# 5. POTENTIAL FOR HUMAN EXPOSURE

## 5.1 OVERVIEW

Hexachloroethane is an industrial chemical which is not known to occur naturally. It is not produced for commercial distribution in the United States, but is imported for use in military smoke and pyrotechnic devices and as an intermediate in the organic chemicals industry. It is released to the environment from these uses, primarily to the atmosphere.

Hexachloroethane is relatively persistent in the environment. It volatilizes readily from water to the atmosphere, with a half-life of less than one day in some waters. Hexachloroethane may also leach through soil to groundwater. Neither hydrolysis nor photolysis are expected to be important removal processes, but hexachloroethane may be reduced in aquatic systems in the presence of specific agents. Bioconcentration in fish has been reported, but biomagnification through the food chain is unlikely. Biodegradation may contribute to hexachloroethane removal from ambient waters, but there is conflicting evidence regarding the significance of this fate process for hexachloroethane.

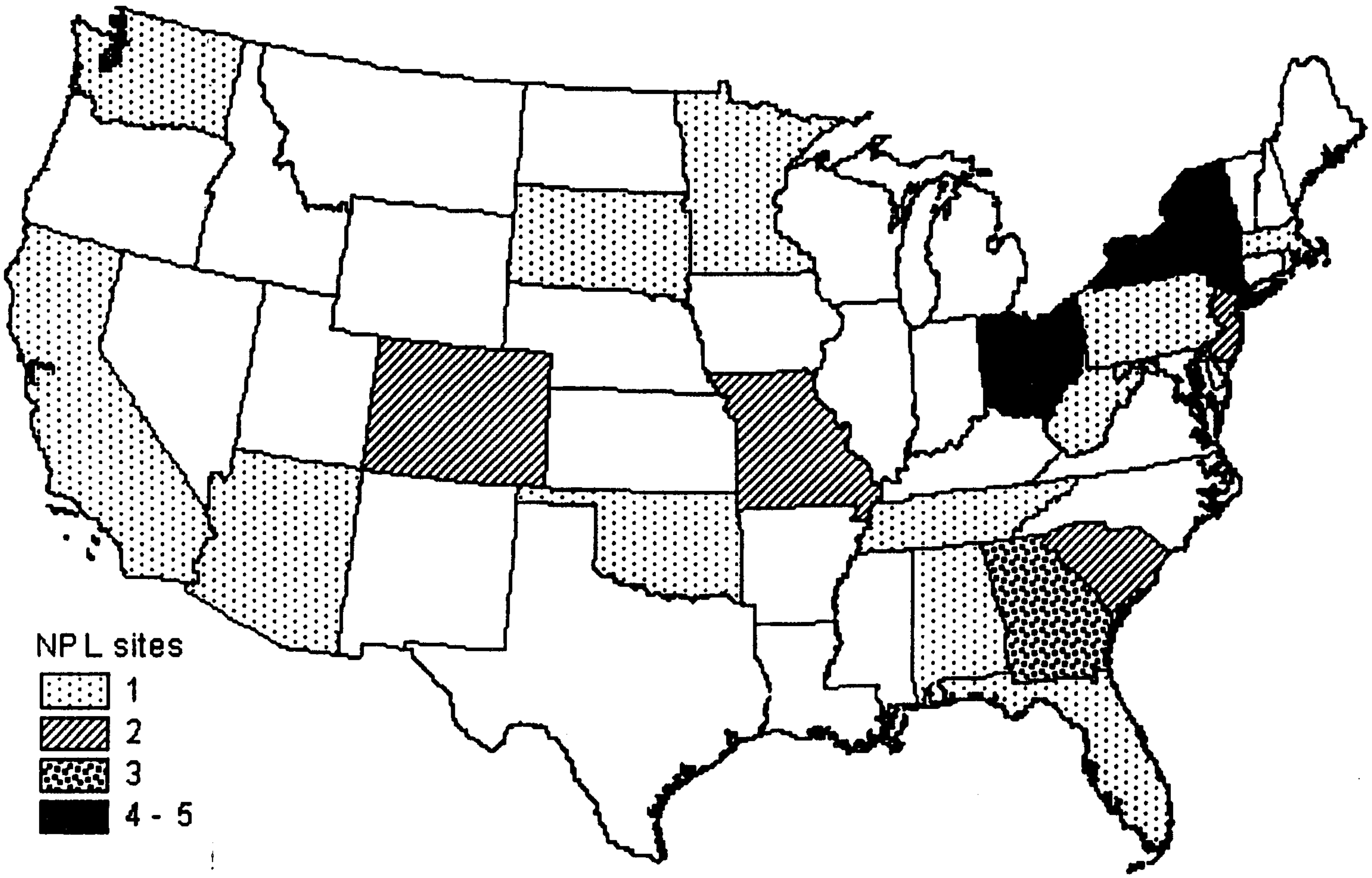
Hexachloroethane has been detected at low (ng/m$^3$) levels in the atmosphere and occasionally in drinking water systems. It is rarely detected in surface waters or biota, and has not been reported in ambient soil, sediments, or commercial food products.

