

Little Schloss Prescribed Fire Smoke Monitoring Report

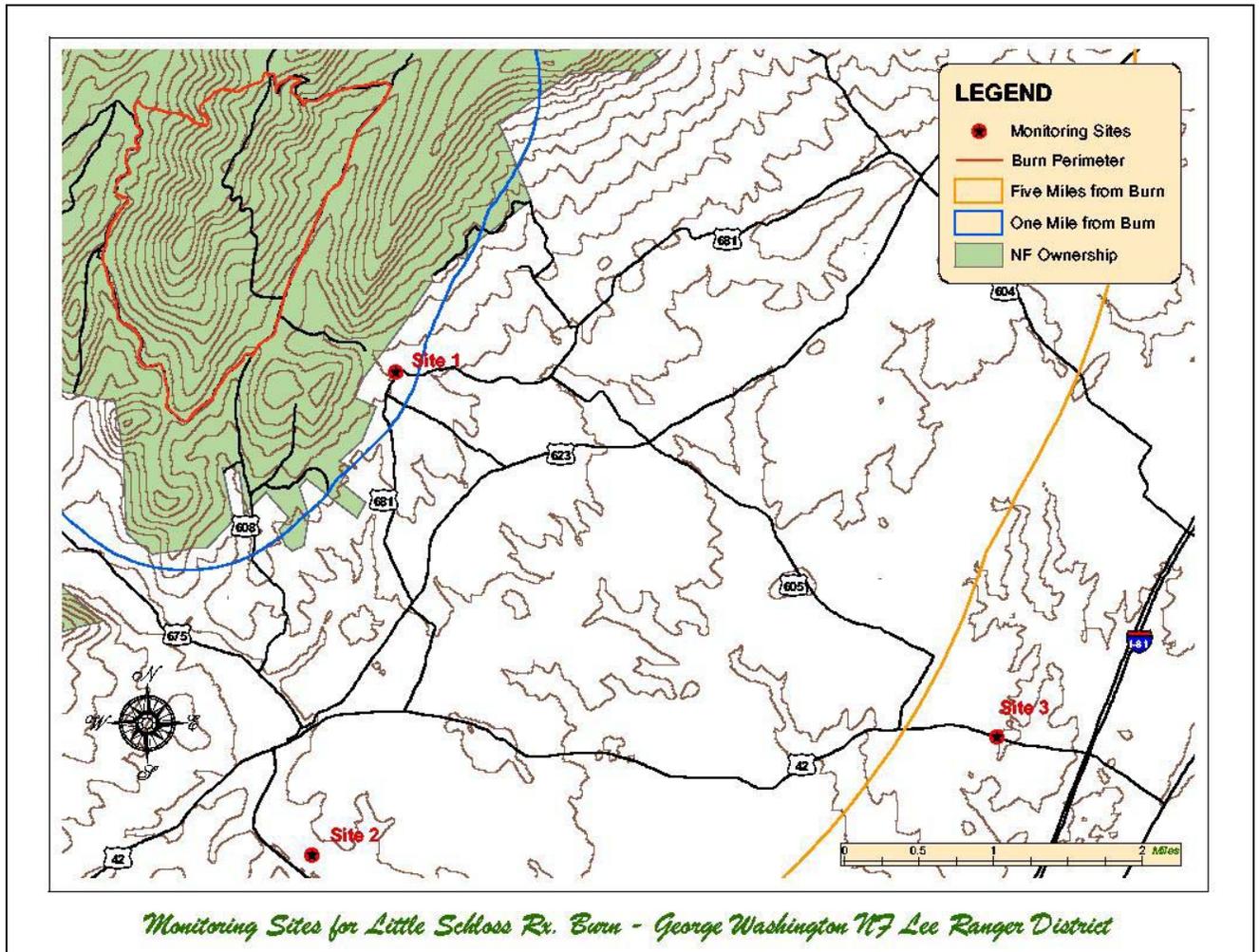
Andrea Stacy, April 24, 2003

Introduction:

The Little Schloss prescribed fire was a 1,500-acre burn conducted on April 15th, 2003 on the Lee Ranger district of the George Washington National Forest. Hand ignition began at 10:30 am, and aerial ignition at 1pm. Aerial ignition stopped at 5:30 pm, and hand ignition was completed by 7 pm.

