

6.0 OCCURRENCE IN DRINKING WATER

PRINCIPAL FINDINGS

- Data from approximately 22,000 groundwater-supplied public water systems (PWS) in 24 states indicates that 12 PWSs reported EDB concentrations above the federal MCL and 24 PWSs reported EDC concentrations above the federal MCL.
- From 1993 to 2004, there were 62 MCL violations for EDB and 32 MCL violations for EDC were reported for 40 and 17 groundwater-supplied PWSs, respectively
- Groundwater-supplied drinking water systems in Florida had EDB concentrations ranging from 3.8 to 272 µg/L and EDC concentrations ranging from 0.1 to 0.5 µg/L.
- From 1991 to 1994, six states reported EDB concentrations above the MCL and one state reported EDC concentrations above the MCL.
- Of the 2,542 rural wells sampled by the U.S. Geological Survey, EDB was detected in 8 wells at a median concentration of 0.9 µg/L. EDB was not detected in any of 406 urban wells.

To evaluate the occurrence of EDB and EDC in drinking water, EPA identified the following documents and databases that provided relevant information:

- “Occurrence of Unregulated Contaminants in Public Water Systems – A National Summary” (Ref. 6-5) covers EDB and EDC data from 1988 to 1992 for more than 24,000 PWSs in 40 states.
- “A Review of Contaminant Occurrence in Public Water Systems” (Ref. 6-4) covers EDB and EDC data from 1982 to 1998 based on an 8-state subset.
- “Occurrence Estimation Methodology and Occurrence Findings Report for the Six-Year Review of Existing National Primary Drinking Water Regulations” (Ref. 6-6) also summarizes data from the eight-state subset evaluated in “A Review of Contaminant Occurrence in Public Water Systems.”
- The Safe Drinking Water Information System (Ref. 6-9) includes information about every PWS in the country, including violations reported from 1993 through June 2004.
- The Drinking Water Database maintained by the Florida Department of Environmental Protection (Ref. 6-2) includes EDB and EDC data for drinking water systems from 2001 to 2003.

Additional information about groundwater quality was gathered from the following sources. The content of these sources, however, is not limited to groundwater-supplied drinking water systems.

- National Water Quality Assessment Program (Ref. 6-11)
- National Library of Medicines (NLM) (Ref. 6-3)
- STORET (Ref. 6-10)
- HazDat database (Ref. 6-1)

The MCL for EDB is set at 0.05 µg/L. The MCL for EDB became effective in 1992 and required water suppliers to collect and analyze water samples once every 3 months for 1 year (between 1993 and 1995) to determine whether EDB was present at concentrations above 0.01 µg/L. If it was present above the 0.01-µg/L level, a water supplier had to continue to monitor for EDB. If EDB concentrations are consistently above the MCL, a water supplier must take steps to reduce the EDB concentration so that it is consistently below the MCL. EPA has identified granular activated carbon (GAC), packed tower aeration (PTA), and oxidation as the best treatment technologies for EDB contamination (Ref. 6-8).

The federal MCL for EDC is set at 5 µg/L. The MCL for EDC became effective in 1989 and required water suppliers to collect water samples once every 3 months for 1 year (between 1993 and 1995) to determine whether EDC was present at concentrations above 0.5 µg/L. If it was present above the 0.5-µg/L level, a water supplier had to continue to monitor for EDC. If EDC concentrations are consistently above the MCL, a water supplier must take steps to reduce the EDC concentration so that it is consistently below the MCL. EPA has identified GAC, PTA, and oxidation as the best treatment technologies for EDC contamination (Ref. 6-7).

Several documents and databases have been reviewed to evaluate the occurrence of EDB and EDC in drinking water. The following sections summarize the sources of information and data available.

