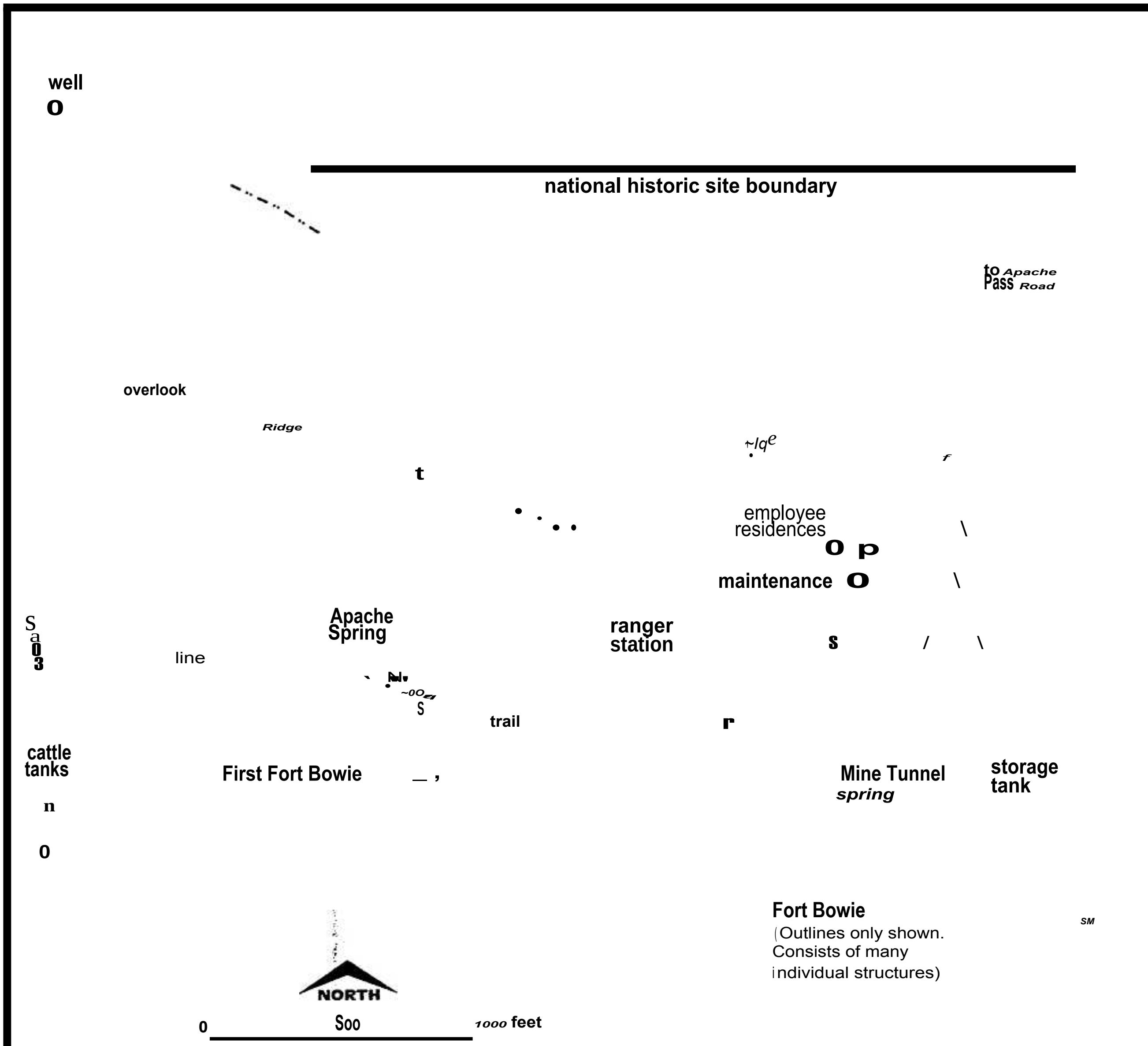
Fort Bowie

National Historic Site

U.S. Department of the Interior - National Park Service

424/ 80,012,

Aug 99 IMDE



Administrative, Fort, and Trail Area

Fort Bowie

National Historic Site

U.S. Department of the Interior - National Park Service

424 80,014
AUg 99 IMDE

2001 ACTUAL CRITERIA EMISSIONS FROM HEATING UNITS AT FORT BOWIE NATIONAL HISTORIC HOUSE

Emission Source	Location	Fuel	Number of Sources	Capacity (Btu/hr)		Consumption (gal/yr)	PM (Ibs/yr)	SO_2 (Ibs/yr)	NO, (lbs/yr)	CO (Ibs/yr)	CO_2 (lbs/yr)	VOC (lbs/yr)
Furnace	Residences	Propane	2	60,000	120,000	380	0	0	5	1	4,750	0

