

6. POTENTIAL FOR HUMAN EXPOSURE

6.1 OVERVIEW

1-Bromopropane has not been identified in any of the 1,832 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (ATSDR 2015).

1-Bromopropane is a solvent widely used in commercial applications, such as adhesive sprays, degreasing operations for cleaning metals, plastics, and electronic components, dry cleaning, asphalt production, aircraft maintenance, and synthetic fiber manufacturing (Chalupka 2014). Almost all of the potential exposure to 1-bromopropane is associated with its production and use. Individuals living in close proximity to facilities that use aerosol products containing 1-bromopropane may be exposed via inhalation of ambient air (Blando et al. 2010; NTP 2011, 2016).

The dominant process affecting the overall environmental fate and transport of 1-bromopropane is volatilization. In water, estimated volatilization half-lives for a model river and a model lake were reported as 1.2 hours and 4.4 days, respectively (EPIWIN 2012). 1-Bromopropane in air will be degraded by photochemically produced hydroxyl radicals, with a half-life of 14 days (Donaghy et al. 1993). Hydrolysis and biodegradation by microorganisms have also been shown to break down 1-bromopropane in aquatic and terrestrial environments (Janssen et al. 1987; Mabey and Mill 1978; NITE 2010). 1-Bromopropane is not expected to bioaccumulate in aquatic organisms (EPIWIN 2012).

6.2 RELEASES TO THE ENVIRONMENT

As of November 23, 2015, the EPA published a final rule adding 1-bromopropane to the TRI list of reportable chemicals (EPA 2015). Under this rule, facilities that manufacture or process 1-bromopropane are required to report release and waste management data under Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) (EPA 2005). This rule applies to the reporting year beginning January 1, 2016, and facility reports are due on July 1, 2017 (EPA 2015).

The use of 1-bromopropane in commercial and industrial applications, such as vapor and immersion degreasing, adhesive sprays, dry cleaning, and solvent sprays, may result in its release to the environment (Chalupka 2014).

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6.2.1 Air

Since 1-bromopropane is volatile and is used as a vapor in emissive applications (NTP 2011), most environmental releases are into the air. No data regarding the amount of 1-bromopropane released to air could be located in the available literature.

There is no information on releases of 1-bromopropane to the atmosphere from manufacturing and processing facilities at this time; however, facility reports are due July 1, 2017 (EPA 2015).

6.2.2 Water

Schwarzenbach et al. (1985) reported on the investigation of groundwater contamination caused by a leaking waste water tank at an alkyl halides chemical plant in Switzerland where 1-bromopropane was manufactured at >5 tons/year. No 1-bromopropane could be detected in groundwater 7 years after the termination of plant operations and an extensive area cleanup, most likely due to hydrolysis.

It was reported that 1-bromopropane may be transported from macroalgae that produce 1-bromopropane as a product of fatty acid hydrolysis to the marine environment (Gschwend et al. 1985).

No other data regarding the amount of 1-bromopropane released to water could be located in the available literature.

There is no information on releases of 1-bromopropane to the water from manufacturing and processing facilities at this time; however, facility reports are due July 1, 2017 (EPA 2015).

6.2.3 Soil

No data regarding the amount of 1-bromopropane released to soil could be located in the available literature.

There is no information on releases of 1-bromopropane to the soil from manufacturing and processing facilities at this time; however, facility reports are due July 1, 2017 (EPA 2015).

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6.3 ENVIRONMENTAL FATE**6.3.1 Transport and Partitioning**

Due to its volatility, 1-bromopropane released to the environment is expected to partition mostly to air. Based on the vapor pressure of 1-bromopropane (see Table 4-2), when released to the atmosphere, it would be expected to exist in the vapor phase (Bidleman 1988).

1-Bromopropane released to water will primarily volatilize based on its estimated Henry's Law constant (see Table 4-2). Estimated volatilization half-lives for a model river and a model lake were reported as 1.2 hours and 4.4 days, respectively (EPIWIN 2012). It is not expected to adsorb to suspended soils or sediments based on its estimated organic carbon partition coefficient (K_{oc}) of 40, and therefore, leaching to groundwater may occur (EPIWIN 2012).

1-Bromopropane is not expected to bioaccumulate in aquatic organisms. This is based on its estimated bioconcentration factor (BCF) of 11 (EPIWIN 2012). No experimental data on the bioaccumulation of 1-bromopropane in fish could be located in the available literature.

