

# **Health Consultation**

## **Trans-border Exposure to Smoke From a Refuse Fire in Naco, Sonora, Mexico**

**December 1 to December 5, 2001  
Naco, Arizona, USA, and Naco, Sonora, Mexico**

**Prepared by**

**Arizona Department of Health Services  
Office of Environmental Health  
Environmental Health Consultation Services**

**under cooperative agreement with the  
Agency for Toxic Substances and Disease Registry**

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## **Introduction**

A refuse dump near Naco, Sonora, Mexico, caught fire and burned from December 1 to December 5, 2001. The fire, which consumed large quantities of household refuse, also generated a large quantity of smoke. During this period, considerable smoke was intermittently present in Naco, Arizona. Persons up to 17 miles away from the fire reported smelling the smoke. At night in the Naco area, smoke concentrations were generally higher when weather conditions caused smoke to settle in residential neighborhoods on both sides of the border.

The Arizona Department of Health Services and the Cochise County Health Department issued public health advisories for the evenings of December 1 and 2, 2001. The Naco, Arizona, Port of Entry closed during periods of heavy smoke to protect the health and safety of employees and travelers. The Cochise County Board of Supervisors declared a state of emergency to gain access to state and federal resources.

This report summarizes the events that occurred during the fire and analyzes the data collected by the Arizona Department of Health Services and the Arizona Department of Environmental Quality to determine the extent of the public health threat from the fire.

## **Background**

*Saturday, December 1, 2001*

The Cochise County Health Department received calls from citizens complaining about the smoke. The Arizona Department of Environmental Quality Hazardous Air Response Team (HART) arrived in Naco on the U.S. side in the late afternoon to monitor the air downwind of the dump fire.

The HART team reported the location of the dump fire as approximately 1.5 miles east of the U.S. Customs station on the Mexican side of the U.S.-Mexico border. At 6:45 p.m., initial instantaneous readings of particulate matter smaller than 10 microns (PM-10) were approximately 350 micrograms per cubic meter ( $\text{ug}/\text{m}^3$ ).

As a result of the levels of respirable particulate matter (PM-10) measured and the expectation that there would be higher particulate levels during the evening, the Cochise County Health Department and the Arizona Department of Health Services issued a health advisory for the Naco, Arizona, area for December 1. The news release recommended that persons remain indoors during the night and shut their windows, that persons with respiratory problems in the Naco area see their physicians if they have respiratory symptoms, and that those with respiratory problems should consider finding an alternative place to sleep. The advisory notices were distributed by the Cochise County Sheriff's Office.

*Sunday, December 2, 2001*

PM-10 readings on the morning of December 2 ranged from  $250 \text{ ug}/\text{m}^3$  to  $1,901 \text{ ug}/\text{m}^3$ . Air sampling results for hydrochloric acid and carbon monoxide were below the minimum detectable limit.

PM-10 levels decreased throughout the early morning as winds picked up. By 5:30 a.m., the PM-10 concentration was down to 221 ug/m<sup>3</sup>. The HART team continued to monitor and record the PM-10 concentrations throughout the day. The readings steadily declined as the heating of the day dispersed the smoke. Hourly averages in Naco, Arizona, dropped to as low as 5.8 ug/m<sup>3</sup> in the early afternoon.

The Cochise County Health Department and the Arizona Department of Health Services continued the health advisory for the evening of December 2 in anticipation of calm weather conditions.

#### *Monday, December 3, 2001*

A storm began to move into the area in the early afternoon of December 3. Winds from the west picked up and kept the plume blowing away from Naco, Arizona. Rain began to fall in the early afternoon and continued until about midnight. The winds associated with the weather system prevented the smoke from settling in Naco on the evening of December 3. In addition to the wind and precipitation, firefighting efforts at the dump kept the smoke from impacting Naco, Arizona.

#### *December 4 and 5, 2001*

The ADEQ sampling team continued to monitor throughout the night and into December 5, 2001. PM-10 levels generally remained well below 50 ug/m<sup>3</sup> except for one hourly average of 60 ug/m<sup>3</sup>. The ADEQ team concluded that the fire was nearly contained on December 5. The team continued monitoring air quality during the evening hours of December 5, 2001, and early morning hours of December 6, 2001. The fire was officially out on December 6, 2001.

## **Methods**

This public health evaluation was prepared using PM-10 air sampling data collected by the ADEQ and observations made by ADHS staff during the event.

This report evaluates environmental sampling data by comparing the PM-10 analytical results to established screening levels and data in the scientific literature to determine the magnitude of the public health threat from the fire. The primary screening values used to evaluate the particulate matter are the U.S. Environmental Protection Agency Ambient Air Quality Standards and Emergency Episode Levels and the World Health Organization Health Guidelines for Vegetation Fire Episodes.<sup>1</sup>

## **Air Sampling Data**

The ADEQ HART team arrived at the scene on December 1 at approximately 6 p.m. The team set up a portable PM-10 monitor at the U.S. Customs station in Naco, Arizona, to quantify respirable particulate matter (PM-10) levels throughout the fire event. Sampling for particles was conducted using the HART team tapered element oscillating microbalance (TEOM). The TEOM is calibrated in accordance with operational requirements by the HART sampling team.

The following tables summarize the PM-10 data collected by the sampling team during the event. Table 1 displays the 1-hour averages measured during the fire. Table 2 displays the 24-hour average concentrations.

