FINAL

2000 AIR EMISSIONS INVENTORY

MAMMOTH CAVE NATIONAL PARK
KENTUCKY

U.S. NATIONAL PARK SERVICE

NOVEMBER 2002

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KENTUCKY

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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 Mammoth Cave National Park (NP) serves three functions in this regard. First, it provides a baseline and 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, and fuel storage tanks. Area sources may include prescribed burning, woodstoves and fireplaces, campfires, and miscellaneous visitor activities. Mobile sources may include vehicles operated by visitors, tour operators, and NPS and concessionaire employees, and nonroad vehicles and equipment.

1.3 INVENTORY METHODOLOGY

The methodology to accomplish the air emissions inventory consisted of a site survey in March 2002, interviews with Mammoth Cave NP[1] and concessionaire personnel, review of applicable park records, emission calculations, 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,

[1] Bob Carson, Mammoth Cave NP, Natural Resource Management Specialist (270) 749-2508

and USEPA *MOBILE5band PARTS* mobile source emissions model. 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 Appendix A.

1.4 PARK DESCRIPTION

Mammoth Cave National Park, KY encompasses 52,830 acres. Mammoth Cave National Park was established to preserve the cave system, including Mammoth Cave, the scenic river valleys of the Green and Nolin rivers, and a section of south central Kentucky. It was authorized as a national park in 1926 and was fully established in 1941. The park was named a World Heritage Site 1981 and was became the core area of an International Biosphere Reserve in 1990.

Mammoth Cave NP contains the world's longest known cave system and offers renowned examples of karst topography. Many types of cave formations are present within the extensive 360 mile cave system, and the park is part of what is believed to be the most diverse cave ecosystem in the world. Of the more than 130 species of fauna within the cave system, fourteen species of troglobites or troglophiles are known to exist only within Mammoth Cave and other caves in the immediate vicinity. Many of these species have been isolated from other cave systems for over a million years, resulting in fragile and unique populations.

In addition to the renowned cave system, the park is noted for its scenic rivers, valleys, bluffs, forests, and abundant wildlife. The park includes twenty-five miles of the Green River and six miles of the Nolin River. The Green River supports a diverse freshwater mussel population including seven federal endangered species in addition to its role as the master stream controlling the geologic development of Mammoth Cave and its unique ecosystem.

A map of the park is provided in Figure 1, and the core visitation area is depicted in Figure 2. Information on developed areas in the park is summarized in Table 1. The Great Onyx Job Corps Center Civilian Conservation Center, which is operated by the U.S. Department of Labor, is located in the northwest corner of the park, and a site plan of the Center is depicted in Figure 3. The principal concessionaire, Forever Resorts, operates a hotel, restaurant, gift shop, motor lodge, and gasoline service station and camp store at the Visitor Center complex. Miss Green River Boat Concessions operates scenic boat rides on the Green River from spring through fall.

TABLE 1: MAMMOTH CAVE **NP DEVELOPED AREAS**

Name/Location	Function/Facilities
Visitor Center Complex	Visitor Center, Park Headquarters, Maintenance Shops, Mammoth cave Hotel, Restaurant/Gift Shop, Woodland Cottages, Sunset Point Motor Lodge, Gasoline Station, Camp Store, U.S. Post Office
Maintenance/Ranger Station	Ranger Station/Training Center, Offices, Garage, Maintenance Offices, resource Management Facility, Trade Shop, Storage, Procurement/Warehouse, Welding Shop, Refueling Tanks, Seasonal Employee Housing
Great Onyx Civilian Conservation Center	See Figure 3

1.5 AIR QUALITY STATUS

Mammoth Cave NP is located in Edmonson, Barren, and Hart Counties, KY, and the Kentucky Department of Environmental Protection, Division for Air Quality is the governing authority for regulating air pollution in the state. All three counties currently are classified as attainment for all the National Ambient Air Quality Standards (NAAQS).

The park operates an air monitoring station approximately 300 feet outside the park boundary on leased property near the town of Pig. The station measures ozone, sulfur dioxide, carbon monoxide, nitric oxide, mercury vapor, and particulate matter, the latter as part of the NPS IMPROVE visibility program. Based on data from the NPS IMPROVE Program, Mammoth Cave was ranked the fifth in a list of national parks with the worst annual average visibility as measured in miles, although the site has shown a significant improvement in recent years (NPS 2002). With respect to ozone, the park area is in attainment with the one-hour standard, but has shown a significant degradation trend over the 1990s, which is analogous to the experience of Great Smoky Mountains NP in nearby TN and NC.

One of the park's current air quality concerns relates to a proposed major power plant in western Kentucky. Peabody Energy has submitted a Prevention of Significant Deterioration (PSD)/Title V air quality operating permit to build a 1,500 megawatt coal-fired power plant in Paradise, KY, which is approximately 50 miles west of the park. In August 2002, the Interior Department stated in a letter to the State of Kentucky that the state lower the plant's emissions limit to a level that would not have an adverse impact on visibility at Mammoth Cave NP; however, this is not a binding requirement for the state. In October 2002, the state of Kentucky issued an air permit.

Mammoth Cave NP is one of 49 NPS units that are designated as Class I areas by the Clean Air Act and its Amendments. A Class I area is one that receives the most stringent degree of air quality protection within and around its borders. For example, potential new or modified sources of significant pollution that plan to locate near a Class I area must obtain a permit from the

applicable air quality regulatory agency. The NPS has significant input to the permitting process to ensure that potential air emissions do not pose a threat to visibility or other park air quality related values.

