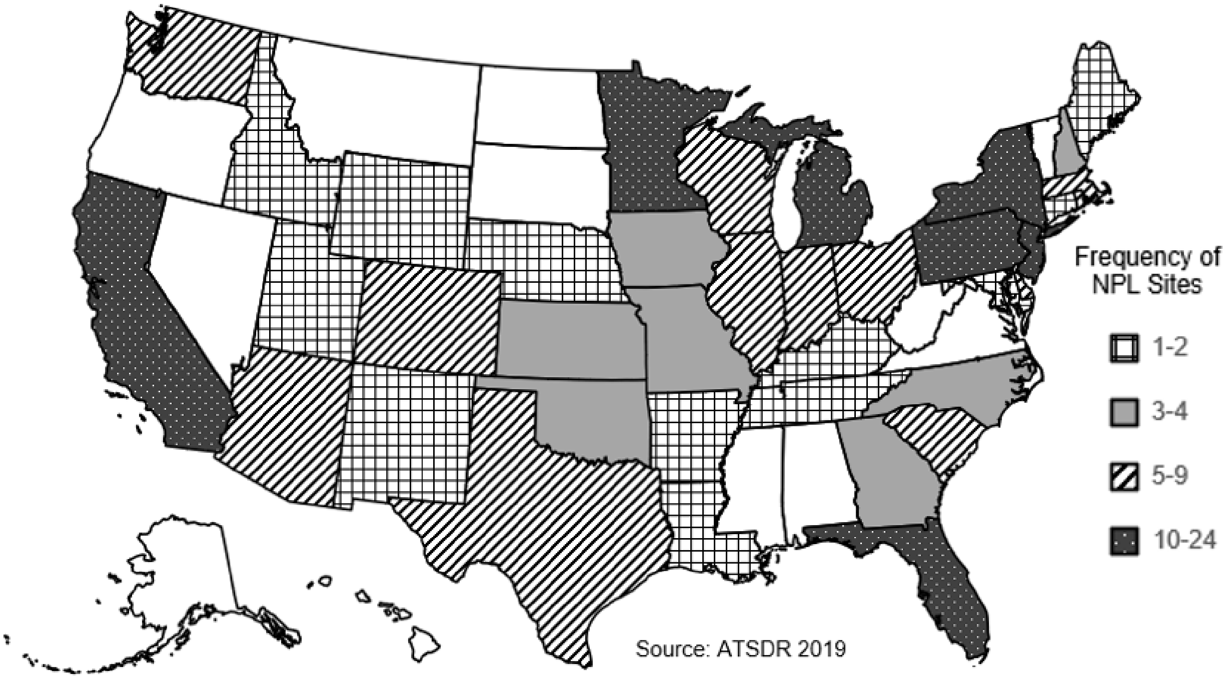
CHAPTER 5. POTENTIAL FOR HUMAN EXPOSURE

5.1 OVERVIEW

1,2-Dichloropropane has been identified in at least 231 of the 1,867 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (ATSDR 2019). However, the number of sites in which 1,2-dichloropropane has been evaluated is not known. The number of sites in each state is shown in Figure 5-1. Of these sites, 230 are located within the United States and 1 is located in Puerto Rico (not shown).

Figure 5-1. Number of NPL Sites with 1,2-Dichloropropane Contamination



Source: ATSDR 2019

- Data indicate that the major use of this substance in consumer products has been diminished, minimizing the potential for exposure to 1,2-dichloropopane in the general population. The most likely route of exposure for the general public to 1,2-dichloropropane is through inhalation of contaminated ambient air and ingestion of waters contaminated with this substance, or through dermal contact with consumer products containing this substance.

- The majority of 1,2-dichloropropane in the environment is a result of anthropogenic activity. This substance is found in the atmosphere as a result of emissions from facilities that produce or use 1,2-dichloropopane and in terrestrial and aquatic environments.

- The general population may be exposed to low levels of 1,2-dichloropropane through inhalation of contaminated ambient air, consumption of contaminated drinking water, or dermal contact.

- Occupational exposure is primarily by inhalation and dermal contact where this substance is produced or used; however, this exposure is limited due to its use in primarily closed systems.

- Volatilization is an important fate process for 1,2-dichloropropane in terrestrial and aquatic environments. In the atmosphere, slow degradation is expected to occur via reaction with photochemically-produced hydroxyl radicals. Due to the slow nature of photodegradation, transport of this chemical from point sources may be possible before it degrades or is washed out of the atmosphere.

5.2 PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

5.2.1 PRODUCTION

In 1980–1984, the U.S. production of 1,2-dichloropropane was 59.8–77 million pounds (EPA 1995; IARC 1986), of which >95% was used onsite as a captive chemical intermediate in the production of perchloroethylene and other chlorinated products (Dow Chemical Co. 1983; EPA 1986). The 2012 Chemical Data Reporting (CDR) website updated in June 2014, which reports information on the production and use of chemicals manufactured or imported into the United States for 2010 and 2011, lists three companies as producing 1,2-dichloropropane, including Dow Chemical in Freeport, Texas, Dow Chemical in Midland, Michigan, and Dow Chemical in Plaquemine, Louisiana (EPA 2016b). Specific production volume data are listed as confidential business information (CBI), not available (N/A), or 0 for these companies. The 2016 CDR website, which reports information on the production and use of chemicals manufactured or imported into the United States for 2012, 2013, and 2014, listed two parent companies for 1,2-dichloropropane, The Dow Chemical Company with three facilities (Freeport, Texas; Midland, Michigan; Plaquemine, Louisiana) and Olin Corporation with two facilities (Freeport, Texas; Clayton, Missouri) (EPA 2017a). Aggregate production data for 1,2-dichloropropane during the years 2012 through 2015 are reported as withheld in the 2016 CDR (EPA 2017a). Global production for 2001 has been reported as approximately 350 kilotonnes (OECD 2006).

Dow Chemical discontinued production of soil fumigants containing 1,2-dichloropropane in 1991, and pesticide formulations containing this chemical are no longer available in the United States (EPA 1995; IARC 2017; Meister 1987; OECD 2006). In 2019, five consumer/commercial products and three industrial products believed to be currently on the market listed 1,2-dichloropropane as an ingredient on their Safety Data Sheet (SDS). The consumer products were waxes for natural stones, waxes to protect and brighten surfaces, wax in paste, brightener wax for natural stone, and a sealer. The products contained 1–50% 1,2-dichloropropane (EPA 2020a). The industrial products were flame retardants, containing <0.002–0.0005% 1,2-dichloropropane. The majority of this substance is used on-site or as a limited transport co-product/raw material for the production of other chlorinated compounds (Dow Chemical Co. 1983; EPA 1986; OECD 2006).

