

Chapter 6: 1,3-Dichloropropene

A chapter from:

**Regulatory Determinations Support Document for Selected Contaminants
from the Second Drinking Water Contaminant Candidate List (CCL 2)**

EPA Report 815-R-08-012

Executive Summary

1,3-Dichloropropene (1,3-DCP), a synthetic volatile organic compound (VOC), is used as a pre-plant soil fumigant to control nematodes and other pests in soils to be planted with all types of food and feed crops. 1,3-DCP is typically injected 12 to 18 inches beneath the soil surface and can only be used by certified handlers. To mitigate risks to drinking water, 1999 labeling requirements restrict the use of 1,3-DCP in areas with shallow ground water and vulnerable soils in certain northern tier States; in fields within 100 feet of a drinking water well; and in areas overlying karst geology.

1,3-DCP is toxic to organs involved in metabolism (e.g., the liver), excretion of conjugated metabolites (e.g., urinary bladder and the kidney), and organs along the portals of entry (e.g., forestomach for oral administration; mucous membrane of the nasal passage and lungs for inhalation exposure). Exposure to 1,3-DCP does not appear to cause adverse reproductive or developmental effects.

The weight of evidence suggests that 1,3-DCP is likely to be carcinogenic to humans. This characterization is supported by tumor observations in chronic animal bioassays for both inhalation and oral routes of exposure. Using an oral cancer slope factor of 1×10^{-1} (mg/kg/day)¹, EPA calculated a health reference level (HRL) of 0.4 µg/L at the 10^{-6} cancer risk level.

Estimates of national annual use during the 1990s vary widely. Based on information from a 1991 data call-in and other sources, EPA estimates that approximately 23 million pounds of 1,3-DCP were used annually from 1990 to 1995. The National Center for Food and Agricultural Policy (NCFAP) estimates that approximately 40 million pounds were used annually around 1992 and approximately 35 million pounds were used annually around 1997. Toxic Release Inventory (TRI) data suggest that 1,3-dichloropropene industrial releases are dominated by air emissions, and generally declined between 1988 and 2003.

To evaluate the extent of 1,3-dichloropropene in drinking water, EPA included 1,3-DCP as an analyte in the Unregulated Contaminant Monitoring (UCM) Round 1 and UCM Round 2 surveys. The minimum reporting levels (MRLs) for UCM Round 1 ranged from 0.02 to 10 µg/L and the MRLs for UCM Round 2 ranged from 0.08 to 1 µg/L. EPA also analyzed for 1,3-DCP using the samples from the small systems that were included in the First Unregulated Contaminant Monitoring Regulation (UCMR 1) survey. The MRL used for the UCMR 1 survey was 0.5 µg/L. Because some of these reporting limits exceeded the thresholds of interest, the occurrence analyses may result in an underestimate of the number of systems affected. However, the MRL values used for UCM Round 1 and UCM Round 2 as well as UCMR 1 are within the 10^{-4} to the 10^{-6} cancer risk range.

The UCM Round 1 Cross Section data indicate that approximately 0.16 percent (or 15) of the 9,164 public water systems (PWSs) sampled had detections of 1,3-DCP at concentrations greater than 0.2 µg/L (½ the HRL), affecting approximately 0.86 percent of the population served (or 438,000 of 51 million). The UCM Round 1 Cross Section data indicate that each one of those systems also had concentrations greater than 0.4 µg/L (the HRL). That is, 0.16 percent (or 15) of the 9,164 PWSs sampled had detections greater than 0.4 µg/L (the HRL), affecting

approximately 0.86 percent of the population served (or 438,000 of 51 million people). The 99th percentile of all detections was 2 µg/L and the maximum reported value was 2 µg/L.

The UCM Round 2 Cross Section data indicate that approximately 0.30 percent (or 50) of the 16,787 PWSs sampled had detections of 1,3-DCP at concentrations greater than ½ the HRL (0.2 µg/L), affecting approximately 0.42 percent of the population served (or 193,000 of 46 million). The UCM Round 2 Cross Section data indicate that approximately 0.23 percent (or 38) of the 16,787 PWSs sampled had detections of 1,3-DCP at concentrations greater than the HRL (0.4 µg/L), affecting approximately 0.33 percent of the population served (or 152,000 of 46 million). The 99th percentile of all detections was 39 µg/L and the maximum reported value was 39 µg/L.

Because the sample preservative used may have resulted in potential underestimates of occurrence for the UCM Rounds 1 and 2 data, EPA subsequently analyzed for 1,3-DCP using the samples provided by 796 of the small systems included in the recent UCMR 1 survey. None of the 3,719 samples from these 796 small systems (serving a total population of 2.8 million) had 1,3-DCP at concentrations of 0.5 µg/L or more (the minimum reporting limit used for the analysis of 1,3-DCP and a level that is slightly higher than the HRL).

EPA also evaluated several sources of supplemental information on 1,3-DCP occurrence in ambient water and drinking water, including the National Pesticide Survey, the Pesticides in Ground Water Database, a well water survey submitted by the pesticide registrant, the USGS VOC National Synthesis Random Source Water Survey and Focused Source Water Survey, and the National Highway Runoff Data and Methodology Synthesis.

The Agency has made a determination not to regulate 1,3-DCP with a national primary drinking water regulation (NPDWR). Because 1,3-DCP appears to occur infrequently at levels of health concern in PWSs, the Agency believes that an NPDWR does not present a meaningful opportunity for health risk reduction. EPA believes the 1999 pesticide labeling requirements, which are intended to mitigate risks to drinking water, may be one reason for the infrequent occurrence of 1,3-DCP at levels of concern in subsequent monitoring surveys.

The Agency plans to update the Health Advisory document for 1,3-DCP with more recent health information. The updated Health Advisory will provide information to any States with public water systems that may have 1,3-DCP above the HRL. If a State finds highly localized occurrence of 1,3-DCP at concentrations above the HRL, it should consider whether State-level guidance (or some other type of action) may be appropriate.

The Agency's regulatory determination for this contaminant is presented formally in the *Federal Register*.

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Abbreviations

a.i.	Active Ingredient
BMD	Benchmark Dose
CAAC	3-chloroacrylic acid
CAAL	3-chloroallyl alcohol
CAS	Chemical Abstracts Service
CCL	Contaminant Candidate List
CWS	Community Water System
1,3-DCP	1,3-Dichloropropene
ELCD	Electrolytic Conductivity Detector
GAC	Granular Activated Carbon
GC	Gas Chromatography
HRL	Health Reference Level
IRIS	Integrated Risk Information System
LOD	Limit of Detection
LOQ	Limit of Quantitation
MDL	Method Detection Limit
MRL	Minimum Reporting Level
MTBE	Methyl Tertiary Butyl Ether
NAWQA	National Water Quality Assessment
NCFAP	National Center for Food and Agricultural Policy
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulation
NPS	National Pesticide Survey
NTIS	National Technical Information Service
NTP	National Toxicology Program
PGWDB	Pesticides in Ground Water Database
PID	Photoionization Detector
PWS	Public Water System
RfC	Reference Concentration
RfD	Reference Dose
TRI	Toxics Release Inventory
UCM	Unregulated Contaminant Monitoring
UCMR 1	First Unregulated Contaminant Monitoring Regulation
USGS	United States Geological Survey
VOC	Volatile Organic Compound

6 1,3-Dichloropropene

6.1 Definition

1,3-Dichloropropene is a volatile organic chemical (VOC) used as a pesticide. It is also known as 1,3-dichloropropylene or 1,3-DCP, and goes by the common trade names Telone II, Dedisol C, and Vorlex (HSDB, 2004). The Chemical Abstracts Service (CAS) registry number for 1,3-dichloropropene is 542-75-6. 1,3-Dichloropropene can exist in either *cis*- and *trans*-isomeric forms, and both forms are typically combined as a racemic mixture in commercial products (USEPA, 1998). The two isomers have very similar properties; thus, this report only treats them separately when appropriate.

6.1.1 Properties and Sources

1,3-Dichloropropene is a colorless to straw-colored or amber liquid with a pungent, sharp, sweet, irritating, chloroform-like odor (Ashford, 1994 as cited in HSDB, 2004; NIOSH, 2004). 1,3-Dichloropropene is used as a soil fumigant to control nematodes and other soil pests, particularly in the control of root predation (USEPA, 1998). Commercially, 1,3-dichloropropene is produced by Dow Agrosciences. It is miscible with hydrocarbons, halogenated solvents, esters and ketones (Tomlin, 1997 as cited in HSDB, 2004), and soluble in toluene, acetone, and octane (Lewis, 1997 as cited in HSDB, 2004). It can be synthesized by the dehydration of 1,3-dichloro-2-propanol, the dehydrochlorination of 1,2,3-trichloropropane, and the reaction of 3-chloro-2-propen-1-ol with phosphorous trichloride (Budavari, 1996 as cited in HSDB, 2004), as well as by chlorination of propylene (Sittig, 1980; Ashford, 1994 both as cited in HSDB, 2004) or allyl chloride (Gerhartz, 1985 as cited in HSDB, 2004). The physical and chemical properties of this VOC are summarized in Exhibit 6-1. The properties listed are common to both isomers except where noted.

Exhibit 6-1: Physical and Chemical Properties of 1,3-Dichloropropene

Identification	
CAS number	542-75-6
Molecular Formula	C ₃ H ₄ Cl ₂
Physical and Chemical Properties	
Boiling Point	<i>cis</i> - isomer: 104 °C ¹ <i>trans</i> - isomer: 112.6 °C ¹
Melting Point	< - 50 °C ²
Molecular Weight	110.97 g/mol ³
K _{oc}	20-42 L/kg ⁴
Log K _{ow}	1.82 ²
Water Solubility	<i>cis</i> - isomer: 2,180 mg/L at 25 °C ¹ <i>trans</i> - isomer: 2,320 mg/L at 25 °C ¹
Vapor Pressure	<i>cis</i> - isomer: 34.3 mm Hg at 25 °C ¹ <i>trans</i> - isomer 23.0 mm Hg at 25 °C ¹
Henry's Law Constant	3.55 x 10 ⁻³ atm·m ³ /mole ⁵ 0.088 (dimensionless), predicted ⁶ 0.14 (dimensionless), from literature ⁶
Freundlich Isotherm Constant (K)	200 (µg/g)(L/µg) ^{1/n} ⁷

¹ USEPA, 1998² Tomlin, 1997 (as cited in HSDB, 2004)³ Budavari, 1996 (as cited in HSDB, 2004)⁴ derived from Speth et al., 2001⁵ Warner et al., 1987 (as cited in HSDB, 2004)⁶ Speth et al., 2001⁷ Gardner et al., 1990 (as cited in Speth et al., 2001)**6.1.2 Environmental Fate and Behavior**

1,3-Dichloropropene is applied to soil as a fumigant. It is estimated that 5-10 percent of the *cis* isomer is lost to the atmosphere from a warm moist sandy loam (USEPA, 1980 as cited in HSDB, 2004). The Henry's law constant and vapor pressure indicate that volatilization from moist and dry soil may be an important fate process (HSDB, 2004).