If released to soil, 1-bromopropane is expected to partition primarily to the atmosphere through volatilization based on its vapor pressure (see Table 4-2). It may also be transported to surface water via runoff and to groundwater as a result of leaching. 1-Bromopropane is expected to have very high mobility in soil based on its estimated K_{oc} (Swann et al. 1983).

6.3.2 Transformation and Degradation

1-Bromopropane is subject to a variety of abiotic and biotic degradation processes in all environmental compartments (Belkin 2002; Donaghy et al. 1993; ECHA 2014; Mabey and Mill 1978).

6.3.2.1 Air

1-Bromopropane in the atmosphere will be degraded by photochemically produced hydroxyl radicals at a rate that has been measured as 1.18×10^{-12} cm³/molecule-second at 25°C (Donaghy et al. 1993). This corresponds to a half-life of 14 days, assuming an atmosphere containing 5×10^5 hydroxyl radicals/m³ at 25°C (Meylan and Howard 1993). The atmospheric lifetime of 1-bromopropane is not largely affected by photolysis (Wuebbles et al. 1998).

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6.3.2.2 Water

1-Bromopropane released to water may be subject to both abiotic and biotic degradation by microorganisms (Belkin 2001; ECHA 2014; Mabey and Mill 1978).

1-Bromopropane will slowly hydrolyze in water. A neutral first-order hydrolysis rate constant of 3.01×10^{-7} /second was measured at 55°C, corresponding to an aqueous hydrolysis half-life of approximately 26 days (Mabey and Mill 1978). It should be noted that this hydrolysis half-life is longer than the estimated volatilization half-lives from a model river and a model pond (see Section 6.3.1), suggesting that most 1-bromopropane will volatilize before extensive hydrolysis can occur.

1-Bromopropane has been shown to degrade in activated sludge during ready biodegradation tests. At a concentration of 100 mg/L, it degraded 70% after 4 weeks using an activated sludge inoculum at 30 mg/L. However, it was noted that 1-bromopropane was hydrolyzed in the test solution to 1-propanol and bromide ion, and degradation of 1-propanol is what was measured (NITE 2010). In a closed bottle test, 5.6 mg/L of 1-bromopropane biodegraded 19.2% after 28 days using an activated sludge inoculum (ECHA 2014).

Pure culture microorganisms have also been shown to have the potential to biodegrade 1-bromopropane. Degradation of haloalkanes, such as 1-bromopropane, by microorganisms takes place primarily via hydrolytic dehalogenation by enzymes (Belkin 2002). 1-Bromopropane was hydrolytically dehalogenated by *Arthrobacter* HA1 with a specific growth rate of 0.12/hour, a growth yield of 4.0 g protein/molC, and producing 1-propanol as a product (Scholtz et al. 1987). *Acinetobacter* strain GJ70 had a generation time of 7.4 hours when utilizing 1-bromopropane as a carbon source (Janssen et al. 1987). 1-Bromopropane was completely dehalogenated within 6 days when added to a 32 mM culture medium, producing 2.2 mM of the halide. A crude cell extract of strain GJ70 degraded 1-bromopropane to reaction products, 1-propanol and bromide ion. The mechanism for this reaction was reported to be hydrolytic dehalogenation, considering that no aldehydes were produced and no oxygen was consumed (Janssen et al. 1987). *Pseudomonas* strain ES-2, isolated from organobromide-rich industrial wastewater, was shown to organically debrominate 1-bromopropane, but was unable to use it as a carbon source for growth (Shochat et al. 1993).

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6.3.2.3 Sediment and Soil

Volatilization from moist and dry soil surfaces will be the predominant removal mechanism from these environmental compartments (Lyman et al. 1990). Ready biodegradation tests and pure culture studies (see Section 6.3.2.2) have shown that biodegradation may also be an important fate process for 1-bromopropane.

6.3.2.4 Other Media

Information on the transformation or degradation of 1-bromopropane in other media was not found in the available literature.

6.4 LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT

Reliable evaluation of the potential for human exposure to 1-bromopropane depends in part on the reliability of supporting analytical data from environmental samples and biological specimens. Concentrations of 1-bromopropane in unpolluted atmospheres and in pristine surface waters are often so low as to be near the limits of current analytical methods. In reviewing data on 1-bromopropane levels monitored or estimated in the environment, it should also be noted that the amount of chemical identified analytically is not necessarily equivalent to the amount that is bioavailable. The analytical methods available for monitoring 1-bromopropane in a variety of environmental media are detailed in Chapter 7.