High-purity 1,2-dichloropropane is obtained commercially as a byproduct in the manufacture of propylene oxide in the chlorhydrin process. 1,2-Dichloropropane may also be obtained as a byproduct from the synthesis of allyl chloride (Langer et al. 2011). The high-purity product may also be obtained by the reaction of propylene and chlorine in the presence of an iron oxide catalyst at moderate temperature (45°C) and pressure (25–30 psia). Pesticide products that contain 1,2-dichloropropane were distillates of the chlorination of propylene (IARC 1986).

Table 5-1 summarizes information on U.S. companies that reported the manufacture or use of 1,2-dichloropropane in 2018 (TRI18 2020). 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-Dichloropropane

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AR	1	100,000	999,999	12
KY	1	1,000	9,999	12
LA	5	10,000	9,999,999	1, 3, 4, 5, 6, 12, 13, 14
MI	1	1,000	9,999	11
OH	1	1,000	9,999	12
TX	3	0	49,999,999	1, 2, 3, 4, 5, 6, 9, 12, 13
VA	1	100,000	999,999	10
WV	1	10,000	99,999	1, 5, 13

[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: TRI18 2020 (Data are from 2018)

5.2.2 IMPORT/EXPORT

Limited information was found concerning U.S. imports and exports of 1,2-dichloropropane. Import/export information for 1,2-dichloropropane in the 2016 CDR database, lists one of the five reporting sites as an importer, with import volume reported as 'withheld' (The Dow Chemical Company in Midland, Michigan) (EPA 2017a). Descartes Datamyne, a commercial trade database that reports global import-export data, reported the following companies as importers of 1,2-dichloropropane between 2012 and 2018: Dow Chemical; Evonik Degussa; Fastco Inc., Laredo, Texas; Feria Associates, Laredo, Texas; Hasson House Food Products Inc., Medford, New Jersey; ICL, St. Louis, Missouri; Phoenix Aromas Essential Oils, Norwood, New Jersey; and Witt Management Group, Crystal Lake, Illinois (EPA 2020a). Imports are reported by number of shipments, which do not specify the volume of imports. Dow Chemical Co. imported a total of 144 shipments during this time period. The other companies imported one or two total shipments (EPA 2020a). Reported imports do not necessarily reflect that the companies are currently importing or using 1,2-dichloropropane.

5.2.3 USE

1,2-Dichloropropane is used as a chemical intermediate, in the manufacture of chlorinated solvents, and as an industrial solvent for material such as plastics, fats, and oils, and as an intermediate in rubber processing. Of the five facilities that produce 1,2-dichloropropane, three report that 1,2-dichloropropane is used as a reactant in all other basic organic chemical manufacturing (The Dow Chemical Company; The Dow Chemical Company, Freeport; Olin Blue Cube, Freeport, Texas), one reports that 1,2-dichloropropane is incorporated into a formulation, mixture, or reaction product for all other chemical product and preparation manufacturing (The Dow Chemical Company), and one did not report usage data to the 2016 CDR (EPA 2020a). Other reported uses include as a textile spot remover, paraffin remover, scrubbing agent ingredient, cleanser/degreaser, and galvanizer. 1,2-Dichloropropane was formerly used as a soil fumigant pesticide. The EPA pesticide registration for 1,2-dichloropropane was discontinued in the 1980s, with the last registration ending in 1989. As of September 2020, there were no federally active products listed on the National Pesticide Information Retrieval System (NPIRS) website that contain this chemical as an active ingredient; however, this chemical is a minor impurity (0.06–0.1% by weight) in EPA-registered pesticides containing the active ingredient, dichloropropene (CASRN 542-75-6) (EPA 1998; Langer et al. 2011; NPIRS 2017; OECD 2006; O'Neil et al. 2013).

5.2.4 DISPOSAL

Incineration under controlled conditions for disposal of 1,2-dichloropropane wastes is the most recommended method (EPA 1981). Disposal using a liquid injection incinerator requires a temperature range of 650–1,600°C and residence time of 0.1–2 seconds. A rotary kiln incinerator requires a temperature range of 820–1,600°C and a residence time of seconds. A fluidized bed incinerator requires a temperature range of 450–980°C and a residence time of seconds (EPA 1981). Where disposal of waste residue containing 1,2-dichloropropane is sought, environmental regulatory agencies should be consulted on acceptable disposal practices as it is considered toxic waste subject to disposal regulations, permit, and notification (WHO 1992). 1,2-Dichloropropane may also be a constituent of wastewater streams where it would be susceptible to removal by air stripping (EPA 1986).

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

Estimated releases of 16,725 pounds (~7.59 metric tons) of 1,2-dichloropropane to the atmosphere from 13 domestic manufacturing and processing facilities in 2018, accounted for about 93% of the estimated total environmental releases from facilities required to report to the TRI (TRI18 2020). These releases are summarized in Table 5-2.

Table 5-2. Releases to the Environment from Facilities that Produce, Process, or Use 1,2-Dichloropropane[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
AR	1	0	0	0	0	0	0	0	0
KY	1	162	0	0	0	0	162	0	162
LA	5	1,373	127	0	477	0	1,977	380	2,357
MI	1	0	0	0	0	0	0	0	0
OH	1	0	0	0	0	0	0	0	0
TX	2	4,402	124	0	4	0	4,530	0	4,530
VA	1	3,802	46	0	0	0	3,848	0	3,848
WV	1	6,986	7	0	0	0	6,993	83	7,076
Total	13	16,725	304	0	481	0	17,510	463	17,973

[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.
[e] The sum of fugitive and point source releases are included in releases to air by a given facility.
[f] Surface water discharges, wastewater 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: TRI18 2020 (Data are from 2018)

Section 112 of the Clean Air Act (CAA) lists 1,2-dichloropropane as one of the original 189 hazardous air pollutants (HAPs) known to cause or suspected of causing cancer or other serious human health effects or ecosystem damage (EPA 2000). EPA's National Emission Inventory (NEI) database contains comprehensive and detailed estimates regarding sources that emit criteria air pollutants and their precursors, and HAPs for the 50 United States, Washington DC, Puerto Rico, and the U.S. Virgin Islands. The NEI database includes point and nonpoint source emissions, onroad sources, nonroad sources, and event sources such as emissions from wildfires. According to data from the 2017 NEI, 71,871 pounds of 1,2-dichloropropane were released from fuel combustion, industrial processes, solvent degreasing and industrial coating solvent use, bulk gasoline terminals, and waste disposal (EPA 2014a). These data are summarized in Table 5-3.