In soil, 1,3-dichloropropene can exist as a vapor or in solution. The phase has important mobility implications. In the vapor phase, 1,3-dichloropropene more strongly adsorbs to soil particles, and is of medium to low mobility in soil. The adsorption potential varies, however, with soil organic matter content and temperature. Adsorption increases with higher organic matter content and lower temperatures (Munnecke and Vangundy, 1979, Leistra, 1970, Swann et al., 1983, all as cited in ATSDR, 1992). The mobility of 1,3-dichloropropene in solution, on the

other hand, is relatively high because adsorption capacity is low in the aqueous phase. Consequently, aqueous 1,3-dichloropropene has the potential to leach to ground water (Swann *et al.*, 1983 as cited in ATSDR, 1992). K_{oc} values for 1,3-dichloropropene (see Exhibit 6-1) also suggest high mobility in soil (HSDB, 2004). Data from a number of States and regions where 1,3-dichloropropene is used indicate that the compound does leach to ground water with normal agricultural use (USEPA, 1998).

Roberts and Stoydin (1976, as cited in HSDB, 2004) report a biodegradation half-life in soil of 3 to 4 weeks, although they speculate that some of the chemical may have been lost due to volatilization. Other researchers have reported half-lives for both isomers that range from 3 to 25 days (van der Pas and Leistra, 1987, Albrecht, 1987, both as cited in HSDB, 2004). The type of soil greatly affects the rate of biodegradation, with half-lives of 1.8, 12.3, and 61 days observed in aerobically incubated Wahiawa silt clay, Catlin silt loam, and Fuquay loamy sand, respectively (Batzer *et al.*, 1997 as cited in HSDB, 2004).

1,3-Dichloropropene in soil is also subject to hydrolysis. Krijgsheld and van der Gen (1986 as cited in HSDB, 2004) have reported hydrolysis half-lives in soil of 1.5 to 20 days at 20 °C and 91 to 100 days at 2 °C. Hydrolysis of the *cis*- and *trans*- isomers results in the formation of the corresponding 3-chloroallyl alcohols, which then form the corresponding 3-chloroallylacrylic acids (Albrecht, 1987 as cited in HSDB, 2004).

The Henry's Law constant indicates that 1,3-dichloropropene is expected to volatilize from water (Lyman *et al.*, 1990 as cited in HSDB, 2004). A half-life of less than five hours for the evaporation of 1,3-dichloropropene from ditch water samples has been reported (Yon *et al.*, 1991 as cited in HSDB, 2004).

6.2 Health Effects

Chronic and subchronic exposures to 1,3-DCP at doses of 12.5 mg/kg/day and above in animal dietary studies indicate that 1,3-DCP is toxic to organs involved in metabolism (liver), excretion of conjugated metabolites (e.g., urinary bladder and the kidney) and organs along the portals of entry (e.g., forestomach for oral administration; mucous membrane of the nasal passage and lungs for inhalation exposure). Exposure to 1,3-DCP has not been shown to cause reproductive or developmental effects. Neither reproductive nor developmental toxicity were observed in a two-generation reproductive study in rats or in developmental studies in rats and rabbits at maternal inhalation concentrations up to 376 mg/m³ (USEPA, 2000). Even concentrations that produced parental toxicity did not produce reproductive or developmental effects (USEPA, 2000).

A reference dose (RfD) of 0.03 mg/kg/day for 1,3-DCP (USEPA, 2000) has been established using a benchmark dose (BMD) analysis based on a two-year chronic bioassay (Stott *et al.*, 1995 as cited in USEPA, 2000) in which chronic irritation (forestomach hyperplasia) and significant body weight reduction were the critical and co-critical effects, respectively. A reference concentration (RfC) of 0.02 mg/m³ was derived from a two-year bioassay (Lomax *et al.*, 1989 as cited in USEPA, 2000), which observed histopathology in the nasal epithelium.

Under the proposed cancer risk assessment guidelines, the weight of evidence for evaluation of 1,3-DCP's ability to cause cancer suggests that it is likely to be carcinogenic to humans (USEPA, 2000). This characterization is supported by tumor observations in chronic animal bioassays for both inhalation and oral routes of exposure.

The oral cancer slope factors calculated from chronic dietary, gavage and inhalation data ranged from 5×10^{-2} to $1 \times 10^{-1}(\text{mg/kg/day})^{-1}$. Due to uncertainties in the delivered doses in some studies, EPA's Integrated Risk Information System (IRIS) recommended using the oral slope factor of $1 \times 10^{-1}(\text{mg/kg/day})^{-1}$ from a National Toxicology Program (NTP) study (NTP, 1985). Using this oral slope factor, EPA calculated a health reference level (HRL) of 0.4 $\mu\text{g/L}$ at the 10^{-6} cancer risk level.

EPA also evaluated whether health information is available regarding the potential effects on children and other sensitive populations. No human or animal studies are available that have examined the effect of 1,3-DCP exposure on juvenile subjects. Therefore, its effects on children are unknown. Developmental studies in rats and rabbits show no evidence of developmental effects and therefore it is unlikely that 1,3-DCP causes developmental toxicity.

6.3 Occurrence and Exposure

6.3.1 Use and Environmental Release

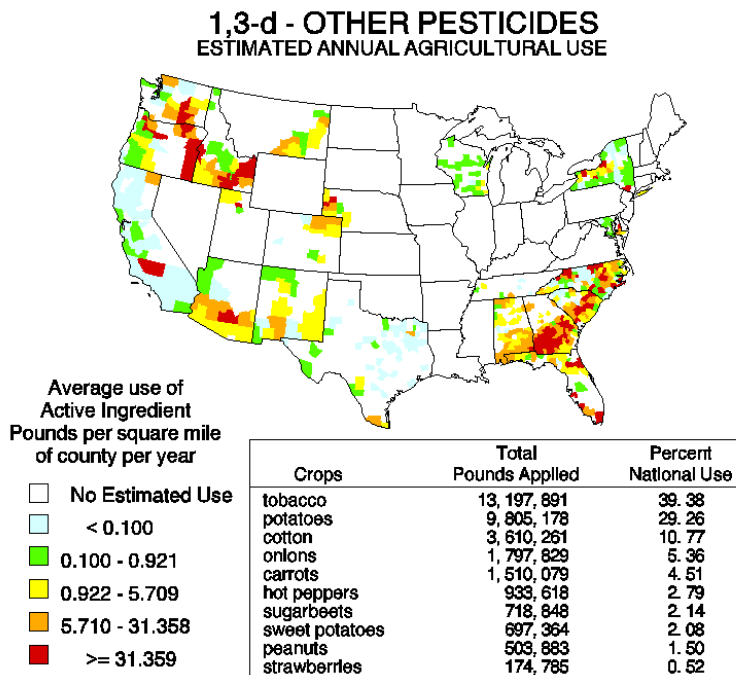
1,3-Dichloropropene, marketed under the trade name "Telone," is used as a soil fumigant to control nematodes and other soil pests. It is applied before planting, and generally injected 12 to 18 inches into the soil to minimize volatilization. 1,3-Dichloropropene was first registered for use in the United States in 1954. It is currently registered for commercial cultivation of all types of food and feed crops, including vegetable, fruit and nut crops, forage crops (grasses, legumes and other non-grass forage crops), tobacco, fiber crops, and nursery crops (ornamental, non-bearing fruit/nut trees and forestry crops). 1,3-Dichloropropene can only be applied by certified operators; it is not registered for household use. Since 1999, use of 1,3-dichloropropene has been restricted to mitigate risks to ground water. Use of the fumigant is prohibited within 100 feet of drinking water wells, in areas overlying karst geology, and in parts of certain northern tier States (ND, SD, WI, MN, NY, ME, NH, VT, MA, UT, MT) where aquifers are shallow and soils are porous (USEPA, 1998).

National use estimates are available. Using data from a variety of published sources and its own proprietary data, mostly from a 1991 data call-in, USEPA (1998) estimated that approximately 23 million pounds of active ingredient (a.i.) were used annually to treat approximately 372 thousand acres during the years 1990-1995. The National Center for Food and Agricultural Policy (NCFAP) lists uses of 1,3-dichloropropene on 17 crops totaling approximately 40.1 million pounds a.i. per year in 1992, and uses on 18 crops totaling approximately 34.7 million pounds of a.i. per year in 1997 (NCFAP, 2003). For more information on NCFAP pesticide estimates, see Chapter 2.

The United States Geological Survey (USGS) combined data collected by NCFAP with data from the Census of Agriculture to estimate that 40.0 million pounds of 1,3-dichloropropene a.i. per year were used in agriculture in the early 1990s (Thelin and Gianessi, 2000). While

USGS has not published national estimates for 1997, an estimate of approximately 33.5 million pounds a.i. can be inferred from the “total pounds applied” and “percent national use” data in the 1997 geographical distribution map (Exhibit 6-2).

Exhibit 6-2 shows the estimated geographic distribution and intensity of typical annual 1,3-dichloropropene use in the United States in the late 1990s. A breakdown of use by crop is also included. The map was created by USGS using State-level data sets on pesticide use rates from 1995-1998 compiled by NCFAP, combined with county-level data on harvested crop acreage obtained from the 1997 Census of Agriculture (USGS, 2004). Due to the nature of the data sources, non-agricultural uses are not reflected here and variations in use at the county-level are also not well represented (Thelin and Gianessi, 2000). However, because there are no registered residential uses for 1,3-dichloropropene, non-agricultural use is expected to be insignificant (USEPA, 1998). For more background on the USGS pesticide use maps, see Chapter 2. The map indicates that 1,3-dichloropropene use is concentrated in the Southeast, the Southwest, and the Northwest of the country, with isolated pockets elsewhere.