Hexachloroethane has been identified in at least 45 of the 1,416 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (HazDat 1995). However, the number of sites evaluated for hexachloroethane is not known. The frequency of these sites within the United States can be seen in Figure 5-l.

## 5.2 RELEASES TO THE ENVIRONMENT

Hexachloroethane is not known to occur naturally (IARC 1979). Most of the hexachloroethane entering environmental media is from releases during manufacture and use of the compound in smoke-producing and pyrotechnic devices and as an intermediate in the production of several other products (Gordon et al.

FIGURE 5-1. FREQUENCY OF NPL SITES WITH HEXACHLOROETHANE CONTAMINATION*



*Derived from HAZDAT 1996

1991). Treatment and disposal of hexachloroethane-containing wastes also contributes to the environmental concentrations of this chemical.

Recent data reported to the TRI indicate that environmental releases of hexachloroethane from manufacture and industrial processing total about 51,088 pounds (TRI93 1995). However, these data do not include releases from the manufacture and use of military smoke and pyrotechnic devices, since federal facilities are not required to report releases to the TRI.

### 5.2.1 Air

The major sources of hexachloroethane releases to air are from its production and use in the organic chemical industry. As shown in Table 5-1, an estimated total of 49,716 pounds of hexachloroethane, amounting to about 97% of the total industrial environmental release, was discharged to the air from manufacturing and processing facilities in the United States in 1993 (TRI93 1995). The TRI data should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list.

Releases may also occur from the use of this chemical in smoke and pyrotechnic devices. Hexachloroethane content of the smoke devices is about 44.5-46% of the total solid material. The smoke device burns, producing smoke which is mainly zinc chloride, but contains some hexachloroethane. It was estimated that about 0.3-5% of the mass of the reagents in the device is released to air as hexachloroethane in the smoke, assuming a 70% burn efficiency (Katz et al. 1980; Novak et al. 1987). On this basis, it was estimated that during 1982-1984, a maximum of about 6,683 kg (14,700 pounds) of hexachloroethane was released to the atmosphere at Fort Irwin, California, a major military training facility (Novak et al. 1987). Hexachloroethane in smoke (aerosol) was measured in a wind tunnel at concentrations ranging from 0.64-1.26 mg/m$^3$ (average 0.89 mg/m3) (Cataldo et al. 1989).

Hexachloroethane may also be released to air during combustion and incineration of chlorinated wastes, from hazardous waste sites, and in small amounts during chlorination of sewage effluent prior to discharge and chlorination of raw water during drinking water treatment (Gordon et al. 1991; Howard 1989).

