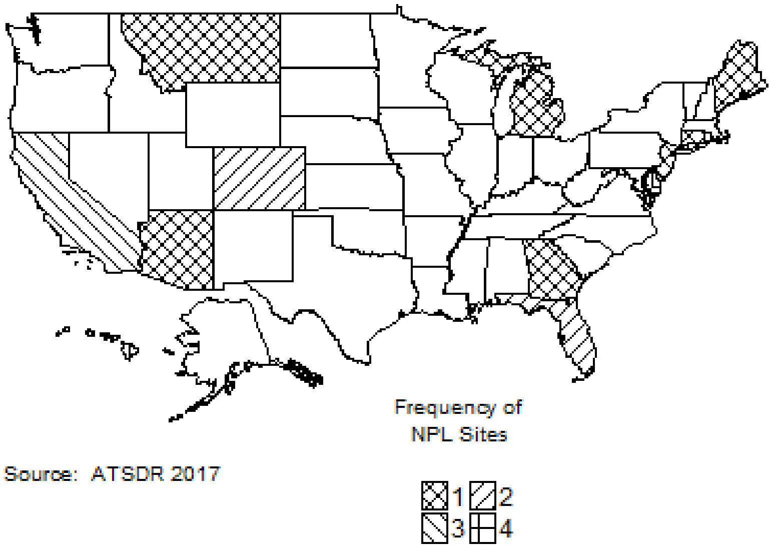
CHAPTER 5. POTENTIAL FOR HUMAN EXPOSURE

5.1 OVERVIEW

1,2-Dibromo-3-chloropropane has been identified in at least 18 of the 1,854 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (ATSDR 2017). However, the number of sites in which 1,2-dibromo-3-chloropropane has been evaluated is not known. The number of sites in each state is shown in Figure 5-1. Of these sites, 18 are located within the United States.

Figure 5-1. Number of NPL Sites with 1,2-Dibromo-3-chloropropane Contamination



Source: ATSDR 2017

- The most likely sources of potential exposure of the general population to 1,2-dibromo-3-chloropropane are from food grown in soil that may still contain small amounts of the chemical or drinking water than may have been contaminated from 1,2-dibromo-3-chloropropane when it was used as a soil fumigant and nematocide prior to 1990.
- EPA canceled the registration of 1,2-dibromo-3-chloropropane in 1985. Only pineapple crops could use 1,2-dibromo-3-chloropropane between 1977 and 1979.
- People who live near hazardous waste sites containing 1,2-dibromo-3-chloropropane may be exposed from contaminated air, surface water or groundwater, or soil.
- Daily intakes from food or drinking water have not been estimated, based on lack of data.
- 1,2-Dibromo-3-chloropropane may be used as an intermediate in the synthesis of organic chemicals, such as brominated flame retardants.
- 1,2-Dibromo-3-chloropropane would be expected to volatilize from surface water and soil. Once in air, 1,2-dibromo-3-chloropropane is expected to degrade via a vapor-phase reaction with hydroxyl radicals. Residues in soil that do not leach or volatilize appear to be persistent.

- Estimated half-lives for 1,2-dibromo-3-chloropropane are:
    - 36 days, hydroxyl radical degradation in air
    - 13.5 hours to 8 days, volatilization from water (environmental conditions limited)
    - 140 days to 38 years, degradation (via hydrolysis) in water

5.2 PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

5.2.1 Production

Table 5-1 summarizes information on U.S. companies that reported the manufacture or use of 1,2-dibromo-3-chloropropane in 2015 (TRI16 2017). Toxics Release Inventory (TRI) data should be used with caution since only certain types of industrial facilities are required to report. This is not an exhaustive list.

Table 5-1. Facilities that Produce, Process, or Use 1,2-Dibromo-3-Chloropropane

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
OH	1	100	999	12

[a]Post office state abbreviations used.
[b]Amounts on site reported by facilities in each state.
[c]Activities/Uses:

1. Produce
2. Import
3. Used Processing
4. Sale/Distribution
5. Byproduct
6. Reactant
7. Formulation Component
8. Article Component
9. Repackaging
10. Chemical Processing Aid
11. Manufacture Aid
12. Ancillary
13. Manufacture Impurity
14. Process Impurity

Source: TRI16 2017 (Data are from 2016)

1,2-Dibromo-3-chloropropane was first produced commercially in the United States in 1955 (IARC 1979). In 1969, U.S. production was 8.58 million pounds (IARC 1979). Estimates of annual production during 1974–1975 ranged from 18 to 20 million pounds (IARC 1979; NTP 1985). EPA canceled the registration of 1,2-dibromo-3-chloropropane in 1985. According to TRI (2017), a single facility was associated with 1,2-dibromo-3-chloropropane in the United States in 2016. This facility is a waste disposal company in Ohio.