There are very limited data on the detection of 1-bromopropane in the environment in the available literature.

6.4.1 Air

The Air Quality System (AQS) database is EPA's repository of criteria air pollutant and hazardous air pollutants monitoring data. In 2014, the AQS reported only positive detections of 1-bromopropane at one monitoring location. 1-Bromopropane was detected in ambient air of Philadelphia, Pennsylvania at levels of 0.14–0.16 ppb (0.047–0.053 ppbv) (EPA 2014b).

6.4.2 Water

No data on monitored levels of 1-bromopropane in water were found in the available literature.

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6.4.3 Sediment and Soil

No data on monitored levels of 1-bromopropane in soil or sediment were found in the available literature.

6.4.4 Other Environmental Media

The EPA (2014e) indicated that some consumer products may contain 1-bromopropane, including aerosol cleaning products, spot cleaners, and arts and craft spray glues, which could result in exposure to the general population; however, no consumer products were identified as containing 1-bromopropane in the U.S. Department of Health and Human Services household database (DHHS 2016). NTP (2016) indicated that no data are available on levels of 1-bromopropane in consumer products.

6.5 GENERAL POPULATION AND OCCUPATIONAL EXPOSURE

Exposure of 1-bromopropane to the general population may occur via inhalation of ambient air at locations in close proximity to the emissive use of 1-bromopropane due to potential vapor migration, such as degreasing operations or dry cleaners (Blando et al. 2010; NTP 2011, 2016). Vapor intrusion may also be a potential source of 1-bromopropane exposure, as vapor intrusion has been observed for several volatile organic chemicals (VOCs) with similar properties and overlapping usage (e.g., tetrachloroethylene and dry cleaning) (Blando et al. 2010). However, no information was located specifically evaluating vapor intrusion potential of 1-bromopropane. 1-Bromopropane has not been identified in consumer products (DHHS 2016; NTP 2016).

In NHANES 2011–2012, the distribution of the urinary metabolite of 1-bromopropane, N-acetyl-S-(n-propyl)-L-cysteine, by age, gender, race/ethnicity, and smoking status among 2,328 participants was examined; participants were ≥ 20 years of age. Adjusted urinary geometric means of N-acetyl-S-(n-propyl)-L-cysteine were the same in males and females (5.3 ng/mL). Nonsmokers did not have statistically significantly different urinary levels of N-acetyl-S-(n-propyl)-L-cysteine than smokers. Non-Hispanic white subjects (3.9 ng/mL) had significantly lower levels of N-acetyl-S-(n-propyl)-L-cysteine than non-Hispanic black subjects (4.1 ng/mL) and non-Hispanic Asians (7.7 ng/mL). Non-Hispanic black subjects (4.1 ng/mL) had significantly lower levels of urinary N-acetyl-S-(n-propyl)-L-cysteine than Hispanics (6.2 ng/mL) and non-Hispanic Asians (7.7 ng/mL).

In the National Children's Vanguard Study from 2009 to 2010 (Boyle et al. 2016), urinary samples collected from 488 pregnant women during the third trimester from seven locations in the United States

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contained N-acetyl-S-(n-propyl)-L-cysteine at a detection frequency of 99%; the median measured concentration was 2.61 ng/mL and the 75th percentile value was 9.44 ng/mL.

Biological exposure to the general population and workers can be assessed by measurement of bromide ion, 1-bromopropane, and its metabolite, N-acetyl-S-(n-propyl)-L-cysteine (AcPrCys) in urine or blood (NTP 2013). N-Acetyl-S-(n-propyl)-L-cysteine is expected to be more specific to 1-bromopropane than bromide due to the presence of the bromide ion in foods; however, there have also been concerns regarding the specificity of N-acetyl-S-(n-propyl)-L-cysteine. The ubiquitous nature of N-acetyl-S-(n-propyl)-L-cysteine in the urine of the general population suggests that it may not be a specific biomarker for 1-bromopropane, as general population exposure is expected to be limited. It is unknown if other chemicals and/or endogenous metabolism contributed to the observed urinary levels of N-acetyl-S-(n-propyl)-L-cysteine in biomonitoring studies.