6.1 HISTORICAL SUMMARY OF OCCURRENCE DATA COMPILED BY EPA

Three sources of historical data compiled by EPA's Office of Water were used to evaluate the occurrence of EDB and EDC:

- "Occurrence of Unregulated Contaminants in Public Water Systems – A National Summary" (EPA-815-P-00-002, June 2001)
- "A Review of Contaminant Occurrence in Public Water Systems" (EPA 816-R-99-006, November 1999)
- "Occurrence Estimation Methodology and Occurrence Findings Report for the Six-Year Review of Existing National Primary Drinking Water Regulations" (EPA 815-R-03-006, June 2003)

"Occurrence of Unregulated Contaminants in Public Water Systems – A National Summary" presents data from two databases: the Unregulated Contaminant Information System (URCIS) and Safe Drinking Water Information System (SDWIS). However, the June 2001 report does not provide EDB and EDC data from SDWIS. The URCIS data for EDB and EDC are generally from 1988 to 1992 and cover more than 24,000 PWSs in 40 states. The report evaluates available data and concludes that 24 states with a total of 22,000 PWSs had adequate and unbiased data that could be used to develop a representative distribution. These data were evaluated to provide results that were generally indicative of national contaminant occurrence, and EDB was identified as a "high occurrence contaminant." A summary of the evaluation is presented in Table 6-1. The report notes that the data suggest widespread occurrence of EDB with no apparent geographic pattern across the country (Ref. 6-5).

Table 6-1: Subset of URCIS Data for EDB and EDC (1988 to 1992)

Approximate number of PWSs nationally	50,000
Number of PWSs used for analyses in the report	22,000
Number of states included in the report	24
Percentage of PWSs included in the report	44%
Percentage of population served included in the report	51%
Percentage of groundwater-supplied PWSs included in the report	88%
Percentage of groundwater-supplied PWSs with EDB concentrations above the federal MCL (0.05 µg/L) (based on 10,274 systems with EDB data)	0.12%
Number of groundwater-supplied PWSs with EDB concentrations above the federal MCL (0.05 µg/L) (based on 10,274 systems with EDB data)	12
Percentage of groundwater-supplied PWSs with EDC concentrations above the federal MCL (5 µg/L) (based on 14,192 systems with EDCB data)	0.17%
Number of groundwater-supplied PWSs with EDC concentrations above the federal MCL (5 µg/L) (based on 14,192 systems with EDC data)	24

Source: Ref. 6-5

Similar data are presented in the EPA report titled “A Review of Contaminant Occurrence in Public Water Systems” (November 1999). These data include information on EDB and EDC (in addition to other contaminants) from several sources, including URCIS and numerous state databases maintained under the Safe Drinking Water Act (SDWA). URCIS data are generally from 1983 to 1992, with most of the data from the first round of required unregulated-contaminant monitoring that began in 1987. State databases maintained under SDWA contain data from various years ranging from 1982 to 1998. The EPA report uses a subset of the states’ data for analyses to provide results that are representative of PWSs across the country. This subset includes data from eight states, which represents more than 20 percent of the PWSs nationwide and over 25 percent of the total population served. The eight states are New Jersey, Illinois, California, Michigan, Alabama, Oregon, New Mexico, and Montana. EDB and EDC data presented in the report for groundwater-supplied PWSs are summarized in Table 6-2 (Ref. 6-4).

Table 6-2: Summary of EDB and EDC Data for Groundwater-Supplied PWSs from Eight State Databases (1982 to 1998) and URCIS (1983 to 1992)

Contaminant: Data Source:	EDB		EDC	
	SDWA	URCIS	SDWA	URCIS
Number of systems analyzing for contaminant	9,122	10,579	15,959	14,640
Number of systems whose data are included in subset of national data	7,732	NA	12,388	NA
Percentage of systems with detections	1.0%	1.08%	1.4%	1.61%
Percentage of systems exceeding MCL (EDB-0.05 µg/L; EDC-5 µg/L)	0.7%	0.69%	0.4%	0.25%