5.2.2 Import/Export

No quantitative data concerning the recent import or export of 1,2-dibromo-3-chloropropane in the United States were found. Historical data indicate a single importer in 1977. It is unlikely that significant amounts of the chemical are imported or exported since its former major uses as a soil fumigant and nematocide are no longer permitted in the United States (EPA 1977, 1979, 1985b, 1985c).

5.2.3 Use

1,2-Dibromo-3-chloropropane was used as an intermediate in the synthesis of organic chemicals, such as the brominated flame retardant tris[(2,3-dibromopropyl)phosphate] (Verschueren 1983). Until 1977, 1,2-dibromo-3-chloropropane was extensively used as a soil fumigant and nematocide on over 40 different crops in the United States (Anonymous 1988). The chemical was used to protect field crops, vegetables, fruits and nuts, nursery and greenhouse crops, and turf from pests (NTP 1985). From 1977 to 1979, EPA suspended registration of products containing 1,2-dibromo-3-chloropropane except for use on pineapples in Hawaii (Anonymous 1988; EPA 1977, 1979). In 1985, EPA issued an intent to cancel all registrations for 1,2-dibromo-3-chloropropane-containing pesticide products, including use on pineapples. Subsequently, the use of existing stocks of 1,2-dibromo-3-chloropropane on pineapples was prohibited (EPA 1985b, 1985c).

Prior to the cancellation of pesticide uses, 1,2-dibromo-3-chloropropane was used extensively; 9.8 million pounds of 1,2-dibromo-3-chloropropane were applied in 1974 (NTP 1985). In California, 831,000 pounds of the chemical were applied, mainly on grapes and tomatoes, during 1977 (NTP 1985). The volume of 1,2-dibromo-3-chloropropane applied to pineapple fields in Hawaii between 1979 and 1985 was probably high, since during much of that time, the chemical was the preferred fumigant for use on pineapple fields (Albrecht 1987).

5.2.4 Disposal

1,2-Dibromo-3-chloropropane has been identified as a hazardous waste by EPA, and the disposal of this compound is regulated under the federal Resource Conservation and Recovery Act (RCRA) (EPA 1988b, 1988c). Specific information regarding federal regulations on the land disposal of 1,2-dibromo-3-chloropropane is provided in the Code of Federal Regulations (EPA 1988c). No acceptable chemical decontamination is known for 1,2-dibromo-3-chloropropane (HSDB 1989). Dilution of the chemical with a flammable solvent is necessary for incineration to be effective, and the products must be passed through scrubbers to remove the hydrogen bromide and hydrogen chloride that is produced (HSDB 1989).

5.3 RELEASES TO THE ENVIRONMENT

The Toxics Release Inventory (TRI) data should be used with caution because only certain types of facilities are required to report (EPA 2005). This is not an exhaustive list. Manufacturing and processing facilities are required to report information to the TRI only if they employ ≥10 full-time employees; if their facility is included in Standard Industrial Classification (SIC) Codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20–39, 4911 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4939 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4953 (limited to facilities regulated under RCRA Subtitle C, 42 U.S.C. section 6921 et seq.), 5169, 5171, and 7389 (limited S.C. section 6921 et seq.), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvents recovery services on a contract or fee basis); and if their facility produces, imports, or processes ≥25,000 pounds of any TRI chemical or otherwise uses >10,000 pounds of a TRI chemical in a calendar year (EPA 2005).

5.3.1 Air

There were no estimated releases of 1,2-dibromo-3-chloropropane to the atmosphere from one domestic manufacturing and processing facility in 2016 required to report to the TRI (TRI16 2017; see Table 5-2).

Table 5-2. Releases to the Environment from Facilities that Produce, Process, or Use 1,2-Dibromo-3-Chloropropane[a]

	Reported amounts released in pounds per year[b]								
							Total release		
State[c]	RF[d]	Air[e]	Water[f]	UI[g]	Land[h]	Other[i]	On-site[j]	Off-site[k]	On- and off-site
OH	1	0	0	0	0	No data	0	No data	0
Total	1	0	0	0	0	0	0	0	0

[a] The TRI data should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list. Data are rounded to nearest whole number.
[b] Data in TRI are maximum amounts released by each facility.
[c] Post office state abbreviations are used.
[d] Number of reporting facilities.

