PUBLIC HEALTH ASSESSMENT

GEORGE AIR FORCE BASE
VICTORVILLE, CALIFORNIA

ENVIRONMENTAL CONTAMINATION AND POTENTIAL PATHWAYS OF EXPOSURE

In this section, ATSDR evaluates potential exposure pathways to determine whether people accessing or living near George AFB could have been, are, or will be exposed to contaminated groundwater, soil, and radiological contamination via ingestion, dermal (skin) contact, or inhalation of vapors. Exposure pathways are considered "complete" when exposure to contaminated media occurs. To determine whether completed pathways pose a potential public health hazard, ATSDR compares contaminant concentrations to health-based comparison values (CVs). If contaminant concentrations are above CVs, ATSDR further analyzes exposure variables (e.g., duration and frequency) and the toxicology of the contaminant. Figure 5 summarizes this exposure evaluation process. Table 2 presents the exposure pathways identified at George AFB.

In evaluating environmental contamination, ATSDR uses several media-specific CVs to select environmental contaminants for further evaluation within an exposure pathway. Because CVs do not represent thresholds of toxicity, exposure to chemical concentrations that are above CVs does not necessarily cause adverse health effects. CVs used in this document include EPA's maximum contaminant levels (MCLs) and ATSDR's environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs). MCLs are enforceable drinking water regulations developed to protect public health, but they also consider economic and technological factors. CREGs, EMEGs, and RMEGs are strictly health-based CVs developed by ATSDR and are not enforceable. Appendix C further describes the CVs used in this evaluation.

Evaluation of Groundwater Exposure Pathway

Could groundwater contamination detected in both on- and off-site monitoring wells either reduce the availability or compromise the safety of area groundwater or Mojave River water?

Conclusions

On-site and off-site groundwater do not represent a past, present, or future public health hazard. On-site groundwater has never been used as a source for drinking water at George AFB and no supply wells are expected to be installed there in the foreseeable future. Groundwater contamination from the OU 1 plume has migrated off site towards the Mojave River, but has not affected any municipal or private drinking water wells. Two supply wells in the path of the plume, at the VVWRA, have never been used to supply drinking water. The installed pump-and-treat system at OU 1 is expected to prevent contaminants from migrating to the Mojave River and regular groundwater sampling will continue to monitor the movement of the plume over time.

Discussion

Hydrogeology and Groundwater Use

George AFB lies in the George Groundwater Sub-basin of the Upper Mojave River Groundwater Basin (groundwater basins are shown in Figure 6). This basin is recharged primarily by infiltration of precipitation runoff from the San Bernardino and San Gabriel mountains. The Upper Mojave River channel has perennial flow near the river's headwaters, while further downstream the river flow is subterranean. At the Mojave River Narrows southeast of the

base, river flow rises back to the surface due to mounding against a bedrock barrier, before again becoming subterranean for the rest of the river's course. The river terminates at Soda Dry Lake. The Mojave River is a major source of drinking water for communities downstream of George AFB. It is estimated that 80% of the recharge for the entire Mojave Groundwater Basin is supplied by infiltration from within the Upper Mojave River Basin. There is little groundwater recharge from precipitation in the Victor Valley, as a result of low precipitation rates and high evapotranspiration rates. Local groundwater recharge occurs at the VVWRA plant (north of the base--see Figure 3), the OU 1 treatment system percolation ponds, and various small agricultural areas near the river channel (Montgomery Watson, 1997c).

The 1923 log of an exploratory oil well in the George AFB area indicates that the site lies on alluvial sediments, including water-bearing sands and gravels with interbedded clays, to a depth of 730 feet. Beneath this is a layer of sandstone and sandy shale to a depth of 1,350 feet; this layer is followed by crystalline limestone, schists, and granite. Subsurface investigations to study environmental conditions have been limited to the upper 425 feet of sediments (Montgomery Watson, 1996). The sediment beneath George AFB has been classified into three hydrogeologic units:

- the upper alluvial unit
- the aquitard
- the lower alluvial unit

The upper and lower alluvial units are alluvial fan deposits and contain the upper and lower aquifers. These aquifers are hydraulically separated by the aquitard, a thin (approximately 25 feet thick) deposit of lacustrine (lake) silts and clays that effectively prevents vertical groundwater (and contaminant) movement from the upper to lower aquifer (see Figure 7). The aquitard appears to be a single continuous unit beneath the entire base, except for the northeast portion of the base where the aquitard is not present. The upper alluvial unit extends from ground surface to 150 to 175 feet below ground surface (bgs). The upper aquifer is encountered at depths of 90 to 150 feet bgs; the groundwater elevation of the upper aquifer drops rapidly towards the east and northeast and vanishes at the edge of the aquitard, where the upper and lower alluvial units merge. The hydraulic separation of the two aquifers by the aquitard is evidenced by a dry upper section of the lower alluvial unit--water of the lower aquifer is not encountered until 210 to 250 feet bgs. Groundwater flow in both the upper and lower aquifers is northeastward under most of the base; flow in the lower aquifer turns eastward near the Mojave River. The existence of northwest-trending paleochannels (ancient river deposits) in the upper alluvial unit may locally affect transport of contaminants by causing preferential migration (Montgomery Watson, 1996, 1997a).

Because of the arid environment and the lack of surface water bodies in the Upper Mojave River Basin, groundwater is the principal source of water in the Victor Valley. The Mojave Water Agency (MWA) oversees the distribution of water within the Mojave River Groundwater Basin. Population increases in this area caused water use to double from 1973 to 1983, and to double again from 1983 to 1994. This increased water demand has led to overdraft of groundwater within the Mojave River Groundwater Basin (i.e., more groundwater is pumped out than is replaced through recharge). Since 1990, the MWA has received additional water from the California Water Project. More recently, the MWA proposed a Mojave River Pipeline Project that would convey imported water from the California Aqueduct to selected recharge areas in the Mojave River basins (Bechtel, 1995). One such recharge area is currently planned for a site directly downstream of George AFB and the VVWRA (U.S. Air Force, 1998d).

There are a number of drinking water supply wells in the vicinity of the base (see Figure 4). The VVWRA has two supply wells north of the base that are believed to be screened in the Mojave River Aquifer, the aquifer lying beneath and to the east of the Mojave River channel (this aquifer is shown in Figure 7). Although recent samples indicate that water from the VVWRA wells is safe to drink, the wells are used only for non-potable and industrial applications at the VVWRA treatment plant and have never been used to supply drinking water (Montgomery Watson, 1996; VVWRA, 1998). According to the California Department of Water Resources, there are four production wells located southeast of the base; screened at depths of 500 to 610 feet bgs; these wells may draw from a deeper aquifer below the lower aquifer. Eight production wells, located at the eastern boundary of the base next to the Mojave River, currently supply drinking water to George AFB and/or the city of Adelanto. A ninth well at this location was closed when its production declined (Montgomery Watson, 1996; U.S. Air Force, 1998a). These wells are not located in or near areas of contaminated groundwater. Adelanto maintains several more municipal wells to the west of George AFB. Three wells, supplying the town of Oro Grande, are located on the eastern bank of the Mojave River east and northeast of the base. A number of smaller capacity domestic and irrigation wells are believed to exist in the vicinity of the base. These wells likely draw from the upper aquifer (Montgomery Watson, 1996); none are believed to be located in areas of contaminated groundwater.

Groundwater Quality and Sources of Contamination

This section addresses the location, extent, and potential for off-site migration, and current remedial actions at the four areas of groundwater contamination identified through IRP investigations. ATSDR has evaluated all available groundwater data and determined that contaminated groundwater from George AFB has not affected any known

drinking water wells in the vicinity of George AFB.

- *OU 1: NEDA TCE plume*. This groundwater TCE plume covers approximately 600 acres in the northeastern portion of the base and extends off site to the north and east as far as the VVWRA treatment plant. TCE is present above MCLs and CVs in both the upper and lower aquifers beneath the site, and is migrating northeast towards the Mojave River (the TCE plume is shown in Figure 8). The maximum TCE concentration detected in the upper aquifer as of February 1997 was 330 ppb, while the highest concentration in the lower aquifer was 22 ppb (Montgomery Watson, 1997a). First detected through groundwater sampling in 1983, the plume is now monitored twice a year through sampling of 20 to 40 monitoring wells on and off the base. The Air Force installed and began operating nine groundwater extraction wells and an air stripper unit in 1991 to clean up the plume. The Air Force installed nine additional extraction wells in 1996. These wells were installed to remove TCE from both the upper and lower aquifers, and to prevent the plume from migrating in to the Mojave River. Figure 9 shows the effect of the extraction wells on groundwater flow in the NEDA. The treatment system is expected to take 30 years to reduce TCE concentrations to below federal drinking water standards (Montgomery Watson, 1994). The system discharges treated water to newly constructed percolation ponds. In the past, this treated water was also discharged to the old sewage treatment plant percolation ponds (Site WP-26--see Figure 2) and an unlined arroyo (U.S. Air Force, 1997b, 1998b).
  The only supply wells in the path of the plume are two wells at the VVWRA treatment plant. The VVWRA does not use these wells to supply drinking water. If the current treatment and monitoring system is maintained, ATSDR does not expect this plume to contaminate any drinking water wells in area.