**Table 1. Naco Dump Fire 1-Hour Average PM-10 Levels**

	<b>1-Hour Average PM-10 Range (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>1-Hour WHO Alert Stage Guideline (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>Exceeds the WHO 1-Hour PM-10 Alert Stage?</b>
<i><b>December 1, 2001</b></i>			
Overnight	210–524	400	<b>Yes</b>
<i><b>December 2, 2001</b></i>			
Daytime	7–129	400	No
Overnight	211–590	400	<b>Yes</b>
<i><b>December 3, 2001</b></i>			
Daytime	17–72	400	No
Overnight	4–79	400	No
<i><b>December 4, 2001</b></i>			
Daytime	30–60	400	No
Overnight	2–18	400	No
<i><b>December 5, 2001</b></i>			
Daytime	4–39	400	No
Overnight	10–59	400	No

**Table 2. Naco Dump Fire 24-Hour Average PM-10 Levels**

	<b>24-Hour Average PM-10 Concentration (ug/m<sup>3</sup>)</b>	<b>24-Hour EPA Standard (ug/m<sup>3</sup>)</b>	<b>Exceeds the EPA 24-Hour PM-10 Standard?</b>
<i>December 1, 2001*</i>	333	150	<b>Yes</b>
<i>December 2, 2001</i>	198	150	<b>Yes</b>
<i>December 3, 2001</i>	110	150	No
<i>December 4, 2001</i>	99	150	No
<i>December 5, 2001</i>	23	150	No

\* 7 p.m. to 12 p.m. average

## **Discussion**

The major emissions from burning refuse are particulate matter containing a variety of combustion products. The particles in the smoke are too small to be filtered by the nose and upper respiratory system, so they wind up deep in the lungs. They can remain there for days, potentially causing tissue damage and respiratory health effects.

The likelihood of exposure to smoke causing a decrease in lung function is well recognized. The occurrence of respiratory illness in children has been shown to increase as concentrations of particulate matter rise. Symptoms include lower respiratory infections and bronchitis. Smoke also aggravates asthma, emphysema, and bronchitis. It can also irritate the eyes and can trigger headaches and allergies.

Epidemiological studies have consistently found that prolonged exposure to PM-10 might result in shortness of breath, increases in coughs, aggravation of asthma, decreases in lung function and lung defense mechanisms, chronic obstructive pulmonary disease, and increased rates of hospitalization for respiratory and cardiovascular illnesses.<sup>2-13</sup>

During the fire, smoke from burning refuse was intermittently present in the residential neighborhoods in the Naco area on both sides of the border. The concentrations of PM-10 sometimes changed by several hundred ug/m<sup>3</sup> in minutes. 1-hour average measurements of PM-10 in Naco on the evenings of December 1 and 2 ranged from 210 ug/m<sup>3</sup> to 590 ug/m<sup>3</sup>. Readings in the 200 to 300 ug/m<sup>3</sup> range were common at night when winds were calm. People in the neighborhoods were generally in their homes during this time.

Particulate matter gets into the indoor air of homes even when doors and windows are shut. The contribution made by PM-10 on indoor air from the outside depends on how airtight the house is and the average outdoor PM-10 concentration. Particle size can also affect how quickly outdoor particulate matter gets into homes since larger particles will stick to surfaces more readily than smaller particles. Since average PM-10 concentrations are not known, and because of the variability in how airtight homes are depending on their structure and operation, it is not possible to determine what the concentrations of particulate matter might have been in area homes during the fire.

The outdoor PM-10 concentrations at night on December 1 and 2, 2001, were sufficient to result in a transient decrease in lung function. Plausible symptoms in area residents include cough, other lower respiratory symptoms, and possibly aggravated asthma symptoms.

During the fire, the concentration of PM-10 was generally lower during the daytime. However, human activity and outdoor exposure are higher during the day. These factors increase exposure and the potential for health effects. Health problems might have included a transient decrease in lung function. Other potential symptoms in area residents might have included cough, other lower respiratory symptoms, and possibly aggravated asthma symptoms.

### **Health Outcome Data**

ADHS staff contacted local schools and the Naco School District to communicate health risks, provide safety advice, and assess the public health impact of the fire. School personnel reported complaints of haze and odor, and some children with asthma were reportedly sent home.

Eight firefighters were treated and released for smoke inhalation at the main hospital in Naco, Sonora, Mexico. In addition, physicians at the main hospital in Naco, Sonora, reported seeing several of their patients who have had previous and recurring respiratory problems. Physicians in Naco, Arizona, also reported seeing patients with respiratory symptoms that might have been aggravated by the smoke. Staff at the U.S. Port of Entry in Naco, Arizona, reported seeing several people on both sides of the border going to the other side for medical treatment.

### **Child Health Initiative**

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contaminants in air. Children are more likely to be exposed because they play outdoors. Their developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages.

Furthermore, children, even those without pre-existing illness or chronic conditions, are susceptible to air pollution because their lungs are still developing, and they are often engaged in vigorous outdoor activities, making them more sensitive to pollution than healthy adults. Studies have shown that in children, particulate pollution is associated with increased episodes of coughing and difficulty breathing,

and decreased lung function. Children, particularly those with asthma, likely were among the most affected persons during the refuse fire.

### **Conclusions**

ADHS finds that the smoke likely caused an increase in respiratory problems in some Naco, Arizona, and Naco, Sonora, residents on December 1 and 2, 2001. The symptoms would be expected to be consistent with smoke inhalation, suggesting that the fire represented an acute (short-term) public health hazard.

### **Recommendations**

No further recommendations are indicated at this time.

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