## Table 5-1. Releases to the Environment from Facilities That Manufacture or Process Hexachloroethane

| | | Range of reported amounts released in pounds per year [a] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| State [b] | Number of facilities | Air | Water | Land | Underground injection | Total environment [c] | POTW transfer | Off-site waste transfer |
| CA | 2 | 0-5 | 0 | 0 | 0 | 0-5 | 0 | 0-1110 |
| IL | 3 | 0-7729 | 0 | 0 | 0 | 0-7729 | 0 | 0 |
| IN | 1 | 36005 | 0 | 0 | 0 | 36005 | 0 | 0 |
| KS | 1 | 10 | 0 | 0 | 1081 | 1091 | 0 | 645 |
| LA | 5 | 0-390 | 0-1 | 0 | 0 | 0-390 | 0 | 0-760 |
| MI | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 41000 |
| MO | 1 | 500 | 0 | 0 | 0 | 500 | 0 | 0 |
| MS | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NJ | 2 | 1-10 | 0 | 0 | 0 | 1-10 | 0 | 0 |
| OH | 3 | 0-738 | 0 | 0 | 0 | 0-738 | 0 | 0-46532 |
| TX | 4 | 0-110 | 0-290 | 0 | 0 | 0-400 | 0 | 0-2198 |

Source: TRI93 1995

[a] Data in TRI are maximum amounts released by each facility.
[b] Post office state abbreviations used
[c] The sum of all releases of the chemical to air, land, water, and underground injection wells by a given facility

POTW = publicly owned treatment works

### 5.2.2 Water

Releases of hexachloroethane to water may occur during production, processing, and disposal of the chemical. In the past, reported concentrations of hexachloroethane in manufacturing effluents and waste waters from industrial and POTW facilities ranged from 0.9 to 1,405.6 μg/L (Gordon et al. 1991). It is estimated that prior to 1979, about 117,000 gallons (443,000 liters) of waste water per day were released from the Pine Bluff Arsenal (Gordon et al. 1991). The average hexachloroethane concentration in the waste water was 168 mg/L, resulting in the release of about 165 pounds of hexachloroethane per day. Following installation of pollution abatement devices at the arsenal in 1979, hexachloroethane was not detected in several samples of waste water from the facility.

Hexachloroethane was detectable in 2.0% of 1,253 effluent samples reported in the storage and retrieval (STORET) database maintained by EPA from 1980 to 1982 (Staples et al. 1985). The median concentration for all samples, including nondetects, was <10 μg/L.

As shown in Table 5-1, an estimated total of 291 pounds of hexachloroethane, amounting to about 0.6% of the total industrial environmental release, was discharged to surface water from manufacturing and processing facilities in the United States in 1993 (TRI93 1995). An additional 1,081 pounds (2% of the total) was discharged to underground injection. The TRI data should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list.

### 5.2.3 Soil

Hexachloroethane may be released to soil by industrial sources and from hazardous waste sites at which this chemical has been detected. It may be also be released to soil from the use of hexachloroethane smoke and pyrotechnic devices via deposition of airborne particulates (see Section 5.3.1) (Cataldo et al. 1989) or ejection of partially reacted compounds from the canister by the force of combustion (Schaeffer et al. 1988). Average hexachloroethane concentrations in deposited residues from several smoke pots, using different bum configurations, ranged from 1,900 to 54,700 mg/kg (Schaeffer et al. 1988). The authors estimated that the soil load of hexachloroethane from a single upright canister (smoke pot) could reach 6,054 mg hexachloroethane per kg soil in a semicircular area with a 5 m radius downwind of the burn.

As shown in Table 5-1, no hexachloroethane was discharged to land from manufacturing and processing facilities in the United States in 1993 (TRI93 1995). The TRI data should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list.

## 5.3 ENVIRONMENTAL FATE

### 5.3.1 Transport and Partitioning

Hexachloroethane released to water or soil may volatilize into air or adsorb onto soil and sediments. Volatilization appears to be the major removal mechanism for hexachloroethane in surface waters (Howard 1989). The volatilization rate from aquatic systems depends on specific conditions, including adsorption to sediments, temperature, agitation, and air flow rate. Volatilization is expected to be rapid from turbulent shallow water, with a half-life of about 70 hours in a 2 m deep water body (Spanggord et al. 1985). A volatilization half-life of 15 hours for hexachloroethane in a model river 1 m deep, flowing 1 m/set with a wind speed of 3 m/sec was calculated (Howard 1989). Measured half-lives of 40.7 and 45 minutes for hexachloroethane volatilization from dilute solutions at 25°C in a beaker 6.5 cm deep, stirred at 200 rpm, were reported (Dilling 1977; Dilling et al. 1975). Removal of 90% of the hexachloroethane required more than 120 minutes (Dilling et al. 1975). The relationship of these laboratory data to volatilization rates from natural waters is not clear (Callahan et al. 1979).