Table 5-2. Releases to the Environment from Facilities that Produce, Process, or Use 1,2-Dibromo-3-Chloropropane[a]

Reported amounts released in pounds per year[b]									
							Total release		
State[c]	RF[d]	Air[e]	Water[f]	UI[g]	Land[h]	Other[i]	On-site[j]	Off-site[k]	On- and off-site

[e] The sum of fugitive and point source releases are included in releases to air by a given facility.

[f] Surface water discharges, waste water treatment-(metals only), and publicly owned treatment works (POTWs) (metal and metal compounds).

[g] Class I wells, Class II-V wells, and underground injection.

[h] Resource Conservation and Recovery Act (RCRA) subtitle C landfills; other onsite landfills, land treatment, surface impoundments, other land disposal, other landfills.

[i] Storage only, solidification/stabilization (metals only), other off-site management, transfers to waste broker for disposal, unknown

[j] The sum of all releases of the chemical to air, land, water, and underground injection wells.

[k] Total amount of chemical transferred off-site, including to POTWs.

RF = reporting facilities; UI = underground injection

Source: TRI16 2017 (Data are from 2016)

5.3.2 Water

There were no estimated releases of 1,2-dibromo-3-chloropropane to surface water from one domestic manufacturing and processing facility in 2016 required to report to the TRI (TRI16 2017). There were no data on releases to publicly owned treatment works (POTWs) (TRI16 2017; see Table 5-2).

5.3.3 Soil

There were no estimated releases of 1,2-dibromo-3-chloropropane to soils from one domestic manufacturing and processing facility in 2016 required to report to the TRI (TRI16 2017). There were no releases via underground injection (TRI16 2017; see Table 5-2).

5.4 ENVIRONMENTAL FATE

5.4.1 Transport and Partitioning

1,2-Dibromo-3-chloropropane in soil is subject both to leaching into groundwater and to volatilization from near-surface soil. The experimental K_{oc} values of approximately 149 in Lincoln fine sand (Wilson et al. 1981) and 128 in an unspecified soil (Sabljic 1984) indicate that 1,2-dibromo-3-chloropropane is highly mobile in soil (Swann et al. 1983). Data from field and laboratory experiments confirm that 1,2-dibromo-3-chloropropane has a strong potential to leach through soil to groundwater (Bomberger et al. 1983; Carter et al. 1984; Hodges and Lear 1974; Kloos 1983; Oki and Giambelluca 1987; Wilson et al. 1981). The rate and extent that 1,2-dibromo-3-chloropropane leaches through agricultural soil depend upon various factors that include the water-holding capacity of the soil (which is related to the size of the air spaces in the soil), the amount of organic matter in the soil, the amount of water applied, and the method of 1,2-dibromo-3-chloropropane application (Hodges and Lear 1974).

In a study using primarily clay, silt, and sandy soils, mobility was lowest in the clay soil, which had a higher content of organic matter than both sandy and silt soil and a lower amount of air space between particles of soil than was found in the silt soil (Hodges and Lear 1974). Mobility was highest in the sandy soil, which had the largest spaces between soil particles (and therefore the fastest rate of water movement) and the lowest amount of organic matter (Hodges and Lear 1974).

Application of 1,2-dibromo-3-chloropropane by either injection or application in irrigation water (flood application) led to extensive and rapid penetration of the fumigant. Application of 1,2-dibromo-3-chloropropane by injection led to greater penetration in the clay and silt soils, compared to its flood application, because it was retained near the soil surface in the latter case and was subsequently lost to the atmosphere (Hodges and Lear 1974).

An illustration of the volatilization behavior of 1,2-dibromo-3-chloropropane from soil was obtained in a study of a pineapple field that was treated with 4 gallons per acre of the chemical injected to a depth of 12 inches (Albrecht and Chenchin 1985). 1,2-Dibromo-3-chloropropane concentration in the air at ground level and at 42 inches above the ground reached peaks after 2 days (approximately 0.4 and 8 ppb, respectively), dropped off to nondetectable levels after 3 days, peaked after 6 days following a 6-mm rainfall on days 5–6 (approximately 1.2 and 0.5 ppb at ground level and 42 inches, respectively), and dropped off but remained at measurable levels for the remainder of the 30-day experiment (Albrecht and Chenchin 1985).