Use of 1-bromopropane in emissive applications can lead to dermal and inhalation exposure of workers (NTP 2011). No data on the contribution of dermal exposure to body burdens could be located, but many studies have assessed personal breathing zone and indoor air concentrations.

Exposure to 24 female and 13 male workers in a 1-bromopropane factory in China was assessed through air, urine, and blood samples (Ichihara et al. 2004a). Mean ambient air concentrations of 1-bromopropane within the factory ranged from 2.1 to 79.7 ppm. Twelve-hour TWA 1-bromopropane breathing zone concentrations for workers ranged from 0.9 to 170.5 ppm. The study found that urinary 1-bromopropane levels directly correlated with individual exposure levels, but serum levels did not, suggesting urine samples may be a better biomarker for exposure. Valentine et al. (2007) studied blood and urine samples from workers and ambient air samples in a Chinese 1-bromopropane production plant in order to support the potential of urinary AcPrCys and globin S-propylcysteine (PrCys) adducts as biomarkers of exposure in humans. It was found that there was a significant increase in globin PrCys adducts on workers' globin (1.52 pmol/mg globin) compared with that of control factory workers (0.11 pmol/mg globin). Also, an increase in urinary AcPrCys levels was directly related to an increase in ambient air exposure levels, which ranged from 0 to 170.54 ppm (Valentine et al. 2007).

Air samples taken at the workplace where furniture foam cushions were manufactured during gluing operations had a mean 1-bromopropane concentration of 130 parts per million by volume (ppmv) (range, 91–176 ppmv) with a 7-hour TWA of 108 ppm (range, 92–127 ppm) (Majersik et al. 2007). Workers who complained of neurological symptoms had serum bromide levels of 44–170 mg/dL. Hanley et al.

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(2006) measured urinary bromide and personal breathing zone concentrations of 1-bromopropane during two full-shift days for 30 workers exposed to flexible foam spray adhesives used to construct foam seat cushions. Mean personal breathing zone concentrations were 92 ppm for adhesive sprayers and 11 ppm for other non-sprayer jobs, including glue line leads, sewing machine operators, wrappers, pillow stuffers, and foam and cloth cutters. Complete 48-hour urine samples for adhesive sprayers contained urinary bromide concentrations of 77–542 mg/g creatinine at work, 58–308 mg/g creatinine after work, and 46–672 mg/g creatinine in wake-up samples. Urinary bromide concentrations taken at the beginning of the week for sprayers were significantly higher than for non-spraying workers and unexposed controls, with measured means of 102, 31, and 3.8 mg/g creatinine, respectively (Hanley et al. 2006). In another study assessing the exposure of workers to 1-bromopropane in foam cushion spray adhesives used to construct foam seat cushions, personal breathing zone concentrations, as well as the metabolite, AcPrCys, in 48-hour urine samples from 30 workers and 21 unexposed controls were measured at two factories (Hanley et al. 2009). Full-shift geometric mean TWA personal breathing zone concentrations were reported as 92.4 and 10.5 ppm for sprayers and non-sprayers, respectively. Complete 48-hour urine samples for adhesive sprayers contained AcPrCys concentrations of 9.9–100 mg/g creatinine at work, 17.5–186 mg/g creatinine after work, and 15–184 mg/g creatinine in wake-up samples. Urinary AcPrCys concentrations taken at the beginning of the week for sprayers were significantly higher than for non-spraying workers and unexposed controls, with measured means of 3.2, 0.58, and 0.02 mg/g creatinine, respectively (Hanley et al. 2009).

In 1999 and 2001, NIOSH (2003a) evaluated exposure to 1-bromopropane at a facility that used a spray adhesive containing 1-bromopropane by measuring air and blood samples. The mean full shift personal breathing zone concentration for 16 samples collected in 1999 was 81.2 ppm (range, 18–254 ppm) and for 13 samples collected in 2001 was 45.7 ppm (range, 7–281 ppm). Unexposed workers full-shift personal breathing zone samples collected in 2001 had a mean 1-bromopropane concentration of 1.1 ppm (range, 0.1–4.9 ppm), which shows that 1-bromopropane vapors may migrate from spraying operations to other areas. Blood samples from all workers taken at the end of the week had a mean bromide concentration of 4.8 mg/dL (range, 1.7–43.5 mg/dL), of which exposed workers had a mean concentration of 14.9 mg/dL and unexposed workers had a mean concentration of 2.7 mg/dL. End of the week urine samples for all workers had a mean bromide concentration of 46.5 mg/dL (range, 15–595 mg/dL), of which exposed workers had a mean concentration of 151.8 mg/dL, and unexposed workers had a mean concentration of 28.5 mg/dL.