Atmospheric transport of hexachloroethane may occur, based on the stability of the compound in air (Class and Ballschmitter 1986; Singh et al. 1979). Hexachloroethane is expected to diffuse slowly into the stratosphere, with a half-life of about 30 years (Howard 1989). Deposition of hexachloroethane from air to water, plants, and soil has been reported (Cataldo et al. 1989).

Based on calculated soil adsorption factors (log $K_{OC}$ of 2.24, 2.98, and 4.3), hexachloroethane is expected to have medium to low mobility in soil (Howard 1989). Thus, leaching to groundwater could occur. Results of studies with low organic carbon (0.02%) soil material indicate that sorption to aquifer materials retards hexachloroethane migration in groundwater (Curtis et al. 1986). In aquatic environments, moderate to slight adsorption to suspended solids and partitioning to sediments is likely (Howard 1989).

Bioconcentration of hexachloroethane is expected to occur to a moderate degree. A measured bioconcentration factor (BCF) of 139 was reported in bluegills (EPA 1980a). After adjustment of the BCF for lipid content, the weighted average BCF calculated for the edible portion of freshwater and estuarine aquatic organisms was 86.9. However, hexachloroethane is rapidly metabolized in bluegill, with an estimated half-life of <l day (Howard 1989). The measured BCFs in rainbow trout were 510 and 1,200 at low (0.32 ng/L) and high (7.1 ng/L) exposure levels, respectively (Oliver and Niimi 1983). A BCF of 245 was calculated for hexachloroethane, based on the octanol water partition coefficient ($K_{ow}$) and the molar solubility in octanol (Banerjee and Baughman 1991). Since hexachloroethane is rarely detected in ambient waters (see Section 5.4.2) and appears to be rapidly metabolized, significant bioaccumulation or biomagnification in the food chain is not expected.

### 5.3.2 Transformation and Degradation

#### 5.3.2.1 Air

Hexachloroethane is quite stable in air. It is not expected to react with hydroxyl radicals or ozone in the atmosphere or to photodegrade in the troposphere (Callahan et al. 1979; Howard 1989). Degradation by photolysis may occur in the stratosphere.

#### 5.3.2.2 Water

Hexachloroethane is also relatively resistant to degradation in the aquatic environment. No hydrolysis of hexachloroethane in water was observed after 11 days at 85°C at 3 pH levels (3,7, and 11) (Ellington et al. 1987). However, hexachloroethane may be reduced in aquatic systems in the presence of sulfide and ferrous ions (Kriegman-King and Reinhard 1991). The transformation rate of hexachloroethane to tetrachloroethylene under simulated groundwater conditions at 50°C was evaluated without ferrous or sulfide ions, with minerals (biotite and vermiculite) providing ferrous ions, and with minerals and sulfide ions. Reported half-lives for hexachloroethane were 365 days for hexachloroethane alone, 57-190 days with minerals present, and 0.45-0.65 days in the presence of both minerals and sulfide.

Photolysis of hexachloroethane in water has been reported, but degradation to carbon dioxide occurred at a temperature of 90-95°C (Knoevenagel and Himmelreich 1976). The relevance of these results to ambient conditions are uncertain.

Biodegradation may be an important removal process in ambient waters, but there is conflicting evidence regarding the significance of this fate process for hexachloroethane. In the presence of a mixed bacterial culture, hexachloroethane had no effect on the growth rate of the culture, was recovered quantitatively after incubation with the culture for 8 days, and hexachloroethane could not be used as a sole source of carbon after incubation for more than 6 weeks (Mrsny et al. 1978). The authors concluded that hexachloroethane was apparently not toxic to or metabolized by bacteria, and used hexachloroethane as an internal standard to monitor the bacterial degradation of crude oil. Results reported in another biodegradation screening study indicated that <30% degradation of hexachloroethane occurred after a 2-week incubation period in activated sludge under aerobic conditions (Howard 1989). However, other studies indicate that considerable biodegradation of hexachloroethane may occur. In a 7-day staticscreening- flask test at 25°C under aerobic conditions, 100% loss of hexachloroethane was reported, with no loss attributable to volatilization (Tabak et al. 1981). Other studies reported significant losses (38% loss in sterile control) resulting from volatilization under aerobic conditions (Spanggord et al. 1985). Under anaerobic conditions, loss of 90% of hexachloroethane was reported from pond water in 18 days, while no loss from sterile pond water was observed (Spanggord et al. 1985).