These data support results obtained in modeling studies that predict that volatilization of 1,2-dibromo-3-chloropropane from near-surface soil is important (Bomberger et al. 1983; Jury et al. 1987). Estimated volatilization half-lives for 1,2-dibromo-3-chloropropane that was evenly distributed in the top 10 cm of soil varied between 0.6 days in dry soil with very low soil organic content to 26.2 days in wet soil with relatively high soil organic content (Bomberger et al. 1983). The use of plastic coverings over 1,2-dibromo-3-chloropropane treated fields retards volatilization loss from soil.

Small amounts of 1,2-dibromo-3-chloropropane may be absorbed through the roots of plants growing in 1,2-dibromo-3-chloropropane contaminated soil and may be translocated to other parts of the plants (see Section 5.5.4.) (Carter and Riley 1982; Newsome et al. 1977). 1,2-Dibromo-3-chloropropane was found in peaches and in the roots and tops of carrots and radishes that were grown in 1,2-dibromo-3-chloropropane-treated soil. The generally lower amounts of the chemical found in the foliage than in the roots of the carrot and radish plants may have resulted from translocation from the roots or from absorption of 1,2-dibromo-3-chloropropane that had volatilized from the soil to the air (Newsome et al. 1977). The possibility of absorption of volatilized 1,2-dibromo-3-chloropropane by the peaches appears to be a less likely explanation than translocation because the 1,2-dibromo-3-chloropropane was applied to the fields in the fall, months before the spring harvest of the peaches (Carter and Riley 1984).

In the atmosphere, 1,2-dibromo-3-chloropropane is expected to exist predominantly in the vapor phase based upon its vapor pressure (see Table 4-2) (Eisenreich et al. 1981; Munnecke and VanGundy 1979). Because significant amounts of 1,2-dibromo-3-chloropropane are not likely to be present in the particulate phase, dry deposition to the earth's surface is not a significant removal process. Based upon its high water solubility (see Table 4-2), the small amounts of 1,2-dibromo-3-chloropropane that are present in air may be removed by wet deposition; however, much of the 1,2-dibromo-3-chloropropane removed from the atmosphere by washout is likely to reenter the atmosphere by volatilization. No experimental or predictive data were located in the literature regarding the transport of 1,2-dibromo-3-chloropropane in the atmosphere; however, the expected half-life of 36 days (see Section 5.4.2) indicates that it could be transported long distances in the atmosphere.

1,2-Dibromo-3-chloropropane that is present in water is expected to volatilize rapidly to the atmosphere. Using the Henry's law constant, a half-life of 13.5 hours was calculated for evaporation from a model river l-m deep, flowing at 1 m/second, with a wind velocity of 3 m/second, and neglecting adsorption to sediment (Thomas 1982). A volatilization half-life of 8 days from a model pond can be estimated using a three-compartment EXAMS model (EPA 1985d). 1,2-Dibromo-3-chloropropane is not expected to adsorb significantly to sediment and suspended organic matter based upon a K_{oc} ranging between 128 and 149 (Sabljic 1984; Wilson et al. 1981). It is not expected to bioconcentrate in fish and other aquatic organisms based upon an estimated bioconcentration factor (BCF) of 11.2 (calculated from water solubility; see Table 4-2) (Bysshe 1982; Munnecke and VanGundy 1979). No data were located that would indicate a potential for 1,2-dibromo-3-chloropropane to biomagnify from lower to higher trophic states of aquatic or terrestrial foodchains.

5.4.2 Transformation and Degradation

Air. The primary degradation process for 1,2-dibromo-3-chloropropane in the atmosphere is likely to be a vapor-phase reaction with photochemically produced hydroxyl radicals. The experimental rate constant for this process is 4.4×10^{-13} cm^3/molecule-second (Tuazon et al. 1986). This corresponds to a half-life of 36 days at an estimated atmospheric concentration of 5×10^5 hydroxyl radicals/cm^3. Direct photolysis of 1,2-dibromo-3-chloropropane is not expected to occur in the atmosphere since the chemical lacks a chromophore that absorbs light at environmentally significant wavelengths (>290 nm) (Silverstein et al. 1974).