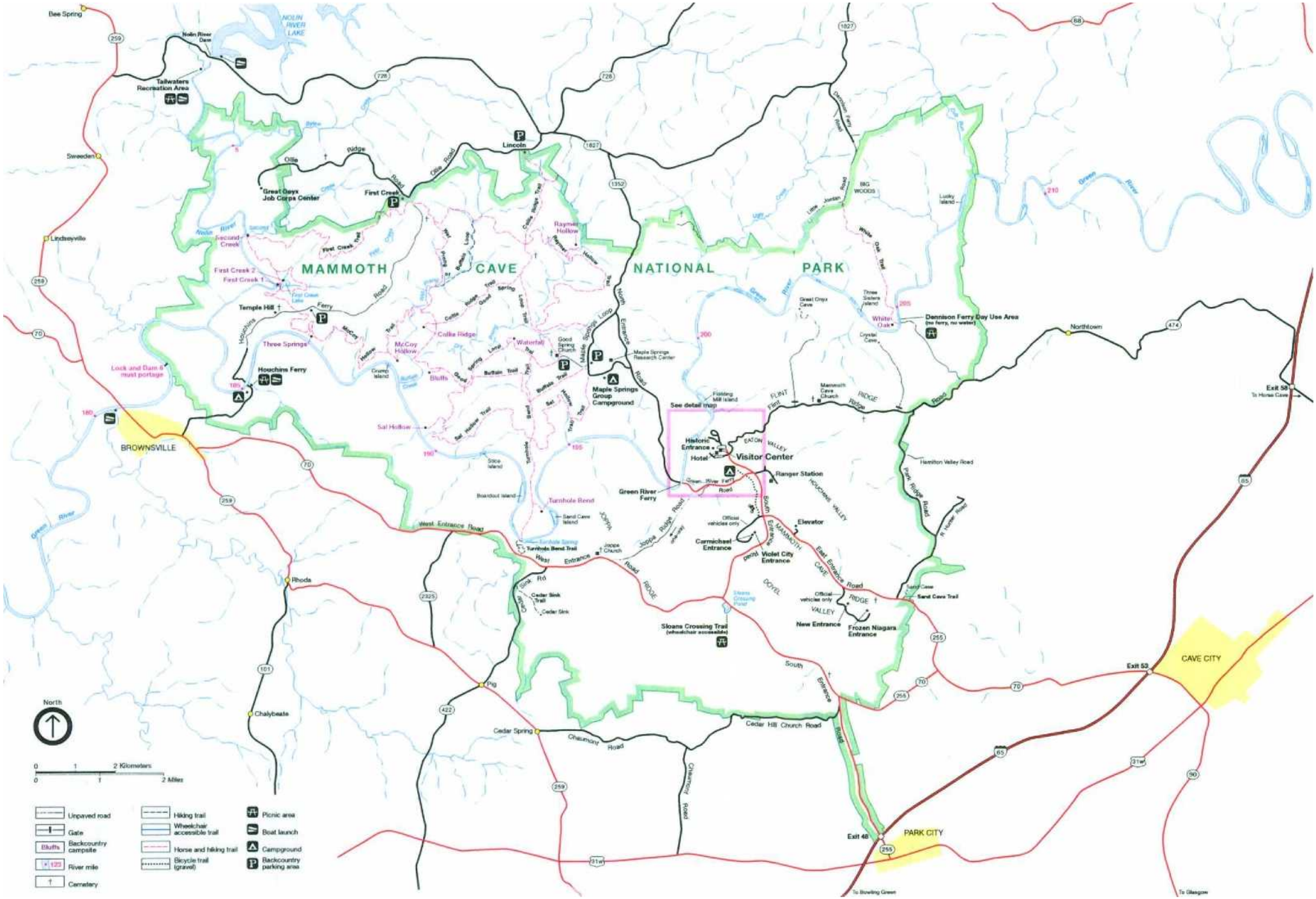

FIGURE 1: MAMMOTH CAVE NATIONAL PARK

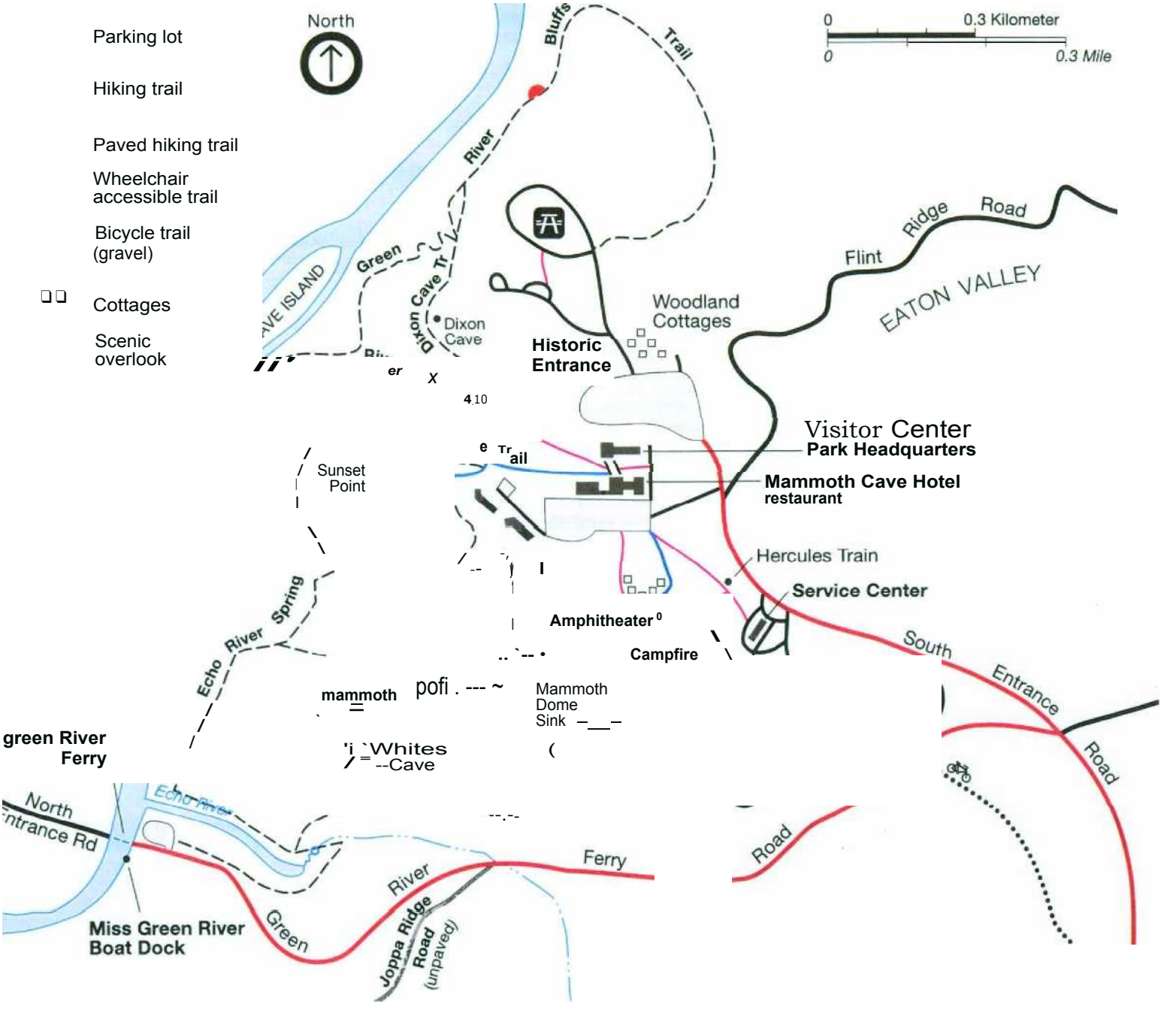

FIGURE 2: MAMMOTH CAVE **NP** VISITOR CENTER COMPLEX

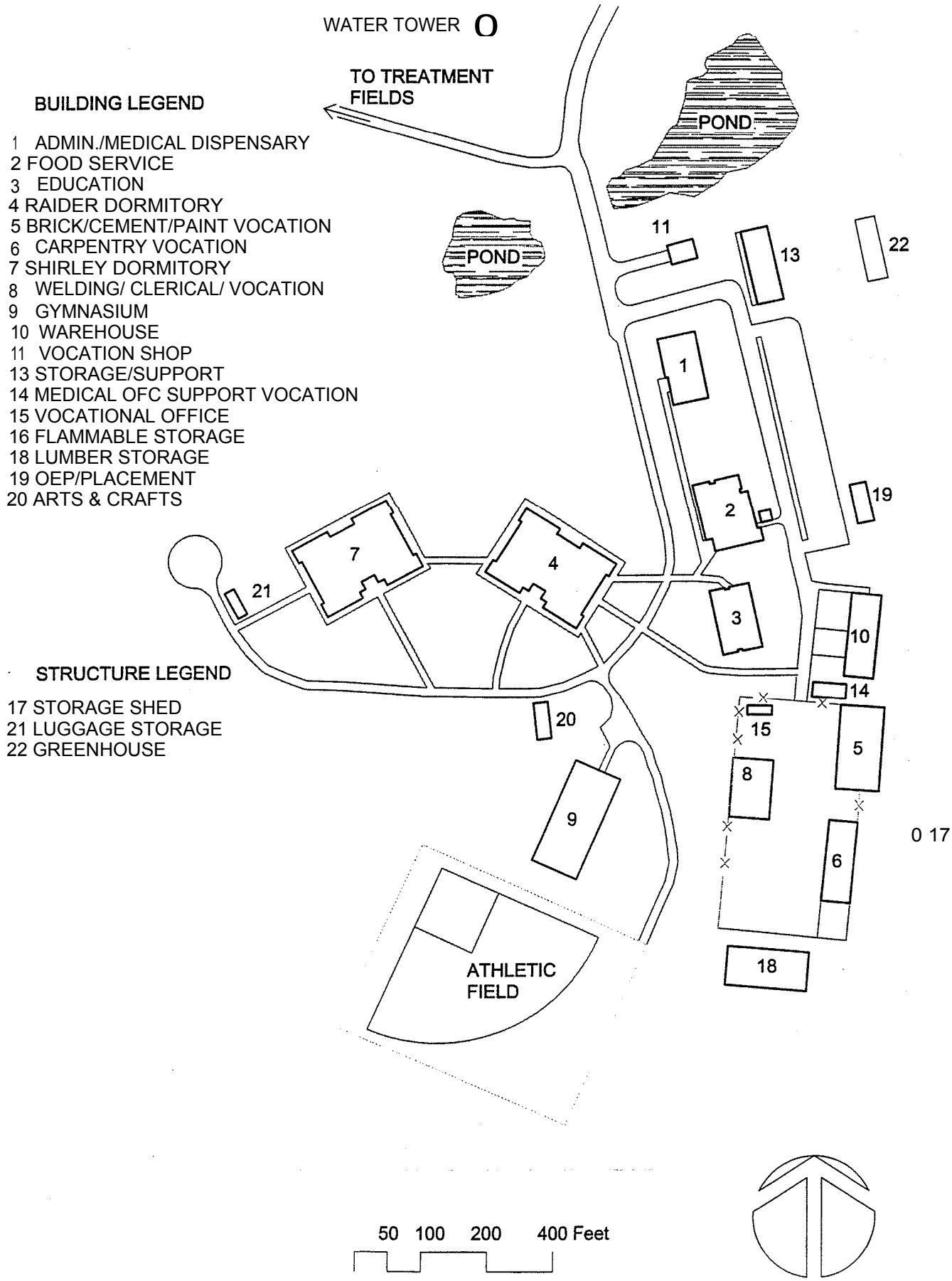

FIGURE 3: GREAT OYNX CIVILIAN CONSERVATION CENTER

2. **STATIONARY** AND AREA **SOURCE EMISSIONS**

This section summarizes emissions from sources at Mammoth Cave NP for the year 2000. 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,,), carbon monoxide (CO), and volatile organic compounds (VOCs). Emission factors used in the calculations are provided in Appendix A.

2.1 STATIONARY SOURCES

2.1.1 Space And Water Heating Equipment

Stationary combustion sources at Mammoth Cave NP include propane and No. 2 fuel oil space and water heating units. Criteria air emissions were calculated using the appropriate residential and commercial unit emission factors. For example, PM emissions from a No. 2 fuel oil boiler at the Mammoth Cave Hotel are calculated as follows:

$$17{,}591\ gal/yr \times \frac{2.0\ lb\ PM}{1{,}000\ gal} = 35\ lb\ PM/yr$$

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 or 8,760 hours per year, and these emissions are summarized in Table 3.

2.1.2 Generators

2.1.2.1 Generator Emissions - Actual

Emissions were calculated by multiplying the unit rating (kW) of the generators by an estimated annual run time (hr/yr) to get the kW-hr/yr, and the appropriate emission factors were then applied. For example, PM emissions from the 30 kW generator at the Maintenance Area Ranger Station are calculated as:

$$30\ kW\ \frac{52\ hours}{year} \times \frac{1.34\ hp}{kW} \times \frac{0.00220\ lb\ PM}{hp\text{ - }hr} = 5\ lb\ PM/yr$$

Actual generator criteria emissions are summarized in Table 4.

TABLE 2: 2000 ACTUAL CRITERIA EMISSIONS FROM HEATING EQUIPMENT AT MAMMOTH CAVE NP

Location	Fuel Type	Consumption (gal/yr)	PM (lbs/yr)	SO_2 (lbs/yr)	NOx (lbs/yr)	CO (Ibs/yr)	VOC (Ibs/yr)
National Park Service							
Maintenance Building	Propane	1,383	1	0	19	3	0
Seasonal Housing	Propane	1,383	1	0	19	3	0
Ranger Station/Training Center	Propane	1,383	1	0	19	3	0
Maintenance Garage	Propane	1,383	1	0	19	3	0
Welding Shop	Propane	1,383	1	0	19	3	0
Maintenance Warehouse	Propane	1,383	1	0	19	3	0
Trade Shop	Propane	1,383	1	0	19	3	0
Chaumont Building	Propane	1,383	1	0	19	3	0
Maple Springs	Propane	1,383	1	0	19	3	0
Housing/Office Units	Propane	7,746	3	0	108	15	2
National Park Service Subtotals		20,193	8	0	283	40	6
Forever Resorts, Inc.							
Mammoth Cave Hotel	No. 2 Fuel Oil	17,591	35	1,249	352	88	6
		Totals	43	1,249	635	128	12

TABLE 3: 2000 POTENTIAL CRITERIA EMISSIONS FROM HEATING EQUIPMENT AT MAMMOTH CAVE NP

Location	Fuel Type	Consumption (gallyr)	PM (lbs/yr)	SO_2 Ohs/yr)	NOx (lbs/yr)	CO (lbs/yr)	VOC (Ibs/yr)
National Park Service							
Maintenance Building	Propane	14,361	6	0	201	29	4
Seasonal Housing	Propane	14,361	6	0	201	29	4
Ranger Station/Training Center	propane	14,361	6	0	201	29	4
Maintenance Garage	Propane	14,361	6	0	201	29	4
Welding Shop	Propane	14,361	6	0	201	29	4
Maintenance Warehouse	Propane	14,361	6	0	201	29	4
Trade Shop	Propane	14,361	6	0	201	29	4
Chaumont Building	Propane	14,361	6	0	201	29	4
Maple Springs	Propane	14,361	6	0	201	29	4
Housing/Office Units	Propane	80,420	32	0	1,126	161	24
National Park Service Subtotals		209,669	84	4	2,935	422	63
Forever Resorts, Inc.							
Mammoth Cave Hotel	No. 2 Fuel Oil	58,129	116	4,127	1,163	291	20
		Totals	200	4,131	4,098	710	83

TABLE 4: 2000 ACTUAL MAMMOTH CAVE NP GENERATOR CRITERIA EMISSIONS

Location	Rating (kW)	Run Time (hrs/yr)	PM (Ibs/yr)	SO_2 (lbs/yr)	NOx (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Maintenance Area	30	52	5	4	65	14	5
Elevator House	125	52	19	18	270	58	22
		Total	24	22	335	72	27

2.1.2.2 Generator Emissions - Potential

Potential emissions were also calculated for the generators, and the same emission factors that were used to calculate the actual emissions were used to calculate these potential emissions. To calculate potential emissions, EPA guidance on the number of hours of operation to assume was adopted:

> EPA does not recommend the use of 8,760 hours per year (i.e., full-year operation) for calculating PTE (potential to emit) for emergency generators...The EPA believes that 500 hours is an appropriate default assumption for estimating the number of hours that an emergency generator could be expected to operate under worst-case conditions.[1]

Potential criteria generator emissions are summarized in Table 5.