A half-life of about 40 days was reported for hexachloroethane in an unconfined sand aquifer (Criddle et al. 1986). Laboratory studies with wastewater microflora cultures and aquifer material provided evidence for microbial reduction of hexachloroethane to tetrachloroethylene under aerobic conditions in this aquifer system (Criddle et al. 1986). In anaerobic groundwater, hexachloroethane reduction to pentachloroethane and tetrachloroethylene was found to occur only when the water was not poisoned with mercury chloride (Roberts et al. 1994). Pentachloroethane reduction to tetrachloroethylene occurred at a similar rate in both poisoned and unpoisoned water. From these results, Roberts et al. (1994) suggested that the reduction of hexachloroethane to tetrachloroethylene occurred via pentachloroethane. The first step, the production of pentachloroethane, was microbially mediated, while the production of tetrachloroethylene from pentachloroethane was an abiotic process.

#### 5.3.2.3 Sedimentand Soil

Hexachloroethane may biodegrade in soil, but abiotic degradation processes are not expected to be significant. Hexachloroethane is biotransformed in soil under both aerobic and anaerobic conditions, but proceeds more rapidly in anaerobic soils (Spanggord et al. 1985). Loss of 99% of hexachloroethane was reported after 4 days of incubation anaerobically and after 4 weeks under aerobic conditions. Volatilization contributed to aerobic losses.

## 5.4 LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT

### 5.4.1 Air

Since hexachloroethane is quite stable in air (see Section 5.3.2.1), it may tend to accumulate in the atmosphere. Based on limited data, typical background concentrations in the northern hemisphere were reported to range from 5 to 7 ppt (48-68 ng/$m^3$) (Singh et al. 1979). Data reported on the National Ambient Volatile Organic Compounds Database indicate that hexachloroethane was detected at an average concentration of 0.001 ppb (9.7 ng/$m^3$) in ambient air in the United States, based on 69 measurements (Shah and Heyerdahl 1988). The detected concentrations were in remote and rural areas (average 3.2 ppt (31 ng/$m^3$)), rather than in urban and industrial locations (Howard 1989; Shah and Heyerdahl 1988). Hexachloroethane was detected in the atmosphere in Portland, Oregon at concentrations ranging from 2.8 to 4.1 ng/$m^3$ (Ligocki et al. 1985) and in air over the Atlantic Ocean at an average concentration of 0.5 ppt (4.8 ng/$m^3$) in the northern hemisphere and 0.34 ppt (3.3 ng/$m^3$) in the southern hemisphere (Class and Ballschmiter 1986).

### 5.4.2 Water

Hexachloroethane is rarely detected in ambient water. Data reported in the STORET database indicate that the chemical was detectable in only 1 of 882 (0.1%) ambient water samples (Staples et al. 1985). The median concentration for all samples was <l0 µg/L. Hexachloroethane was detected in Lake Ontario water, but not in Lake Erie (International Joint Commission 1983). The concentration of hexachloroethane in Lake Ontario was reported at 0.02 ng/L (Oliver and Niimi 1983). It was also identified in leachate from a hazardous waste site in Niagara Falls, New York (Hauser and Bromberg 1982). Hexachloroethane was not detected in 86 samples of urban runoff from 15 cities analyzed for the National Urban Runoff Program (Cole et al. 1984).

Hexachloroethane has occasionally been reported in drinking water in the United States. Hexachloroethane was detected in drinking water from Cincinnati, Ohio and three water supplies in the New Orleans area at concentrations ranging from 0.03 to 4.3 µg/L (Keith et al. 1976); in the municipal water supply in Evansville, Indiana (Kleopfer and Fairless 1972); and in 4 of 16 samples of Philadelphia drinking water (Suffet et al. 1980). It was also reported in 19 of 31 samples from private wells within 1 mile of a toxic waste dump in Hardeman County, Tennessee, at a median concentration of 0.26 μg/L (Clark et al. 1982).