Exhibit 6-2: Estimated Annual Agricultural Use of 1,3-Dichloropropene (c. 1997)

Source: USGS, 2004

1,3-Dichloropropene is listed as a Toxics Release Inventory (TRI) chemical. For a discussion of the nature and limitations of TRI data, see Chapter 2.

TRI data for 1,3-dichloropropene (see Exhibit 6-3) are reported for the years 1988 to 2003 (USEPA, 2006). Air emissions constitute most of the on-site releases (and total releases), and generally decrease throughout the period of record. A sharp decline is evident between 1995 and 1996, and a modest increase in 2000 and 2001. Surface water discharges are of secondary importance, and no obvious trend is evident. Reported underground injection, releases to land, and off-site releases are generally insignificant. TRI releases of 1,3-dichloropropene were reported from facilities in 17 States (AR, CA, DE, FL, GA, HI, IL, KY, LA, MI, MS, NJ, NC, OH, SC, TX, and WA), although not all States had facilities reporting releases every year.

Exhibit 6-3: Environmental Releases (in pounds) of 1,3-Dichloropropene in the United States, 1988-2003

Year	On-Site Releases				Off-Site Releases	Total On- & Off-site Releases
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
1988	54,590	250	0	0	0	54,840
1989	50,917	340	0	0	3,354	54,611
1990	59,473	310	0	0	0	59,783
1991	20,405	0	0	0	0	20,405
1992	37,711	69	0	0	0	37,780
1993	33,348	2	0	0	0	33,350
1994	24,670	86	0	0	0	24,756
1995	32,977	193	0	0	0	33,170
1996	10,875	1,270	0	0	0	12,145
1997	10,131	67	0	0	0	10,198
1998	11,566	61	0	1	0	11,628
1999	6,600	68	0	0	168	6,836
2000	10,295	288	2	200	10	10,795
2001	13,062	460	0	0	505	14,027
2002	9,860	85	0	332	255	10,532
2003	8,256	6	0	412	250	8,924

Source: USEPA, 2006

6.3.2 Ambient Water Occurrence

Ambient lakes, rivers, and aquifers are sources of drinking water. Recent data on the occurrence of 1,3-dichloropropene in ambient surface and ground water are available from the National Water Quality Assessment (NAWQA) program of the USGS. For details on this program, see the discussion in Chapter 2. USGS has also collected data on 1,3-dichloropropene occurrence in reviews of existing literature.

NAWQA VOC National Synthesis

Random and Focused VOC Surveys

Using data collected from the NAWQA study units and other sources, USGS and collaborating institutions have recently completed a national assessment of VOC occurrence in the nation's drinking water supply. The assessment included a random survey (1999-2000) of VOC occurrence in ground and surface water resources used by geographically representative community water systems (CWSs) in different size categories (Grady, 2003) and a focused survey (1999-2001) of VOC occurrence patterns, including seasonal variability, in source waters considered particularly susceptible to methyl tertiary butyl ether (MTBE) contamination (Delzer and Ivahnenko, 2003). 1,3-Dichloropropene was included as an analyte in both surveys, with a reporting level of 0.2 µg/L (Ivahnenko *et al.*, 2001).

Neither the national random survey nor the focused survey found any detections of 1,3-dichloropropene at the reporting level of 0.2 µg/L (Grady, 2003; Delzer and Ivahnenko, 2003).

Even when evaluating occurrence at levels as low as the method detection limit (0.024 µg/L for *cis*-1,3-dichloropropene and 0.026 µg/L for *trans*-1,3-dichloropropene), the focused survey found no detections of either isomer (Delzer and Ivahnenko, 2003).

Compilation of Historical VOC Monitoring Data

USGS (Squillace *et al.*, 1999) assessed VOC occurrence in untreated ambient ground water samples collected between 1985 and 1995 by local, State, and federal agencies. The samples represented both urban and rural areas, and both drinking water and non-drinking water wells.

Multiple investigators collected *cis*-1,3-dichloropropene samples from 349 urban wells and 2,138 rural wells and *trans*-1,3-dichloropropene samples from 347 urban wells and 2,039 rural wells. At a reporting level of 0.2 µg/L, there were no detections of either isomer (Squillace *et al.*, 1999).

USGS Stormwater Studies

For the National Highway Runoff Data and Methodology Synthesis, USGS conducted a review of 44 highway and urban runoff studies implemented since 1970 (Lopes and Dionne, 1998). 1,3-Dichloropropene results are reported in four of these studies. For more information on this collection of studies, see Chapter 2.

Three of the studies were stormwater studies conducted in major metropolitan areas in connection with National Pollutant Discharge Elimination System (NPDES) permitting. In metropolitan Phoenix (Maricopa County), USGS collected 35 samples from five drainage basins and the City of Phoenix collected an additional 26 samples from seven sites (Lopes *et al.*, 1995). In Colorado Springs, 35 samples were collected from five sites (von Guerard and Weiss, 1995). In Dallas-Fort Worth, 182 samples were collected from 26 stormwater drainage basins (Baldys *et al.*, 1998). The reporting limits were 0.2 µg/L in Phoenix and Colorado Springs, and they ranged from 0.2 to 10 µg/L in Dallas/Fort Worth. Not all samples were monitored for every contaminant. These three studies reported no detections of 1,3-dichloropropene.

The fourth study analyzed 86 urban runoff samples from 15 cities, collected between 1979 and 1982 in connection with the National Urban Runoff Program (Cole *et al.*, 1984). 1,3-Dichloropropene was detected in 2 percent of samples, in concentrations ranging from 1 µg/L to 2 µg/L. All detections were from Eugene, Oregon. A detection limit was not reported.

6.3.2 Drinking Water Occurrence

Nationally representative data on 1,3-dichloropropene occurrence in drinking water were collected by large and small public water systems under EPA's Unregulated Contaminant Monitoring (UCM) program (1987-1999). However, there are doubts about the reliability of these data. Subsequently, additional 1,3-dichloropropene monitoring has been conducted, using a revised protocol, in conjunction with recent First Unregulated Contaminant Monitoring Regulation (UCMR 1) monitoring.

UCM Program, Rounds 1 and 2

1,3-Dichloropropene monitoring results from UCM Rounds 1 and 2 may have been compromised by the widespread use of sodium sulfate and sodium thiosulfate as dechlorinating agents. Before it was recognized that sodium sulfate and sodium thiosulfate degrade 1,3-dichloropropene in analytical samples, the two compounds were commonly used to preserve drinking water samples for VOC testing. Hence, older drinking water surveys like UCM Rounds 1 and 2 likely underestimate actual 1,3-dichloropropene occurrence. (This concern does not apply to the ambient 1,3-dichloropropene monitoring described above. USGS's ambient monitoring typically does not involve a dechlorination step. In rare cases when dechlorination is necessary, USGS employs ascorbic acid as the dechlorinating agent.)

With the caveat that UCM occurrence estimates are likely underestimates, it is still instructive to analyze the occurrence data collected. Round 1 of the UCM lasted from 1988 to 1992, and Round 2 lasted from 1993 to 1999. A geographical cross-section of States with the most complete and reliable data was chosen to provide a roughly representative picture of national occurrence in each round. For details on the UCM program, see Chapter 2 and USEPA (2008a).

Exhibits 6-4 and 6-5 show the results from the Round 1 and Round 2 cross-sections. Results from all States, including those with incomplete and less reliable data, are also presented for the sake of comparison. Results are analyzed at the level of simple detections (at or above the minimum reporting level, or \geq MRL), exceedances of the health reference level ($>$ HRL, or $>$ 0.4 $\mu\text{g/L}$), and exceedances of one half the value of the HRL ($>$ $\frac{1}{2}$ HRL, or $>$ 0.2 $\mu\text{g/L}$). MRLs for 1,3-dichloropropene were not uniform. They varied from 0.02 to 10 $\mu\text{g/L}$ in the first Round, and from 0.08 to 1 $\mu\text{g/L}$ in the second Round. The modal (most common) MRL in both Rounds was 0.5 $\mu\text{g/L}$. Because the MRL was often higher than the HRL and $\frac{1}{2}$ HRL, it is likely that the sampling failed to capture some $\frac{1}{2}$ HRL and HRL exceedances at the participating systems, and that the $\frac{1}{2}$ HRL and HRL analyses underestimate actual 1,3-dichloropropene occurrence. However, all MRLs fell within (or below) the risk range of 10^{-6} to 10^{-4} used by EPA to evaluate carcinogens (see Section 2.1.1).

In Round 1 cross-section States, 1,3-dichloropropene was detected at approximately 0.16% of public water systems (PWSs), affecting 0.86% of the population served, equivalent to approximately 1.8 million people nationally. All of these detections were at concentrations higher than the HRL. This is not surprising, since the most common MRL, 0.5 $\mu\text{g/L}$, is higher than the HRL.

When all Round 1 results are included in the analysis, including results from States with incomplete or less reliable data, 1,3-dichloropropene detection frequencies appear to be slightly higher than the cross-section data indicate. Detections affect 0.20% of PWSs and 0.95% of the population served; exceedances of the HRL (and $\frac{1}{2}$ HRL) affect 0.19% of PWSs and 0.94% of the population served.

In Round 2 cross-section States, 1,3-dichloropropene was detected at 0.35% of PWSs, affecting 0.55% of the population served, equivalent to approximately 1.2 million people nationally. The $\frac{1}{2}$ HRL benchmark was exceeded in 0.30% of PWSs, affecting 0.42% of the

population served, equivalent to approximately 0.9 million people nationally. The HRL benchmark was exceeded in 0.23% of PWSs, affecting 0.33% of the population served, equivalent to approximately 0.7 million people nationally. Compared with Round 1, Round 2 shows greater occurrence of 1,3-dichloropropene across the board, and shows a greater proportion of detections at low levels that do not exceed the health-related benchmarks. Both of these phenomena are at least partly explained by the fact that the analytical detection methods used in Round 2 were generally more sensitive.