Methods:

Three DataRAM4 real-time particulate samplers were used to monitor fine particulate in the smoke at various distances from the Little Schloss burn. All monitors were positioned East, South and Southeast of the burn. The map below shows the locations of the three monitoring sites relative to the burn area.



Smoke sensitive areas were identified by the FMO. Locations for monitors, within these areas, were identified prior to the ignition date by the air specialist, zone FMO and district ranger. Smoke sensitive areas identified were: Interstate I-81 which is roughly 5-

6 miles southeast of the burn, local communities such as Edinberg and Wookstock and the homes of people living adjacent to the burn perimeter. Sensitive areas to the south and southeast of the burn were focused on because they are situated in the path of expected smoke drainage that occurs during a nocturnal inversion. If weather conditions during daytime hours remain within prescription, that is a mixing height of 2000 feet or higher with 0-8 mph winds out of the southwest, the smoke can be expected to form a distinct convective column, rise to the mixing height and disperse towards the north east; keeping ground level concentrations relatively low. Yet evening and nocturnal inversions (often called radiation inversions) occur, inhibiting effective smoke dispersion. Smoke can no longer disperse vertically, and hovering near the ground, it follows the natural topography down into the valleys. Drainage areas created by natural topography lie on the eastern and southeastern sides of the Little Schloss burn perimeter.

Site 1 is adjacent to the burn block (approximately .8 miles east of the burn perimeter) at the Frenzel residence on Stultz Gap road. Site 2 is located approximately 3 miles south of the burn perimeter at the Plum residence on Stoney Creek road. Site 3 is located approximately 5-6 miles southeast of the burn perimeter at the Helmsley residence on W. Reservoir road (Rt. 42) in Woodstock.

DataRAM number DO36 and telemetry unit USFS15, were deployed and running at Site 1 on April 14th, the day prior to ignition. An attempt was made to deploy a DataRAM at Site 2 on the 14th, but due to equipment malfunction this was not completed. Additional monitoring equipment was available and deployed on April 15, the day of the burn. DataRAM number DO10 and telemetry unit USFS16 were deployed at Site 2 shortly after ignition began. DataRAM DO16 was set up at Site 3, in mid-afternoon. No telemetry system was available for Site 3. All DataRAMs were left running until Thursday, April 17th when they were collected.

Data was successfully transmitted from Sites 1 and 2 via satellite, but there was some lag time between updates and not all data was posted through the web. All three DataRAM samplers were programmed to internally log data, preventing any data that was not posted to the web from being lost. The samplers continually measure particulate concentrations. The sampling period on the DataRAM was set to five minutes, so that the instrument logged an average concentration for that sampling period. This logged data was downloaded onto the computer, and using MS Excel, graphs showing continuous concentrations, as well as 1-hour and 24-hour running averages were produced. The 24-hour and 1-hour averages are rolling averages calculated from all continuous concentration values for the previous 24 or 1-hour sampling periods, respectively. The 1-hour and 24-hour averages are important because these values can be compared to the EPA and Idaho State Air Quality Index (AQI) to assess human health risk related to PM_{2.5} exposure (See figure 1 below). The index values are based on time averages because the length of exposure to fine particulates, and not just concentration values, is a factor in the level of health risk.

Figure 1: Air Quality Index health rankings are based on 1-hour and 24-hour concentration averages. (EPA developed the health indices based on 24-hour averages. Idaho State's Department of Environmental Quality developed health indices based on 1-hour averages.)