### 5.4.3 Sediment and Soil

Data regarding hexachloroethane concentrations in soil or sediments are sparse. Hexachloroethane was not detectable in any of 356 sediment analyses reported in the STORET database (Staples et al. 1985). The median detection limit was 500 μkg.

### 5.4.4 Other Environmental Media

Hexachloroethane has not generally been reported in foods. Hexachloroethane was not detected in 116 fish samples reported in the STORET database (Staples et al. 1985), nor was it detected in 28 fish samples from 14 Lake Michigan tributaries (Camanzo et al. 1987). However, hexachloroethane was detected in 10 of 10 Lake Ontario rainbow trout at an average concentration of 0.03 ng/g (Oliver and Niimi 1983). No information was located regarding hexachloroethane in other foods.

## 5.5 GENERAL POPULATION AND OCCUPATIONAL EXPOSURE

Exposure of the general population to hexachloroethane is expected to be low. Analysis of blood from 13 individuals, using a method with a detection limit of 0.028 ppb, did not identify hexachloroethane in any sample (Ashley et al. 1992). The chemical has not been frequently detected in any environmental medium. Ambient air is the most likely source of hexachloroethane for exposed individuals in the general population (Howard 1989). Due to the stability of hexachloroethane (see Section 5.3.2.1), it may remain in the atmosphere for extended periods.

Workers in industrial facilities manufacturing or using hexachloroethane as an intermediate in the manufacture of other products may be exposed to the chemical by inhalation or dermal absorption. In addition, military or civilian personnel working with smoke or pyrotechnic devices may be exposed. Based on information collected for the National Occupational Exposure Survey, the National Institute for

Occupational Safety and Health (NIOSH) estimates that 8,515 workers were potentially exposed to hexachloroethane (NOES 1991).

## 5.6 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

Residents or workers near hazardous waste sites containing hexachloroetbane wastes or military training areas using smoke or pyrotechnic devices containing hexachloroethane may be exposed to higher than ambient levels.

## 5.7 ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA, as amended, directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of hexachloroethane is available. Where adequate information is not available, ATSDR, in conjunction with the NTP, is required to assure the initiation of a program of research designed to determine the health effects (and techniques for developing methods to determine such health effects) of hexachloroethane.

The following categories of possible data needs have been identified by a joint team of scientists from ATSDR, NTP, and EPA. They are defined as substance-specific informational needs that if met would reduce the uncertainties of human health assessment. This definition should not be interpreted to mean that all data needs discussed in this section must be filled. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

### 57.1 Identification of Data Needs

**Physical and Chemical Properties.** The physical and chemical properties of hexachloroethane are sufficiently wellcharacterized to allow estimation of its environmental fate (see Table 3-2) (EPA 1991a; Spanggord et al. 1985; Verschueren 1983; Weast 1986). On this basis, it does not appear that further research in this area is required at this time.

**Production, Import/Export, Use, Release, and Disposal.** Hexachloroethane is not manufactured for commercial distribution in the United States (Gordon et al. 1991; IARC 1979; Santodonato et al. 1985). However, current production as a by-product and import information are not available. Current uses of this chemical and the amounts consumed by each use, including military uses, were not located. This information would be helpful in assessing potential exposure to workers and the general population. The amount of the chemical disposed of by industrial facilities was reported to EPA (TRI93 1995), but information on quantities of hexachloroethane-containing wastes disposed of by military facilities was not located. Rotary kiln or fluidized bed incineration are acceptable methods for disposal of waste containing hexachloroethane (HSDB 1995).

According to the Emergency Planning and Community Right-to-Know Act of 1986,42 U.S.C. Section 11023, industries are required to submit substance release and off-site transfer information to the EPA. The Toxics Release Inventory (TRI), which contains this information for 1993, became available in 1995. This database is updated yearly and should provide a list of industrial production facilities and emissions.