  TCE groundwater contamination at OU 3 Site FT-19 is being cleaned up and monitored as part of OU 1.

- *OU 2: JP-4 and BTEX plume.* This plume, consisting of free product and associated dissolved contaminants, is in the upper aquifer beneath the flight line and operational apron in the central portion of the base (see Figure 2). The plume contains perhaps as much as 750,000 to 800,000 gallons of jet fuel (U.S. Air Force, 1997b). George AFB has installed approximately 40 monitoring wells to define the plume and monitors the contaminants through twice-yearly groundwater sampling. The plume is contained within the boundaries of the base and affects no drinking water wells (IT, 1992). Recent feasibility and treatability studies have not demonstrated significant migration of the plume. However, additional studies will be undertaken to further characterize this plume. The Air Force is considering a natural-attenuation, cleanup strategy that they estimate would lower contaminants to drinking water standards in approximately 50 years (IT, 1996), but federal regulators have not yet agreed to a natural-attenuation clean-up approach for this plume.
- *OU 3: Site OT-69 VOC plumes.* OT-69 consists of several small isolated plumes of perchloroethylene and TCE above MCLs and CVs. One plume is south of the sewage treatment plant percolation ponds (WP-26) and another is located south of the operational apron (OT-69 plumes are shown as white areas in Figure 2). TCE concentrations in these plumes are highest in the upper 6 feet of the upper aquifer and decrease to nondetectable at 30 feet and deeper below the water table (Montgomery Watson, 1996). These plumes are contained within the boundaries of the base and affect no drinking water wells. The Air Force selected natural attenuation as the cleanup strategy for these plumes and monitors the plumes through twice-yearly groundwater sampling. The Air Force has also instituted limits on future groundwater use at these sites (U.S. Air Force, 1997d).
- *OU 3: Site OT-51 JP-4 and BTEX plume.* OT-51 is a former jet engine test cell located west of the main runway (see Figure 2). The Air Force monitors the plume through groundwater sampling two times per year. The plume is contained within the boundaries of the base and affects no drinking water wells. A bioventing system has reduced most of the contaminants from the groundwater at this site; the Air Force may use oxygen enhancement if needed to complete the groundwater remediation (U.S. Air Force, 1998d).

The Air Force has instituted a long-term basewide groundwater monitoring program involving OU 1, OU 2, and OU 3 landfills and other sites. This program monitors the elevation, flow direction, and quality of groundwater and is used to assess the efficacy of groundwater remediation and the integrity of landfills at the base.

Exposure Potential

No exposure to contaminated on-site groundwater has occurred at George AFB because on-site groundwater has never been used for drinking water at the facility. Although the OU 1 TCE plume extends off the base, it does not affect any municipal or private drinking water wells. There are two supply wells at the VVWRA treatment plant, but these wells have never been used to supply drinking water. The OU 1 plume is migrating towards the Mojave River, which is a major drinking water source for downstream communities. The installed pump-and-treat system, together with groundwater monitoring, is expected to prevent the plume from reaching the river, however. The city of Adelanto has detected no VOC contaminants in its municipal wells; the only water quality problem the city has experienced with its wells is naturally elevated fluoride levels (City of Adelanto, 1998).

The California Department of Health Services (CDHS) specifies water sampling schedules for all water purveyors, including those with supply wells located in the vicinity of George AFB. CDHS reviews the water sampling data to ensure that the drinking water distributed to consumers is safe.

Evaluation of Soil Exposure Pathway

Could exposure to surface soil contamination at George AFB result in adverse human health effects?