Water. Degradation of 1,2-dibromo-3-chloropropane in natural waters is a slow process. It volatilizes from surface waters before significant degradation can occur. Hydrolysis of 1,2-dibromo-3-chloropropane in natural waters is unlikely to be an important removal process. The base hydrolysis rate constant at 25°C of 20.6 $hour^{-1}$ M^{-1} was extracted from data obtained at 40–100°C (Burlinson et al. 1982). This rate constant corresponds to half-lives for hydrolysis of 38 years and 140 days at pH 7 and 9, respectively. Direct photolysis of 1,2-dibromo-3-chloropropane is not likely to occur in environmental waters since the chemical lacks a chromophore that absorbs light at environmentally significant wavelengths (>290 nm) (Silverstein et al. 1974).

No studies were located regarding the biodegradation of 1,2-dibromo-3-chloropropane in natural waters. 1,2-Dibromo-3-chloropropane may be susceptible to slow biodegradation in natural waters based upon the observation of biologically mediated dehalogenation in certain soils amended with a nutrient (Castro and Belser 1968). In experiments using anoxic biofilm columns that were designed to resemble groundwater environments, 1,2-dibromo-3-chloropropane was susceptible to biodegradation under conditions of methanogenesis, denitrification, and sulfate respiration (Bouwer and Wright 1988). Although data from these experiments cannot be used to predict what type of aquifer is likely to support biodegradation or the rate of biodegradation to be expected, they indicate that some biodegradation of 1,2-dibromo-3-chloropropane in groundwater may occur under anaerobic conditions.

Sediment and Soil. 1,2-Dibromo-3-chloropropane is subject to biodehalogenation in soil-water suspensions (aerobic/anaerobic conditions not specified) in the presence of an added nutrient (Castro and Belser 1968). Biodegradation did not occur in the absence of the added glycerol nutrient or in suspensions of sterilized soil. Dehalogenation occurred in approximately 75% of the soil samples that were tested. The highest rate of dehalogenation was 20% in 1 week at pH 8, which was measured by the rate of bromide ion formation. The maximum observed yield of bromide from 1,2-dibromo-3-chloropropane was 63% of the theoretical yield in 4 weeks under unspecified conditions. The data from these experiments suggest that 1,2-dibromo-3-chloropropane may be susceptible to biodegradation in soil under certain conditions; however, it is not possible to predict the soils that will biodegrade the chemical or the rate of biodegradation (Castro and Belser 1968). In another study, it appears that no degradation of 1,2-dibromo-3-chloropropane was observed in soil columns within 25 days under aerobic conditions (Wilson et al. 1981). Based upon aqueous hydrolysis data, chemical hydrolysis is not expected to be significant except in very alkaline soils.

Based upon monitoring data obtained years after the last known application, 1,2-dibromo-3-chloropropane residues that do not leach or volatilize are very persistent in soil. For example, 1,2-dibromo-3-chloropropane residues as high as 0.5 µg/kg were found in the soil at a site 6–7 years following the last known application (Nelson et al. 1981).

5.5 LEVELS IN THE ENVIRONMENT

Reliable evaluation of the potential for human exposure to 1,2-dibromo-3-chloropropane depends, in part, on the reliability of supporting analytical data from environmental samples and biological specimens. Concentrations of 1,2-dibromo-3-chloropropane 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 1,2-dibromo-3-chloropropane 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.

Table 5-3 shows the lowest limit of detections that are achieved by analytical analysis in environmental media.

Table 5-3. Lowest Limit of Detection Based on Standards[a]

Media	Detection limit	Reference
Air	0.02 ppb	Mann et al. 1980
Drinking water	0.01 µg/L	EPA 1986a
Surface water and groundwater	0.01 µg/L	EPA 1986a
Whole blood	3 ng/mL	Pellizzari et al. 1985b

[a] Detection limits based on using appropriate preparation and analytics. These limits may not be possible in all situations.

Detections of 1,2-dibromo-3-chloropropane in air, water, and soil at NPL sites are summarized in Table 5-4.

Table 5-4. 1,2-Dibromo-3-Chloropropane Levels in Water, Soil, and Air of National Priorities List (NPL) Sites

Medium	Median[a]	Geometric mean[a]	Geometric standard deviation[a]	Number of quantitative measurements	NPL sites
Water (ppb)	2.2	2.86	6,840	10	5
Soil (ppb)	61,000	63,000	23,700	5	3
Air (ppbv)			No data		

[a] Concentrations found in ATSDR site documents from 1981 to 2017 for 1,854 NPL sites (ATSDR 2017). Maximum concentrations were abstracted for types of environmental media for which exposure is likely. Pathways do not necessarily involve exposure or levels of concern.