When all Round 2 results are included in the analysis, 1,3-dichloropropene occurrence findings appear to be slightly lower than those observed for the cross-section data. Detections affect 0.31% of PWSs and 0.47% of the population served; $\frac{1}{2}$ HRL exceedances affect 0.27% of PWSs and 0.36% of the population served; and HRL exceedances affect 0.20% of PWSs and 0.27% of the population served.

Exhibit 6-4: Summary UCM Occurrence Statistics for 1,3-Dichloropropene (Round 1)

Frequency Factors	24-State Cross-Section ¹		All Reporting States ²		National System & Population Numbers ³	
	Number	Percentage	Number	Percentage	Cross-Section	All States
Total Number of Samples	31,104		31,973		--	
Percent of Samples with Detections	0.06%		0.09%		--	
99 th Percentile Concentration (all samples)	< MRL		< MRL		--	
Health Reference Level (HRL)	0.4 µg/L		0.4 µg/L		--	
Minimum Reporting Level (MRL) - Range (modal value) ⁴	0.02 - 10 µg/L (0.5 µg/L)		0.02 - 10 µg/L (0.5 µg/L)		--	
Maximum Concentration of Detections	2.0 µg/L		17.0 µg/L		--	
99 th Percentile Concentration of Detections	2.0 µg/L		15.6 µg/L		--	
Median Concentration of Detections	1.0 µg/L		1.0 µg/L		--	
Total Number of PWSs	9,164		9,307		65,030	
Number of GW PWSs	8,303		8,401		59,440	
Number of SW PWSs	898		947		5,590	
Total Population	50,917,006		52,879,061		213,008,182	
Population of GW PWSs	24,660,968		26,106,876		85,681,696	
Population of SW PWSs	29,271,833		29,867,090		127,326,486	
Occurrence by System	Number	Percentage	Number	Percentage	National Extrapolation⁵	
					Cross-Section	All States
PWSs with detections (≥ MRL)	15	0.16%	19	0.20%	106	133
Range across States	0 - 7	0 - 1.75%	0 - 7	0 - 100%	N/A	N/A
GW PWSs with detections	10	0.12%	14	0.17%	72	99
SW PWSs with detections	5	0.56%	6	0.63%	31	35
PWSs > 1/2 HRL	15	0.16%	18	0.19%	106	126
Range across States	0 - 7	0 - 1.75%	0 - 7	0 - 100%	N/A	N/A
GW PWSs > 1/2 HRL	10	0.12%	13	0.15%	72	92
SW PWSs > 1/2 HRL	5	0.56%	6	0.63%	31	35
PWSs > HRL	15	0.16%	18	0.19%	106	126
Range across States	0 - 7	0 - 1.75%	0 - 7	0 - 100%	N/A	N/A
GW PWSs > HRL	10	0.12%	13	0.15%	72	92
SW PWSs > HRL	5	0.56%	6	0.63%	31	35
Occurrence by Population Served						
Population served by PWSs with detections	436,223	0.86%	500,486	0.95%	1,825,000	2,016,000
Range across States	0 - 225,630	0 - 6.12%	0 - 225,630	0 - 100%	N/A	N/A
Pop. Served by GW PWSs with detections	146,155	0.59%	210,418	0.81%	508,000	691,000
Pop. Served by SW PWSs with detections	290,068	0.99%	342,118	1.15%	1,262,000	1,458,000
Population served by PWSs > 1/2 HRL	436,223	0.86%	497,246	0.94%	1,825,000	2,003,000
Range across States	0 - 225,630	0 - 6.12%	0 - 225,630	0 - 100%	N/A	N/A
Pop. Served by GW PWSs > 1/2 HRL	146,155	0.59%	207,178	0.79%	508,000	680,000
Pop. Served by SW PWSs > 1/2 HRL	290,068	0.99%	342,118	1.15%	1,262,000	1,458,000
Population served by PWSs > HRL	436,223	0.86%	497,246	0.94%	1,825,000	2,003,000
Range across States	0 - 225,630	0 - 6.12%	0 - 225,630	0 - 100%	N/A	N/A
Pop. Served by GW PWSs > HRL	146,155	0.59%	207,178	0.79%	508,000	680,000
Pop. Served by SW PWSs > HRL	290,068	0.99%	342,118	1.15%	1,262,000	1,458,000

1. Summary Results based on 24-State Cross-Section, UCM Round 1 data.

2. Summary Results based on All Reporting States, UCM Round 1 data.

3. Total PWS and population numbers are from EPA March 2000 Water Industry Baseline Handbook, 2nd Edition.

4. Because several different analytical methods were used, MRLs were not uniform. The modal value is the most common MRL.

5. National extrapolations are generated by multiplying the system/population percentages and the national Baseline Handbook system/population numbers.

Abbreviations:

PWS = Public Water Systems; GW = Ground Water; SW = Surface Water; N/A = Not Applicable; Total Number of Samples = total number of samples on record for the contaminant; 99th Percentile Concentration = the concentration in the 99th percentile sample (out of either all samples or just samples with detections); Median Concentration of Detections = the concentration in the median sample (out of samples with detections); Total Number of PWSs = the total number of PWSs for which sampling results are available; Total Population Served = the total population served by PWSs for which sampling results are available; PWSs with Detections, PWSs > 1/2 HRL, or PWSs > HRL = PWSs with at least one sampling result greater than or equal to the MRL, exceeding the 1/2 HRL benchmark, or exceeding the HRL benchmark, respectively; Population Served by PWSs with Detections, by PWSs > 1/2 HRL, or by PWSs > HRL = population served by PWSs with at least one sampling result greater than or equal to the MRL, exceeding the 1/2 HRL benchmark, or exceeding the HRL benchmark, respectively.

Notes:

-Only results at or above the MRL were reported as detections. Concentrations below the MRL are considered non-detects.

-Because some systems were counted as both ground water and surface water systems and others could not be classified, GW and SW figures might not add up to totals.

-Due to differences between the ratios of GW and SW systems with monitoring results and the national ratio, extrapolated GW and SW figures might not add up to extrapolated totals.

-Due to MRL variability, it is likely that the sampling failed to capture some 1/2 HRL and HRL exceedances at the participating systems, and the 1/2 HRL and HRL analyses underestimate actual contaminant occurrence.

Exhibit 6-5: Summary UCM Occurrence Statistics for 1,3-Dichloropropene (Round 2)

Frequency Factors	20-State Cross-Section ¹		All Reporting States ²		National System & Population Numbers ³	
	Number	Percentage	Number	Percentage	Cross-Section	All States
Total Number of Samples	70,631		79,388		--	
Percent of Samples with Detections	0.11%		0.10%		--	
99 th Percentile Concentration (all samples)	< MRL		< MRL		--	
Health Reference Level (HRL)	0.4 µg/L		0.4 µg/L		--	
Minimum Reporting Level (MRL) - Range - (modal value) ⁴	0.08 - 1 µg/L (0.5 µg/L)		0.08 - 1 µg/L (0.5 µg/L)		--	
Maximum Concentration of Detections	39 µg/L		39 µg/L		--	
99 th Percentile Concentration of Detections	39 µg/L		25 µg/L		--	
Median Concentration of Detections	0.5 µg/L		0.5 µg/L		--	
Total Number of PWSs	16,787		18,944		65,030	
Number of GW PWSs	15,178		17,098		59,440	
Number of SW PWSs	1,609		1,846		5,590	
Total Population	45,951,052		55,713,623		213,008,182	
Population of GW PWSs	17,423,030		21,446,615		85,681,696	
Population of SW PWSs	28,528,022		34,267,008		127,326,486	
Occurrence by System	Number	Percentage	Number	Percentage	National Extrapolation⁵	
					Cross-Section	All States
PWSs with detections (≥ MRL)	58	0.35%	59	0.31%	225	203
Range across States	0 - 43	0 - 2.91%	0 - 43	0 - 2.91%	N/A	N/A
GW PWSs with detections	48	0.32%	48	0.28%	188	167
SW PWSs with detections	10	0.62%	11	0.60%	35	33
PWSs > 1/2 HRL	50	0.30%	51	0.27%	194	175
Range across States	0 - 35	0 - 2.36%	0 - 35	0 - 2.36%	N/A	N/A
GW PWSs > 1/2 HRL	41	0.27%	41	0.24%	161	143
SW PWSs > 1/2 HRL	9	0.56%	10	0.54%	31	30
PWSs > HRL	38	0.23%	38	0.20%	147	130
Range across States	0 - 23	0 - 1.55%	0 - 23	0 - 1.55%	N/A	N/A
GW PWSs > HRL	29	0.19%	29	0.17%	114	101
SW PWSs > HRL	9	0.56%	9	0.49%	31	27
Occurrence by Population Served						
Population served by PWSs with detections	252,643	0.55%	260,157	0.47%	1,171,000	995,000
Range across States	0 - 209,261	0 - 5.78%	0 - 209,261	0 - 5.78%	N/A	N/A
Pop. Served by GW PWSs with detections	197,066	1.13%	197,066	0.92%	969,000	787,000
Pop. Served by SW PWSs with detections	55,577	0.19%	63,091	0.18%	248,000	234,000
Population served by PWSs > 1/2 HRL	192,870	0.42%	200,384	0.36%	894,000	766,000
Range across States	0 - 149,488	0 - 4.13%	0 - 149,488	0 - 4.13%	N/A	N/A
Pop. Served by GW PWSs > 1/2 HRL	141,275	0.81%	141,275	0.66%	695,000	564,000
Pop. Served by SW PWSs > 1/2 HRL	51,595	0.18%	59,109	0.17%	230,000	220,000
Population served by PWSs > HRL	151,553	0.33%	151,553	0.27%	703,000	579,000
Range across States	0 - 108,171	0 - 2.99%	0 - 108,171	0 - 2.99%	N/A	N/A
Pop. Served by GW PWSs > HRL	99,958	0.57%	99,958	0.47%	492,000	399,000
Pop. Served by SW PWSs > HRL	51,595	0.18%	51,595	0.15%	230,000	192,000

1. Summary Results based on 20-State Cross-Section, UCM Round 2 data.

2. Summary Results based on All Reporting States, UCM Round 2 data.

3. Total PWS and population numbers are from EPA March 2000 Water Industry Baseline Handbook, 2nd Edition.

4. Because several different analytical methods were used, MRLs were not uniform. The modal value is the most common MRL.