TABLE 5: 2000 POTENTIAL MAMMOTH CAVE NP GENERATOR CRITERIA EMISSIONS

Location	Rating (kW)	Run Time (hrs/yr)	PM (Ibs/yr)	SO_2 (lbs/yr)	*NOx* (Ibs/yr)	CO (Ibs/yr)	VOC (lbs/yr)
Maintenance Area	30	500	44	41	623	134	50
Elevator House	125	500	184	172	2,596	559	210
		Total	228	313	3,219	694	261

2.1.3 Fuel Storage Tanks

Mammoth Cave NP has two aboveground gasoline storage tanks and Forever Resorts has three underground storage tanks at its service station at the Visitor Center complex. Information on these tanks is provided in Tables 6. Emissions from fuel storage tanks were calculated using the EPA *TANKS 4.0* model. The gasoline tanks are equipped with Phase I vapor emission controls

[1] *Calculating Potential to Emit (PTE) for Emergency Generators,* Office of Air Quality Planning and Standards (MD-10), U.S. Environmental Protection Agency, 06 September 1995.

that capture vapors displaced from the vapor space in the tank when it is refilled. Emissions associated with gasoline dispensing are accounted for in the mobile source model.

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. VOC emissions from gasoline storage tanks are summarized in Tables 6.

TABLE 6: MAMMOTH CAVE NP GASOLINE STORAGE TANK EMISSIONS

Location	Number	Type	Volume (gal)	Throughput (gal/yr)	VOC (lbs/yr)
	National Park Service				
Maintenance Area - Gasoline	1	AST	3,000	17,185	490
Maintenance Area - E85	1	AST	3,000	2,560	58
	Forever Resorts, Inc.				
Service Station Tank #1	1	UST	6,000	29,720	200
Service Station Tank #1	1	UST	6,000	11,238	76
Service Station Tank #1	1	UST	6,000	6,425	43
			Totals	67,128	867

2.1.4 Wastewater Treatment Plants

There is no wastewater treatment plant at Mammoth Cave NP. Wastewater is delivered off-site to a treatment plant in Park City

2.2 AREA SOURCES

2.2.1 Woodstoves/Fireplaces

There are no woodstoves or fireplaces in Mammoth Cave NP.

2.2.2 Campfires

There are three campgrounds with 130 campsites in Mammoth Cave NP. It was assumed that these sites were occupied between 180 days a year and that approximately 50 percent had an

evening or morning campfire at each site. Assuming that each campfire site consumes approximately 10 lbs of wood, air emissions from campsites in 2000 were calculated and are summarized in Table 7.

TABLE 7: 2000 MAMMOTH CAVE NP CAMPFIRE EMISSIONS

Location	Campfires	Fuel (tons/yr)	PM10 (lbs/yr)	SO_2 (Ibs/yr)	NO_X (Ibs/yr)	CO (Ibs/yr)	VOC (Ibs/yr)
Headquarters	9,990	25	864	10	65	6,309	5,719
Houchins Ferry	1,080	3	93	1	7	682	618
Maple Springs	630	2	54	1	4	398	361
Total	11,700	29	1,012	12	76	7,389	6,698
			tons/yr				
			0.51 ~	0.01	0.04	3.69	3.35

2.2.3 Prescribed Fires

There have been no prescribed fires in Mammoth Cave NP prior to 2002.

2.2.4 Miscellaneous Area Sources

Miscellaneous area sources include food preparation, degreasers, paints and other surface coatings, lighter fluid consumption, consumer solvents, propane use by visitors in recreational vehicles, and highway maintenance, such as paving materials. However, few data on these activities and products were available.

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 **2000** STATIONARY AND AREA SOURCE EMISSIONS AT MAMMOTH CAVE NP

Activity	Particulates		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
Stationary Combustion Sources										
Space and Water Heating Units	43	0.02	1,249	0.62	635	0.32	128	0.06	12	<0.01
Generators	24	0.01	22	0.01	335	0.17	72	0.04	27	0.01
Gasoline Storage Tanks	-								867	0.43
Stationary Sources Subtotal	67	0.03	1,271	0.64	970	0.49	200	0.10	906	0.45
Area Sources										
Campfires	1,012	0.51	12	0.01	76	0.04 ~	7,3891	3.69	6,698	3.35
Totals										
	Particulates		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
Totals without Prescribed Burning	1,079	0.54	1,283	0.64	1,046	0.52	7,589	3.79	7,604	3.80

3. MOBILE SOURCE EMISSIONS

This section summarizes emissions from mobile sources at Mammoth Cave NP for 2000. Mobile emission sources include highway and nonroad vehicles.

3.1 HIGHWAY VEHICLES

3.1.1 Visitor Vehicles

The number of visitor vehicles operating in national parks generally correlates to the number of visitors. The park does not maintain statistics specifically on visitor vehicles, but does have monthly statistics on levels of visitation. Using a person per vehicle factor of 2.8 and assuming that the vehicles made one trip to the visitor center after entering the park form the two principal entrances off Interstate 65, an estimate of vehicles miles traveled was made and is summarized in Table 9.

TABLE 9: ESTIMATED VISITOR VEHICLE TRAVEL IN MAMMOTH CAVE NP

Visitors		Visitor Vehicles		**Visitor VMT (miles)**	
Summer	**Winter**	Summer	Winter	**Summer**	Winter
1,565,063	276,458	558,951	98,735	5,589,510	987,350
Total	1,841,521	Total	657,686	Total	6,576,860

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, PKo 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 MOBILE5b model were used in conjunction with VMT data in order to estimate mobile source emissions for VOC (both exhaust and evaporative), NOx, and CO for visitor vehicles. Similarly, emission factors produced by the PARTS model

were used in conjunction with VMT data to estimate PM_{10} emissions. MOBILE5b produces exhaust and evaporative emission factors for the following classes of vehicles: Light Duty Gasoline Vehicles (LDGV), Light Duty Gasoline Trucks 1 (LDGT1), 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 VMT 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 MOBILE5b 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 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 Mammoth Cave NP.

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 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 model was 35 mph, fuel volatility was assumed to be Reid vapor pressure (RVP) 9,

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 MOBILE5b 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 Mammoth Cave NP also were calculated based on VMT.

A summary of visitor vehicle emissions is provided in Table 14 at the end of this section.

3.1.2 NPS Highway Vehicles

Mammoth Cave NP operates a fleet of highway vehicles that are leased from the General Services Administration (GSA). There were data on the number of vehicles and their annual VMT. A summary of NPS and concessionaire vehicles and their estimated annual mileage is provided in Table 10, and emissions are summarized in Table 13 at the end of this section.

TABLE 10: **NPS** ROAD VEHICLES AT MAMMOTH CAVE **NP**

Vehicle Type	Number	Annual Usage (mi/yr)
National Park Service		
Light-Duty Gasoline Vehicles	5	34,945
Light-Duty Gasoline Trucks	28	189,182
Light Duty Diesel Trucks	4	39,764
Heavy Duty Gasoline Vehicles	3	18,075
Forever Resorts Shuttle Buses		
Heavy Duty Gasoline Vehicles	11	77,540

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 were no readily available records of the Mammoth Cave NP equipment, but park officials provided estimates, which are noted in Table 11. Emission factors from the USEPA nonroad emission database were used to calculate annual emissions, and estimated emissions are provided in Table 13.

TABLE 11: NPS NONROAD VEHICLES AT MAMMOTH CAVE NP

Vehicle Type	Number	Annual Usage (hrs/yr/each)
Tractors	10	600
Backhoe	2	200
Grader	1	100
Bobcat	1	100
Utility Vehicles	6	600

3.3 MARINE VESSELS

The park operates two outboard powered boats and two ferries across the Green River. A concessionaire operates a twin-diesel riverboat to provide visitors with scenic rides on the Green River. Data on these marine vessels and estimates of emissions are summarized in Table 12.

TABLE 12: MAMMOTH CAVE NP MARINE VESSEL EMISSIONS

Marine Vessels	No. of Engines	Engine Power (hp)	Hours of Operation	HC (Iblyr)	CO (lb/yr)	NO= (Ib/yr)	PM (Ib/yr)	SO_2 (Ib/yr)
National Park Service								
Outboard[1]	1	25	80	108	**214**	1	7	--
Outboard[1]	1	75	80	323	642	3	**21**	--
Car Ferries[1]	**2 ea**	40	8,760	204	**309**	1,445	**91**	57
Miss Green River II Scenic Boat								
Miss Green River 11[2]	2	135	990	156	236	1,102	70	43
			Total	790	1,401	2,552	**189**	100

1 Two-stroke gasoline engines
2 Diesel **engines**

3.4 SUMMARY OF MOBILE SOURCE EMISSIONS

Table 13 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 13: SUMMARY **OF 2000 MOBILE SOURCE EMISSIONS AT MAMMOTH CAVE NP**

Activity	Particulates[1]		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	13,167[1]	6.58	--	--	13,739	6.87	130,895	65.45	13,833	6.92
NPS Road Vehicles	564[1]	0.28	--	--	167	0.35	5,584	2.79	578	0.29
Resorts Forever Shuttle Buses	155[1]	0.08	--	--	718	0.36	1,443	0.72	206	0.10
Road Vehicle Emissions Subtotal	13,886	6.93	--	--	14,624	7.31	137,922	68.96	14,617	7.31
	Nonroad Vehicles									
NPS Nonroad Vehicles	166	0.08	--	--	293	0.15	248	0.12	185	0.09
Marine Vessels	189	0.09	100	0.05	2,552	1.28	1,400	0.70	790	0.40
	355	0.18	100	0.05	2,845	1.42	1,648	0.82	975	0.49
	Totals									
Totals	Particulates[1]		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
	14,241	7.12	100	0.05	17,469	8.73	139,570	69.79	15,592	7.80

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

4. MAMMOTH CAVE NP AND REGIONAL EMISSIONS

4.1 MAMMOTH CAVE NP SUMMARY

A summary of Mammoth Cave NP emissions is provided in Table 14.