PM_{2.5} 24-hr Avg. Concentration (ug/m³)	PM_{2.5} 1-hr Avg. Concentration (ug/m³)	Index Values	Visibility (Miles)	Level of Health Concern	Cautionary Statements
0.0 – 15.4	0.0 – 40.0	0-50	> 10	Good	None
15.5 – 40.4	40.1 – 80.0	51 – 100**	5.1 – 10.0	Moderate	None
40.5 – 65.4	80.1 – 175.0	101 - 150	3.1 – 5.0	Unhealthy for Sensitive Groups	People with respiratory or heart disease, the elderly, and children should limit prolonged exertion.
65.5 – 150.4	175.1 – 300.0	151 – 200	1.6 – 3.0	Unhealthy	People with respiratory or heart disease, the elderly and children should avoid prolonged exertion, everyone else should limit prolonged exertion.
150.5 – 250.4	300.1 – 500	201 – 300	1.0 – 1.5	Very Unhealthy	People with respiratory or heart disease, the elderly and children should avoid any outdoor activity, everyone else should avoid prolonged exertion.
250.5 +	500.0 +	301 - 500	< 1.0	Hazardous	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly and children should remain indoors.

** An AQI of 100 for PM_{2.5} corresponds to a PM_{2.5} level of 40 micrograms per cubic meter (24-hr avg.).

Results:

In general, the monitoring results show that smoke from the fire did not affect sites 1, 2 or 3 during the *daytime* hours. During the day, the smoke formed a distinct convective column rose to the mixing height and dispersed to the northeast (Figure 2),. Weather conditions during the day remained within prescription and recorded ground level concentrations were low.

Figure 2: Little Schloss Prescribed Fire smoke plume, April 15th, 2003.



Though daytime concentrations remained low, a nocturnal inversion occurred on the evening of April 15th. All three sites show elevated concentrations during the evening and nighttime hours; but only site 1 reached concentrations that are considered extremely high.

Site 1: The monitoring results indicate that concentrations remained low at Site 1 on the day of the burn until approximately 9:45 pm when concentrations rose rapidly as an inversion occurred (Figure 3). The concentrations at Site 1 during the inversion reached values as high as 1324 $\mu\text{g}/\text{m}^3$. The 1-hour averages were as high as 1182 $\mu\text{g}/\text{m}^3$, and the 24-hour averages reached values of 368 $\mu\text{g}/\text{m}^3$. The concentration data reflects visual observations that during the day smoke was rising and dispersing keeping ground level concentrations low, yet local residents reported extremely smoky conditions the night of the burn.