Emission Factors (Ibs/1,000 gal)

	PM	SO_2	NO,	CO	CO_2	VOC
Propane	0.4	0.005	14	1.9	12,500	0.3

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

Identification

User Identification:	Fort Bowie NHS
City:	Tucson
State:	Arizona
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	500 gallon white, AST

Tank Dimensions

Shell Length (ft):	5.50
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	0.00
Net Throughput (gal/yr):	1,413.00
Is Tank Heated (y/n):	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: Tucson, Arizona (Avg Atmospheric Pressure = 13.41 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	70.84	63.74	77.95	68.42	5.0011	4.3555	5.7215	68.0000			92.00	Option 4: RVP=8, ASTM Slope=3

Fort Bowie NHS
NPS

Horizontal Tank
Tucson, Arizona

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathincq Loss	Total Emissions
Gasoline (RVP 8)	11.44	131.01	142.45

APPENDIX D

PUBLIC USE DATA

Monthly Public Use Report

Printed on 01/20/2003

CHIRICAHUA NM			12/2002	8620
	December 2002			
	Recreational	Non-Recreational	Total	Calendar Year-To-Date
Visits	2,668	292	2,960	74,874
Visitor Hours	12,846	97	12,943	332,692
				Fiscal YTD
Total Fiscal YTD Visitor Days				5,022

Recreation O/N stays	Current Month	Year-To-Date	
Concessioner Lodging	0	0	**NPS Campgrounds**
Concessioner Campgrounds	0	o	**Tents** 175 R/V's 211
NPS Campgrounds	386	9,116	**Total** 386
NPS Backcountry	0	0	
NPS Miscellaneous	0	1,039	
Non Recreation O/N stays	0	0	
Total Overnight stays	386	10,155	

	This Month	Same Month Last Year	Percent Change
Total Rec	2,668	3,198	-16.58
Total NonRec	292	220	32.73
Total Visits	2,960	3,418	-13.40
Total YTD	74,874	78,315	-4.39

APPENDIX E

SELECTED ARIZONA
AIR QUALITY REGULATIONS

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

R18-2-601. General

For purposes of this Article, any source of air contaminants which due to lack of an identifiable emission point or plume cannot be considered a point source, shall be classified as a nonpoint source. In applying this criteria, such items as air-curtain destructors, heater-planners, and conveyor transfer points shall be considered to have identifiable plumes. Any affected facility subject to regulation under Article 7 of this Chapter or A.A.C. Title 9, Chapter 3, Article 8, shall not be subject to regulation under this Article.

Historical Note

Former Section R9-3-601 repealed, new Section R9-3-601 adopted effective May 14, 1979 (Supp. 79-1). Former Section R9-3-601 renumbered without change as Section R18-2-601 (Supp. 87-3). Amended effective September 26, 1990 (Supp. 90-3). Former Section R18-2-601 renumbered to R18-2-801, new Section R18-2-601 renumbered from R18-2-401 and amended effective November 15, *1993* (Supp. 93-4).

R18-2-602. Unlawful Open Burning

A. Notwithstanding the provisions of any other rule in this Chapter, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire.

B. "Open outdoor fire", as used in this rule, means any combustion of combustible material of any type outdoors, in the open where the products of combustion are not directed through a flue. "Flue", as used in this rule, means any duct or passage for air, gases or the like, such as a stack or chimney.

C. The following fires are excepted from the provisions of this rule:

1. Fires used only for cooking of food or for providing warmth for human beings or for recreational purposes or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.
2. Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires.
3. Fires set by or permitted by the state entomologist or county agricultural agents of the county for the purpose of disease and pest prevention.
4. Fires set by or permitted by the federal government or any of its departments, agencies or agents, the state or any of its agencies, departments or political subdivisions, for the purpose of watershed rehabilitation or control through vegetative manipulation.

D. Permission for the setting of any fire given by a public officer in the performance of official duty under subsections (C)(2), (3), or (4) shall be given, in writing, and a copy of such written permission shall be transmitted immediately to the Director of the Department of Environmental Quality and the control officer, if any, of the county, district or region in which such fire is allowed. The setting of any such fire shall be constructed in a manner and at such time as approved by the Director, unless doing so would defeat the purpose of the exemption.