Note: NA -- Not available

Source: Ref. 6-4

The June 2003 EPA document titled “Occurrence Estimation Methodology and Occurrence Findings Report for the Six-Year Review of Existing National Primary Drinking Water Regulations” (Ref. 6-6) also summarizes data from the eight-state subset identified above. This document is based on the data presented in EPA’s “A Review of Contaminant Occurrence in Public Water Systems” (November 1999, Ref 6-4) and includes analytical evaluations and statistical analyses of the data. The document states that several contaminants, including EDB, are consistently ranked as the most frequently occurring synthetic organic chemicals. This report also indicates that in groundwater-supplied PWSs, EDB was detected above its MCL at a higher percentage than combined BTEX compounds, and EDC was detected above its MCL at a lower percentage than combined BTEX compounds. More than 17 percent of the populations served by all systems (both groundwater- and surface water-supplied PWSs) included in the eight-state subset had EDB concentrations above the MCL. The document includes EDB data from 7,344 groundwater-supplied PWSs that serve nearly 39 million people. Nearly 23 percent of this population is served by systems that have reported EDB concentrations above the MCL. Similarly, the document includes EDC data from 10,081 groundwater-supplied PWSs that serve approximately 44 million people. Nearly 18 percent of this population is served by systems that have reported EDC concentrations above the MCL.

6.2 EPA SAFE DRINKING WATER INFORMATION SYSTEM

SDWIS maintained by EPA’s Office of Water contains basic information about the nation’s drinking water supply. The information is provided by the states and EPA’s regional offices and is reported for every PWS in the United States. The PWS information includes data on system status, the population served, the primary source of drinking water, enforcement actions, variances, milestones, and violations for federally regulated contaminants. Information about violations, such as the type of violation, the contaminant involved, and when the violation occurred, is available for the period from 1993 through June 2004 (Ref. 6-9).

Data were reviewed for groundwater-supplied systems with MCL violations for EDB and EDC. SDWIS includes data for violations (1) where average concentrations for four quarters exceed an MCL and (2) where a single sample exceeds an MCL. Fourteen states and one tribal community reported a total of 62 violations for EDB, and eight states reported 32 violations for EDC. Table

6-3 summarizes these MCL violations, including concentration ranges and populations served by these systems. The total population served by systems that reported EDB violations is approximately 65,000; the populations for each system range from 10 to 31,590. The total population served by systems that reported EDC violations is nearly 95,000; the populations for each system range from 43 to 44,000. Based on data presented in this report only, MCL violations for these two contaminants are more likely to occur in smaller systems. Figures 6-1 and 6-2 respectively show EDB and EDC concentration ranges associated with drinking water violations across the United States (Refs. 6-5 and 6-9).

Table 6-3: Summary of EDB and EDC MCL Violations at Groundwater-Supplied Systems (1993 to 2004)