TABLE 14: ESTIMATED ANNUAL EMISSIONS FROM MAMMOTH CAVE NP

Source	PM_{10} (tons/yr)	SO_2 (tons/yr)	NOx (tons/yr)	CO (tons/yr)	VOCs (tons/yr)
Point Sources					
Space and Water Heaters	0.02	0.62	0.32	0.06	<0.01
Generators	0.01	0.01	0.17	0.04	0.01
Gasoline Storage Tanks	--	--	--	--	0.43
Subtotal	0.03	0.64	0.49	0.10	0.45
Area Sources					
Campfires	0.54	0.07	0.52	3.79	3.80
Mobile Sources					
Road Vehicles	6.93	--	7.31	*68.96*	7.31
Nonroad Vehicles	0.18	--	1.42	0.82	0.49
Subtotal	7.12	--	8.73	69.79	7.80
Totals	7.69	0.71	17.43	73.68	12.05

As methane

4.2 REGIONAL AIR EMISSIONS

Emission estimates for Edmonson, Hart, and Barren Counties, KY and the state of Kentucky 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 NET. For example, here gasoline storage tanks have been included as stationary sources, while the NEI treats them as area sources. Table 15 provides a comparison of Mammoth Cave NP emissions with those from the surrounding counties and the two states. For all pollutants, Mammoth Cave NP emissions account for less than 1 percent of the surrounding county point and area source emissions.

TABLE 15: ESTIMATED ANNUAL EMISSIONS FROM MAMMOTH CAVE NP, SURROUNDING COUNTIES, AND KENTUCKY

Area	I'M$_{i}$a (tons/yr)	SO_2 (tons/yr)	NOx (tons/yr)	CO (tons/yr)	VOC (tons/yr)
Point Sources					
Mammoth Cave NP Total	0.03	0.64	0.49	0.10	0.45
Edmonson County	0	0	0	0	0
Hart County	44	9	21	20	118
Barren County	153	12	55	48	205
Surrounding County Total	197	21	76	68	323
Kentucky	26,148	698,840	344,319	75,615	63,760
Area Sources					
Mammoth Cave NP Total	0.54	0.07	0.52	3.79	3.80
Edmonson County	1,126	24	34	1,274	379
Hart County	1,802	70	143	1,646	637
Barren County	3,835	1,239	947	2,873	1,972
Surrounding County Total	6,763	1,333	1,124	5,793	2,988
Kentucky	146,687	54,855	70,723	169,936	129,203
Mobile Sources					
Mammoth Cave NP Total	7.12	--	8.73	69.79	7.80
Edmonson County	28	46	685	2,707	299
Hart County	65	99	1.938	7,240	708
Barren County	114	1,415	2,723	13,234	1,342
Surrounding County Total	207	1,560	5,346	23,181	2,349
Kentucky	122,815	31,740	280,314	1,262,005	136,976

Finally, estimated emissions from the eight states that constitute Region 4 and those from the United States are summarized in Table 16.

TABLE 16: ESTIMATED 1999 EMISSIONS FROM REGION 4 AND THE U.S.

Area	PM_{10} (tons/yr)	SO_2 (tons/yr)	NO_X (tons/yr)	CO (tons/yr)	VOC (tons/yr)
Point Sources					
Kentucky	26,148	698,840	344,319	75,615	63,760
Tennessee	26,966	609,058	284,711	106,151	120,220
North Carolina	27,473	544,445	271,630	80,879	68,306
South Carolina	9,570	272,578	136,304	66,773	49,525
Georgia	39,711	594,918	242,933	178,368	36,050
Mississippi	10,226	164,064	158,352	90,578	43,430
Alabama	46,634	665,668	285,896	207,527	96,960
Florida	23,225	820,475	373,354	74,422	27,154
Region 4 Totals	209,953	4,370,046	*2,097,499*	880,313	505,405
United States	1,111,756	16,296,167	9,037,572	5,307,982	2,061,167
Area Sources					
Kentucky	146,687	54,855	70,723	169,936	129,203
Tennessee	272,941	40,504	49,156	318,682	226,223
North Carolina	340,059	31,162	30,971	867,428	318,707
South Carolina	93,467	13,868	136,304	66,773	49,525
Georgia	307,592	5,681	64,864	1,316,334	248,555
Mississippi	180,140	71,135	52,021	442,300	142,759
Alabama	158,799	43,682	63,506	628,610	151,317
Florida	204,469	38,115	61,110	979,936	376,167
Region 4 Totals	1,704,154	299,002	528,655	4,789,999	1,642,456
United States	9,734,269	1,289,884	2,251,929	16,972,636	7,574,071
Mobile Sources					
Kentucky	122,815	31,733	280,317	1,262,003	137,257
Tennessee	111,674	36,420	406,655	1,879,125	202,336
North Carolina	171,063	32,259	373,528	2,208,120	248,798
South Carolina	201,778	16,156	218,302	1,360,805	152,338
Georgia	520,615	35,260	453,921	2,810,844	288,475
Mississippi	219,254	14,662	194,181	1,013,591	127,336
Alabama	320,076	20,540	285,785	1,733,273	197,263
Florida	341,205	65,103	678,983	4,808,725	543,028
Region 4 Totals	2,008,480	252,133	2,891,672	17,076,486	1,896,831
United States	12,831,958	1,299,342	14,105,483	75,151,535	8,536,092

5. COMPLIANCE AND RECOMMENDATIONS

5.1 COMPLIANCE

The Kentucky Depailment of Environmental Protection, Division for Air Quality is the governing authority for regulating air pollution. Park personnel should continue to 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. For example, the KY DEP/DAQ Permit Review Branch maintains a list of activities that they have approved as insignificant, and they do not require permits. These include:

- gas-fired space heaters rated at less than one million BTU per hour heat input
- natural gas-fired boilers with rated capacity less than 10 million BTU per hour
- distillate oil-fired space heaters rated at less than two million BTU per hour heat input and distillate oil with a maximum sulfur content of less than 0.5 percent by weight
- emergency electric generators rated at 500 hp or less operating on distillate oil, propane, natural gas, or gasoline, providing that no unit is operated more than 500 per year.

Kentucky also has exemptions to open burning regulations that may apply to visitor activities in the park. Title 401 Kentucky Administrative Regulation 63:005 exempts "fires set for the cooking of food for human consumption and fires set for ceremonial purposes." Fires set for recognized agricultural, silvicultural, range, and wildlife management practices also are allowed. Measures to prevent the creation of fugitive dust also must be taken. For example, 401 KAR 63:010 Section 3 requires that persons handling, transporting, or storing materials take reasonable precautions to prevent particulate matter from becoming airborne.

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.

Opportunities to reduce NOx and VOC emissions, which are the precursors for ozone formation, in Mammoth Cave NP are related to the reduction or replacement of conventional fossil fuels. Efforts in recent years have been directed at the utilization of some alternative fuels in park vehicles. In FY 1998, the park began replacing some of its vehicles with bi-fuel vehicles. Using a grant from the Kentucky Corn Growers Association, a fuel storage tank for E85 (a mixture of 85 percent ethanol and 15 percent gasoline) was acquired, and 12 bi-fuel vehicles have been leased to date. Park records indicate that approximately 2,600 gallons of E85 were consumed in FY 2001, and this represents about 13 percent of the total gasoline and E85 consumed by park vehicles in FY 2001. The park also is utilizing biodiesel fuel (B20) in all of its small diesel-powered equipment, including mowers, tractors, and similar equipment typically operated in view of the pubic by the Facilities Management Division. The park also is investigating the replacement of its two Cushmans and two John Deere Gators with electric carts.

An analysis of the emission reductions possible with the use of E85 in all park gasoline road vehicles and biodiesel fuels in the park's diesel road vehicles and concessionaire shuttle buses is summarized in Table 17.

TABLE 17: ESTIMATED EMISSIONS WITH E85 GASOLINE/BIODIESEL VEHICLE FUELS

Fuel		Percent Reduction			
	PM,o	**SO_2**	**NOx**	**CO**	**VOC**
E85 Gasoline'	-20	-80	-10	-40	-15
Biodiesel (20% biomass based oil)	-10.1	--	+2	-11.0	-21.1
	Emissions (tons/yr)				
Regular Gasoline	0.264	--	0.270	2.624	0.265
E85 Gasoline'	0.211	--	0.243	1.574	0.225
Regular Diesel	0.096	--	0.443	0.890	0.127
Biodiesel (20% biomass based oil)	0.085	--	0.452	0.792	0.100

85 percent ethanol/15 percent gasoline

The park may consider investigating the use of low sulfur gasoline and diesel fuels for use in its vehicles and the sale of low sulfur gasoline at the concessionaire service station at the Visitor Center complex. An analysis of the emission reductions possible with these fuels is summarized in Table 18. Although these reductions would be minor if such fuels were used by park vehicles only, significant reductions may be possible if these fuels were widely available to the general public in the park and in the surrounding communities.

TABLE 18: ESTIMATED EMISSION REDUCTIONS WITH LOW SULFUR VEHICLE FUELS

Fuel	Percent Reduction				
	PM_{10}	**SO_2**	**NOr**	**CO**	VOC
Low Sulfur Gasoline[1]	-13	-88	-11	-15	-16
Low Sulfur Diesel[2]	-9	-97	0	0	0

[1] 30 ppmw (Tier 2 gasoline rule) versus 300 ppmw
[2] 15 ppmw (proposed diesel sulfur rule) versus 500 ppmw

The park has also undertaken several initiatives that directly or indirectly reduce emissions and/or energy and water consumption:

- A number of waterless urinals have been installed in comfort stations and restrooms, and it is estimated that they are saving approximately 500,000 gallons of water a year.
- Park recycling programs include campground recycling, cardboard and aluminum recycling, battery recycling, and the use of recycled lumber on park trails when feasible.
- Solar powered parking lot lights have been installed at the Green River boat launch ramp.
- The park joined with the local community in the construction of a state of the art municipal treatment plant and constructed a sewer line four miles to tie into the new system.

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APPENDIX A

FUEL DATA AND EMISSION FACTORS

FUEL DATA

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

STATIONARY SOURCE EMISSION FACTORS - BOILERS/HEATING UNITS

DISTILLATE OIL (DF-2) - CRITERIA POLLUTANTS					
Combustor Type	Emission Factor (lb/1,000 gal fuel burned)				
	PM[a]	50 ([b])	NO,,[c]	CO	VOC[d]
Residential Furnace[e]	0.4	142S	18	5	0.713
Boilers < 100 Million Btu/hr (Commercial/Institutional Combust.[w])	2	142S	20	5	0.34
Boilers < 100 Million Btu/hr (Industrial Boilers[g])	2	142S	20	5	0.2
Boilers > 100 Million Btu/hr (Utility Boilers[h])	2	157S	24	5	--
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Tables 1.3-1 and 1.3-3.					

NATURAL GAS - CRITERIA POLLUTANTS					
Combustor Type (MMBtu/hr Heat Input)	Emission Factor (lb/10^6 ft^3 fuel burned)				
	PM[0)]	SO_2	NO_X[(`)]	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_x burners	7.6	0.6	50	84	5.5
-Controlled-Low NO_x 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)[`]	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]	SOP)	NO_x[c]	CO	VOC[d]
Commercial Boilers[o]	0.4	0.105	14	1.9	0.3
Industrial Boilers[g]	0.6	0.1OS	19	3.2	0.3
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.5-1.					

