APPENDIX

D Wright-Patterson Air Force Base—A Case Study

ATSDR became involved at Wright-Patterson Air Force Base in 1990, at the request of the Environmental Protection Agency (EPA) Region VI. At that time, ATSDR conducted a health consultation to address gases migrating from two closed landfills to a nearby housing area. In 1999, ATSDR returned to Wright-Patterson Air Force Base to complete a public health assessment, which also included an evaluation of exposure to gases from these landfills.

This appendix provides background information about the landfills at Wright-Patterson and describes the sampling, health evaluations, gas control measures, and community involvement conducted at the site. The intent of this case study is to highlight issues and problems that were addressed during the effort to control landfill gas emissions at this site.

Background

Wright-Patterson Air Force Base has operated outside of Dayton, Ohio since the early 1900s. From the late 1940s until the early 1970s, both nonhazardous and hazardous waste from base operations was dumped into two landfills located next to each other and divided by a small stream. The U.S. Air Force closed the landfills in the early 1970s by covering the waste with a soil layer ranging from 1 to 12 feet deep. No other control measures (e.g., liners or impermeable caps) were installed when the landfills were closed, leaving the hazardous materials in the landfills available to migrate from the site. This is common of open dumps, as discussed in Chapter Two.

After closing the landfills, the U.S. Air Force began building military housing on land abutting the landfills. In 1973, military personnel and their families began moving into these multi-family housing units. These families used the landfills as a recreation area, and the U.S. Air Force built a playground on one of the landfills. People living in the housing units may have been exposed to landfills gases seeping from the landfill surface when they were using the landfills for recreation. Landfill gas migrating in ambient air or underground may have also reached people in their homes.

In the 1980s, the landfills began to settle, and one of the housing units had to be demolished because the settling caused structural problems to the home. In 1985, the Ohio Environmental Protection Agency (OEPA) asked the U.S. Air Force to put up a fence and stop recreational use of the landfills because of concerns about people coming in contact with contaminants. The U.S. Air Force complied and began to study the landfill under OEPA's direction.

Monitoring of Landfill Gas

When investigations of the two landfills began in 1985, OEPA was concerned about potential explosion hazards from methane in the landfill gas. The U.S. Air Force collected only soil gas samples to assess methane migration. As studies continued, OEPA and U.S. Air Force found that hydrogen sulfide and non-methane organic compounds (NMOCs), along with methane, were migrating away from the landfill. Under OEPA's guidance, the U.S. Air Force collected soil gas as well as ambient air and indoor air samples to assess whether landfill gases had migrated to homes.

Soil gas. Permanent soil gas monitoring wells were installed throughout the landfills and near the homes. Analysis of samples from some of these wells found methane at levels well above its lower explosive level (LEL) of 5% by volume and its upper explosive level (UEL) of 15% by volume. Later sampling found NMOCs, such as the gasoline components benzene, toluene, ethylbenzene, and xylenes.

In reviewing these data for its 1990 health consultation, however, ATSDR noted two issues that affect data interpretation:

- *Soil gas monitoring wells filled with water,* in some cases up to 3 feet from the top of the well. Water blocks or reduces gas from entering the well, so that gases found in the well may represent the gases in the soil only a few feet underground. The only two wells that were dry when they were sampled had much higher concentrations of methane (62% and 38% by volume) than wells with water (up to 10% by volume). The two dry wells, therefore, might be most representative of subsurface conditions.
- *The geology of the area might affect gas movement.* Underground channels of sand and gravel are present between layers of clay and silt. The sand and gravel offer the least resistance to gas movement and would create preferred pathways for gas migration. Soil gas wells placed in a sand or gravel channel might have higher concentrations of gases—and represent a worst-case scenario—than wells placed in clay or silt layers. The two wells that were dry when sampled and contained the highest methane concentrations also were placed in sand and gravel.

Ambient air. A series of ambient air samples was collected from locations upwind and downwind of the landfills over a 6-month period from July to December. This sampling effort detected methane, hydrogen sulfide, a number of NMOCs, and several metals. Table D-1 (page D-5) shows the levels of contaminants found during this sampling effort, along with their screening values derived from ATSDR's minimal risk levels (MRLs) (discussed in Chapter Three).