5.5.1 Air

Few data concerning the detection of 1,2-dibromo-3-chloropropane in the atmosphere were found. Ambient air surrounding bromine industry chemical plants in the vicinity of two cities in Arkansas were analyzed for the presence of 1,2-dibromo-3-chloropropane in 1976 and 1977 (Pellizzari et al. 1978). In the vicinity of Magnolia, Arkansas, the maximum concentration of the chemical found in air surrounding a Dow Chemical Company plant was 6,653 ng/m^3. The maximum concentration in the El Dorado, Arkansas, area was 187 ng/m^3 at the Velsicol Chemical Corporation (Pellizzari et al. 1978). In a study that reported data collected primarily between 1970 and 1980, the median concentration of 1,2-dibromo-3-chloropropane was 1.8 ng/m^3 in ambient air near source-dominated areas; no data were listed for rural, remote, urban, or suburban areas (Brodzinsky and Singh 1982). This study is not comprehensive since it involved only scattered sampling of bromine industry chemical plants in one state. Furthermore, the data are old and were taken when the chemical was still being manufactured and widely used as a soil fumigant. Current releases to the atmosphere from manufacturing or research-use point sources are not likely to be significant since only limited amounts are presumed to be made and used (Section 5.2). Significant concentrations of the chemical are probably not present in the ambient atmosphere at this time; therefore, the background level estimated for ambient air is expected to be less than the detection limit. Exceptions may include air near NPL sites where 1,2-dibromo-3-chloropropane has been disposed, although no data were found concerning atmospheric concentrations at these sites.

5.5.2 Water

Data concerning levels of 1,2-dibromo-3-chloropropane in water are lacking, and those available are neither current nor comprehensive. The data in Table 5-5 indicate that contamination of municipal drinking water supplies was not widespread in the past. Where contamination was found, the concentrations had been <10 µg/L; however, concentrations as high as 95 and 137 µg/L have been reported in water from drinking water wells in California and Arizona, respectively, although no information was provided on possible sources of contamination (Burmaster 1982).

In a study of water from drinking water wells in the Fresno area of California's Central Valley conducted between 1979 and 1983, the tested wells generally had seasonal concentration patterns ranging from a low in winter to highs in spring/summer months. The 1,2-dibromo-3-chloropropane concentration also changed with daily use patterns ranging from highs at the start of pumping with lower concentrations as pumping continued (Kloos 1983). In a study of various waters in South Carolina sampled between 1979 and 1980, concentrations of 1,2-dibromo-3-chloropropane in water from one of three municipal water supplies ranged from 0.008 µg/L (detection limit) to 0.05 µg/L in an area where 1,2-dibromo-3-chloropropane was not known to have been used (Carter and Riley 1981).

Few data concerning the detection of 1,2-dibromo-3-chloropropane in surface water were found. In a study of South Carolina surface waters that were sampled between 1979 and 1980, concentrations of 1,2-dibromo-3-chloropropane ranged from not detected (detection limit 0.008 µg/L) to 0.05 µg/L in areas where 1,2-dibromo-3-chloropropane usage rates ranged from non-use to scattered use (Carter and Riley 1981). In high-use areas, 18 of 48 sites had concentrations exceeding the background level of 0.05 µg/L;

Table 5-5. Levels of 1,2-Dibromo-3-chloropropane in Potable Water[a]

Location	Date of sampling	Number of samples	Number positive samples	Concentration (µg/L)		Reference
				Range	Mean	
Municipal water supplies						
United States	1981–1982	466	1	5.5	5.5	Westrick et al. 1984
Mainly rural California	1979	61	12	0.1–9.5	1.4	Peoples et al. 1980
Riverside & Stanislaus Counties (California)	1979	3	3	0.1	0.1	Kutz and Carey 1986
South Carolina DBCP nonuse area[b]	1979–1980	3	1	<0.008–0.05	No data	Carter and Riley 1981
South Carolina DBCP high-use area[b]	1979–1980	8	4	<0.05	No data	Carter and Riley 1981
Drinking water wells						
South Carolina DBCP nonuse area[b]	1979–1980	8	3	<0.008–0.05	No data	Carter and Riley 1981
South Carolina DBCP high-use area[b]	1979–1980	49	29	<0.008–>1.0[c]	No data	Carter and Riley 1981
Madera, Stanislaus, and San Joaquin Counties (California)	1979	7	7	0.1–10.8	3.2	Kutz and Carey 1986
Well water and groundwater in areas with agricultural or undefined uses						
California	1979–1984	8,190	2,522	No data[d]	No data	Cohen 1986
Fresno County, California	1979–1983	9,000–10,000	1,500[e]	0.001–32[f]	No data	Kloos 1983
Mainly rural California	1979	262	90	0.1–39.2	No data	Peoples et al. 1980
San Joaquin Valley, California	April 1980	4 sites	3 sites	0.54–12	4.6	Nelson et al. 1981
Hawaii pineapple-growing regions	1980–1983	No data	No data	0.002–11	No data	Oki and Giambelluca 1987
United States[g]	No data	No data	No data	0.02–20[h]	No data	Cohen et al. 1986