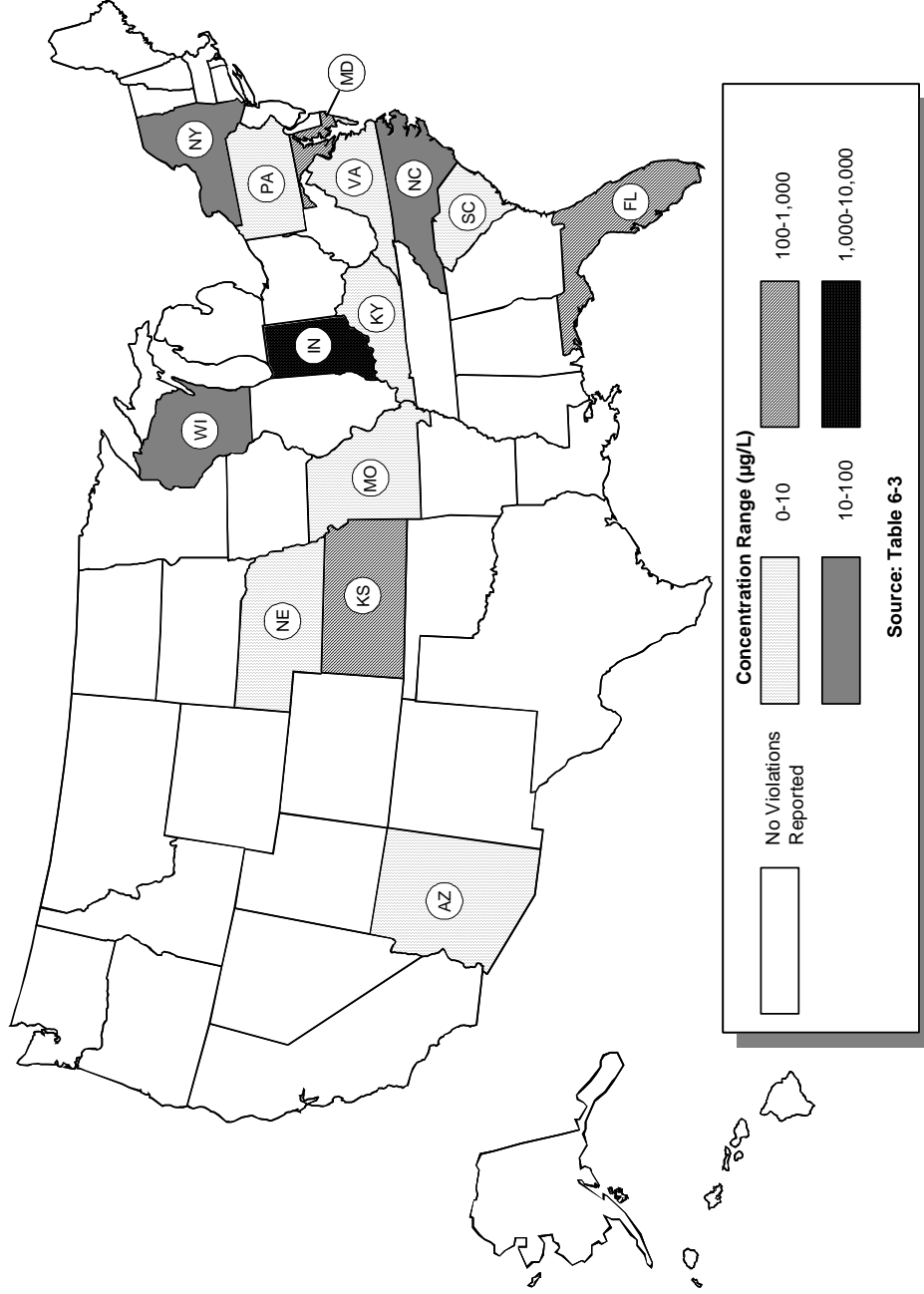
State	EDB (Federal MCL = 0.05 µg/L)				EDC (Federal MCL = 5 µg/L)			
	Number of Violations*	Number of Systems	Conc. Range (µg/L)*	Pop. Served	Number of Violations*	Number of Systems	Conc. Range (µg/L)*	Pop. Served
Tribal	4	2	104 – 890	350 – 530	0	0	NA	NA
Alaska	0	0	NA	NA	2	1	5,860 – 6,230	100
Arizona	1	1	0.01	1,200	0	0	NA	NA
Connecticut	0	0	NA	NA	1	1	12.7	318
Florida	4	4	44.4 – 272	40 – 3,200	0	0	NA	NA
Indiana	3	3	220 – 9,400	250 – 31,590	0	0	NA	NA
Kansas	2	2	90 – 750	148 – 243	0	0	NA	NA
Kentucky	1	1	0.41	15	0	0	NA	NA
Maryland	2	2	80 – 693	63 – 84	0	0	NA	NA
Michigan	0	0	NA	NA	1	1	20,000	51
Minnesota	0	0	NA	NA	2	2	6,200 – 7,400	46 – 44,000
Missouri	1	1	0.12	750	0	0	NA	NA
Nebraska	4	3	0.08 – 1.372	198 – 9,800	2	2	7.12 – 11,000	187 – 237
New Jersey	0	0	NA	NA	19	7	2,600 – 12,000	82 – 23,892
New York	1	1	58	10	0	0	NA	NA
North Carolina	25	13	0.062 – 15	80 – 4,016	0	0	NA	NA
Pennsylvania	2	1	0.29	400	3	2	17 – 133	43 – 4,000
South Carolina	1	1	0.14	1,240	0	0	NA	NA
Virginia	10	4	0.08 – 0.31	60 – 1,300	0	0	NA	NA
Wisconsin	1	1	77.6	385	2	1	6,640 – 7,430	44
Total	62	40	NA	65,269	32	17	NA	94,663

*Violations and ranges are based on both single sample concentrations and averages.