Table 5-3. 1,2-Dichloropropane Emissions as Reported by the 2017 National Emission Inventory[a]

Release source	Emissions (pounds)
Industrial processes, storage and transfer	3,935.13
Industrial processes, chemical manufacturing	14,459.52
Fuel combustion, industrial boilers, ICEs; biomass	15,724.75
Industrial processes, oil and gas production	15,689.60
Waste disposal	8,000.44
Fuel combustion, industrial boilers; natural gas	7,043.80
Fuel combustion, electric generation; biomass	3,096.47
Industrial processes, not elsewhere classified	851.21
Industrial processes, pulp and paper	831.41
Fuel combustion, commercial/institutional; biomass	688.61
Fuel combustion, electric generation; coal	547.70
Fuel combustion, industrial boilers, ICEs; other	265.83
Fuel combustion, industrial boilers, ICEs; coal	119.36
Industrial processes, ferrous metals	93.07
Fuel combustion, commercial/institutional; natural gas	73.65
Fuel combustion, electric generation; other	53.31
Industrial processes, cement manufacturing	64.27
Fuel combustion, industrial boilers, ICEs; oil	48.73
Fuel combustion, commercial/institutional; other	32.76
Solvent, industrial surface coating and solvent use	25.48
Industrial processes, non-ferrous metals	46.56
Solvent, degreasing	8.04
Fuel combustion, electric generation; natural gas	12.47
Industrial processes; petroleum refineries	8.60
Fuel combustion, electric generation; oil	0.20
Bulk gasoline terminals	150.03

ICEs = internal combustion engines

Source: EPA 2014a

5.3.2 Water

Estimated releases of 304 pounds (~0.14 metric tons) of 1,2-dichloropropane to surface water from 13 domestic manufacturing and processing facilities in 2018, accounted for about 1.69% of the estimated total environmental releases from facilities required to report to the TRI (TRI18 2020). These releases are summarized in Table 5-2.

The total estimated annual environmental release of 1,2-dichloropropane in wastewater from production and industrial use was 198,000 pounds (EPA 1986). Table 5-4 shows the types of industries that discharged 1,2-dichloropropane, their frequency of release, and concentrations in wastewater. These data come from a comprehensive wastewater survey conducted by EPA's Effluent Guidelines Division. Over 4,000 samples of wastewater from a broad range of industrial facilities and publicly owned treatment works were analyzed in this survey. Between 1980 and 1988, 708 samples of wastewater in EPA's STORET database were analyzed for 1,2-dichloropropane (WQP 2017a). Ten percent of the samples were ≥10 ppb with a maximum level of 910 ppb. Unfortunately, the detection limit was apparently recorded when no chemical is detected, so it is impossible to say whether the 90th percentile figure represents positive samples or merely higher detection limits.

Table 5-4. Sources of 1,2-Dichloropropane Effluents

		Concentration (ppb)		
Industry	Frequency	Maximum	Medium	Low
Paint and ink	3	3,457.22	38.9176	29.30
Organics and plastics	2	15.93	38.92	6.25
Inorganic chemicals	14	54.30	3.31	0.74
Textile mills	2[a]	40.43	38.76	37.09
Plastics and synthetics	1	5.60	5.60	5.60
Rubber processing	1	0.82	0.82	0.82
Auto and other laundries	1	66.92	66.92	66.92
Pesticides manufacture	1	0.90	0.90	0.90
Photographic industries	3	121.79	36.34	3.59
Organic chemicals	16	1,411.98	23.67	1.23
Publicly owned treatment works	4	52.22	24.86	1.94
Industry unknown	4	60.03	27.07	22.44

[a] Incorrectly listed as 1 reference; data are consistent with a frequency of 2.

Source: Shackelford et al. 1983

1,2-Dichloropropane was found at concentrations of 5.6, 22, 60, and 310 ppb in four outfalls from the Dow Chemical of Canada plant into the St. Clair River for a net loading of 11.8 kg/day (King and Sherbin 1986). This survey was performed because puddles of chlorinated hydrocarbons were discovered on the bottom of the St. Clair River. These chemicals are thought to be products or byproducts of chlorinated hydrocarbons manufactured at this site. Waste from this operation is now being incinerated, but it was historically landfilled. Landfill leachate was treated with carbon and then discharged into the St. Clair River. The concentrations of 1,2-dichloropropane in the landfill leachate before and after treatment were 320 and 510 ppb, respectively (King and Sherbin 1986). The study authors indicated that the carbon filter was reportedly saturated at the time of the survey, which could account for the increased levels of 1,2-dichloropropane after treatment.

In 1979, the daily amount of 1,2-dichloropropane discharged on 5 days ranged from 37.2 to 5,100 pounds (Weston 1980). The report covering the discharges in 1979 stated that on 4 days, Rohm and Haas contributed all of the 1,2-dichloropropane influent going into Philadelphia's Northeast Water Pollution Control Plant (NEWPCP). On one day, 35% came from elsewhere. At times, all of the 1,2-dichloropropane was removed in the treatment plant. Tidal excursions of the NEWPCP effluents affected the intake of the Baxter Drinking Water Plant, located 2 miles upstream on the Delaware River. EPA’s Philadelphia Geographic Area Pollutant Survey found that the average 1,2-dichloropropane concentration in the intake water during 1982–1983 was 1.6 ppb, indicating that 1,2-dichloropropane was being discharged from the wastewater treatment plant into the Delaware River (EPA 1986). If the typical daily discharge from the Rohm and Haas plant was 500 pounds, then the annual discharge would have been 182,000 pounds, a figure approaching the estimated 198,000 pounds of 1,2-dichloropropane discharged into waterways for all production and industrial use. It is not clear for what year the estimated environmental release figure applies and whether the releases into water include industrial discharges that may undergo treatment before being discharged into a waterway or only that which is discharged into a waterway. As of January 1989, Rohm and Haas discontinued use of 1,2-dichloropropane in the manufacture of ion exchange resins (Rohm and Haas 1989). 1,2-Dichloropropane was only detected in one sample at 3 ppb from Eugene, Oregon in the National Urban Runoff Program, which analyzed runoff in 86 samples from 19 cities throughout the United States (Cole et al. 1984).

Surface water was analyzed after 39,000 tons of coal ash from an industrial steam station was spilled into the Dan River in Eden, North Carolina on February 2, 2014 (EPA 2014b). Surface water samples taken from the intake waters and river waters between the Danville Water Treatment Plant and South Boston Water Treatment Plant on February 6th, 7th, and 11th, 2014 did not contain concentrations of 1,2-dichloropropane above the detection limit of 0.5 µg/L (EPA 2014c, 2014d, 2014e).

5.3.3 Soil

Estimated releases of 481 pounds (~0.22 metric tons) of 1,2-dichloropropane to soils from 13 domestic manufacturing and processing facilities in 2018, accounted for about 2.68% of the estimated total environmental releases from facilities required to report to the TRI (18 2020). No 1,2-dichloropropane was released via underground injection (TRI18 2020). These releases are summarized in Table 5-2.

The total estimated annual environmental release of 1,2-dichloropropane by industry into land disposal sites was 176,000 pounds (EPA 1986). This is not the recommended method of disposal and this figure may have been much higher in the past.