When ATSDR reviewed these data, several factors to consider were identified:

- *Data were collected from July through December.* Sampling over the changing seasons, in this case summer, fall, and winter, provides information about how landfill gas emissions may change throughout the year and react to climatic conditions. No spring sampling data, however, are available. In addition, sampling was conducted in a single calendar year, so that possible changes over the years cannot be assessed.
- *Ambient air was collected as a grab sample.* This presents a snapshot of the gases in air at a single moment in time. Any possible daily changes cannot be assessed, however.
- *The upwind sample contained the highest concentration of some contaminants.* This indicates that perhaps other sources are contributing to ambient air contamination. Identification of non-landfill sources or air modeling of area-wide sources and gas dis-

persion to examine the relative input of various sources to ambient air contamination would prove useful.

Indoor air. Most indoor air sampling done by the U.S. Air Force focused on methane because of concerns about explosion hazards. Low levels of methane were found in homes, but never at levels considered explosive. The U.S. Air Force also conducted one round of indoor air sampling for contaminants other than methane during investigations of the landfills. This sampling revealed only very low levels of hydrogen sulfide and three NMOCs (acetone, toluene, and xylenes), as shown in Table D-2 (page D-6).

Again, data review identified some issues of note:

- *The U.S. Air Force sampled for contaminants other than methane only once.* Sampling for a contaminant only once provides a picture of indoor air contamination for only that point in time. No information is available to assess possible daily, season, or annual changes.
- *The location of indoor air samples was not identified.* Gases may collect in different concentrations throughout a home. For example, methane leaking into a home along plumbing pipes may collect under a sink or in a utility closet. Thus, samples collected in the center of a room do not represent enclosed spaces within the room.

Landfill Gas Safety and Health Issues

ATSDR made a determination, based on available sampling data, that potential explosion hazards, odors, and low-level exposures in homes near the landfill should be evaluated during the 1990 health consultation and the 1999 public health assessment.

Explosion hazard. Indoor air sampling found no explosive levels of methane; however, the data do not indicate if samples were collected in locations where methane might collect to the greatest extent, such as under sinks or in utility closets. Soil gas samples found methane concentrations as high as 62% by volume, well above methane's LEL of 5% as well as its UEL of 15%. Some of the soil gas wells where methane was found above its LEL and/or its UEL were near homes. As methane migrates, concentrations may disperse, so that by the time methane in soil gas reaches homes, it could be present between the LEL and UEL, levels at which explosions may occur. Although homes near the landfill were built on slab foundations, settling of the landfill caused the structure of one housing unit to fail. Foundations of other housing units may also be affected by settling. At a landfill in California, ATSDR had found explosive levels of methane in homes with cracked slab foundations.

For these reasons, ATSDR concluded in its 1990 health consultation that the landfill posed an explosion hazards for housing units built abutting the landfill. ATSDR recommended evacuating homes where explosion hazards existed until landfill gas emissions, especially methane, were controlled. The U.S. Air Force concurred and installed a landfill gas collection system, which was in operation at the time of the 1999 public health assessment.

Odors. Residents living in the housing units near the landfills reported smelling hydrogen sulfide odors. When indoor air in homes was sampled in 1991, hydrogen sulfide was found at levels (0.7 parts per billion [ppb]) just at the odor threshold. Humans begin to smell hydrogen sulfide at levels between 0.5 and 1 ppb. Ambient air monitoring from July through December also found hydrogen at slightly higher levels (to 1.3 ppb). ATSDR has not drawn any conclusions about possible health effects from these odors.

Low-level exposures. Soil gas, ambient air, and indoor air sampling indicate that NMOCs, such as acetone, benzene, toluene, ethylbenzene, and xylenes, were also migrating from the landfills into the surrounding housing areas. In its 1999 public health assessment, ATSDR evaluated ambient air data and found that past exposures to NMOCs were unlikely to cause illness of area residents based on the detected concentrations, the frequency and duration of exposure, and toxicity information. Only past exposures were evaluated, because landfill gas control measures were in operation at the time of the 1999 public health assessment.

Landfill Gas Control Measures

To address concerns about landfill gas migration and exposures to the community living in nearby housing, the U.S. Air Force, under supervision of EPA and OEPA, designed and constructed landfill gas collection systems. Construction of these systems began in 1994 and was completed in 1996. Construction of the collection systems included installing a new landfill cap made of an impermeable geomembrane and a 2-foot soil cover. In order to accommodate the new cap footprint, several housing units abutting the landfills were demolished. The U.S. Air Force collects landfill gas through a series of active gas collection wells and burns the gas in flares. Regular monitoring and sampling of the collection system is required to make sure the system is operating properly.