NA – Not applicable

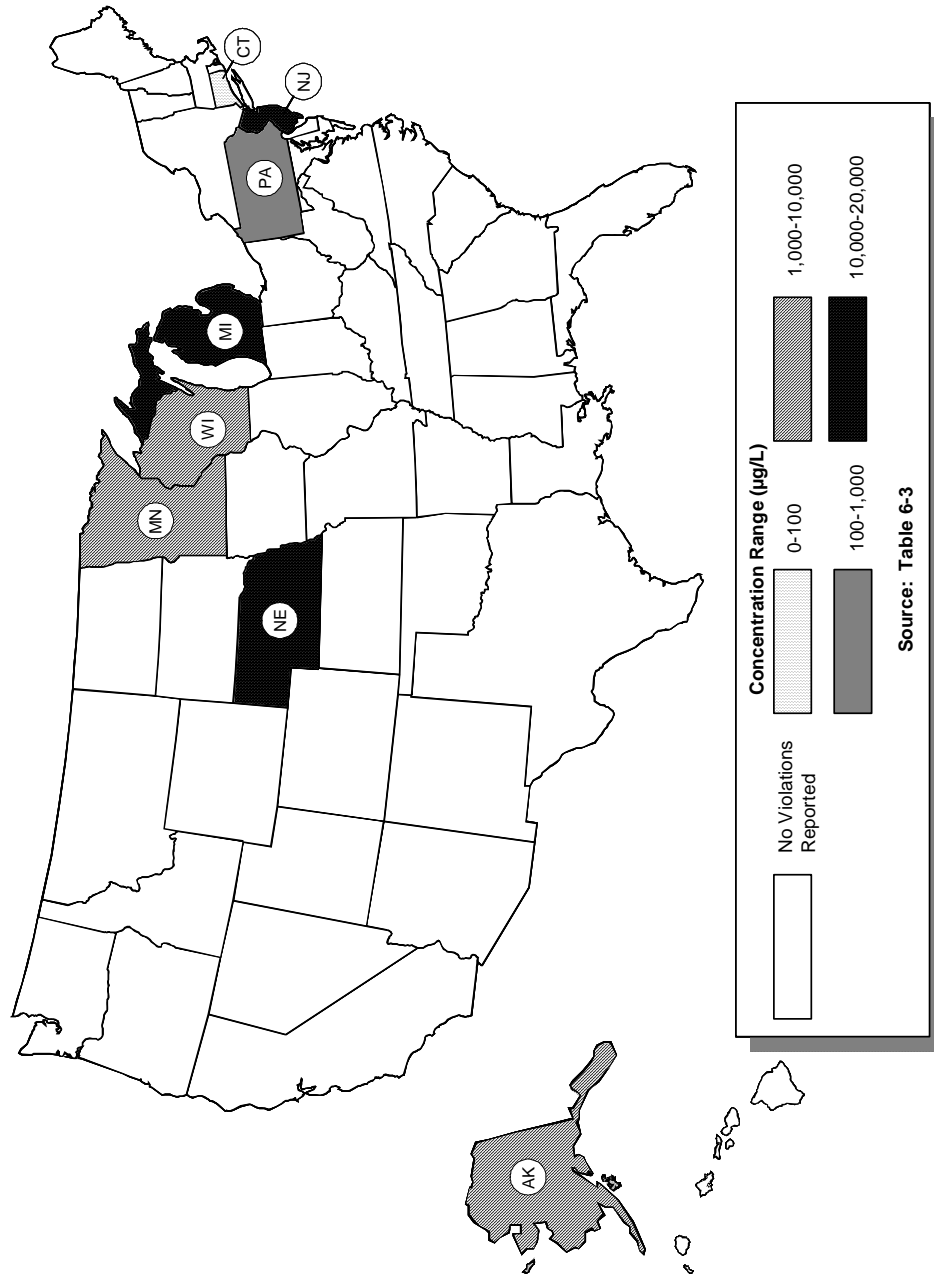
Source: Ref. 6-9

Figure 6-1
Drinking Water Violations for EDB at Groundwater-Supplied Systems as
Reported in SDWIS (1993 to 2004)



Note: This map highlights states where EDB was detected at least once in groundwater-supplied drinking water at a concentration greater than the MCL.