In the past, the major source of release of 1,2-dichloropropane into soil was from its use as a soil fumigant for nematodes. For this purpose, the fumigant was injected into the root zone, after which the soil was compacted to enhance retention of the vapor. However, 1,2-dichloropropane is no longer permitted to be used in the United States for agricultural purposes because this use pollutes groundwater.

Production of 1,2-dichloropropane for use as a solvent in consumer products such as paint strippers, varnishes, and furniture finish removers, from which inadvertent releases to soil (i.e., spills) would be expected, has been discontinued. In addition to spills, chemicals can be released into soil from leaking storage tanks. A case of groundwater contamination by 1,2-dichloropropane resulting from a leaking underground storage tank at a paint factory has been documented in the literature (Botta et al. 1984).

Releases into the subsoil and groundwater can also result from the landfilling of process residues. Four out of 11 samples of landfill leachate in Minnesota and Wisconsin contained 2.0–81 ppb 1,2-dichloropropane (Sabel and Clark 1984).

5.4 ENVIRONMENTAL FATE

5.4.1 Transport and Partitioning

Air. Based on its high vapor pressure, lack of functional groups that absorb at wavelengths above 290 nm, relatively slow photodegradation with photochemically-produced hydroxyl radicals, and half-lives >16 days, atmospheric transport of 1,2-dichloropropane from point sources may be possible before it degrades or is washed out of air. The relatively high water solubility of 1,2-dichloropropane suggests that washout by rain should be an important process for removing this chemical from the atmosphere.

Water. The dominant removal process for 1,2-dichloropropane from surface waters is expected to be volatilization. Based on the measured relative mass transfer coefficient of 1,2-dichloropropane between water and air of 0.57 (Cadena et al. 1984) and the range of reaeration coefficients typical of relatively rapid and shallow streams found in the western United States, 0.14–1.96 hour^{-1} (Cadena et al. 1984), the half-life of 1,2-dichloropropane in these streams will range from 0.62 to 8.68 hours. The residence time in a lake or pond would be much longer. Based on a measured Henry's Law constant at 25°C of 2.82×10^{-3} atm-m^3/mol (EPA 1987a), the volatilization half-life in a model lake 1 m deep with a 0.05 m/second current and a 0.5 m/second wind speed is estimated to be 4.3 days; the volatilization half-life of 1,2-dichloropropane in a model river 1 m deep flowing 1 m/second with a wind speed of 3 m/second is estimated to be 3.4 hours (EPA 2012), with resistance in the liquid phase controlling volatilization (Thomas 1982). In such cases, the current will have a much greater effect on volatilization than the wind speed. In wastewater treatment plants that receive volatile compounds such as 1,2-dichloropropane from industrial discharges or other sources, stripping will be an important mechanism for transferring the chemical from the water into the air. In stripping, as opposed to ordinary volatilization, the liquid and gas phases are dispersed with the result that the interfacial surface area is much greater and liquid/gas mass transfer is greatly enhanced. More than 99% removal of 1,2-dichloropropane from wastewater plants has been attributed to the stripping process (Kincannon et al. 1983).

Sediment and Soil. The measured K_{oc} of 1,2-dichloropropane is 47 in a silt loam soil (Chiou et al. 1979). This value is low, suggesting that 1,2-dichloropropane will not adsorb appreciably to soil, sediment, or suspended solids in water. 1,2-Dichloropropane sorbs to clay minerals in dry soil but desorbs when the soil is moist (Cohen et al. 1984). 1,2-Dichloropropane has been used as a soil fumigant for nematodes in California and the coastal areas of Georgia, South Carolina, North Carolina, and Virginia, where soils are sandy and have a low organic carbon content (Cohen et al. 1984). Adsorption to these soils will be lower than to soils with a higher organic content; therefore, the mobility of 1,2-dichloropropane will not be reduced significantly. The leaching potential of 1,2-dichloropropane is illustrated by a case study in California in which a soil core was taken from an agricultural field where a fumigant containing the chemical had recently been used. Residues of 1,2-dichloropropane up to 12.2 ppb were detected throughout much of the 24-foot core profile and two adjacent drinking water wells contained concentrations of 1,2-dichloropropane in excess of 10 ppb (Ali et al. 1986). As much as 300 ppt of 1,2-dichloropropane have been detected in bank-filtered Rhine River water, indicating that not all of the chemical was being retained by the soil (Piet and Morra 1979). The finding that highly mobile and biologically resistant residues of the fumigant pesticide 1,2-dibromoethane persisted in topsoil for years after application, despite its mobility and volatility, spurred a study of this phenomenon in other halogenated hydrocarbons (Sawhney et al. 1988). Sandy loam soils treated with 10,000 ppm of 1,2-dichloropropane for 1 day were extracted 16 times with water. The apparent soil-water partition coefficient, initially 0.56 (K_{oc} 22), rose to 72 (K_{oc} 2,800); the final concentration of 1,2-dichloropropane in the soil was 1.4 ppm. After a 57-day period, the apparent partition coefficient was >250 (K_{oc} >9,700). Some of the 1,2-dichloropropane molecules were adsorbed more strongly than others, and these molecules became even more strongly adsorbed in time. The fact that pulverization of the soil released a portion of the chemical suggests that the strongly adsorbed 1,2-dichloropropane eventually became occluded in the soil structure. Additionally, these observations suggest that the rate at which the chemical becomes occluded, or the adsorption coefficient increases, is diffusion controlled.

The dissipation of 1,2-dichloropropane was determined in two clay and two sandy soils in closed systems following application at normal field rates (van Dijk 1980). The mean dissipation rate was 0.013 day^{-1} (half-life 52 days), with the rate roughly twice as high in the sandy soil as in the clay soil. Additionally, the rate of volatilization increased by a factor of 2 for a 10°C increase in temperature. In another experiment in which 1,2-dichloropropane was mixed with 3 cm of soil in an open container, covered with 12 cm of soil and left outdoors, <1% of the chemical remained after 10 days (Roberts and Stoydin 1976). This loss was attributed to volatilization.

Other Media. A bioconcentration factor (BCF) of 9 in fish has been estimated for 1,2-dichloropropane using linear regression equations with estimated measured log K_{ow} of 1.98 (EPA 2012; Thomas 1982). Experimental BCF values of 3.2 and 2.5 were calculated for carp (*Cyprinus carpio*) exposed to 1,2-dichloropropane (0.4 ppm) over a 4- and 6-week period, respectively (NITE 2017a). An experimental value for the BCF of <10 has also been reported (Kawasaki 1980). These BCF data suggest that 1,2-dichloropropane is expected to have very low potential for bioconcentration in fish.

When potatoes were grown in sandy loam soil that had been treated with a mixture of ^{14}C-labeled 1,2-dichloropropane and 1,3-dichloropropene 5 months before sowing, only 7 ppb of the radioactivity was found in the mature potatoes indicating minimal uptake of either of these chemicals (Roberts and Stoydin 1976).