[a] Based upon positive values; if one is listed, it is a maximum.
[b] Areas of no 1,2-dibromo-3-chloropropane use (nonuse) and widespread use (high use), respectively.
[c] 13 of 49 sites contained greater than the background level of 0.05 µg/L, and 5 contained >1.0 µg/L.
[d] 1,455 wells contained >1.0 µg/L 1,2-dibromo-3-chloropropane.
[e] Approximate number.
[f] 850 wells contained >1.0 µg/L 1,2-dibromo-3-chloropropane.
[g] Five U.S. states: Arizona, California, Hawaii, Maryland, and South Carolina.
[h] Typically positive values.

DBCP = 1,2-dibromo-3-chloropropane

concentrations as high as 0.35 µg/L were detected (Carter and Riley 1981). 1,2-Dibromo-3-chloropropane was identified, but not quantified, in surface water at a bromine industry chemical plant in the vicinity of Magnolia, Arkansas, which was sampled in 1977 (Pellizzari et al. 1978).

These data, combined with the knowledge that use of 1,2-dibromo-3-chloropropane as a soil fumigant has not been permitted in the United States for several years, suggest that widespread exposure to the chemical in drinking water is not likely. The estimated background level for groundwater in areas where the chemical has not been used or disposed of in the past and in surface water is less than the detection limit. In areas where it was used as a soil fumigant, background levels of 0.001–0.008 µg/L can be expected depending on the amount used and environmental conditions.

5.5.3 Sediment and Soil

Few data concerning the detection of 1,2-dibromo-3-chloropropane in soil were found. 1,2-Dibromo-3-chloropropane was tentatively identified, but not quantified, in sediment at a bromine industry chemical plant in the vicinity of Magnolia, Arkansas, which was sampled in 1977 (Pellizzari et al. 1978).

In a study conducted in 1980, 1,2-dibromo-3-chloropropane was analyzed in soils and subsoils from fields at four sites that were known to have been treated with 1,2-dibromo-3-chloropropane (the last application was 3–6 years prior to sampling) and where groundwater contamination with the chemical had been identified (Nelson et al. 1981). The concentrations in the soil and subsoils ranged from not detected (detection limit not stated) to 9 µg/kg (dry weight basis); higher levels were generally found in clay and silt layers. In 32 fields that had received 1,2-dibromo-3-chloropropane treatments 2–4 years prior to sampling, the surface of the topsoil contained approximately 2–5 µg/kg of the chemical (Peoples et al. 1980).

In another study, soil samples taken from two Edgefield County, South Carolina peach orchards (site 1 containing Wagram sand; site 2 containing Faceville sandy loam) with similar histories of 1,2-dibromo-3-chloropropane usage contained mostly undetectable levels (detection limit 0.025 µg/kg); the highest 1,2-dibromo-3-chloropropane concentrations were 0.095 and 0.497 µg/kg at sites 1 and 2, respectively (Carter et al. 1984). Soil profile samples indicated residues were usually found in the upper 90 cm (Carter et al.1984). A higher level of soil contamination (up to 7.84 µg/kg) was measured in soil near a well in site 2; the concentration of 1,2-dibromo-3-chloropropane was 1 µg/kg. The higher soil level in this area was attributed to a spill in which a formulation containing 1,2-dibromo-3-chloropropane had leaked from a rusting barrel.

These data, combined with the knowledge that use of 1,2-dibromo-3-chloropropane as a soil fumigant has not been permitted in the United States for several years, suggest that widespread exposure to the chemical due to contamination of soil is unlikely. The estimated background level for ambient soil in areas where the chemical has not been used is less than the detection limit. In areas where it was used as a soil fumigant or disposed, background levels of up to 0.5 µg/kg can probably be expected.

5.5.4 Other Media

Few data concerning levels of 1,2-dibromo-3-chloropropane in other environmental media were found.