STATIONARY SOURCE EMISSION FACTORS - GENERATORS

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

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

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

Fuel Type	Emission Factor (lb/hp-hr)				
	PM	SO_x[b]	NO_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 3.4-1.					

FIREPLACE EMISSION FACTORS

Fuel Type	Emission Factor (lb/ton)				
	PM[U)]	SO.	NO_X[(ˇ)]	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[0)]	SO_X	NO_X[cc)]	CO	VOC
Conventional	30.6	0.4	2.8	230.8	53
Noncatalytic	19.6	0.4	--	140.8	12
Catalytic	20.4	0.4	2.0	104.4	15
Source: AP-42, 5th Edition, Supplements A, B, C, D, and E, Table 1.10-1.					

STATIONARY SOURCE EMISSION FACTORS - SURFACE COATING OPERATIONS

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

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

APPENDIX B

EMISSION CALCULATIONS

2000 ACTUAL CRITERIA EMISSIONS FROM GENERATORS AT MAMMOTH CAVE NP

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO_2 (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Generator	Maintenance Area Ranger Station	Diesel	1	30	52	1,560	5	4	65	2,404	14	5
Generator	Elevator House	Diesel	1	125	52	6,500	19	18	270	10,017	58	22
	Diesel Generator Totals		2				24	22	335	12,420	72	27
Emission Factors from AP-42, Table 3.3-1 for generators rated < 448 kW							2.20E-03	0.00205	3.10E-02	1.15E+00	6.68E-03	2.51E-03

Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)

2000 POTENTIAL CRITERIA EMISSIONS FROM GENERATORS AT MAMMOTH CAVE NP

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO, (lbs/yr)	CO, (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Generator	Maintenance Area Ranger Station	Diesel	1	30	500	15,000	44	41	623	23,115	134	50
Generator	Elevator House	Diesel	1	125	500	62,500	184	172	2,596	96,313	559	210
	Diesel Generator Totals		2				228	213	3219	119,428	694	261
Emission Factors from AP-42, Table 3.3-1 for generators rated < 448 kW							2.20E-03	0.00205	3.10E-02	1.15E+00	6.68E-03	2.51E-03

Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)

2000 ACTUAL CRITERIA EMISSIONS FROM GENERATORS AT MAMMOTH CAVE NP

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{10} (lbs/yr)	SO_2 (lbs/yr)	NO_X (lbs/yr)	CO_2 (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Generator	Maintenance Area Ranger Station	Diesel	1	30	52	1,560	5	4	65	2,404	14	5
Generator	Elevator House	Diesel	1	125	52	6,500	19	18	270	10,017	58	22
	Diesel Generator Totals		2				24	22	335	12,420	72	27
Emission Factors from AP-42, Table 3.3-1 for generators rated < 448 kW							2.20E-03	0.00205	3.10E-02	1.15E+00	6.68E-03	2.51E-03

Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)

2000 POTENTIAL CRITERIA EMISSIONS FROM GENERATORS AT MAMMOTH CAVE NP

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM_{t0} (lbs/yr)	SO_2 (lbs/yr)	$NO_{,;}$ (Ibs/yr)	CO_2 (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Generator	Maintenance Area Ranger Station	Diesel	1	30	500	15,000	44	41	623	23,115	134	50
Generator	Elevator House	Diesel	1	125	500	62,500	184	172	2,596	96,313	559	210
	Diesel Generator Totals		2				228	213	3219	119,428	694	261
Emission Factors from AP-42, Table 3.3-1 for generators rated < 448 kW							2.20E-03	0.00205	3.10E-02	1.15E+00	6.68E-03	2.51E-03

Formula = Output (kW-hr/yr)* 1.34 (hp/kW) * Emission Factor (lb/hp-hr)

2000 ACTUAL CRITERIA EMISSIONS FROM GENERATORS AT MAMMOTH CAVE NP

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM (Ibs/yr)	SO_2 (Ibs/yr)	NO_z (Ibs/yr)	CO (lbs/yr)	VOC (Ibs/yr)
Generator	Maintenance Area	Diesel	1	30	52	1,560	5	0	65	14	5
Generator	Ranger Station Elevator House	Diesel	1	125	52	6,500	19	1	270	58	22
	Diesel Generator Totals		2				24	1	335	72	27

Emission Factors from AP-42, Chapter 3.4-1 for generators rated less than 448 kW, 5=.05 2.20E-03 00205*S 3.10E-02 6.68E-03 2.51E-03
Formula = Output (kW-hr/yr) * 1.34 (hp/kW) * Emission Factor (lb/hp-hr)

2000 POTENTIAL CRITERIA EMISSIONS FROM GENERATORS AT MAMMOTH CAVE NP

Emission Source	Location	Fuel	Number of Sources	Rating (kW)	Run Time (hrs/yr)	Output (kW-hr/yr)	PM (Ibs/yr)	SO_2 (Ibs/yr)	NO, (Ibs/yr)	CO (Ibs/yr)	VOC (Ibs/yr)
Generator	Maintenance Area Ranger Station	Diesel	1	30	500	15,000	44	2	623	134	50
Generator	Elevator House	Diesel	1	125	500	62,500	184	9	2,596	559	210
	Diesel Generator Totals		2				228	11	3219	694	261

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

Identification

User Identification:	MACA Gas
City:	Louisville
State:	Kentucky
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	3000 Gallon AST

Tank Dimensions

Shell Length (ft):	18.00
Diameter (ft):	5.25
Volume (gallons):	3,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	17,185.00
Is Tank Heated (yin):	N
Is Tank Underground (y/n):	N

Paint Characteristics

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

Breather Vent Settings

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

Meteorological Data used in Emissions Calculations: Louisville, Kentucky (Avg Atmospheric Pressure = 14.5 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 9)	All	57.79	52.64	62.94	56.05	4.4143	3.9812	4.8847	67.0000			92.00	Option 4: RVP=9, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Workin LOSS	Breathing Loss	Total Emissions
Gasoline (RVP 9)	121.02	369.03	490.05

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

Identification

User Identification:	MACA E85
City:	Louisville
State:	Kentucky
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	3000 AST

Tank Dimensions

Shell Length (ft):	18.00
Diameter (ft):	5.25
Volume (gallons):	3,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	2,560.00
Is Tank Heated (yin):	N
Is Tank Underground (y/n):	N

Paint Characteristics

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

Breather Vent Settings

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

Meteorological Data used in Emissions Calculations: Louisville, Kentucky (Avg Atmospheric Pressure = 14.5 psia)

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

Mixture/Com.onent	Month	Daily Liquid Surf. Temperatures (deg F) Av..	Min.	Max.	Liquid Bulk Temp. de. F	Vapor Pressures (psia) Av..	Min.	Max.	Vapor Mol. Wei.ht	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Wei.ht	Basis for Vapor Pressure Calculations
Ethyl alcohol	All	64.76	54.95	74.58	59.11	0.7733	0.5521	1.0680	46.0700			46.07	Option 2: A=8.321, B=1718.21, C=237.52

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Ethyl alcohol	2.17	55.94	58.11

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

Identification

User Identification:	Forever Resorts No. 1
City:	Louisville
State:	Kentucky
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	6000 Gallon UST

Tank Dimensions

Shell Length (ft):	16.00
Diameter (ft):	8.00
Volume (gallons):	6,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	29,720.00
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: Louisville, Kentucky (Avg Atmospheric Pressure = 14.5 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 9)	All	55.47	55.47	55.47	55.03	4.2145	4.2145	4.2145	67.0000			92.00	Option 4: RVP=9, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)			
Components	Working Loss	Breathing Loss	Total Emissions	
Gasoline (RVP 9)	199.81	0.00	199.81	

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

Identification

User Identification:	Forever Resorts No. 2
City:	Louisville
State:	Kentucky
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	6000 Gallon UST

Tank Dimensions

Shell Length (ft):	16.00
Diameter (ft):	8.00
Volume (gallons):	6,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	11,238.00
Is Tank Heated (yin):	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: Louisville, Kentucky (Avg Atmospheric Pressure = 14.5 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 (psis) Avg.	Min.	Max.	Vapor Mot. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mot. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 9)	All	55.47	55.47	55.47	55.03	4.2145	4.2145	4.2145	67.0000			92.00	Option 4: RVP=9, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 9)	75.55	0.00	75.55

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

Identification

User Identification:	Forever Resorts
City:	Louisville
State:	Kentucky
Company:	NPS
Type of Tank:	Horizontal Tank
Description:	6000 Gallon UST

Tank Dimensions

Shell Length (ft):	16.00
Diameter (ft):	8.00
Volume (gallons):	6,000.00
Turnovers:	0.00
Net Throughput (gal/yr):	6,425.00
Is Tank Heated (yin):	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: Louisville, Kentucky (Avg Atmospheric Pressure = 14.5 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 9)	All	55.47	55.47	55.47	55.03	4.2145	4.2145	4.2145	67.0000			92.00	Option 4: RVP=9, ASTM Slope=3

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)			
Components	Working Loss	Breathing Loss	Total Emissions	
Gasoline (RVP 9)	43.20	0.00	43.20	

2000 ACTUAL EMISSIONS FROM CAMPFIRES AT MAMMOTH CAVE NATIONAL PARK

Location	Campsites	Open Days/Yr	Camps	Fires/Yr	Tons/Yr	PM (lbs/yr)	SO_2 (lbs/yr)	$NO_{,,}$ (lbs/yr)	CO (lbs/yr)	VOC (lbs/yr)
Headquarters	111	180	9,990	4,995	25	864	10	65	6,309	5,719
Houchins Ferry	12	180	1,080	540	3	93	1	7	682	618
Maple Springs	7	180	630	315	2	54	1	4	398	361
	130		11,700	5,850	29	1,012	12	76	7,389	6,698
					Tons/Yr	0.51	0.01	0.04	3.69	3.35

Assumption: Fifty percent of camp sites have either an evening or morning campfire
Campsites are open half a year and are occupied 50 percent of the time

					Emission Factors (lbs/ton)
34.6	0.4	2.6	252.6	229	

TOTAL MAMMOTH CAVE NP VISITOR VEHICLES

	Total Visitors	Winter Visitors	Summer Visitors	Winter Vehicles	Summer Vehicles	Winter VMT	Summer VMT
Jan	87,536	87,536		31,263			
Feb	88,980	88,980		31,779			
Mar	130,307		130,307		46,538		
Apr	155,470		155,470		55,525		
May	163,393		163,393		58,355		
Jun	210,883		210,883		75,315		
Jul	256,005		256,005		91,430		
Aug	209,310		209,310		74,754		
Sep	172,186		172,186		61,495		
Oct	156,210		156,210		55,789		
Nov	111,299		111,299		39,750		
Dec	99,942	99,942		35,694			
	1,841,521	276,458	1,565,063	98,735	558,951	987,350	5,589,511