5.4.2 Transformation and Degradation

Air. The primary mode of degradation in air is through reaction with photochemically-produced hydroxyl radicals by H-atom abstraction (Singh et al. 1982). Experimental determinations of the reaction rate yield a half-life of >23 days (Atkinson 1985), whereas theoretical estimates result in a half-life of 16 days (Atkinson 1985). Lacking a chromophore that absorbs radiation >290 nm, direct vapor-phase photolysis would not be expected. Accordingly, no photolysis occurred when 1,2-dichloropropane was exposed to simulated sunlight for prolonged periods of time (Cohen et al. 1984).

Water. 1,2-Dichloropropane is resistant to hydrolysis, with an estimated hydrolysis half-life of 25–200 weeks (Cohen et al. 1984). Most studies indicated that 1,2-dichloropropane is also resistant to biotransformation. No degradation was observed in a semicontinuous activated sludge process after 10 weeks, even when the retention time was as long as 25 hours (Shell Oil Co. 1984). There was also no degradation in two standard 4-week tests that simulated biodegradability in environmental waters (Anonymous 1983; Kawasaki 1980). While >99% of 1,2-dichloropropane was lost in a wastewater treatment facility, the loss was attributed to stripping, rather than biodegradation (Kincannon et al. 1983).

Sediment and Soil. Based on limited data, biodegradation of 1,2-dichloropropane may not be a rapid fate process; however, it may occur under certain conditions in sediment and soil. When 71 ppm of radiolabeled 1,2-dichloropropane was applied to a sandy loam soil and a medium loam soil in closed glass containers and incubated for 20 weeks, <0.2% of the applied radioactivity was found in degradation products (Roberts and Stoydin 1976). Using the Japanese MITI test, 1,2-dichloropropane present at 100 mg/L, reached 0% of its theoretical biological oxygen demand (BOD) in 2 weeks using an activated sludge inoculum at 30 mg/L (NITE 2017b). 1,2-Dichloropropane, present at 5 and 10 mg/L, achieved 42 and 36% biodegradation, respectively, after 7 days of incubation in the dark at 25°C using a static culture screening test with microbial inoculum from a sewage treatment plant (Tabak et al. 1981). 1,2-Dichloropropane was completely degraded to propene after 4 months under anaerobic conditions with enrichment cultures derived from river sediments at temperatures between 20 and 25°C (Loffler et al. 1997). Nonmethanogenic *Dehalococcoide* and *Dehalobacter* species obtained from river sediments have been attributed to the biotransformation of 1,2-dichloropropane to propene via dichloroelimination (Fletcher et al. 2009; Ritalahti and Loffler 2004; Schlötelburg et al. 2002). Biotransformation rates of approximately 2.57 and 1.08 µmoles/day were calculated from experiments under anaerobic conditions using two *Dehalococcoide* cultures; biotransformation of >90% radiolabeled 1,2-dichloropropane to propene was observed after 6 and 11 days, following initial lag phases of 3 and 15 days, respectively (Fletcher et al. 2009).

Other Media. Atmospheric contaminants may accumulate on terrestrial vegetation. Air-to-vegetation transfer of 1,2-dichloropropane was investigated using a *Lycopersicon esculentum* fruit cuticular matrix at 25°C. The matrix/air partition coefficient experimentally determined for 1,2-dichloropropane was approximately 770, indicating a propensity towards intermediate partitioning (Welke et al. 1998).

5.5 LEVELS IN THE ENVIRONMENT

No natural sources of 1,2-dichloropropane have been identified (IARC 2017). Therefore, levels in the environment are due to anthropogenic activity. Reliable evaluation of the potential for human exposure to 1,2-dichloropropane depends in part on the reliability of supporting analytical data from environmental samples and biological specimens. Concentrations of 1,2-dichloropropane 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-dichloropropane 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 5-5 shows the lowest limit of detections that are achieved by analytical analysis in environmental media.

Table 5-5. Lowest Limit of Detection of 1,2-Dichloropropane Based on Standards

Media	Detection limit	Reference
Air	0.2–10 ppb	De Bortoli et al. 1986; EPA 1999, 2002; NIOSH 1994; Shikiya et al. 1984
Drinking water	0.018–0.17 ppb	Comba and Kaiser 1983; EPA 1982a, 1986, 2009
Surface water and groundwater	0.01–5 ppb	EPA 1987b, 1995
Soil	1 ng/g	NEMI 1998
Sediment	1 ng/g	NEMI 1998
Whole blood	0.008–0.012 ppb	Ashley et al. 1992, 1994

An overview summary of the range of concentrations detected in environmental media is presented in Table 5-6.

Table 5-6. Summary of Environmental Levels of 1,2-Dichloropropane

Media	Low	High	Reference
Outdoor air (ppt)	<2	724	McCarthy et al. 2006; OECD 2006
Indoor air (ppbv)	Trace	0.46	Pellizzari 1982
Water (ppm)		<50	OECD 2006
Surface water (ppb)	0.5	2.5	WQP 2017b
Ground water (ppb)	0.000001	5,000	WQP 2017b
Drinking water	Not detected		WQP 2017b
Soil/sediment (ppb)	Not detected	1,700,000	WQP 2017b

Detections of 1,2-dichloropropane in air, water, and soil at NPL sites are summarized in Table 5-7.

Table 5-7. 1,2-Dichloropropane Levels in Water, Soil, and Air of National Priorities List (NPL) Sites

Medium	Median	Geometric mean	Geometric standard deviation[a]	Number of quantitative measurements	NPL sites
Water (ppb)	10	21.4	24.1	73	51
Soil (ppb)	260	996	73.9	12	11
Air (ppbv)	0.539	3.39	149	12	11

[a] Concentrations found in ATSDR site documents from 1981 to 2019 for 1,867 NPL sites (ATSDR 2019). 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

1,2-Dichloropropane has been detected in ambient air. The highest concentrations were found near point sources or directly after application of products containing this chemical. Outdoor and indoor air monitoring data for 1,2-dichloropropane have been compiled in Tables 5-8 and 5-9.