5. National extrapolations are generated by multiplying the system/population percentages and the national Baseline Handbook system/population numbers.

Abbreviations:

PWS = Public Water Systems; GW = Ground Water; SW = Surface Water; N/A = Not Applicable; Total Number of Samples = total number of samples on record for the contaminant; 99th Percentile Concentration = the concentration in the 99th percentile sample (out of either all samples or just samples with detections); Median Concentration of Detections = the concentration in the median sample (out of samples with detections); Total Number of PWSs = the total number of PWSs for which sampling results are available; Total Population Served = the total population served by PWSs for which sampling results are available; PWSs with Detections, PWSs > 1/2 HRL, or PWSs > HRL = PWSs with at least one sampling result greater than or equal to the MRL, exceeding the 1/2 HRL benchmark, or exceeding the HRL benchmark, respectively; Population Served by PWSs with Detections, by PWSs > 1/2 HRL, or by PWSs > HRL = population served by PWSs with at least one sampling result greater than or equal to the MRL, exceeding the 1/2 HRL benchmark, or exceeding the HRL benchmark, respectively.

Notes:

-Only results at or above the MRL were reported as detections. Concentrations below the MRL are considered non-detects.

-Due to differences between the ratios of GW and SW systems with monitoring results and the national ratio, extrapolated GW and SW figures might not add up to extrapolated totals.

-Due to MRL variability, it is likely that the sampling failed to capture some 1/2 HRL and HRL exceedances at the participating systems, and the 1/2 HRL and HRL analyses underestimate actual contaminant occurrence.

Each of the following maps focuses on a somewhat different aspect of the geographical distribution of 1,3-dichloropropene occurrence. The first exhibit (Exhibit 6-6) identifies all States with at least one PWS with a detection of 1,3-dichloropropene in Round 1 or Round 2. All States are included in this analysis, including both cross-section States with reliable data and non-cross-section States with less reliable data, in order to provide the broadest assessment of possible 1,3-dichloropropene occurrence. The second exhibit (Exhibit 6-7) presents the same information (identifying States with detections, regardless of whether they were included in the cross-sections) separately for Round 1 (1988-1992) and Round 2 (1993-1999), to reveal temporal trends.

The third exhibit (Exhibit 6-8) illustrates the geographic distribution of States with different detection frequencies (percentage of PWSs with at least one detection), and the fourth exhibit (Exhibit 6-9) illustrates the geographic distribution of different HRL exceedance frequencies (percentage of PWSs with at least one HRL exceedance). Only cross-section States, which have the most complete and reliable occurrence data, are included in these two analyses. In each exhibit, Round 1 data are presented in the upper map and Round 2 data are presented in the lower map to reveal temporal trends.

In each map, two color categories represent States with no data. States in white do not belong to the relevant Round or cross-section, and States in the lightest category of shading were included in the Round or cross-section but have no data for 1,3-dichloropropene. The darker shades are used to differentiate occurrence findings in States with 1,3-dichloropropene data.

These maps reveal no clear geographic or temporal patterns of 1,3-dichloropropene occurrence. States with PWSs with detections are distributed from the east to the west coast, and from the Canadian to the Mexican borders. Even the States with the highest proportion of PWSs with detections are generally distributed across the United States.

Exhibit 6-6: Geographic Distribution of 1,3-Dichloropropene Detections in Both Cross-Section and Non-Cross-Section States (Combined UCM Rounds 1 and 2)

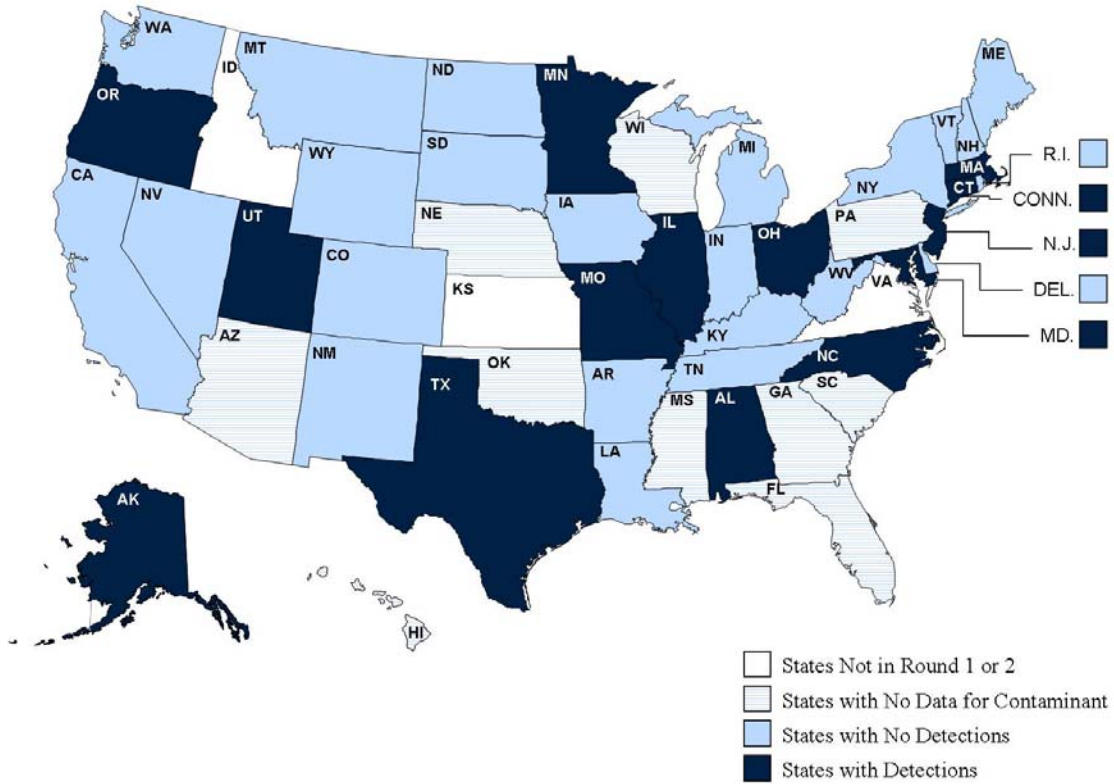


Exhibit 6-7: Geographic Distribution of 1,3-Dichloropropene Detections in Both Cross-Section and Non-Cross-Section States (Above: UCM Round 1; Below: UCM Round 2)

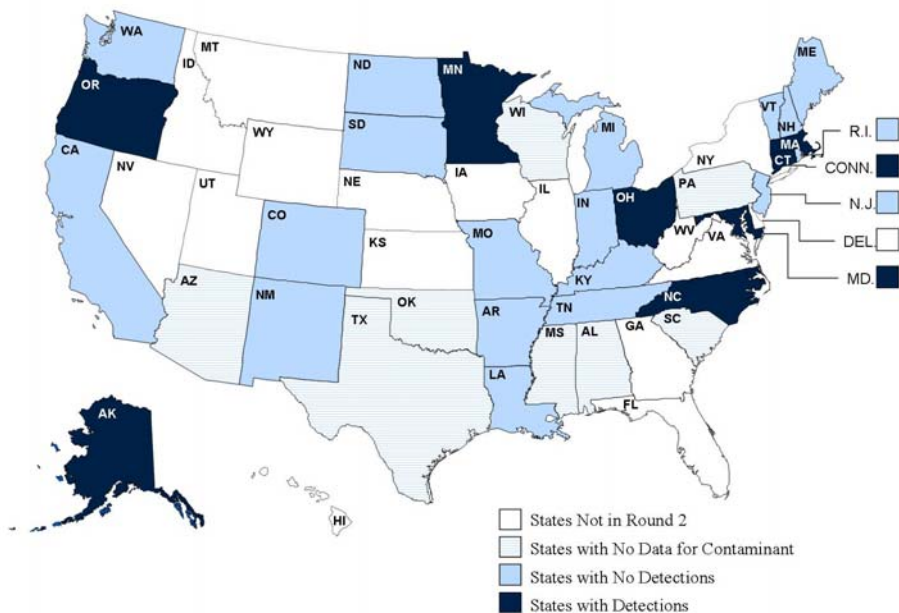
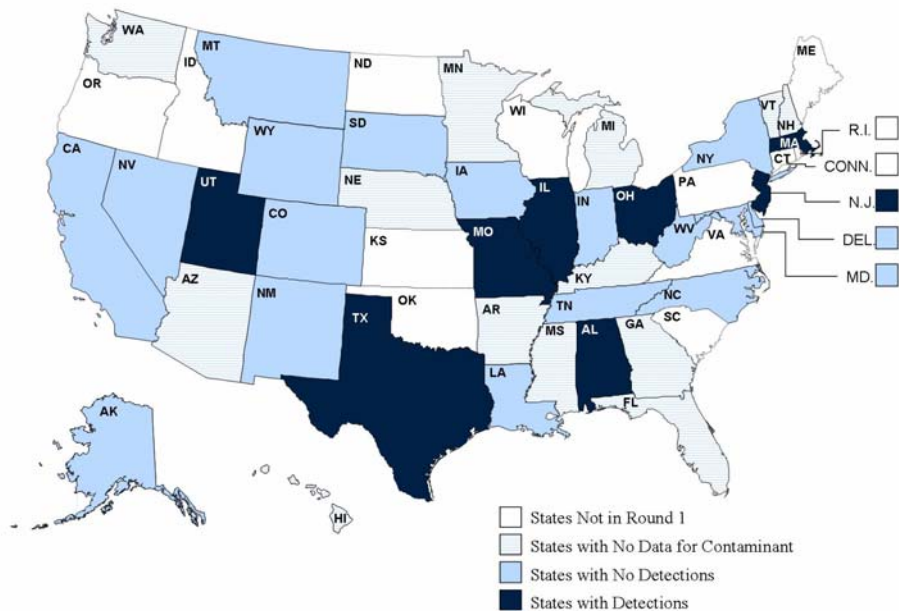


Exhibit 6-8: Geographic Distribution of 1,3-Dichloropropene Detection Frequencies in Cross-Section States (Above: UCM Round 1; Below: UCM Round 2)