**Environmental Fate.** The environmental fate of hexachloroethane has been characterized (Gordon et al. 1991; Howard 1989; Spanggord et al. 1985). The chemical is relatively unreactive and degrades slowly in environmental media. In groundwater the half-life of hexachloroethane may range from 365 days to less than a day when minerals and sulfide are present (Kriegman-King and Reinhard 1991). Because hexachloroethane appears to remain in the atmosphere for long periods (half-life not available) and may migrate to groundwater (Callahan et al. 1979; Curtis et al. 1986; Howard 1989), additional studies of adsorption and intermediate partitioning might be useful to assess the potential for emission and transport of this chemical from hazardous waste sites.

**Bioavailability from Environmental Media.** No data are available on the absorption of hexachloroethane following inhalation or dermal contact. However, systemic toxicity (though minimal) was observed and suggests that some absorption can occur by these routes (Weeks et al. 1979). Data from animal studies that used gavage in oil for exposure to hexachloroethane indicate that the compound can also be absorbed following oral exposure (Fowler 1969b; Mitoma et al. 1985). No data were located regarding the absorption of hexachloroethane from air, water, soil, or plant material. Hexachloroethane exists in the air almost entirely as a vapor and there are no known processes that would impair its bioavailability from this medium. Since there is some adsorption of hexachloroethane to suspended solids and sediments in water, bioavailability from water may be limited (Howard 1989). On the other hand, hexachloroethane is not expected to adsorb to soil significantly (Howard 1989). Additional studies would be useful to determine the extent of bioavailability of hexachloroethane from contaminated air and drinking water near hazardous waste sites.

**Food Chain Bioaccumulation.** Hexachloroethane in water may bioconcentrate in aquatic organisms to a moderate degree (Howard 1989), with a BCF of 139 reported in bluegills (EPA 1980a). Due to its rapid metabolism (Howard 1989) and the low incidence of hexachloroethane in ambient waters (Staples et al. 1985), food chain bioaccumulation is unlikely. Additional research in this area does not appear to be necessary at this time.

**Exposure Levels in Environmental Media.** Hexachloroethane has been detected in smoke generated from smoke-producing devices during military training exercises (Katz et al. 1980; Novak et al. 1987). In the Northern hemisphere and the United States, hexachloroethane has been detected in air at concentrations in the parts per trillion (Howard 1989; Ligocki et al. 1985; Shah and Heyerdahl l988; Singh et al. 1979). In water, concentrations in the parts per billion are occasionally detected (Cole et al. 1984; International Joint Commission 1983; Staples et al. 1985). Hexachloroethane was not found in any of 356 sediment samples (Staples et al. 1985). Additional information regarding hexachloroethane in soil or sediments was not available. Since this chemical is not prevalent in the environment, monitoring of ambient environmental media does not appear to be required at this time. However, monitoring of workplace air, and environmental media at hazardous waste sites and military training areas at which hexachloroethane has been detected would help to determine potential sources of exposure.

Reliable monitoring data for the levels of hexachloroethane in contaminated media at hazardous waste sites are needed so that the information obtained on levels of hexachloroethane in the environment can be used in combination with the known body burden of hexachloroethane to assess the potential risk of adverse health effects in populations living in the vicinity of hazardous waste sites.

**Exposure Levels in Humans.** Hexachloroethane has not been detected in human tissuesas a result of exposure to this chemical from environmental media. Biological monitoring data were not located for populations surrounding hazardous waste sites. Hexachloroethane has been detected in the plasma of workers at concentrations of 7.3 ± 6 μg/L, despite the use of protective equipment including disposable overalls and compressed-air-fed visors or full-facepiece masks with filters (Selden et al. 1994). Because of protective equipment, exposure concentrations could not be related to plasma levels of hexachloroethane. This information is necessary for assessing the need to conduct health studies on these populations.

**Exposure Registries.** No exposure registries for hexachloroethane were located. This substance is not currently one of the compounds for which a subregistry has been established in the National Exposure Registry. The substance will be considered in the future when chemical selection is made for subregistries to be established. The information that is amassed in the National Exposure Registry facilitates the epidemiological research needed to assess adverse health outcomes that may be related to exposure to this substance.

### 5.7.2 On-going Studies

No on-going studies regarding human exposure were located.