Table 5-8. Outdoor Air Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
United States	Urban/suburban	Not specified (1982 or earlier)	22–110 ppt	57 ppt (median)	Detected in 396 U.S. samples	EPA 1982b
United States	City	Not specified (1982 or earlier)	21–78 ppt		24-Hour sampling for 1–2 weeks in seven U.S. cities	Singh et al. 1982
San Jose, California; Downey, California; Houston, Texas; Denver, Colorado	Urban	1984–1985	<2–724 ppt			Singh et al. 1992
California	City	Not specified (1984 or earlier)	0.2–1,100 ppt		Only 2% of the levels monitored were >0.2 ppt; one site had a high of 1,100 ppt; four sites monitored by the California Air Monitoring Program	Shikiya et al. 1984
Portland, Oregon		Not specified (1985 or earlier)	4.4–8.4 ppt		Measured during rain events	Ligocki et al. 1985
United States	Industrial or source-related sites	Not specified (1982 or earlier)	0–130 ppt	120 ppt (median)	39 Sites monitored	EPA 1982b
Philadelphia, Pennsylvania	Source-related sites	Not specified (1985 or earlier)		259 ppt	3-Month survey of 10 source-related sites	Sullivan et al. 1985

Table 5-8. Outdoor Air Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
Philadelphia, Pennsylvania	City		40,740 ppt in various sections of the city; 77,000–120,000 ppt downwind of plant		Northeast Water Pollution Control Plant had received discharges from the Rohm and Haas plant, which produced ion exchange resins using 1,2-dichloropropane as a solvent	EPA 1986
United States		January–December 2016	0.000027–0.121 ppb	Mean 0.0025 ppb median 0.119 ppb	Detected in 25 out of 128 samples: Philadelphia, Pennsylvania; Essex, Maryland; Beltsville, Maryland; Asheville, North Carolina; Burlington, Vermont; North Laurel, Maryland; Baltimore, Maryland; Underhill, Vermont; Rutland, Vermont; Terre Haute, Indiana; Hopewell, Virginia; Portland, Oregon; East Highland Park, Virginia; Calvert City, Kentucky; Medford, Oregon; Los Angeles, California; Grapevine, Texas; Rubidoux, California; Davie, Florida	EPA 2016c
United States	Various ambient air monitoring sites; industrial; near roads	January–December 2017	0–1.00 ppb	Mean 0.0023 ppb median 0	Arizona; California; Colorado; Delaware; District of Columbia; Florida; Georgia; Illinois; Indiana; Kentucky; Maryland; Massachusetts; Michigan; Minnesota; Missouri; North Carolina; New Jersey; New York; North Carolina; Ohio; Oklahoma; Oregon; Pennsylvania; Rhode Island; South Carolina; Texas; Utah; Vermont; Virginia; Washington; West Virginia; Wisconsin (10,768 samples)	EPA 2020b
United States	Various ambient air monitoring sites; industrial; near roads	January–December 2015	0–1.74 ppb	Mean 0.0035 ppb median 0	Indiana; Michigan; North Carolina; Texas; Pennsylvania; Minnesota; Vermont; Utah; Virginia; Wisconsin; Oregon; Oklahoma; West Virginia; Maryland; Delaware; Kentucky; Colorado; Florida; California;	EPA 2017b

Table 5-8. Outdoor Air Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
					District of Columbia; New Jersey; Missouri; Arizona; Illinois; Georgia; Iowa; Ohio; New York; Rhode Island; Massachusetts (11,295 samples)	
United States	Various ambient air monitoring sites; industrial; near roads	January–December 2010	0–3.67 ppb	Mean 0.0048 ppb median 0	Iowa; Texas; Wyoming; Virginia; Oregon; West Virginia; Wisconsin; Florida; North Carolina; California; Indiana; Minnesota; Pennsylvania; District of Columbia; Maryland; Delaware; South Carolina; New York; New Jersey; Arizona; Rhode Island; Massachusetts; Mississippi; Missouri; New Mexico; Georgia; Hawaii; Illinois; Alabama; Colorado; Michigan; Maine; Ohio; Kentucky; Washington; Vermont; Utah; Oklahoma; South Dakota; Tennessee (11,945 samples)	EPA 2017b
United States	Various ambient air monitoring sites; industrial; near roads	January–December 2005	0–10.42 ppb	Mean 0.0089 ppb median 0	Indiana; Virginia; Oregon; Texas; Ohio; California; South Carolina; Florida; Vermont; New York; Wisconsin; North Carolina; Washington; Idaho; Maryland; Pennsylvania; New Jersey; Arizona; Minnesota; New Hampshire; Delaware; District of Columbia; West Virginia; Maine; Massachusetts; Georgia; Illinois; Louisiana; Michigan; Iowa; Puerto Rico; Alabama; Colorado; Rhode Island; North Dakota; Utah; Oklahoma; South Dakota; Tennessee; Mississippi; Missouri (14,254 samples)	EPA 2017b
United States	Various ambient air monitoring sites; industrial; near roads	January–December 2000	0–8 ppb	Mean 0.0098 ppb median 0	Washington; Indiana; Maine; Florida; Texas; Louisiana; New York; Oregon; Pennsylvania; Maryland; Virginia; Minnesota; District of Columbia; Delaware; Michigan; Colorado; Massachusetts; Iowa; Rhode Island; Vermont; Utah; Wisconsin;	EPA 2017b

Table 5-8. Outdoor Air Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
					South Dakota; New Jersey; Ohio; North Dakota (8,184 samples)	
United States	Various ambient air monitoring sites; industrial; near roads	January–December 1995	0–10.14 ppb	Mean 0.051 ppb median 0	Indiana; Texas; Pennsylvania; Vermont; Maryland; Minnesota; Louisiana; Washington; Illinois; Alabama; New Jersey; Tennessee; Michigan (2,097 samples)	EPA 2017b
United States	Various ambient air monitoring sites; industrial; near roads	January–December 1991	0–10.14 ppb	Mean 0.028 ppb median 0	New Jersey; Florida; Illinois; District of Columbia; Texas; Louisiana; Tennessee; Maryland; Kansas; Virginia (644 samples)	EPA 2017b

Table 5-9. Indoor Air Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range/mean concentrations	Notes	Reference
Montana	Residential, rural, and urban		Below reporting limit of 0.46 μg/m^3	Indoor air of 50 non-smoking homes without vapor intrusion issues	MDEQ 2012
Old Love Canal in Niagara Falls, New York	Residential	Not reported (1980 or earlier)	Trace (indoor); 0.29 ppb (one basement)	Indoor air of nine homes	Barkley et al. 1980; Pellizzari 1982
Edison, New Jersey	Industrial waste disposal site	Not reported (1982 or earlier)	Not detected		Pellizzari 1982
Iberville Parish, Louisiana	Industrial		Traces to 0.46 ppb	Several organic chemical producers, users, and storage facilities are located along this section of the Mississippi River	Pellizzari 1982

5.5.2 Water

1,2-Dichloropropane has been detected in surface water, well water, and groundwater. Monitoring data indicate a decrease of the detectable concentrations in the environment over the past few decades, most likely a result of the discontinuation of several use categories. Water monitoring data for 1,2-dichloropropane have been compiled in Table 5-10.