E. The following fires may be excepted from the provisions of this Section when permitted in writing by the Director of the Department of Environmental Quality or the control officer of the county, district or region in which such fire is allowed:

1. Fires set for the disposal of dangerous materials where there is no safe alternative method of disposal.
   a. "Dangerous material" is any substance or combination of substances which is able or likely to inflict bodily harm or property loss unless neutralized, consumed or otherwise disposed of in a controlled and safe manner.
   b. Fires set for the disposal of dangerous materials shall be permitted only when there is no safe alternative method of disposal, and when the burning of such materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts which will endanger health or safety.

R18-2-604. Open Areas, Dry Washes or Riverbeds

A. No person shall cause, suffer, allow, or permit a building or its appurtenances, or a building or subdivision site, or a driveway, or a parking area, or a vacant lot or sales lot, or an urban or suburban open area to be constructed, used, altered, repaired, demolished, cleared, or leveled, or the earth to be moved or excavated, without taking reasonable precautions to limit excessive amounts of particulate matter from becoming airborne. Dust and other types of air contaminants shall be kept to a minimum by good modern practices such as using an approved dust suppressant or adhesive soil stabilizer, paving, covering, landscaping, continuous wetting, detouring, barring access, or other acceptable means.

B. No person shall cause, suffer, allow, or permit a vacant lot, or an urban or suburban open area, to be driven over or used by motor vehicles, trucks, cars, cycles, bikes, or buggies, or by animals such as horses, without taking reasonable precautions to limit excessive amounts of particulates from becoming airborne. Dust shall be kept to a minimum by using an approved dust suppressant, or adhesive soil stabilizer, or by paving, or by barring access to the property, or by other acceptable means.

C. No person shall operate a motor vehicle for recreational purposes in a dry wash, riverbed or open area in such a way as to cause or contribute to visible dust emissions which then cross property lines into a residential, recreational, institutional, educational, retail sales, hotel or business premises. For purposes of this subsection "motor vehicles" shall include, but not be limited to trucks, cars, cycles, bikes, buggies and 3-wheelers. Any person who violates the provisions of this subsection shall be subject to prosecution under A.R.S. § 49-463.

Historical Note

Adopted effective May 14, 1979 (Supp. 79-1). Former Section R9-3-604 renumbered without change as Section R18-2-604 (Supp. 87-3). Amended effective September 26, 1990 (Supp. 90-3). Former Section R18-2-604 renumbered to R18-2-804, new Section R18-2-604 renumbered from R18-2-404 and amended effective November 15, 1993 (Supp. 93-4).

R18-2-605. Roadways and Streets

A. No person shall cause, suffer, allow or permit the use, repair, construction or reconstruction of a roadway or alley without taking reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne. Dust and other particulates shall be kept to a minimum by employing temporary paving, dust suppressants, wetting down, detouring or by other reasonable means.

B. No person shall cause, suffer, allow or permit transportation of materials likely to give rise to airborne dust without taking reasonable precautions, such as wetting, applying dust suppressants, or covering the load, to prevent particulate matter from becoming airborne. Earth or other material that is deposited by trucking or earth moving equipment shall be removed from paved streets by the person responsible for such deposits.

Historical Note

Adopted effective May 14, 1979 (Supp. 79-1). Former Section R9-3-605 renumbered without change as Section R18-2-605 (Supp. 87-3). Amended effective September 26, 1990 (Supp. 90-3). Former Section R18-2-605 renumbered to R18-2-805, new Section R18-2-605 renumbered from R18-2-405 effective November 15, 1993 (Supp. 93-4).

R18-2-606. Material Handling

No person shall cause, suffer, allow or permit crushing, screening, handling, transporting or conveying of materials or other operations likely to result in significant amounts of airborne dust without taking reasonable precautions, such as the use of spray bars, wetting agents, dust suppressants, covering the load, and hoods to prevent excessive amounts of particulate matter from becoming airborne.

Historical Note

Section RI 8-2-606 renumbered from RI 8-2-406 effective November 15, 1993 (Supp. 93-4).

R18-2-607. Storage Piles

A. No person shall cause, suffer, allow, or permit organic or inorganic dust producing material to be stacked, piled, or otherwise stored without taking reasonable precautions such as chemical stabilization, wetting, or covering to prevent excessive amounts of particulate matter from becoming airborne.

B. Stacking and reclaiming machinery utilized at storage piles shall be operated at all times with a minimum fall of material and in such manner, or with the use of spray bars and wetting agents, as to prevent excessive amounts of particulate matter from becoming airborne.

Historical Note