MAMMOTH CAVE NP VISITOR VEHICLE EMISSIONS

Summer VMT	Winter VMT
5,589,511	987,350

	Emission Factors (glmi)					Emissions (tons/yr)			
	NOx	CO	VOC	PM10		NOx	CO	VOC	PM10
Summer	0.93	8.41	0.95	0.91		5.72	51.71	5.84	5.60
Winter	1.06	12.65	0.99	0.91		1.15	13.74	1.08	0.99
					Total	6.87	65.45	6.92	6.58
						Emissions (lbs/yr)			
						13,739	130,895	13,833	13,167

MAMMOTH CAVE NP-OWNED VEHICLE EMISSIONS

	LDGV	LDGT	LDGT2	LDDT	HDGV	
Vehicles	5	27	1	4	3	40
	0.12	0.67	0.03	0.11	0.06	1
VMT	34,944	189,182	9,640	30,124	18,075	281,965

	Emission Factors (g/mi)					Emissions (lbs/yr)			
	NOx	CO	VOC	PM10		NOx	CO	VOC	PM10
LDGV	0.73	7.65	0.83	0.91		56	588	64	70
LDGT	0.93	10.52	1.00	0.91		387	4,378	416	379
LDGT2	1.00	10.52	0.97	0.91		21	223	21	19
LDDT	1.13	0.88	0.44	0.91		75	58	29	60
HDGV	4.21	8.46	1.21	0.91		167	336	48	36
					Total	707	5,584	578	564
					tons/yr	0.35	2.79	0.29	0.28

RESORTS FOREVER SHUTTLE BUSES

HDGV	Emission Factors (g/mi)					Emissions (lbs/yr)			
11 Vehicles	NOx	CO	VOC	PM10		NOx	CO	VOC	PM10
77,540 VMT	4.21	8.46	1.21	0.91		718	1,443	206	155
					Total	718	1,443	206	155
					tons/yr	0.36	0.72	0.10	0.08

MAMMOTH CAVE NP-OWNED VEHICLE EMISSIONS

	LDGV	LDGT	LDGT2	LDDT	HDGV	
Vehicles	5	27	1	4	3	40
	0.12	0.67	0.03	0.11	0.06	1
VMT	34,944	189,182	9,640	30,124	18,075	281,965

	Emission Factors (g/mi)					Emissions (lbs/yr)			
	NOx	CO	VOC	PM10		NOx	CO	VOC	PM10
LDGV	0.73	7.65	0.83	0.91		56	588	64	70
LDGT	0.93	10.52	1.00	0.91		387	4,378	416	379
LDGT2	1.00	10.52	0.97	0.91		21	223	21	19
LDDT	1.13	0.88	0.44	0.91		75	58	29	60
					Regular Gasoline	539	5,248	530	528
						Emissions (tons/yr)			
					Totals	0.270	2.624	0.265	0.264
					E85 Totals	0.243	1.574	0.225	0.211
						Emissions (lbs/yr)			
HDGV	4.21	8.46	1.21	0.91	Regular Diesel	167	336	48	36
						Emissions (tonslyr)			
					Totals	0.084	0.168	0.024	0.018
					Biodiesel	0.085	0.150	0.019	0.016

RESORTS FOREVER SHUTTLE BUSES

HDGV	Emission Factors (glmi)					Emissions (lbs/yr)			
11 Vehicles	NOx	CO	VOC	PM10		NOx	CO	VOC	PM10
77,540 VMT	4.21	8.46	1.21	0.91		718	1,443	206	155
					Regular Diesel Totals	Emissions (tons/yr)			
						0.359	0.722	0.103	0.078
					Biodiesel	0.366	0.642	0.081	0.069
					Park and Resorts Forever Regular Diesel	0.443	0.890	0.127	0.096
					Park and Resorts Forever Biodiesel	0.452	0.792	0.100	0.085

2000 MAMMOTH CAVE NP NONROAD VEHICLE EMISSIONS

		Emission Factors (gm/hp-hr)							Emissions (lbs/yr)			
Vehicle	No.	PM	Nox	CO	VOC	hp	load	hrs/yr	PM	Nox	CO	VOC
Utility Vehicle	6	2.04	1.03	2.31	2.19	15	0.55	600	22.2	11.2	25.2	23.8
Tractors	10	2.04	1.03	2.31	2.19	42.35	0.68	600	77.5	39.2	87.8	83.2
										0.0	0.0	
Backhoe	2	2.04	1.03	2.31	2.19	77	0.55	200	38.0	19.2	43.0	40.8
Bobcat	1	2.04	1.03	2.31	2.19	15	0.55	100	3.7	1.9	4.2	4.0
Grader	1	1.06	9.6	3.8	1.43	172	0.61	100	24.5	221.6	87.7	33.0
							Totals:	(lbs/yr)	166	293	248	185
								(tons/yr)	0.08	0.15	0.12	0.09

MAMMOTH CAVE NP MARINE VESSEL EMISSIONS

Diesel Engine Emission Factors[1]

Units	HC	CO	NO,	PM	SO_2
(g/hp-hr)	1.26	1.91	8.92	0.563	0.352
(lb/hp-hr)	0.003	0.004	0.020	0.001	0.001

1 g = 0.0022016 lbs
BSFC = 0.367 lb/hp-hr

[1] Source: Exhaust Emission Factors for Nonroad Engine Modeling - Compression-Ignition EPA Report No., NR-009A; Table 1

2-Stroke Gasoline Engine Emission Factors[3]

Units	HC	CO	NO,	PM	SO_2
(g/hp-hr)	116.38	231.26	1.19	7.7	0.000
(lb/hp-hr)	0.256	0.509	0.003	0.017	0.000

4-Stroke Gasoline Engine Emission Factors[3]

Units	HC	CO	NO,	PM	SO_2
(g/hp-hr)	14.92	339.18	7.46	0.06	0.000
(lb/hp-hr)	0.033	0.747	0.016	0.0001	0.000

[3] Source: Nonroad Emission Inventory Model, Draft, June 17, 1998

NPS Criteria Pollutant Emissions[4]

No. of Engines	Engine Power (hp)	Hours of Operation	Load Factor	HC (lb/yr)	CO (lb/yr)	NO, (lb/yr)	PM (lb/yr)	SO_2 (lb/yr)
1	25	80	0.21	108	214	1	7	0
1	75	80	0.21	323	642	3	21	
				430	855	4	28	0
				(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)
				0.22	0.43	0.00	0.01	0.00

"Assumes 2-stroke engines

Emissions = Emission Factor' No. of Engines' Engine Power * Hours of Operation *Load Factor

MISS GREEN RIVER || SCENIC BOAT RIDES[4]

No. of Engines	Engine Power (hp)	Hours of Operation[5]	Load Factor	HC (lb/yr)	CO (lb/yr)	NO, (lb/yr)	PM (lb/yr)	SO_2 (lb/yr)
2	135	990	0.21	156	236	1,102	70	43
				(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)
				0.08	0.12	0.55	0.03	0.02

[4] Assumes diesel engines

NPS FERRIES[4]

Ferry	No. of Engines	Engine Power (hp)	Hours of Operation[5]	Load Factor	HC (lb/yr)	CO (lb/yr)	NO, (lb/yr)	PM (lb/yr)	SO_2 (lb/yr)
Green River	1	40	5,840	0.21	136	206	963	61	38
Houchins	1	40	2,920	0.21	68	103	482	30	19
					204	309	1,445	91	57
					(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)
					0.10	0.15	0.72	0.05	0.03

[4] Assumes diesel engines

TOTALS

	HC	CO	NO,	PM	SO_2
(lb/yr)	790	1,401	2,552	189	100
(ton/yr)	0.40	0.70	1.28	0.09	0.05

APPENDIX C

PUBLIC USE DATA

MAMMOTH CAVE NATIONAL PARK

VISITATION FOR 2000 ***and*** 2001

2000 ***Visitation***

January	87,536
February	88,980
March	130,307
April	155,470
May	163,393
June	210,883
July	256,005
August	209,310
September	172,186
October	156,210
November	111,299
December	99,942
Total	1,841,521

2001 ***Visitation***

January	92,422
February	84,631
March	124,351
April	172,121
May	195,851
June	225,981
July	297,661
August	262,033
September	158,683
October	150,867
November	114,447
December	105,221
"'uLal	1, 983, 433

Form 10-157
(Rev. 3/77)

U.S. DEPARTMENT OF INTERIOR

MONTHLY PUBLIC USE REPORT

PARK	MONTH YEAR	UPDATE CODE	PARK CODE	iONTH YEAR	CATE-GORY	R/U
MAMMOTH CAVE NATIONAL PARK	112/2001		55301			

	CURRENT-MONTH Recreational	Nonrecreational	Total	YEAR-TO-DATE
VISITS	97047	8174	1052211	1983433

	CURRENT-MONTH Recreational	Nonrecreational	Total	YEAR-TO-DATE
VISITOR HOURS	2084221	72121	2156341	4969340

RECREATION O/N STAYS	CURRENT MONTH	YEAR-TO-DATE
CONCESSIONER LODGING	10141	26258
CONCESSIONER CAMPGROUNDS		
NPS CAMPGROUNDS	48	48996
NPS BACKCOUNTRY	1321	4981
NPS MISCELLANEOUS	01	11468
TOTAL OVERNIGHT STAYS	1194	91703

NPS CAMPGROUNDS

TENTS	44
R/VS	4
TOTAL	48

VISITOR-HOUR APPENDIX

SEE WORKSHEET

SPECIAL USE DATA	THIS MONTH	YEAR-TO DATE		THIS MONTH	YEAR-TO DATE
CAVE VISITORS	8867	407288	TRAIL USE	614	46961
NON-CAVE VISITORS	88180	1483892	BOAT/CANOE USE	187	10728
GR FERRY VEHICLES	6112	96713	MISS GREEN PASS	0	35896
HOUCHINS FERRY VEH'S	563	5711	BUSES	9	417

	THIS YEAR	SAME MONTH LAST YEAR		%CHANGE
TOTAL VISITS TM	105221	TOTAL VISITS LY	99942	5.3
YID VISITS TM	1983433	YID VISITS Lt	1841521	/./
CAVE VISITS TM	8867	CAVE VISITS LY	5945	49.2
CAVE YTD TM	407288	CAVE YTD LY	419307	-2.9

SIGNATURE WAYNE C. ELLIOTT

TITLE CHIEF PARK RANGER

DATE 01/08/02

MAMMOTH CAVE NATIONAL PARK WORKSHEET VER=4.02

ENTER REPORTING MONTH/YEAR >*12/2001

		ENTER THE # OF DAYS TC WAS OUT
ENTER TRAFFIC COUNT (TC) AT 3202 LANE 2 (EAST ENTRANCE ROAD WESTBOUND LANE)	0	31
ENTER TRAFFIC COUNT AT 3202 LANE 3 (SOUTH ENTRANCE ROAD NORTHBOUND LANE)	0	31
ENTER TRAFFIC COUNT AT 3201 LANE 4 (S.H. 70 EASTBOUND LANE)	0	31
ENTER TRAFFIC COUNT AT 3201 LANE 2 (S.H. 70 WESTBOUND LANE)	0	31