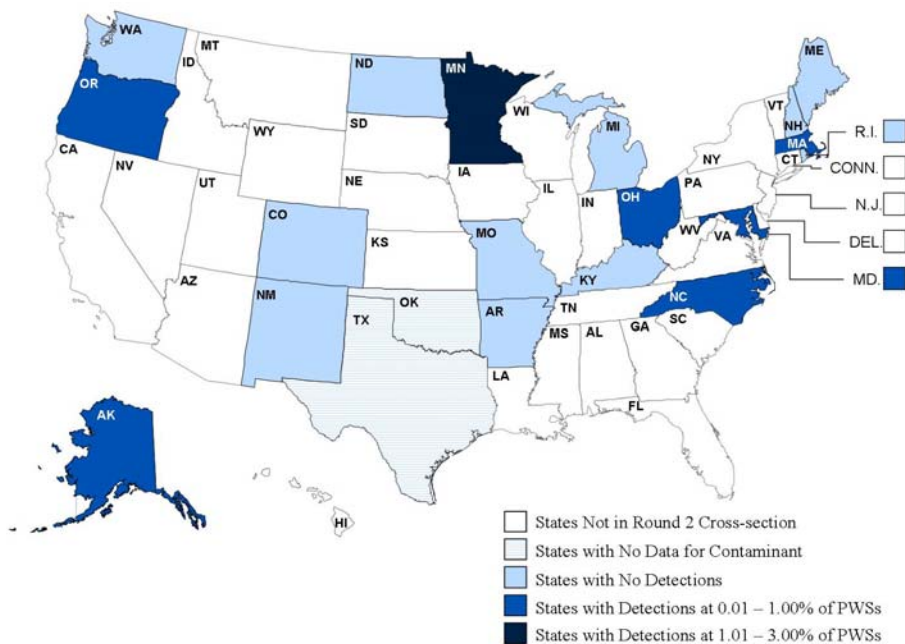
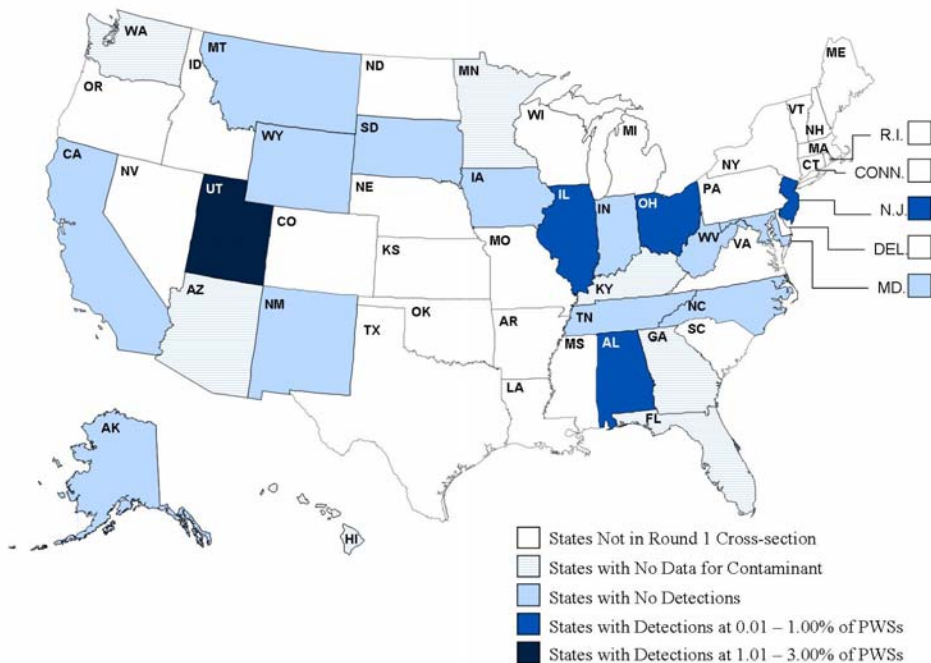
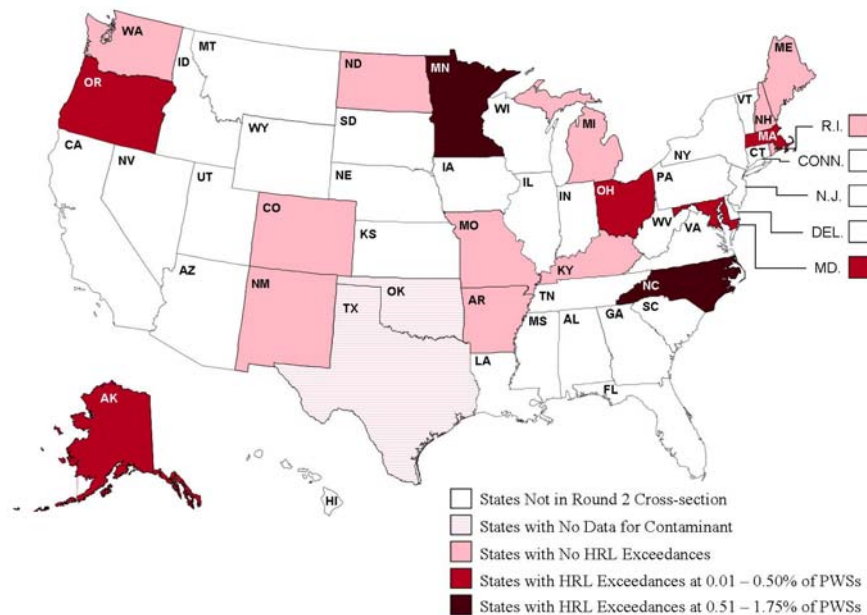
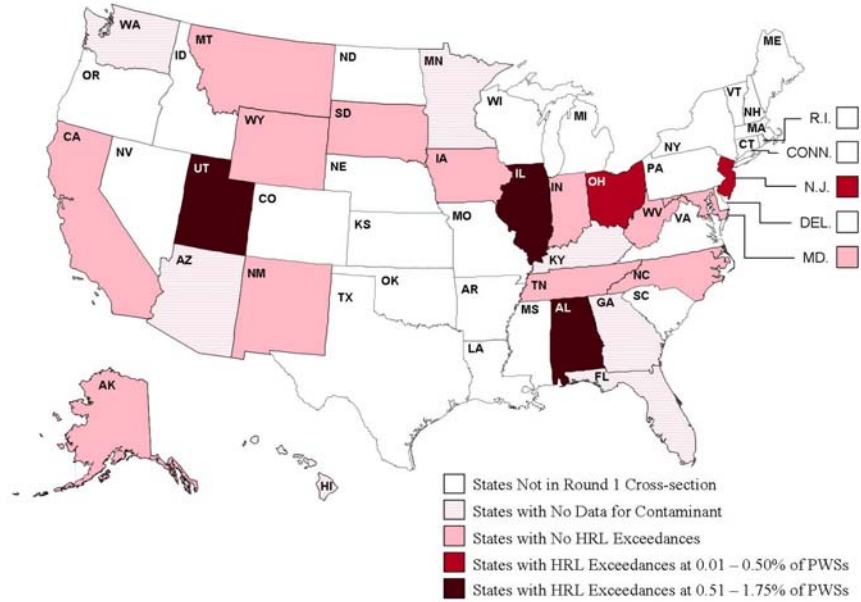
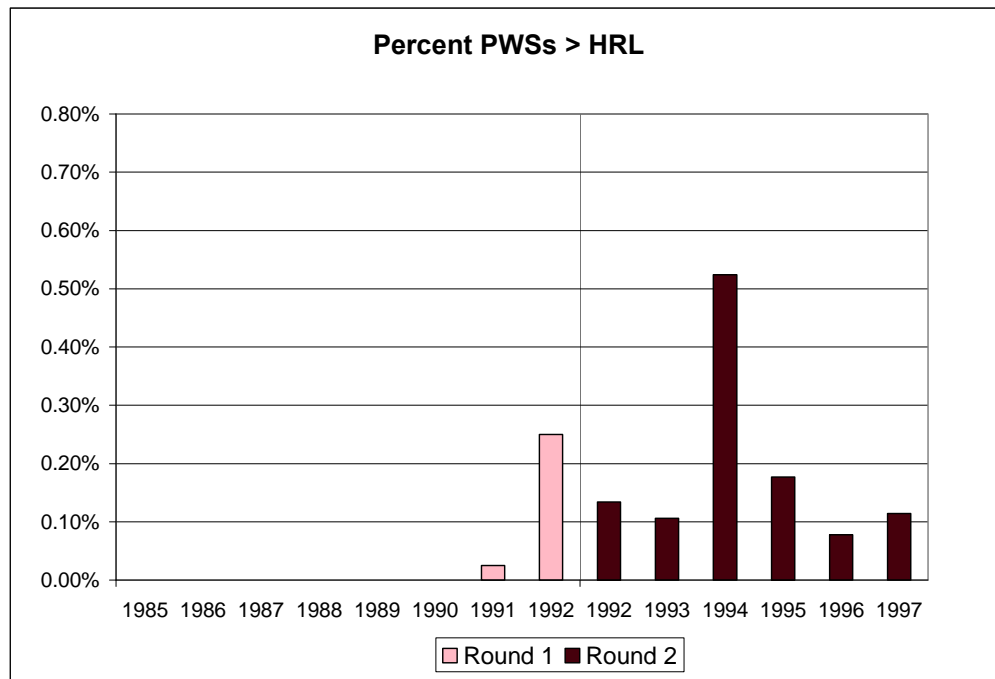
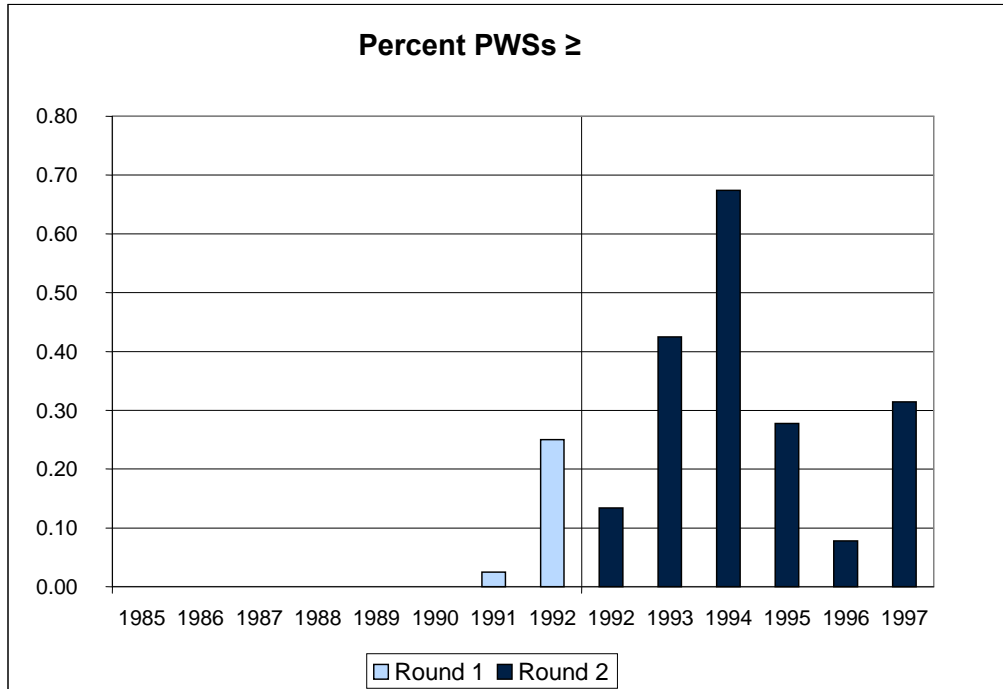