Community Involvement

The extent of community involvement actions conducted when investigations first began at the landfills is unclear. The details of an ongoing community relations program also are unknown. However, local residents were, and continue to be, invited to attend Environmental Advisory Board (EAB) meetings. The EAB is a group of community members, regulatory agency representatives, and U.S. Air Force personnel that regularly meet to discuss environmental issues, clean-up actions, and community concerns at Wright-Patterson Air Force Base. Meetings are announced in the local papers, and all interested people are invited to attend.

In 1998, the U.S. Air Force conducted a community fair to educate residents living near the landfills about the landfills and proposed future uses of the area, as well as to answer questions and address concerns. This fair was held on a fall evening near the landfills. Posters described the landfills and the actions taken to control landfill gases. People were given fact sheets and telephone numbers to call if they had questions later.

ATSDR attended this fair, as well as an EAB meeting, during the public health assessment process to understand community concerns about the landfills. People expressed concerns about illnesses, specifically cancer and multiple sclerosis, related to exposure to contaminants from the landfills. In its public health assessment, ATSDR addressed these concerns and concluded that past low-levels exposure to landfill gases would not cause illness. The U.S. Air Force has installed a landfill gas control system to prevent any additional exposures.

Table D-1: Summary of Ambient Air Data					
	Ambient Air			Screening Values	
Chemical	Minimum Detected (μg/m³)	Maximum Detected (μg/m³)	Frequency of Detection[a]	Value (μg/m³)	Source[b]
Acetone	45N	236,000NJ	17/40	30,892	EMEG child
Benzene	16.6NJ	17.6NJ	3/40	0.1	CREG
Dimethyl Sulfide	2.9J	5.1J	4/40	not available	
Methylene Chloride	17J	46	5/40	3	CREG
Tetrachloroethylene[c]		16.3J	1/5	0.6	CREG
1,1,2-Trichloroethane		53.6NJ	1/40	0.6	CREG
Trichloroethylene	13N	20.5J	3/40	0.6	CREG
Phenanthrene[d]	0.004NJ	0.02N	37/40	not available	
Arsenic	0.0012J	0.0028J	29/40	0.0002	CREG
Beryllium	0.0006	0.0008	6/40	0.0004	CREG
Chromium		0.0061	1/40	0.00008	CREG
Lead[d]	0.0124	0.0202	16/40	1.5	NAAQS

Source: Engineering Science, Inc. 1993

Notes:

CREG	Cancer Risk Evaluation Guide
child	standard for a child
EMEG	Environmental Media Evaluation Guide
J	data qualifier, indicates that the reported concentration is estimated
N	data qualifier, indicates that the analyte was tentatively identified
NAAQS	National Ambient Air Quality Standards
μg/m³	micrograms per cubic meter

[a]Frequency of detection is the times detected/times sought.

[b]The EMEGs and CREGs presented are derived using ATSDR's MRLs. The NAAQS are developed by EPA.

[c]Tetrachloroethylene was detected only in an upwind (background) sample.

[d]Phenanthrene and lead were detected below the upwind (background) concentrations (0.033NJ and 0.0205, respectively) at all sampling locations.

Table D-2: Summary of Ambient Air Data			
Chemical	Minimum Detected ($\mu g/m^3$)	Maximum Detected ($\mu g/m^3$)	Frequency of Detection[a]
Methane	2112J	29700J	12/12
Hydrogen Sulfide	1	1	4/12
Acetone	38	3,332J	4/12
Toluene	9.43J	15.46J	3/12
Xylene (total)	8.7J	16.53J	3/12

Source: Engineering Science, Inc. 1993

Notes: J — Indicates that the analyte was detected, but the concentration was estimated
μg/m3 — micrograms per cubic meter

[a]Frequency of detection is the times detected/times sought. Field duplicates are included.

References

ATSDR. 1991. Agency for Toxic Substances and Disease Registry. Health Consultation: Methane Migration at Landfills 8 and 10, Wright-Patterson Air Force Base, Dayton, Ohio. Atlanta: U.S. Department of Health and Human Services. September 12, 1990.

ATSDR. 1999. Agency for Toxic Substances and Disease Registry. Public Health Assessment for Wright-Patterson Air Force Base, Fairborn, Greene County, Ohio. Atlanta: U.S. Department of Health and Human Services. November 12, 1999.

Engineering Science, Inc. 1993. Off-Source Remedial Investigation Report for Landfills 8 and 10 at Wright-Patterson Air Force Base, Ohio. (Revision No. 2). August 12, 1993.