	BUSES
ENTER THE NUMBER OF BUSES AT VISITOR CENTER	* 9

	TENTS	RV'S
ENTER THE NUMBER OF SITES OCCUPIED AT HEADQUARTERS CG	* 0	* 0
ENTER THE NUMBER OF SITES OCCUPIED AT HOUCHINS FERRY CG	11	* 1

ENTER THE NUMBER OF OVERNIGHT STAYS AT MAPLE SPRINGS GROUP CG	* 0
ENTER THE NUMBER OF BACKCOUNTRY OVERNIGHT STAYS	* 110
ENTER THE NUMBER OF OVERNIGHT STAYS AT MAMMOTH CAVE HOTEL	* 1014
ENTER THE NUMBER OF CAVE VISITORS	* 8867
ENTER FERRY COUNT AT HOUCHINS FERRY	* 563

	LAUNCHES	TAKE-OUTS
ENTER BOAT LAUNCHES/BOATS TAKEN OUT AT HOUCHINS FERRY	* 14	* 17

	LAUNCHES	TAKE-OUTS
ENTER CANOE LAUNCHES/CANOES TAKEN OUT AT HOUCHINS FERRY	0	* 4

ENTER FERRY COUNT AT GREEN RIVER FERRY * 6112

	LAUNCHES	TAKE-OUTS
ENTER BOAT LAUNCHES/BOATS TAKEN OUT AT GREEN RIVER FERRY	* 20	* 17

	LAUNCHES	TAKE-OUTS
ENTER CANOE LAUNCHES/CANOE TAKEN OUT AT GREEN RIVER FERRY	* 5	* 1

MAMMOTH CAVE NATIONAL PARK WORKSHEET=PAGE=2

ENTER THE NUMBER OF TRAIL VISITORS AT TEMPLE HILL	*	54
ENTER THE NUMBER OF TRAIL VISITORS AT GOOD SPRING	*	161
ENTER THE NUMBER OF TRAIL VISITORS AT JAGGERS	*	16
ENTER THE NUMBER OF TRAIL VISITORS AT LINCOLN	*	2
ENTER THE NUMBER OF HORSEBACK RIDERS	*	84
ENTER THE NUMBER OF MISS GREEN RIVER TRIPS	*	0
ENTER THE NUMBER OF MISS GREEN RIVER PASSENGERS	*	0

ENTER TRAIL USE AT:

CEDAR SINK	*	14
TURNHOLE	*	15
SLOANS CROSSING	*	29
HEADQUARTERS TRAILS	*	196
SAND CAVE	*	25

PRESS> 1110I^L TO SAVE

	VEHICLES	EST VEH COUNTS		VISITORS
		-70 East-	70 West	
STATE HIGHWAY 70	0	10850	11470	42029
		-3202 (2)-		
SOUTH ENTRANCE	0	8525		20449
		-3202 (3)-		
EAST ENTRANCE	0	9300		22309
BUS VISITORS				360
CAVE VISITORS				8867
FERRY VISITORS				10857
O/N STAY VISITORS		Dennison Ferry (no longer used)		180
BOAT/CANOE VISITORS				203
TRAIL VISITORS				559
HORSEBACK RIDERS				101
MISS GREEN PASSENGERS				0
'lul'AL u/LI J1'A1				1194

TOTAL RECREATION VISITS	97047	TOTAL NONRECREATION VISITS	8174
TOTAL RECREATION HOURS	208422	TOTAL NONRECREATION HOURS	7212

CONTROL#00120 LAST # 119 CLY 108

APPENDIX D

SELECTED KENTUCKY AIR REGULATIONS

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Division of Environmental Services

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401 KAR 63:005. Open burning.

RELATES TO: KRS 224.10-100, 224.20-100, 224. 20-110, 224.20-120, 42 USC 7401 through 7671q

STATUTORY AUTHORITY: KRS 224.10-100

NECESSITY, FUNCTION, AND CONFORMITY: KRS 224.10-100 requires the Natural Resources and Environmental Protection Cabinet to prescribe administrative regulations for the prevention, abatement, and control of air pollution. This administrative regulation provides for the control of open burning.

Section 1. Definitions. Terms not defined in this section shall have the meaning given them in 401 KAR 63:001.

(1) "Garbage" means putrescible animal and vegetable matter accumulated by a family in a residence in the course of ordinary day to day living.

(2) "Household rubbish" means waste material and trash, not to include garbage, normally accumulated by a family in a residence in the course of ordinary day to day living.

(3) "Open burning" means the burning of any matter without an approved burn chamber and a stack or chimney with approved control devices.

(4) "Priority I Region" means a region classified as Priority I in 401 KAR 50:020, Appendix A.

Section 2. Applicability. This administrative regulation shall apply to all open buming that is not subject to another administrative regulation in 401 KAR Chapters 50 through 65.

Section 3. Prohibition of Open Burning. Except as provided in this section open burning is prohibited. Fires may be set for the purposes specified in this section throughout the year in any area of the Commonwealth which is not designated, or was not previously designated, moderate nonattainment for ozone pursuant to 401 KAR 51:010, if the fires do not violate KRS Chapters 149, 150, 227, other laws of the Commonwealth of Kentucky, or local ordinances. Purposes for which open burning is allowed are:

(1) Fires set for the cooking of food for human consumption;

(2) Fires set for recreational or ceremonial purposes;

(3) Small fires set by construction and other workers for comfort heating purposes if excessive or unusual smoke is not created;

(4) Fires set for the purpose of weed abatement, disease, and pest prevention;

(5) Fires set for prevention of a fire hazard, including the disposal of dangerous materials if no safe alternative is available;

(6) Fires set for the purpose of bona fide instruction and training of public and industrial employees in the methods of fighting fires;

(7) Fires set for recognized agricultural, silvicultural, range, and wildlife management practices;

(8) Fires set by individual home owners for burning of leaves except in cities greater than 8,000 population located in a Priority I Region;

(9) Fires for disposal of household rubbish, not to include garbage, originating at dwellings of five (5) family units or less, if the fires are maintained by an occupant of the dwelling at the dwelling, except in cities greater than 8,000 population located in a Priority I Region;

(10) Fires set for the purpose of disposing of accidental spills or leaks of crude oil, petroleum products or other organic materials, and the disposal of absorbent material used in their removal, if no other economically feasible means of disposal is available and practical. Permission shall be obtained from the cabinet prior to burning;

(11) Fires set for disposal of natural growth for land clearing, and trees and tree limbs felled by storms, if no extraneous materials such as tires or heavy oil which tend to produce dense smoke are used to cause ignition or aid combustion and the burning is done on days when conditions do not pose a threat of igniting a forest fire. In regions classified Priority I with respect to particulate matter pursuant to 401 KAR 50:020, Appendix A, the emissions from such fires shall not be equal to or greater than forty (40) percent opacity.

(12) heating ropes that are set on fire to repair steel rails during cold weather.

Section 4. Additional Restrictions for Ozone Nonattainment Areas and Areas Previously Designated Nonattainment for Ozone. For those areas which are, or were previously, designated moderate nonattainment for ozone pursuant to 401 KAR 51:010, fires may be set according to the provisions of Section 3 of this administrative regulation except during the months of May, June, July, August, and September. During these months, the only open burning activities allowed are:

(1) Fires set for the cooking of food for human consumption;

(2) Fires set for prevention of a fire hazard, including disposal of dangerous materials if no safe alternative is available;

(3) Fires set for the purpose of bona fide instruction and training of public and industrial employees in the methods of fighting fires;

(4) Fires set for recognized agricultural, silvicultural, range, and wildlife management practices;

(5) Fires set for the purpose of disposing of accidental spills or leaks of crude oil, petroleum products or other organic materials, and the disposal of absorbent material used in their removal, if no other economically feasible means of disposal is available and practical. Permission shall be obtained from the cabinet prior to burning; and

(6) Fires set for recreational or ceremonial purposes. (5 Ky.R. 510; eff. 6-6-79; Am. 10 Ky.R. 634; eff. 3-1-84; 24 Ky.R. 654; 1299; eff. 1-12-98.)

401 KAR 63:010. Fugitive emissions.

RELATES TO: KRS Chapter 224

STATUTORY AUTHORITY: KRS 224.10-100

NECESSITY, FUNCTION, AND CONFORMITY: KRS 224.10-100 requires the Natural Resources and Environmental Protection Cabinet to prescribe administrative regulations for the prevention, abatement, and control of air pollution. This administrative regulation provides for the control of fugitive emissions.

Section 1. Applicability. The provisions of this administrative regulation are applicable to each affected facility as defined in Section 2 of this administrative regulation.

Section 2. Definitions. Terms used in this administrative regulation not defined herein shall have the meaning given to them in 401 KAR 50:010.

(1) "Affected facility" means an apparatus, operation, or road which emits or may emit fugitive emissions provided that the fugitive emissions from such facility are not elsewhere subject to an opacity standard within the administrative regulations of the Division for Air Quality.

(2) "Fugitive emissions" means the emissions of any air contaminant into the open air other than from a stack or air pollution control equipment exhaust.

(3) "Open air" means the air outside buildings, structures, and equipment.

(4) "Classification date" means the effective date of this administrative regulation.

Section 3. Standards for Fugitive Emissions. (1) No person shall cause, suffer, or allow any material to be handled, processed, transported, or stored; a building or its appurtenances to be constructed, altered, repaired, or demolished, or a road to be used without taking reasonable precaution to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, when applicable, but not be limited to the following:

(a) Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;

(b) Application and maintenance of asphalt, oil, water, or suitable chemicals on roads, materials stockpiles, and other surfaces which can create airborne dusts;

(c) Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials, or the use of water sprays or other measures to suppress the dust emissions during handling. Adequate containment methods shall be employed during sandblasting or other similar operations;

(d) Covering, at all times when in motion, open bodied trucks transporting materials likely to become airborne;

(e) The maintenance of paved roadways in a clean condition;

(f) The prompt removal of earth or other material from a paved street which earth or other material has been transported thereto by trucking or earth moving equipment or erosion by water.

(2) No person shall cause or permit the discharge of visible fugitive dust emissions beyond the lot line of the property on which the emissions originate.

(3) When dust, fumes, gases, mist, odorous matter, vapors, or any combination thereof escape from a building or equipment in such a manner and amount as to cause a nuisance or to violate any administrative regulation, the secretary may order that the building or equipment in which processing, handling and storage are done be tightly closed and ventilated in such a way that all air and gases and air or gas-borne material leaving the building or equipment are treated by removal or destruction of air contaminants before discharge to the open air.