Exhibit 6-9: Geographic Distribution of 1,3-Dichloropropene HRL Exceedance Frequencies in Cross-Section States (Above: UCM Round 1; Below: UCM Round 2)



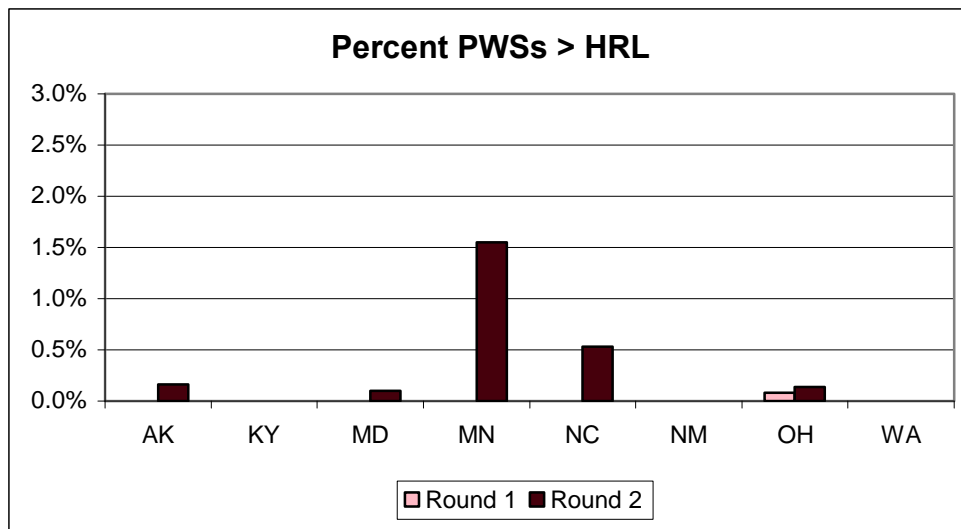
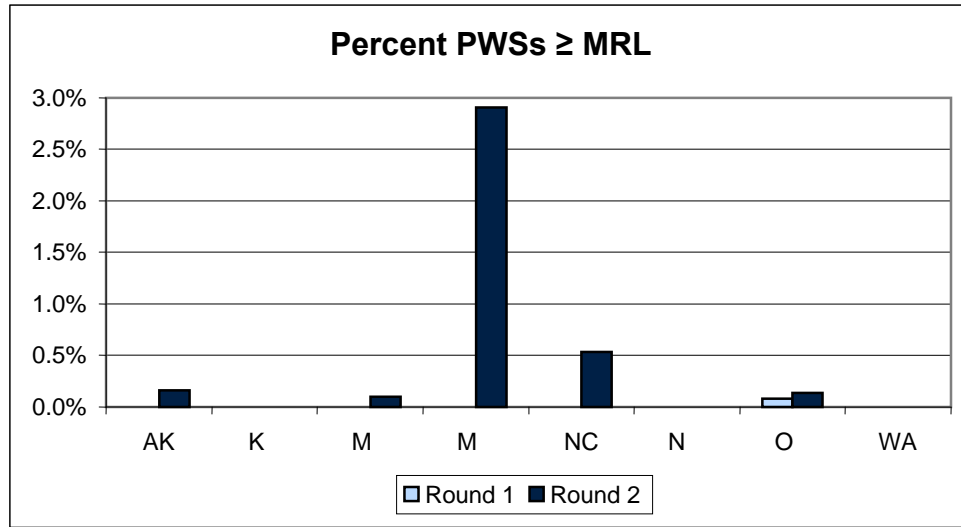
Eight States (AK, KY, MD, MN, NC, NM, OH, and WA) contributed 1,3-dichloropropene data to both the Round 1 and Round 2 cross-sections. While these States are not necessarily nationally representative, they enable some assessment of temporal trends in 1,3-dichloropropene occurrence. Exhibits 6-10 and 6-11 indicate that both detections and HRL exceedances began in 1991 and peaked in 1994, and that by far the State with the highest rate of detections, among the eight, was Minnesota.

Exhibit 6-10: Annual Frequency of 1,3-Dichloropropene Detections (above) and HRL Exceedances (below), 1985 - 1997, in Select Cross-Section States



Note: Data are from AK, KY, MD, MN, NC, NM, OH, and WA. (These eight States are the only States in both the Round 1 and the Round 2 cross-sections.) Both Round 1 and Round 2 have data for 1992; 1992 results from each Round are presented separately. The HRL for 1,3-dichloropropene is 0.4 µg/L.

Exhibit 6-11: Distribution of 1,3-Dichloropropene Detections (above) and HRL Exceedances (below) Among Select Cross-Section States



Note: These eight States are the only States in both the Round 1 and Round 2 cross-sections. The HRL for 1,3-dichloropropene is 0.4 µg/L.

Additional Monitoring in Conjunction with UCMR 1 Monitoring

UCMR 1 monitoring was conducted primarily from 2001 to 2003. Although 1,3-dichloropropene was not officially a UCMR 1 contaminant, EPA collected 1,3-dichloropropene data from UCMR 1 small system samples alongside the regular List 1 contaminants, using an appropriate analytical method that does not involve sodium sulfate or sodium thiosulfate. The surface water and ground water systems were selected to be representative of small systems nationwide. For a description of the UCMR 1 monitoring plan, see Chapter 2. See also USEPA (2008b) for more information on UCMR 1.

A total of 3,719 samples from 796 systems were analyzed for *cis*- and *trans*-1,3-dichloropropene. Neither isomer was detected in any sample. The reporting limit for each isomer was 0.50 µg/L. See Exhibit 6-12.

Exhibit 6-12: Summary UCMR 1 Occurrence Statistics for 1,3-Dichloropropene in Small Systems

Frequency Factors	UCMR Data - Small Systems		National System & Population Numbers ¹
Total Number of Samples	3,719		--
Percent of Samples with Detections	0.00%		--
99 th Percentile Concentration (all samples)	< MRL		--
Health Reference Level (HRL)	0.4 µg/L		--
Minimum Reporting Level (MRL)	0.50 µg/L		--
99 th Percentile Concentration of Detections	< MRL		--
Median Concentration of Detections	< MRL		--
Total Number of PWSs	796		60,414
Number of GW PWSs	589		56,072
Number of SW PWSs	207		4,342
Total Population	2,758,082		45,414,590
Population of GW PWSs	1,937,327		36,224,336
Population of SW PWSs	820,755		9,190,254
Occurrence by System	Number	Percentage	National Extrapolation²
PWSs (GW & SW) with Detections (≥ MRL)	0	0.00%	0
PWSs (GW & SW) > 1/2 HRL	0	0.00%	0
PWSs (GW & SW) > HRL	0	0.00%	0
Occurrence by Population Served			
Population Served by PWSs with Detections	0	0.00%	0
Population Served by PWSs > 1/2 HRL	0	0.00%	0
Population Served by PWSs > HRL	0	0.00%	0

1. Total PWS and population numbers are from EPA September 2004 Drinking Water Baseline Handbook, 4th edition.

2. National extrapolations are generated separately for each population-served size stratum and then added to yield the national estimate of GW PWSs with detections (and population served) and SW PWSs with detections (and population served). For intermediate calculations at the level of individual strata, see EPA's UCMR 1 Occurrence Report, entitled "The Analysis of Occurrence Data from the First Unregulated Contaminant Monitoring Regulation (UCMR 1) in Support of Regulatory Determinations for the Second Drinking Water Contaminant Candidate List."

Abbreviations:

PWS = Public Water Systems; GW = Ground Water; SW = Surface Water; N/A = Not Applicable; Total Number of Samples = the total number of samples on record for the contaminant; 99th Percentile Concentration = the concentration in the 99th percentile sample (out of either all samples or just samples with detections); Median Concentration of Detections = the concentration in the median sample (out of samples with detections); Total Number of PWSs = the total number of PWSs for which sampling results are available; Total Population Served = the total population served by PWSs for which sampling results are available; PWSs with detections, PWSs > 1/2 HRL, or PWSs > HRL = PWSs with at least one sampling result greater than or equal to the MRL, exceeding the 1/2 HRL benchmark, or exceeding the HRL benchmark, respectively; Population Served by PWSs with detections, by PWSs > 1/2 HRL, or by PWSs > HRL = population served by PWSs with at least one sampling result greater than or equal to the MRL, exceeding the 1/2 HRL benchmark, or exceeding the HRL benchmark, respectively.

Notes:

-Small systems are those that serve 10,000 persons or fewer.

-Only results at or above the MRL were reported as detections. Concentrations below the MRL are considered non-detects.

Pesticides in Ground Water Database (PGWDB)

The Pesticides in Ground Water Database (PGWDB) is a compilation of data from ground water studies conducted by federal, State, and local governments, the pesticide industry, and other institutions between 1971 and 1991 (USEPA, 1992). Most of the data are from drinking water wells. Since PGWDB data come from multiple sources, they should be interpreted with caution. Results might be biased high, because areas with suspected contamination are likely to have been sampled more frequently than pristine areas. For more information on PGWDB, see Chapter 2.