Conclusions

Soil at George AFB does not represent an apparent past public health hazard and does not represent a present or future public health hazard. Soil contamination has been detected above ATSDR health-based comparison values in very few areas of George AFB. Access to most areas of contamination is limited and the contaminant levels detected would not pose a health hazard to either children or adults from short-term exposure. Due to the low levels of contamination, exposure to contaminated soil through future industrial reuse of the base is not expected to pose a public health hazard to adults working at the base.

Discussion

Extent and Sources of Contamination

Soil data have not been available for most of George AFB's history because the base's environmental investigation program did not begin until 1980. ATSDR therefore evaluated past public hazards posed by past conditions at George AFB based on current environmental data.

Since 1980, soil investigations at George AFB have included soil-gas sampling, test pitting and trenching, and surface and subsurface soil sampling. Background soil samples have also been collected to determine natural soil conditions in the area. These investigations have identified areas of soil contamination at many of the IRP sites throughout the base. (Table 1 lists the investigation results for each IRP site.) Contaminants detected at various locations include VOCs, semivolatile organic compounds, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, pesticides, dioxins, and metals (Montgomery Watson 1996; IT, 1992). These contaminants are attributable to the variety of base activities that involved fuels, oils, solvents, paints, and other hazardous materials.

Metals were the most common contaminants detected in surface soils. In some locations, such as industrial sites, landfills, or other waste disposal areas (see Table 1), metals and other contaminants were detected above CVs for pica children (children with an increased tendency to eat soil or other nonfood items). A few areas of the base had contaminants present at levels above CVs for non-pica children or adults. However, the contaminants that did exceed CVs were not at levels high enough to present a health hazard.

Exposure Potential

In the past, George AFB maintained residences for base personnel and their families. It is, therefore, possible that a few contaminated areas, such as landfills and waste disposal areas, may have been accessible to children living on the base. Although some soil contamination was detected at levels above CVs for pica children, ATSDR believes it is highly unlikely that any children were exposed to these areas for long enough to experience chronic adverse health effects of soil exposure. No contaminant levels detected in soil at George AFB were high enough to cause acute health effects. Based on the current soil sampling data, past exposure to soil contamination at George AFB does not represent a public health hazard.

The current reuse plan for George AFB does not call for any residential use at the base except for the federal prison to be located south of Air Base Road. All other areas of the base will be used to support SCIA, leased to industrial and commercial tenants, remain in possession of the Air Force, or be left as is until additional reuse plans are developed. (Two schools located at George AFB will remain open and are discussed below under "ATSDR Child Health Initiative.") ATSDR evaluated the available soil data with the assumption that the base will continue to be used for industrial activities only and that children generally will not be present at George AFB (except on school grounds). Based on these assumptions, the low contaminant levels detected, and the ongoing remediation activities, present or future exposure to soil contamination at George AFB does not represent a public health hazard.

Surface soil samples were not collected adjacent to Site OT-62, a suspected pesticide rinse water disposal pit located near the Civil Engineering Facility. However, this pit was examined during the Environmental Baseline Survey phase of the installation in 1992 and no cracks or seams were observed in the pit. Because the original procedure was to discharge rinsate waters into the pit and allow them to evaporate and then, sometime before 1992, that procedure was changed and all rinsate wastes were drummed and shipped to the Defense Reutilization and Marketing Office for proper disposal, the decision was made to remove, backfill, and pave over the pit facility.

Evaluation of Radiological Exposure Pathway

Is radioactive waste present at George AFB, and, if so, could it cause adverse health effects?

Conclusions

Radiological contamination does not represent an apparent past public health hazard and does not represent a present or future public health hazard. A small amount of radioactive material was discovered and removed from a portion of the Southeast Disposal Area (SEDA). Radiation surveys and exploratory soil excavation indicate that this

area and the two munitions storage areas were not used for disposal of significant quantities of waste containing small quantities of radioactive material. Although people using the SEDA for recreation in the past may have been exposed to small amounts of low-level radioactive material, such exposures would have been infrequent and of short duration and would not be expected to pose a health hazard. The SEDA has recently been fenced and its landfill cover has been rehabilitated. The George AFB property located south of Air Base Road, which includes the SEDA, has been transferred to the Federal Bureau of Prisons and will be site of a prison that is currently under construction; the SEDA will remain fenced and will be within the fenceline of the prison.