Table 5-10. Water Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
Lake Ontario		Not reported (1983 or earlier)	Trace–440 ppt		Detectable concentrations in 19 of 95 monitoring stations	Kaiser et al. 1983
Lower Niagara River		Not reported (1983 or earlier)	Trace–55 ppt		Detectable concentrations in 9 of 16 monitoring stations	Kaiser et al. 1983
California	Finished water	June 2010–June 2012	Not detected		Data collected by U.S. Geological Survey (USGS) California Water Science Center	WQP 2017b
Grenada, Mississippi	Industrial related site	January 2016	Not detected		Not detected at or above the detection limit, 0.50 µg/L (ppb)	EPA 2016d
United States	Surface water	January 2010–December 2016	0.5–2.5 µg/L (ppb)	Mean: 0.6 µg/L (ppb); median 0.5 µg/L (ppb)	Data collected by USGS monitoring stations across the United States; mean and ranges do not reflect samples reported as not detected/below detection limit	WQP 2017b
United States	Surface water	Not reported		1.2 mg/L	Data collected at a site following application of this chemical as a pesticide	OECD 2006
Ohio River, United States	Surface water	Not reported (1979 or earlier)		0.1 ppb	Identified in 1.6% of samples from 11 water utilities	EPA 1980
United States	Surface water	Not reported (1984 or earlier)	0.9 and 21 ppb		Detectable concentrations in 13 of 945 water supplies from groundwater sources	Westrick et al. 1984
Suffolk County, New York	Surface water	Not reported (1983 or earlier)	Not reported	Not reported	Detectable concentrations in 0.9% of 575 community water supplies from groundwater sources; detectable concentrations in 5.5% of 19,000 non-community and private wells	SCDHS 1983

Table 5-10. Water Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
United States	Surface water	1980–1988	≥0.40–300 ppb		Detectable concentrations in 10% of 29,320 samples	WQP 2017a
California	Well water	1982	Trace–1,200 ppb		Detectable concentrations in 75 wells in 9 counties; 12 wells exceeded the state's action level of 10 ppb	Cohen 1986; Ali et al. 1986
Western Washington	Well water	Not reported (1986 or earlier)			Detectable concentrations in seven shallow wells near soil injection in strawberry fields	Cohen 1986
United States	Domestic wells	1996–2002	~0.02–>10 μg/L		Detected at concentrations >5 μg/L in 3 of 2,400 wells; detected in 9 of 1,207 domestic well samples analyzed by USGS's low-level analytical method and reported with no censoring of data	Rowe et al. 2007
Minnesota	Groundwater underlying landfills	Not reported (1984 or earlier)	0.5–43 ppb		Detectable concentrations in groundwater samples underlying soil/sand/clay landfills	Sabel and Clark 1984
Colorado	Groundwater underlying major urban center (Denver)	1993	<0.2 ug/L		Detected at concentrations of <0.2 ug/L (method detection limit) in 1 of 30 wells	Bruce and McMahon 1996
United States	Groundwater	January 2010–December 2016	0.000001–5,000 μg/L (ppb)	Mean: 12.6 μg/L (ppb); median 1 μg/L (ppb)	Data collected by USGS monitoring stations across the United States; mean and ranges do not reflect samples reported as not detected	WQP 2017b
United States	Groundwater	1980–1988	3–1,500 ppb		Concentrations above 3 ppb in 10% of 22,457 samples	WQP 2017a

Table 5-10. Water Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range	Mean concentration	Notes	Reference
United States	Source water samples; 569 groundwater and 373 surface water samples (170 river, 203 reservoir)	May 3, 1999 to October 23, 2000	<0.2		Not detected above the method detection limit	USGS 2003

5.5.3 Sediment and Soil

1,2-Dichloropropane has been detected in sediment and soil. Concentrations in soil are likely a direct result of its former use as a soil fumigant. Soil and sediment monitoring data for 1,2-dichloropropane have been compiled in Table 5-11.

Table 5-11. Soil and Sediment Monitoring Data for 1,2-Dichloropropane

Location(s)	Geographic type	Date(s)	Range/mean concentrations	Notes	Reference
United States	Sediment	1980–1988	>44 ppb	Concentrations above 3 ppb in 10% of 859 samples	WQP 2017a
California	Soil		Up to 12.2 ppb	From soil cores underlying a recently fumigated field	Ali et al. 1986
California	Soil		0.2–2.2 ppb	From soil cores up to 7 m below the surface	Cohen et al. 1984
Salt Chuck Mine, State of Alaska	Subsurface soil/sediment	July 16, 2011	4.6–19 µg/kg (ppb)	Depth 2–4 feet	WQP 2017b
Big Valley Band of Pomo Indians of the Big Valley Rancheria, California	Sediment	April 2011–May 2011	Not detected	Depth 0.152 m	WQP 2017b
City and county of Honolulu	Sediment	January 2010–September 2014	Not detected	Depth 57.9–75.3 m	WQP 2017b
EPA Great Lakes National Program	Sediment	April 2011–October 2011	5–1,700,000 µg/kg (ppb)	Depth 0–10.3 m; mean 46,600 µg/kg (ppb); median: not detected/less than detection limit of specific sampling method used	WQP 2017b

5.5.4 Other Media

No monitoring data for 1,2-dichloropropane were identified for flora or fauna collected from the environment in the United States. Based on partition coefficient data (see Section 5.4), there is potential for atmospheric 1,2-dichloropropane to accumulate on terrestrial vegetation (Welke et al. 1998).

Monitoring data collected by the City and County of Honolulu in January 2010, January 2011, January 2012, January 2013, and January 2014 reported that 1,2-dichloropropane was not detected in liver or muscle tissue samples collected from the following fish species: *Lutjanus kasmira*, *Selar crumenophthalmus*, and *Myripristis berndti* (WQP 2017b).

5.6 GENERAL POPULATION EXPOSURE

Results from the NHANES show that concentrations of 1,2-dichloropropane in whole blood samples were below the detection limit of 0.008 ng/mL for study years 2003–2004 and 2005–2006 in 1,364 and 3,120 members of the U.S. general population, respectively. Concentrations in whole blood samples for study years 2007–2008 and 2009–2010 were below the detection limit of 0.01 ng/mL in 2,840 and 3,255 members of the U.S. general population, respectively. For the most recent available study years, 2011–2012, concentrations of 1,2-dichloropropane in whole blood samples were below the detection limit of 0.01 ng/mL in 2,740 members of the U.S. general population (CDC 2019). The evaluation of general population exposure levels is limited by the detection limits of the analytical method employed by NHANES (Kirman et al. 2012). However, Kirman et al. (2012) and Aylward et al. (2010) indicate that the whole blood analytical method used to collect NHANES data is sensitive enough to detect recent toxicologically relevant exposures.