According to the data compiled in the PGWDB, 1,3-dichloropropene was detected in 6 (0.03 percent) of 21,270 wells sampled. The detections were found in 3 out of 7 States where 1,3-dichloropropene was investigated. All three States with detections had concentrations higher than the HRL of 0.4 µg/L. Concentrations at three California wells ranged from 0.890 µg/L to 31.0 µg/L; concentrations at two Florida wells ranged from 0.279 µg/L to 7.83 µg/L; and concentrations at one New York well ranged from 18 to 140 µg/L (USEPA, 1992).

National Pesticide Survey (NPS)

EPA collected samples from approximately 1,300 CWS wells and rural drinking water wells between 1988 and 1990 for the National Pesticide Survey (NPS). The survey was designed to provide a statistically reliable estimate of pesticide occurrence in the nation's drinking water wells. For details about NPS, see Chapter 2.

Cis- and *trans*-1,3-dichloropropene were included in the survey as separate analytes, each with a minimum reporting limit of 0.010 µg/L. Neither compound was detected in the survey (USEPA, 1990).

Monitoring by Registrant

As a condition of re-registration in 1998, Dow AgroSciences agreed to conduct tap water monitoring for 1,3-dichloropropene and its alcohol and acid degradates. High-use areas were to be targeted. It was decided that risk reduction measures would be implemented if levels exceeded 0.2 µg/L (USEPA, 1998).

Monitoring was conducted between April 2000 and April 2001 in five regions: the Central Columbia Plateau, Upper Snake River Basin, North Platter River, Albermarle-Pamlico Sound, and the Georgia/Florida basins. Approximately 5,800 samples were taken from 518 wells considered vulnerable to 1,3-dichloropropene contamination. Samples were tested for 1,3-dichloropropene, and two metabolites, 3-chloroallyl alcohol (CAAL) and 3-chloroacrylic acid (CAAC). Limits of detection (LODs) for the parent, CAAL, and CAAC were 0.015 µg/L, 0.023 µg/L, and 0.023 µg/L, respectively, and limits of quantitation (LOQs) were 0.05 µg/L, 0.092 µg/L, and 0.046 µg/L, respectively. Each well was sampled approximately four times (USEPA, 2004).

Of approximately 5,800 samples, 68 had at least one of the compounds in detectable quantities. These detections came from 65 of the 518 wells. Three wells had more than one

detection, but no well had more than two. There were 4 detections of 1,3-dichloropropene, with a maximum concentration of 0.145 µg/L; 14 detections of CAAL, with a maximum concentration of 0.11 µg/L; and 50 detections of CAAC, with a maximum detection of 0.12 µg/L. All detected concentrations were less than 0.2 µg/L, so no further action was required of the registrant (USEPA, 2004).

6.4 Technology Assessment

6.4.1 Analytical Methods

Analytical methods for 1,3-dichloropropene are readily available. EPA Methods 502.2 and 524.2 rely on purge and trap gas chromatography (GC), with detection accomplished using an electrolytic conductivity detector (ELCD) or a mass spectrometer, respectively. Description of these methods can be found in EPA's *Methods for the Determination of Organic Compounds in Drinking Water, Supplement III*, available from the Drinking Water Public Docket or the National Technical Information Service (NTIS), NTIS PB91-231480 (USEPA, 1995a). Historically, Methods 502.1 and 524.1 were also used to collect occurrence data for 1,3-dichloropropene. These methods were based on similar technology to Methods 502.2 and 524.2, but their approval for use in compliance monitoring of VOCs was withdrawn as of July 1, 1996.

The method detection limit (MDL) and the average recovery for each analytical method that can be used for the analysis of 1,3-dichloropropene in water are included in the method descriptions below¹.

Current versions of Methods 502.2 and 524.2 use either sodium thiosulfate or ascorbic acid for reducing free chlorine at the time of sample collection. However, there is evidence that 1,3-dichloropropene is unstable in the presence of sodium thiosulfate (Vuong *et al.*, 1998). While the current version of Method 524.2 does specify that only the ascorbic acid option should be used if samples are being collected for 1,3-dichloropropene analysis, previous versions of 524.2 did not include that requirement. Both the current and previous versions of Method 502.2 also do not include that requirement. Therefore, any sample that used sodium thiosulfate (or sodium sulfate) as a dechlorinating agent may yield an analytical result which underestimates the concentration of 1,3-dichloropropene present in the sample.

¹ The MDL is a statistical estimate of the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, *i.e.*, greater than the background signal. The calculation of the MDL is based upon a series of replicate measurements of the analyte at low concentrations. The MDL is not a concentration that can typically be measured by the method on a routine basis. Detection limits may vary between analysts and laboratories under various laboratory conditions.

The average recovery is the fraction or percent concentration of a target analyte determined relative to the true or expected concentration from a sample containing a known amount of the target analyte. (This can result in apparent recovery values greater than 100 percent.)

EPA Method 502.2

EPA Method 502.2 (Revision 2.1), entitled “*Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series,*” determines the presence of VOCs in water samples using GC in conjunction with either an ELCD or a photoionization detector (PID). Either detector may be used to detect and quantify *cis*- and *trans*-1,3-dichloropropene with similar sensitivity.

The MDL for *cis*- and *trans*-1,3-dichloropropene Method 502.2 is reported to range from 0.06 to 0.10 µg/L depending on the method option used. The average recovery for *cis*- and *trans*-1,3-dichloropropene using Method 502.2 is reported to range from 97 to 99 percent, depending on the method option (USEPA, 1995b).

EPA Method 524.2

EPA Method 524.2 (Revision 4.1), entitled “*Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography/Mass Spectrometry,*” is used to detect volatile aromatic compounds in finished drinking water, raw source water, or drinking water in any treatment stage. VOCs such as DCP are extracted by bubbling an inert gas through the aqueous sample. Purged sample components are trapped in a tube containing suitable sorbent materials. When purging is complete, the sorbent tube is heated and backflushed with helium to thermally desorb trapped sample components onto a capillary GC column. The column is temperature-programmed to separate the method analytes, which are then detected with a mass spectrometer. Analytes are identified and quantitated by comparison to standard materials (USEPA, 1995c).

MDLs for *cis*- and *trans*-1,3-dichloropropene are reported as 0.02 and 0.048 µg/L, respectively. The average recovery values are reported as 100 and 110 percent, respectively (USEPA, 1995c).

6.4.2 Treatment Technologies

Treatment technology status does not influence the determination of whether or not a contaminant should be regulated. However, treatment technologies must be readily available before a contaminant can be regulated with a national primary drinking water regulation (NPDWR). There is no evidence that 1,3-dichloropropene is substantially removed by conventional treatments, such as coagulation/flocculation, sedimentation, and inert media filtration. Potential treatment technologies include air stripping and activated carbon.

Air stripping involves the continuous contact of air with the water being treated, allowing dissolved volatile contaminants to transfer from the source water to the air. Systems often consist of a large column (or tower) filled with molded plastic or ceramic packing material. As the water flows along the column, air is forced counter-current through the water. The packing material increases the area of air-liquid interface, enhancing mass transfer. After contact, the air is vented to an additional treatment device that safely contains or destroys the contaminant.

The Henry's Law constant is commonly used to indicate the tendency of a contaminant to partition from water to air. A larger Henry's constant indicates a greater equilibrium concentration of the contaminant in the air. Thus, contaminants with larger Henry's constants are more efficiently removed by air stripping. A compound is generally considered amenable to air stripping if it has a Henry's constant above that of dibromochloropropane (0.003 mol/mol) or ethylene dibromide (0.013 mol/mol) (Speth *et al.*, 2001). Speth *et al.* (2001) compiled Henry's Law constants, both calculated by the authors and reported in the literature, for Contaminant Candidate List (CCL) compounds. According to Speth *et al.* (2001), the Henry's Law constant for 1,3-dichloropropene is 0.088 mol/mol or 0.14 mol/mol, both of which indicate that air stripping is a viable treatment option.

Granular activated carbon (GAC) treatment removes contaminants via the physical and chemical process of sorption: the contaminants attach to the carbon surface as water passes through the carbon bed. Activated carbon has a large sorption capacity for many water impurities, including synthetic organic chemicals, taste- and odor-causing compounds, and some species of mercury.

Adsorption capacity is typically represented by the Freundlich isotherm constant, with higher Freundlich (K) values indicating greater sorption potential. Activated carbon is considered to be cost-effective for removing a particular contaminant if the Freundlich (K) value of the contaminant is above 200 $\mu\text{g/g (L}/\mu\text{g)}^{1/n}$ (Speth *et al.*, 2001). Gardner *et al.* (1990 as cited in Speth *et al.*, 2001) report that the Freundlich (K) value for 1,3-dichloropropene is 200 $\mu\text{g/g (L}/\mu\text{g)}^{1/n}$, which indicates that GAC might be a viable treatment option.

6.5 Regulatory Determination

The Agency has made a determination not to regulate 1,3-DCP with a NPDWR. Because 1,3-DCP appears to occur infrequently at health levels of concern in PWSs, the Agency believes that an NPDWR does not present a meaningful opportunity for health risk reduction. While 1,3-DCP was detected in the UCM Round 1 (late 1980's) and the UCM Round 2 (mid 1990's) surveys, it was not detected in a subsequent evaluation of 796 small systems from the UCMR 1 survey. In addition, the USGS did not detect 1,3-DCP in two occurrence studies performed between 1999 and 2001 using monitoring levels that were lower than the HRL. EPA believes the 1999 pesticide labeling requirements, which are intended to mitigate risks to drinking water, may be one reason for the lack of occurrence of 1,3-DCP at levels of concern in subsequent monitoring surveys.

The Agency plans to update the Health Advisory document for 1,3-DCP with more recent health information. The updated Health Advisory will provide information to any States with public water systems that may have 1,3-DCP above the HRL. If a State finds highly localized occurrence of 1,3-DCP at concentrations above the HRL, it should consider whether State-level guidance (or some other type of action) may be appropriate.

The Agency's regulatory determination for this contaminant is presented formally in the *Federal Register*.

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