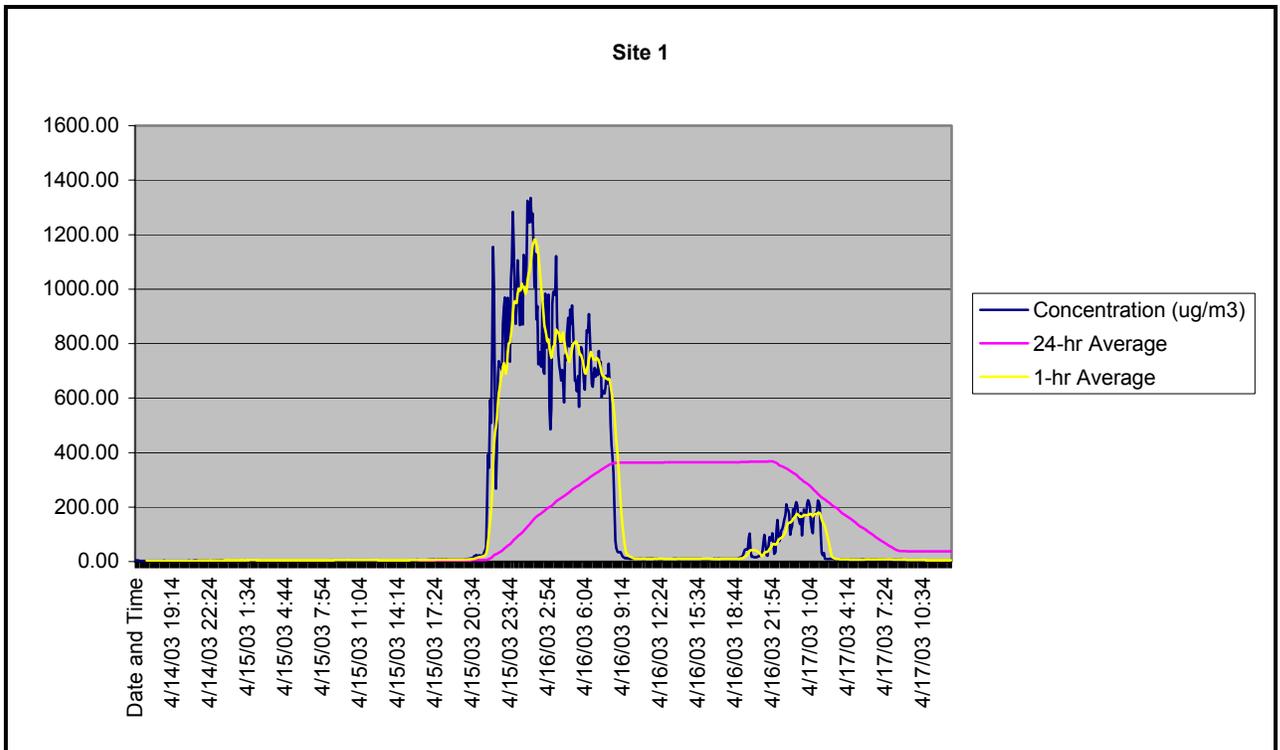


Figure 3: PM2.5 concentrations and running averages for Site 1 located adjacent to the burn at the Frenzel residence.

The 1-hour and 24-hour averages at Site 1 were well above the minimum value that places them in the Hazardous category in the AQI. The cautionary statement provided for this category states that everyone should avoid any outdoor exertion; and people with respiratory or heart disease, the elderly and children should remain indoors. Had these concentrations occurred earlier in the evening when people tend to be outdoors, it would have been advisable for Forest Service personal to warn residents living in this area of the health risks involved; advising people that they should remain indoors with their windows closed. Since these concentrations occurred during the night, it is assumed most people are not outdoors but that they observed the smoky conditions and kept their windows closed. Concentrations remained extremely high at Site 1 until about 8:30 am the morning of the 16th. Photographs taken early in the morning of the 16th showed residual nighttime smoke “trapped” behind Black Oak Ridge, which acted like a dam with smoke accumulating behind it. Site 1 was located near Stults Gap, the only place for the trapped smoke to escape. This may explain the extremely Concentrations immediately dropped when the inversion lifted, and smoke was able to disperse vertically. District personnel reported that by 10 am the smoke was gone and there was not even a smell of smoke in the air. The concentrations remained low (in the “Good” AQI category for the 1-hour average) throughout the daytime hours on the 16th. Once again, concentrations rose rapidly that evening starting around 8:00 pm when the nocturnal inversion occurred, but concentrations were not as high as the previous night. On the night of the 16th, the 1-hour averages reached 180 ug/m³, which is in the “Unhealthy” AQI category. At this level people with respiratory or heart disease, the elderly and children should avoid prolonged exertion, everyone else should limit

prolonged exertion. The concentrations remained high until the early morning hours (2:00 – 3:00 am) of the 17th and then rapidly dropped again. Concentrations remained extremely low (in the “Good” AQI category for the 1-hour standard) until the monitor was taken down at 1:00 pm on the 17th.

Sites 2 and 3: Although PM2.5 concentrations for both Sites 2 and 3 are elevated for roughly the same period of time (during the inversion) as Site 1, concentrations at these sites never reached levels harmful to human health. Concentrations at remained within the 1-hour Good category of the AQI.