(4) The provisions of this administrative regulation shall not apply to agricultural practices, such as tilling of land or application of fertilizers, which take place on a farm.

Section 4. Additional Requirements. In addition to the requirements of Section 3 of this administrative regulation, the following shall apply:

(1) At all times when in motion, open bodied trucks, operating outside company property, transporting materials likely to become airborne shall be covered.

(2) Agricultural practices, such as tilling of land or application of fertilizers, which take place on a farm shall be conducted in such a manner as to not create a nuisance to others residing in the area. Agricultural practices are not subject to the opacity standard.

(3) The provisions of Section 3(1) and (2) of this administrative regulation shall not be applicable to temporary blasting or construction operations.

Kentucky Division for Air Quality

Insignificant and Trivial Activities

The Kentucky Division for Air Quality, Permit Review Branch, maintains a list of Insignificant and Trivial Activities for use by air pollution sources when submitting permit applications.

Emissions from Trivial Activities are not required to be included on permits or permit applications, and are not considered when determining source status or other applicability determinations. Following is a list of Trivial Activities that has been approved by the division and the U.S. EPA.

LIST OF **TRIVIAL ACTIVITIES**

1. Combustion emissions from propulsion of mobile sources, except for vessel emissions from Outer Continental Shelf sources.
2. Air conditioning units used for human comfort that do not have applicable requirements under Title VI of the Act.
3. Ventilating units used for human comfort that do not exhaust air pollutants into the ambient air from any manufacturing, industrial, or commercial process.
4. Non-commercial food preparation.
5. Consumer use of office equipment and products, not including printers or other businesses primarily involved in photographic reproduction.
6. Janitorial services and consumer use of janitorial products.
7. Laundry activities, except for dry-cleaning and steam boilers.
8. Bathroom/toilet vent emissions.
9. Emergency (backup) electrical generators used at residential locations.
10. Tobacco smoking rooms and areas.
11. Blacksmith forges.
12. Plant maintenance and upkeep activities (e.g., grounds-keeping, general repairs, cleaning, painting, welding, plumbing, re-tarring roofs, installing insulation, and paving parking lots) providing these activities are not conducted as part of a manufacturing process, are not related to the source's primary business activity, and do not otherwise trigger a permit modification. [1]
13. Repair or maintenance shop activities not related to the source's primary business activity, providing they do not include emissions from surface coating or de-greasing (solvent metal cleaning) activities, or emissions that would otherwise trigger a permit modification.
14. Portable electrical generators that can be moved by hand from one location to another. [2]
15. Hand-held equipment for buffing, polishing, cutting, drilling, sawing, grinding, turning or machining wood, metal or plastic.
16. Brazing, soldering and welding equipment, and cutting torches related to manufacturing and construction activities that do not result in emissions of HAP metals. [3]
17. Air compressors and pneumatically operated equipment, including hand tools.
18. Batteries, and battery charging stations, except at battery manufacturing plants.
19. Air compressors and pneumatically operated equipment, including hand tools.
20. Storage tanks, vessels, and containers holding or storing liquids that do not emit VOCs or HAPs. [4]
21. Storage tanks, reservoirs, and other equipment used to contain, pump, mix, handle, or package soaps, vegetable oils, grease, animal fat, and nonvolatile aqueous salt solutions, providing they are appropriately covered.
22. Drop hammers or hydraulic presses for forging or metalworking.
23. Equipment used exclusively to slaughter animals, but not including other equipment at

slaughterhouses, such as rendering cookers, boilers, heating plants, incinerators, or electrical power generating equipment.

24. Vents from continuous emissions monitors and other analyzers.
25. Natural gas pressure regulator vents, excluding venting at oil and gas production facilities.
26. Hand-held applicator equipment for hot melt adhesives with no VOCs in the adhesive formulation.
27. Equipment used for surface coating, painting, dipping, or spraying operations, except those that will emit VOCs or HAPs.
28. CO_2 lasers used only on metals or other materials which do not emit HAPs in the process.
29. Consumer use of paper trimmers and binders.
30. Electric or steam-heated drying ovens and autoclaves, but not the emissions from the articles or substances being processed in the ovens or autoclaves, or from the boilers delivering the steam.
31. Salt baths using nonvolatile salts that do not emit any regulated air pollutants.
32. Laser trimmers using dust collection to prevent fugitive emissions.
33. Bench-scale laboratory equipment used for physical or chemical analysis, but not lab fume hoods or vents. [5]
34. Routine calibration and maintenance of laboratory equipment or other analytical instruments.
35. Equipment used for quality control/assurance or inspection purposes, including sampling equipment used to withdraw materials for analysis.
36. Hydraulic and hydrostatic testing equipment.
37. Environmental chambers that do not use HAP gases.
38. Shock chambers.
39. Humidity chambers.
40. Solar simulators.
41. Fugitive emissions related to movement of passenger vehicles, provided the emissions are not counted for applicability purposes and any required fugitive dust control plan or its equivalent is submitted.
42. Process water filtration systems and demineralizers.
43. Demineralized water tanks and demineralizer vents.
44. Boiler water treatment operations, not including cooling towers.
45. Oxygen scavenging (de- aeration) of water.
46. Ozone generators.
47. Fire suppression systems.
48. Emergency road flares.
49. Steam vents and safety relief valves.
50. Steam leaks.
51. Steam cleaning operations.
52. Steam sterilizers.

Notes:

1. Cleaning and painting activities qualify if they are not subject to VOC or HAP control requirements. Asphalt batch plant owners or operators must still get a permit if otherwise required.
2. "Moved by hand" means that it can be moved without the assistance of a motorized or non-motorized vehicle, conveyance, or device.
3. Brazing, soldering and welding equipment, and cutting torches related to manufacturing and construction activities that emit HAP metals are more appropriate for treatment as Insignificant Activities based on size or production level thresholds. Brazing, soldering, welding and cutting torches directly related to plant maintenance, upkeep, and repair, or to maintenance shop activities that emit HAP metals are addressed in item 12.

4. Exemptions for storage tanks containing petroleum liquids or other volatile organic liquids should be based on size limits such as storage tank capacity and vapor pressure of liquids stored. They are not appropriate for this list.
5. Many lab fume hoods or vents might qualify for treatment as insignificant activities, depending on the applicable SIP, or be grouped together for purposes of description.

INSIGNIFICANT **ACTIVITIES**

Insignificant Activities and any applicable requirements to which they are subject must be included in permit applications and listed in the permit. While detailed estimates of their emissions are not required, the owner, operator, or other responsible official must certify in the application that each Insignificant Activity proposed on Form DEP7007DD meets the following criteria:

1. The potential to emit (PTE) from each activity cannot exceed one (1) thousand pounds of combined HAPs per year, or five (5) tons per year of any non-hazardous regulated air pollutant;
2. The activity cannot involve the incineration of medical waste;
3. The activity cannot be subject to a federally-enforceable requirement, other than generally-applicable requirements; and
4. For non-major sources, the emissions from all Insignificant Activities, when added with the source's other emissions, cannot cause the source to equal or exceed a major source threshold, or an emission limit contained in the permit to avoid major source status under Title V of the Act, or New Source Review under Title I of the Act.

The following is a general list of activities which the division has approved as_insignificant. To see other types of activities approved by the division for specific sources, go to Title _V permits or Other permits requiring public notice.

LIST OF INSIGNIFICANT **ACTIVITIES**

1. Pressurized storage vessels containing petroleum or volatile organic liquids that are designed to operate in excess of 204.9 kPa with no emissions to the ambient air.
2. Storage vessels having less than 10,567 gallons capacity that contain petroleum or organic liquids with a vapor pressure of 1.5 psia or less at storage temperature.
3. Storage vessels having less than 10,567 gallons capacity that contain petroleum or organic liquids with a vapor pressure greater than 1.5 psia at storage temperature, providing those vessels having more than 580 gallons capacity are equipped with a permanent submerged fill pipe.
4. Storage vessels containing inorganic aqueous liquids, except inorganic acids with boiling points below the maximum storage temperature at atmospheric pressure.
5. Laboratory fume hoods and vents used exclusively for chemical or physical analysis, or for "bench-scale production" R&D facilities.
6. Photographic processing equipment used for developing film by exposure to radiant energy, including the bleach, stabilizer, fixer, developer, and other aqueous solutions used in the development process.
7. Mixers, blenders, roll mills, and calenders for rubber or plastics, providing no materials in powder form are added, and no organic solvents, dilutants, or thinners are used.
8. Powder coating booths with an appropriately designed and operated particulate control device.
9. Surface coating and printing applicators equipped with properly designed and operated particulate control devices, providing the applicators use less than five gallons per day, verifiable by appropriate records, of air-dried coating material.
10. Machinery lubricants and waxes, including oils, greases, or other lubricants applied as temporary protective coatings.

11. Indirect heat exchangers or water heaters rated at one (1) million BTU per hour or less actual heat input that use #2 fuel oil, wood, natural gas, LP gas, or refinery fuel gas.
12. Natural gas-fired boilers with rated capacity less than ten (10) million BTY per hour, providing they are subject to 401 KAR 59:015 or 61:015.
13. Coal-fired indirect heat exchangers or water heaters rated at less than 220,000 BTU per hour actual heat input, providing the maximum sulfur content is less than 3.3% by weight, verifiable by appropriate records.
14. Distillate oil-fired space heaters or ovens rated at less than 2 million BTU per hour actual heat input, providing the maximum sulfur content is less than 0.5% by weight, verifiable by appropriate records.
15. Residual oil-fired space heaters or ovens rated at less than 300,000 BTU per hour actual heat input, providing the maximum sulfur content is less than 3.8% by weight, verifiable by appropriate records.
16. Gas-fired space heaters or ovens rated at less than one million BTU per hour actual heat input.
17. Covered conveyors for coal or coke rated at less than 200 tons per day.
18. Equipment used exclusively for forging, pressing, drawing, stamping, spinning, or extruding metals. This does not include emissions due to quenching activities.
19. Emissions from die casting machinery, but not from melt furnaces or other associated processes.
20. Foundry sand mold forming equipment, providing no heat is applied and no organics are emitted.
21. Equipment used for compression, molding, and injection of plastics.
22. Machining of metals, providing total solvent usage at the source for this activity does not exceed 60 gallons per month.
23. Direct-fired kilns for ceramic ware using natural or LP gas and having a rated capacity of less than ten million BTU per hour actual heat input.
24. Internal combustion engines rated at 50 hp or less that use only gasoline, diesel fuel, natural gas, or LP gas.
25. Emergency electric generators and emergency fire fighting water pump engines (except boilers) rated at 500 hp or less that use only gasoline, natural gas, LP gas, or distillate oils, providing no unit is operated more than 500 hours per year, verifiable by appropriate records.
26. Wastewater treatment facilities used for domestic sewage only, excluding combustion or incineration equipment.

Revised June 2000