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Breathing zone samples taken at five facilities using 1-bromopropane solvents for vapor degreasing operations had mean full shift (8–10 hours) TWA 1-bromopropane concentrations of 2.6 and 0.31 ppm for workers near degreasers and those remote from degreasers, respectively (Hanley et al. 2010). Urinary metabolites for workers near degreasers were reported at mean bromide and AcPrCys concentrations of 8.9 and 1.3 mg/g creatinine, respectively, while workers remote from degreasers had mean bromide and AcPrCys concentrations of 3.7 and 0.12 mg/g creatinine, respectively (Hanley et al. 2010). In an assessment of a facility using 1-bromopropane in a cold vapor degreaser, the full shift time weighted average 1-bromopropane personal breathing zone concentrations for 20 remote workers ranged from 0.01 to 0.63 ppm, while two short-term task-based measurements from employees using the degreaser were 2.3 and 8.4 ppm (NIOSH 2001). The highest ambient air concentration in the facility collected during one area air sampling event was found in the degreaser room, which had 1-bromopropane concentrations of 4.42 ppm at the degreaser and 1.7 ppm at an area 5 feet from the degreaser.

In an investigation of potential exposure to 1-bromopropane among dry cleaners in New Jersey by measuring personal breathing zone and indoor air samples, the highest exposure measured for a dry cleaning machine operator was 54.55 ppmv as an 8-hour TWA, and the highest exposure for a clerk was 21.85 ppmv as an 8-hour TWA. Indoor air samples taken continuously for the time period dry cleaning work was being performed had measured average 1-bromopropane air concentrations ranging from not detected to 35.12 ppmv. This study found that the highest exposures to dry cleaning workers may occur during the addition of 1-bromopropane to the machines, during machine maintenance, unloading and sorting the cleaned clothes, when interrupting the wash cycle, and possible leaks from the machine (Blando et al. 2010). In 2008, NIOSH conducted an evaluation of the use of 1-bromopropane in four dry cleaning facilities in New Jersey (NIOSH 2010). Personal breathing zone air concentrations of 40 ppm for the machine operator and 17 ppm for the cashier during full shift sampling conducted at one of the facilities were reported. At the other three facilities, personal breathing zone concentrations in partial shift samples ranged from 1.5 to 160 ppm.

6.6 EXPOSURES OF CHILDREN

This section focuses on exposures from conception to maturity at 18 years in humans. Differences from adults in susceptibility to hazardous substances are discussed in Section 3.7, Children's Susceptibility.

Children are not small adults. A child's exposure may differ from an adult's exposure in many ways. Children drink more fluids, eat more food, breathe more air per kilogram of body weight, and have a

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larger skin surface in proportion to their body volume than adults. A child's diet often differs from that of adults. The developing human's source of nutrition changes with age: from placental nourishment to breast milk or formula to the diet of older children who eat more of certain types of foods than adults. A child's behavior and lifestyle also influence exposure. Children crawl on the floor, put things in their mouths, sometimes eat inappropriate things (such as dirt or paint chips), and may spend more time outdoors. Children also are generally closer to the ground and have not yet developed the adult capacity to judge and take actions to avoid hazards (NRC 1993).

The general population may be exposed to 1-bromopropane in air when it is used during aerosol applications due to potential vapor migration, particularly at locations in close proximity to the emissive use of 1-bromopropane (NTP 2011). No studies on exposures specific to children could be located in the available literature.

Evaluation of 417 children, 6–11 years of age, also participants in the NHANES 2011–2012 study examining the distribution of the urinary metabolite of 1-bromopropane, N-acetyl-S-(n-propyl)-L-cysteine, among the general population, showed measured mean concentrations of 2.6 ng/mL in males and 3.3 ng/mL in females (Jain 2015b). Non-Hispanic Asian children had the highest urinary levels of N-acetyl-S-(n-propyl)-L-cysteine (5.0 ng/mL) followed by non-Hispanic black children (3.4 ng/mL), non-Hispanic white children (2.4 ng/mL), and Hispanic children (2.1 ng/mL). Children had significantly lower levels of urinary N-acetyl-S-(n-propyl)-L-cysteine than nonsmoking adults (3.4 versus 5.7 ng/mL).