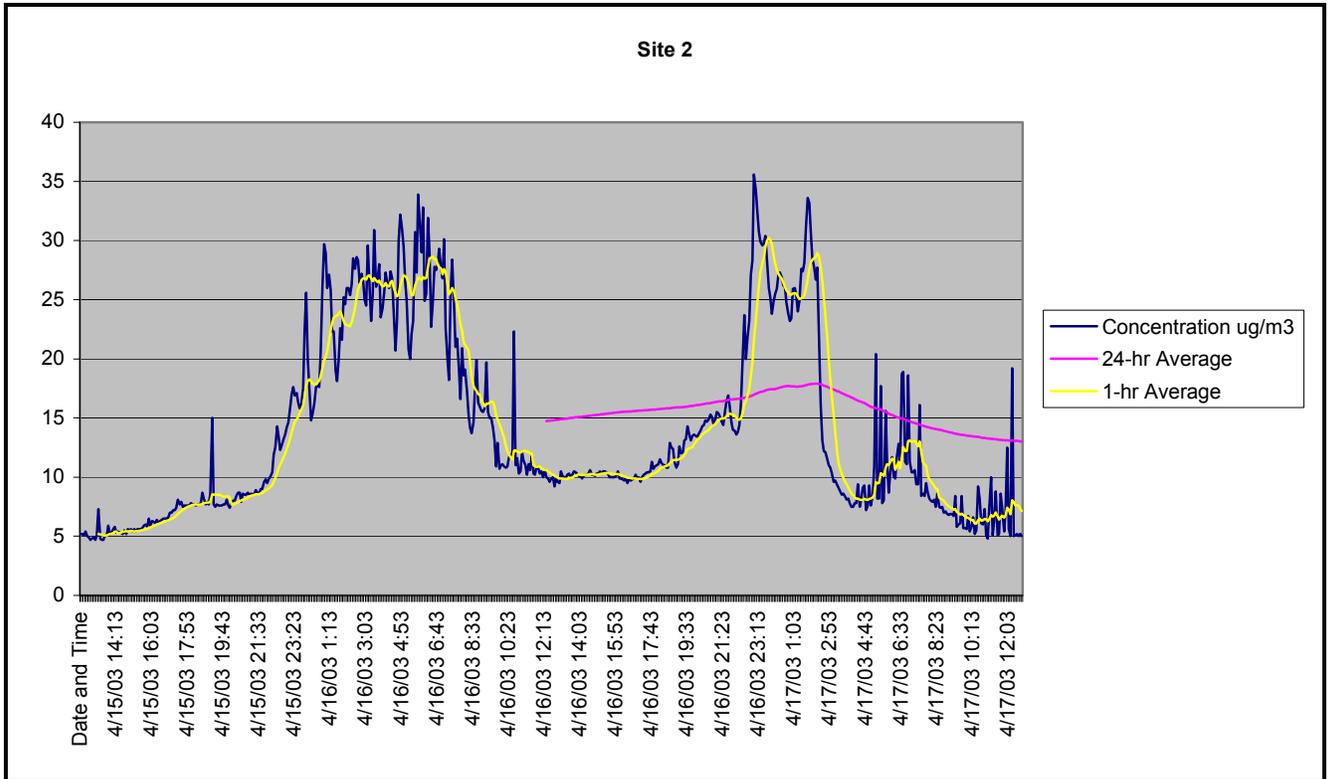


Figure 4: PM2.5 concentrations and running averages for site 2 located south of the burn at the Plum residence.