A National Occupational Exposure Survey (NOES) conducted by NIOSH from 1981 to 1983 estimated that 2,944 workers, including 1,022 women, were potentially exposed to 1,2-dichloropropane in the United States (NOES 1990). The distribution of these estimated exposed workers by standard industrial category (SIC) was: 408 in business services, 1,656 in machinery (except electrical), 161 in fabricated metal products, 672 in the chemical and allied products, and 47 in textile mill products. The estimate was provisional, as all the data for trade name products that may contain 1,2-dichloropropane had not been analyzed. The NOES was based on field surveys of 4,490 facilities and was designed as a nationwide survey based on a statistical sample of virtually all workplace environments in the United States where eight or more persons were employed in all SIC codes except mining and agriculture. The use pattern of 1,2-dichloropropane has changed radically since the survey was conducted, as it has been eliminated from agricultural fumigants, photographic film manufacture, and paint strippers. Therefore, the estimate of the number of exposed workers reported by the NOES is expected to be an overestimate of the current occupational exposure scenario, despite exclusion of agricultural workers. Another category of workers who may be exposed to 1,2-dichloropropane are those at wastewater treatment facilities that handle effluent containing this chemical. Volatilization would be expected during treatment operations. According to Dow Chemical Company, the major manufacturer of 1,2-dichloropropane, all processes involving the production, conversion, and disposal of 1,2-dichloropropane are closed processes (Dow Chemical Co. 1983). By their estimates, 45 and 123 workers are routinely and potentially exposed, respectively, to the chemical (Dow Chemical Co. 1983). The levels of exposure reported are <2 ppm for toluene diisocyanate production, <1 ppm in ion exchange resin manufacture, and <25 ppm in paper coating (Dow Chemical Co. 1983). According to the 2016 Toxic Substances Control Act (TSCA) Inventory Update Reporting data, five reporting facilities under two parent companies, Dow Chemical and Olin Corporation, estimate that the number of workers reasonably likely to be exposed during the manufacturing, processing, or use of 1,2-dichloropropane in the United States may be as low as fewer than 10 workers and as high as at least 50 but fewer than 100 workers per plant; the data may be greatly underestimated due to confidential business information (CBI) or unknown values (EPA 2017a).

According to drinking water surveys conducted in the mid-1980s (Ali et al. 1986; Cohen 1986; EPA 1980; Westrick et al. 1984), a significant number of drinking water supplies contained 1,2-dichloropropane, and people drinking this water would have been exposed to this chemical. In the most broadly-based groundwater survey, 1.4% of these supplies contained median water concentrations of 0.9 ppb (Westrick et al. 1984). People drinking this water would ingest 1.8 μg of 1,2-dichloropropane/day. While most of the drinking water supplies tested for 1,2-dichloropropane were taken from groundwater sources, in cities such as Philadelphia, Pennsylvania, which obtains its water from a river that received sizeable amounts of 1,2-dichloropropane-containing effluent, the concentration of 1,2-dichloropropane in the drinking water from the Baxter Drinking Water Plant averaged 1.5 ppb (EPA 1986). People consuming this water would have ingested 3.0 μg of 1,2-dichloropropane daily.

The general population is exposed to 1,2-dichloropropane in ambient air. Reported mean measured ambient air concentrations in the United States were 0.0025 ppb in 2019, 0.0023 ppb in 2017, 0.0048 ppb in 2010, 0.0089 ppb in 2005, 0.0098 ppb in 2000, and 0.051 ppb in 1995 (EPA 2017b). Residents of Philadelphia, according to EPA's Philadelphia Geographic Area Multimedia Pollutant Survey, would have been exposed to much higher inhalation levels up to 0.12 ppb, with an estimate intake of 98–660 μg/day, because a large user of 1,2-dichloropropane was located there (EPA 1986). People living in the vicinity of landfills containing 1,2-dichloropropane may be exposed to 1,2-dichloropropane present in landfill gases. Not enough information is available to estimate what the level of exposure from this source might be. Subsurface and surface emissions of VOCs have been found from RCRA Subtitle D disposal sites, which reportedly received only non-hazardous waste. However, hazardous waste from small quantity generators or household hazardous waste may be disposed of at these landfills. For landfills that are similar in design and content, emissions are estimated to be a factor of 2.6 greater in a wet climate than in a dry one (Vogt et al. 1987).

About 45% of 1,2-dichloropropane volatilizes from water while showering (ATSDR 2020). Volatility from other household uses of water range from about 20% (sinks, toilets) to 65% (dishwashers) (ATSDR 2020). Thus, there is potential for inhalation exposure during showering, bathing, and other household water uses, such as dishwashers, clothes washers, toilets, and sinks. ATSDR's three-compartment Shower and Household-Use Exposure (SHOWER) model predicts air concentrations in the shower stall, bathroom, and main house throughout the day by estimating the contribution from showering or bathing and the contribution from other water sources in the house, such as the dishwasher, clothes washer, and faucets. This information, along with human activity patterns, is used to calculate a daily TWA exposure concentration via inhalation exposure and from dermal uptake from skin contact. ATSDR's SHOWER model is available by sending a request to showermodel@cdc.gov.

Vapor intrusion may also be a potential source of 1,2-dichloropropane exposure, as vapor intrusion has been observed for several volatile organic chemicals (VOCs) with similar properties. EPA's compilation of five studies of background indoor air concentrations found a 0–2% detection rate for 1,2-dichloropropane in 1,050 U.S. resident samples between 1990 and 2005 (EPA 2011). The background medians and 95th percentiles were below the reporting limits, which ranged from 0.04 to 2.31 μg/m^3, and maximum values ranged from less than the reporting limit to 34 μg/m^3. ATSDR did not find 1,2-dichloropropane to exceed any ATSDR vapor intrusion comparison values from air, soil gas, or groundwater in a review of 148 public health assessments published between 1994 and 2010 (Burk and Zarus 2013).

5.7 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

Those people consuming contaminated drinking water will have the greatest potential for exposure to 1,2-dichloropropane. Since the odor threshold for 1,2-dichloropropane is 10 ppb (Amoore and Hautala 1983), people consuming water with this level of 1,2-dichloropropane may detect a chloroform-like odor, which could provide a warning that their water is contaminated. In general, drinking water supplies that are most apt to be contaminated are those taken from groundwater sources. Contaminated drinking water wells are most likely to be found in agricultural areas with sandy soil where the chemical was used as a fumigant. However, there are special situations, such as in Philadelphia, where drinking water derived from surface water sources may be contaminated with 1,2-dichloropropane-containing effluent. In Philadelphia, 1,2-dichloropropane-containing effluent from an industrial plant was driven upstream to the influent of a drinking water plant by tidal action. This plant recently discontinued using 1,2-dichloropropane. People residing in the vicinity of industrial sources may be exposed to 1,2-dichloropropane in the ambient air, either from direct emissions or volatilization of the chemical from wastewater. Although industrial uses of 1,2-dichloropropane have decreased, workers who use 1,2-dichloropropane as a chemical intermediate (even in a “closed” system) are still considered a potentially high exposure group.