Peaches grown in soil treated by injection into the soil of 51.4 and 137.5 L/hectare of a fumigant formulation containing 1.45 kg/L of 1,2-dibromo-3-chloropropane (peaches harvested between 183 and 217 days following treatment) contained 0.13 and 0.72 ppb of 1,2-dibromo-3-chloropropane (Carter and Riley 1984). No residues were found in peaches grown in nonfumigated soil or in soil treated at or below the recommended treatment rate of 46.8 L/treated hectare (Carter and Riley 1984). In another study, Carter and Riley (1982) found levels as high as 24.7 ppb in peaches that were treated 114 days prior to harvest (application rate not reported).

Three weeks after treatment, carrots grown in soil that was injected with 12.26 pounds/acre of 1,2-dibromo-3-chloropropane contained up to 1.50 ppm and the residues persisted for 16 weeks when fumigation was at seeding (Newsome et al. 1977). Most of the residues were contained in the pulp of the carrots and two-thirds of the residues in unpeeled carrots disappeared when the carrots were boiled for 5 minutes. The maximum concentration found in radishes from treated fields (application rate of 12.26 pounds/acre of 1,2-dibromo-3-chloropropane) was 0.194 ppm (Newsome et al. 1977).

1,2-Dibromo-3-chloropropane was found at concentrations between 15 and 25 ppb in a commercial sample of sodium humate that was apparently imported from Germany (Gabbita 1986). It was not known whether the soil from which the humate was extracted was itself contaminated with the chemical.

5.6 GENERAL POPULATION EXPOSURE

The general population may be exposed to 1,2-dibromo-3-chloropropane through the ingestion of contaminated drinking water and food. Contaminated drinking water is most likely to be derived from contaminated groundwater sources at or near locations where 1,2-dibromo-3-chloropropane had been used as a soil fumigant. Not only are these areas limited in number and size, but the use of 1,2-dibromo-3-chloropropane as a soil fumigant was banned in the late 1970s and early 1980s; therefore, although no current and comprehensive data were found to calculate an estimate of general population exposure to 1,2-dibromo-3-chloropropane from drinking water, the estimate is expected to be minimal based upon older data concerning the presence of 1,2-dibromo-3-chloropropane in drinking water and groundwater in the United States (see Section 5.5).

1,2-Dibromo-3-chloropropane has been detected in some food products in the past (Carter and Riley 1982, 1984; Newsome et al. 1977). Selected food source could presently contain very small amounts of 1,2-dibromo-3-chloropropane because the chemical is persistent in soil. However, it is unlikely that food sources would contain 1,2-dibromo-3-chloropropane in amounts likely to cause adverse health effects. Although data are lacking, inhalation is not expected to contribute significantly to general population exposure to 1,2-dibromo-3-chloropropane.

Due to the lack of recent comprehensive monitoring data, the average daily intake of 1,2-dibromo-3-chloropropane and the relative significance of each source of exposure cannot be determined. Since releases of 1,2-dibromo-3-chloropropane to the environment are generally limited to areas where it was used as a soil fumigant, a use that was banned by the EPA in 1985, widespread exposure to the chemical is not likely.

The Fourth National Report on Human Exposures to Environmental Chemicals, published and updated by the Centers for Disease Control and Prevention reporting biomonitoring data from the National Health and Nutrition Examination Survey (NHANES) for survey years 2003–2010, does not include data for 1,2-dibromo-3-chloropropane (CDC 2018).

5.7 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

The highest levels of exposure may occur with workers who manufacture or use the compound for research or as a chemical intermediate in synthesis.

Populations with potentially higher exposure than normal for the general population include those in areas that obtain drinking water from contaminated groundwater sources. These areas are generally at or near agricultural regions where 1,2-dibromo-3-chloropropane had been used as a soil fumigant, and include, for example, the San Joaquin Valley in California (Kloos 1983), the pineapple-growing regions of Hawaii (Oki and Giambelluca 1987), and the peach-growing regions of South Carolina (Carter and Riley 1981).

Drinking water derived from contaminated groundwater at or near hazardous waste sites that contain 1,2-dibromo-3-chloropropane might contain the chemical and contribute to exposure. Inhalation of contaminated air may contribute significantly to overall exposure for those populations living at or near hazardous waste dumps where 1,2-dibromo-3-chloropropane has been found. Most, if not all, of these exposures are expected to be rare and at relatively low levels.