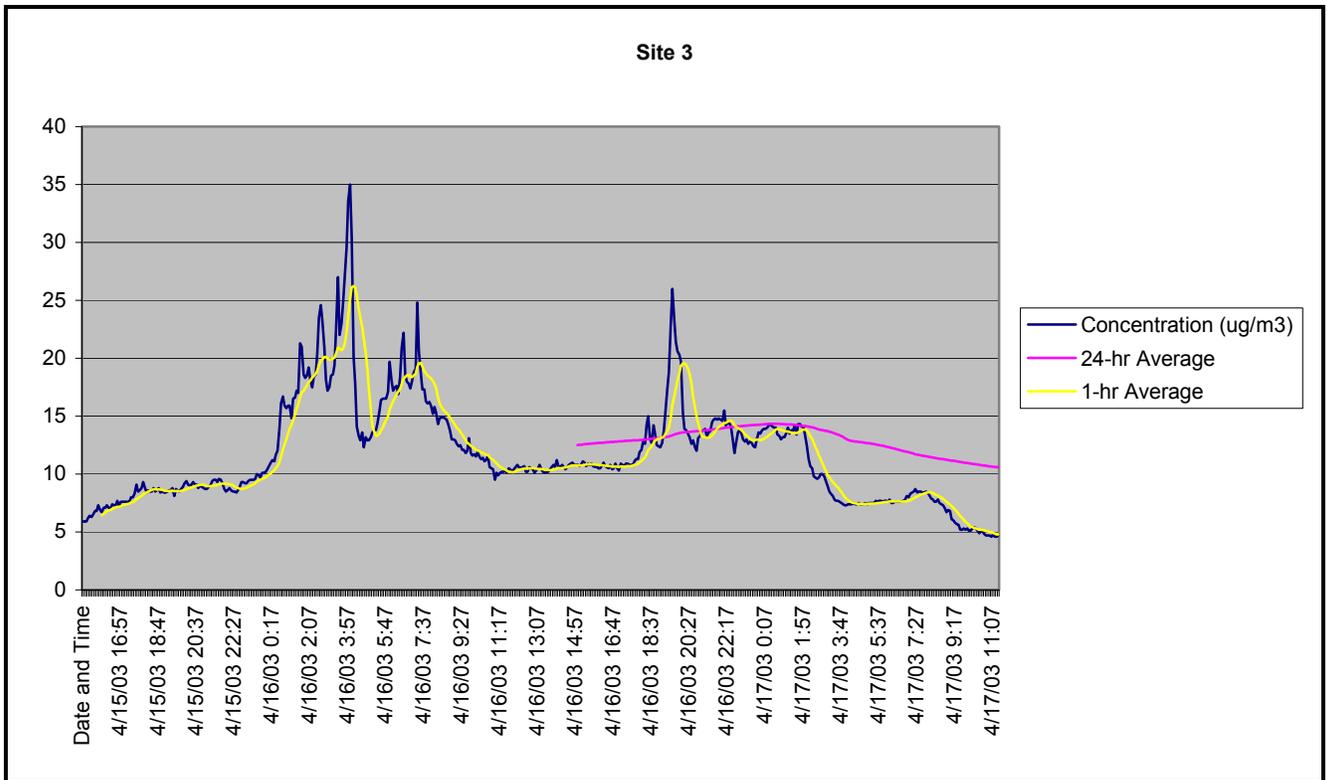


Figure 5. PM2.5 concentrations and running averages for site 3 located southeast of the burn at the Helmsley residence

Visibility:

Although PM2.5 monitoring does not directly measure visibility impacts, it is likely that visibility at Site 1 was reduced due to the very high PM2.5 concentrations in that area. Yet, as the other monitors show, these concentrations dropped off rapidly with increasing distance from the burn perimeter and visibility was not affected. The data from Site 3, located near I-81, shows that concentrations at night were minimal, and residents reported that visibility was not impaired near that location.

National Ambient Air Quality Standard (NAAQS):

EPA’s National Ambient Air Quality standard (NAAQS) for PM2.5 is 65 ug/m³ for a 24-hour average. (There is no 1-hour NAAQS for PM2.5.) The 24-hour averages observed at Site 1 were well above this standard. However, since the DataRAM is not a Federal Reference Monitor (an EPA-approved air quality monitor used to identify NAAQS violations) these concentrations will not contribute towards a NAAQS violation. Concentrations at the other two monitors were well below the NAAQS.

Summary: Three DataRAM particulate samplers were deployed to monitor smoke from the 1,500-acre Little Schloss prescribed fire. The main concern, in terms of smoke management, was that residual smoke trapped under a nocturnal inversion would follow natural drainages into smoke sensitive areas to the south and southeast of the burn perimeter, affecting human health and visibility. Monitoring showed that nighttime smoke was extremely thick adjacent to the burn perimeter, with fine particulate

concentrations remaining at levels considered hazardous to human health throughout the night. Visibility was not directly monitored, but it can be assumed that there would be some impairment on roads adjacent to the burn at the particulate levels recorded. This condition abruptly changed when the inversion lifted and particulate concentrations returned to low levels similar to those before the burn. Nighttime smoke was minimal at distances further from the burn, and remained below levels that cause concern for human health and visibility. Since major highways are located some distance from the burn, visibility conditions more than likely remained within a safe range.