6.7 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

Exposure to 1-bromopropane occurs mainly in occupational settings. Workers may be exposed by inhalation of vapors or spray mists or by dermal absorption. Workers involved in the production of 1-bromopropane, as well as those using it in commercial applications, such as adhesive sprays, degreasing operations for cleaning metals, plastics, and electronic components, dry cleaning, asphalt production, aircraft maintenance, and synthetic fiber manufacturing, have potential for high dose exposures (Chalupka 2014).

6.8 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 1-bromopropane is available. Where adequate information

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is not available, ATSDR, in conjunction with 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 1-bromopropane.

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.

6.8.1 Identification of Data Needs

Physical and Chemical Properties. The physical-chemical properties of 1-bromopropane are provided in Chapter 4. Important properties such as melting point, boiling point, vapor pressure, water solubility, and octanol/water partition coefficient are available. No data needs are identified.

Production, Import/Export, Use, Release, and Disposal. No information is available in the TRI database on facilities that manufacture or process 1-bromopropane because this chemical is not required to be reported under Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) (EPA 2005). However, as of November 23, 2015, the EPA published a final rule adding 1-bromopropane to the TRI list of reportable chemicals (EPA 2015). This rule applies to the reporting year beginning January 1, 2016, and facility reports are due on July 1, 2017 (EPA 2015). It is estimated that 140 facilities will be required to report release and waste management data (EPA 2015).

Production, use, and import/export data are available (NTP 2003, 2011, 2013). Continuously updated information regarding these quantities is necessary. Information regarding use in consumer products, if any, would be useful. The identification of stabilizers and additives used in commercial grades of 1-bromopropane would be useful in determining potential health effects.

Environmental Fate. The environmental fate and transport of 1-bromopropane is well understood. Volatilization is the dominant process affecting the overall fate and transport. Additional studies on the rate of volatilization, rate of hydrolysis, and bioaccumulation potential would be useful.

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Bioavailability from Environmental Media. 1-Bromopropane is expected to volatilize and hydrolyze in water and is not frequently detected in ambient air, so bioavailability from environmental media is expected to be low. No data needs are identified.

Food Chain Bioaccumulation. Due to the low bioavailability of 1-bromopropane, it is not expected to bioaccumulate. Measured BCF data would be useful in determining the actual bioaccumulation potential in the food chain.

Exposure Levels in Environmental Media. Reliable monitoring data for the levels of 1-bromopropane in contaminated media at hazardous waste sites are needed so that the information obtained on levels of 1-bromopropane in the environment can be used in combination with the known body burden of 1-bromopropane to assess the potential risk of adverse health effects in populations living in the vicinity of hazardous waste sites.

Exposure Levels in Humans. Additional studies on levels of 1-bromopropane in the general environment would be useful in determining the exposure to the general public (NTP 2003). Environmental levels in indoor air due to use of consumer products containing 1-bromopropane would be particularly useful (EPA 2016). No measured data were located on levels of 1-bromopropane found in food, consumer products, or non-occupational exposures (NTP 2016). As there is potential for exposure to the general population through the use of at home consumer products, monitoring data on these products would be useful in determining exposure levels to the general public (EPA 2016).

Studies assessing the contribution of dermal contact to exposure of workers would be useful (NTP 2003). Additional research to better understand the potential exposure of the general public living or working in close proximity to dry cleaners that may vent 1-bromopropane vapors would be useful in assessing risk to these populations (Blando et al. 2010).

This information is necessary for assessing the need to conduct health studies on these populations.

Exposures of Children. Studies assessing the exposure of children due to their proximity to commercial uses of 1-bromopropane would be helpful in assessing their overall exposure risk. Specifically, monitoring data determining the exposure to children through the use of at home consumer products containing 1-bromopropane would be useful.

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Child health data needs relating to susceptibility are discussed in Section 3.12.2, Identification of Data Needs: Children's Susceptibility.

Exposure Registries. No exposure registries for 1-bromopropane were located. This substance is not currently one of the compounds for which a sub-registry has been established in the National Exposure Registry. The substance will be considered in the future when chemical selection is made for sub-registries 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.

6.8.2 Ongoing Studies

No ongoing studies were located for 1-bromopropane.