Discussion

Extent and Sources of Contamination

Base records and community members suggest that a portion of the SEDA (located south of Air Base Road), as well as two munitions areas, may have been used for the disposal of low-level radioactive waste between 1965 and 1970 (U.S. Air Force 1997a, 1997b; Montgomery Watson, 1996). Disposed aircraft dials, circuit breakers, toggle switches, compasses, and aircraft engine gear boxes can be potential sources for low-level radioactivity because, in the 1960s, radium was used for aircraft dials, circuit breakers, and toggle switches, and tritium was used in the gear boxes of aircraft engines.

In 1993, base personnel identified and removed one radioactive object--a cesium-137 source--from RW-09, the suspected radiation disposal site in the SEDA. More recently, walk-over and drive-over radiation surveys, as well as extensive soil excavation, were performed at RW-09 and the two munitions storage areas. Investigations of OU 3 in 1994 included a walk-over radiation survey of the suspected waste sites, followed by excavation and inspection of 4,000 cubic yards of soil at the site. These activities led to the recovery of another cesium-137 source and one vacuum tube that contained low levels of uranium and thorium, which are not considered dangerous at the detected levels (Montgomery Watson, 1996). A drive-over survey (using a specially equipped four-wheel drive vehicle) in 1995 covered a total of over 230,000 data points in the three suspected disposal areas (IT, 1995). Radiation counts (500 to 1,200 counts/second) in all three areas were considered normal for the native soils. Small, isolated areas of high (1,200 to 1,400 counts/second) to very high (1,400 to 3,000 counts/second) readings were observed. These readings appeared to be artifacts, however. In the first instance, the areas of higher radiation appeared to be caused by depressions in the ground surface between a bunker and a wall, which effectively magnified the amount of background radiation, and in the second instance, asphalt pavement, which tends to emit higher background levels of radiation than the native soil at George AFB, caused the higher radiation counts (IT, 1995).

Exposure Potential

Three radioactive objects, containing limited amounts of radioactive materials, were identified and removed from the suspected disposal areas. The data gathered indicate that these areas were not used for the disposal of significant quantities of radioactive materials. Although in the past this area may have been used by hunters, dirt bikers, and other recreational users, any exposures to these radioactive materials during recreational activity are assumed to have been infrequent and of short duration and would not be expected to pose a health hazard. Access to the area is now restricted by a fence, a rehabilitated landfill cover, and the federal prison which is under construction at the site.

ATSDR CHILD HEALTH INITIATIVE

ATSDR recognizes that infants and children may be more sensitive to exposures than adults in communities with contamination of their water, soil, air, or food. This sensitivity is a result of several factors: 1) Children are more likely to be exposed to soil or surface water contamination because they play outdoors and often bring food into contaminated areas (e.g., children may come into contact with and ingest soil particles at higher rates than do adults; also, some children with a behavior trait known as "pica" are more likely than others to ingest soil and other nonfood items); 2) Children are shorter than adults, which means they can breathe dust, soil, and any vapors close to the ground; 3) They are smaller, resulting in higher doses of chemical exposure per body weight; and 4) The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at sites such as George AFB, as part of the ATSDR Child Health Initiative.

ATSDR has attempted to identify populations of children in the vicinity of George AFB and any completed exposure pathways to these children. The Adelanto School District operates two schools on base: a magnet school for the visual and performing arts and a middle school. Two other schools are located within a mile southwest of the base. In the past, George AFB maintained residences for base personnel and their families. Residential areas are also located directly to the west of George AFB in Adelanto and to the southeast in Victorville.

ATSDR did not identify any completed exposure pathways from George AFB to children at nearby schools or residential areas. The school grounds at George AFB are located more than 1,000 feet from the nearest IRP sites.

There are no health hazards associated with soil on the school grounds or along the normal school route on Corey Boulevard (U.S. Air Force, 1994). In fact, most contamination present at George AFB is in groundwater or subsurface soil. Although some surface soil contamination was detected at levels above CVs for pica children, ATSDR believes it is highly unlikely that any children living or attending school at the base were exposed to these areas for long enough to experience chronic adverse health effects of soil exposure. Assuming that the base will continue to be used for industrial activities only and that children generally will be present only on school grounds, present and future exposure to soil should not present a public health hazard for children.

Next Section **Table of Contents**

Page last reviewed: October 2, 2009
Page last updated: October 2, 2009
Content source: Agency for Toxic Substances and Disease Registry

Agency for Toxic Substances and Disease Registry, 4770 Buford Hwy NE, Atlanta, GA 30341
Contact CDC: 800-232-4636 / TTY: 888-232-6348