Figure 6-2
Drinking Water Violations for EDC at Groundwater-Supplied Systems as
Reported in SDWIS (1993 to 2004)



Note: This map highlights states where EDC was detected at least once in groundwater-supplied drinking water at a concentration greater than the MCL.

6.3 FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION DRINKING WATER DATABASE

The Drinking Water Database maintained by the Florida Department of Environmental Protection contains information on all the PWSs in Florida and is discussed in this report as an example of the types of data that may be available for other states. The “chemical data” search allows database users to query analytical results for several contaminant groups for the years 2001, 2002, and 2003. EDB is included in the “Synthetic Organics” group, and EDC is included in the “Volatile Organics” group. A summary of a database query for EDB and EDC at groundwater-supplied PWSs is presented in Table 6-4. According to this database, the two EDB violations occurred in small systems, serving populations of 40 and 423 people. In addition, 10 of the 14 systems with EDB detections served less than 5,000 people, while the other 4 served more than 17,000 people (Ref. 6-2).

Table 6-4: Summary of EDB and EDC in Florida’s Groundwater-Supplied Drinking Water Systems (2001 to 2003)

Contaminant:	EDB	EDC
Number of drinking water systems monitoring the contaminant	2,371	2,919
Number of drinking water systems with detections	14	10
Number of drinking water systems with concentrations above the MCL	2	0
Concentration range (µg/L)	3.8 – 272*	0.1 – 0.5

* EDB concentration data obtained from the Florida Department of Environmental Protection Drinking Water Database were not equal to the concentration data provided by U.S. EPA (Ref. 6-9). Data from Florida database indicated EDB concentration range to be 0.0038 to 0.272 µg/L. Data from U.S. EPA, Office of Water indicated EDB concentration range to be 3.8 to 272.0 µg/L. EPA data were confirmed correct and are included as the concentration range above.

Source: Ref. 6-2

6.4 USGS NATIONAL WATER QUALITY ASSESSMENT DATA WAREHOUSE

USGS implemented the National Water Quality Assessment Program in 1991 to collect data on chemical, biological, and physical water quality parameters at 36 study units across the United States, most of which were in the eastern half of the country. Additional study units have been established in each of the 50 states. Data are now available from 2,800 surface water sites and 5,000 groundwater monitoring wells. Chemical concentrations, groundwater levels, site characteristics, and well information are included in the database system. This system also allows users to select contaminants and concentration ranges to be displayed across a map of a particular EPA region, state, or study unit or the entire United States. Figure 6-3 shows groundwater monitoring locations in the study units where EDB and EDC concentrations exceeded MCLs (Ref. 6-11).

Based on the data, EDB was reported at concentrations above the MCL in six states, and EDC was reported at concentrations above the MCL in one state. These data include groundwater monitoring locations and are not limited to groundwater-supplied drinking water.

Figure 6-3
Summary of USGS Groundwater Monitoring Locations Where EDB and EDC
Concentrations Exceeded MCLs (1991-1994)



Additional USGS data are available from the NLM, which operates under the National Institutes of Health, U.S. Department of Health and Human Services. The NLM maintains TOXNET, a cluster of databases that contain information on toxicology, hazardous chemicals, and related topics. Selected USGS data for EDB and EDC are maintained in these databases; these data are not limited to groundwater-supplied drinking water. Between 1985 and 1995, 2,948 wells (both urban and rural drinking water supply wells) were sampled for EDB analysis. EDB was not detected in any of the 406 urban wells but was detected in 8 of the 2,542 rural wells at a median concentration of 0.9 µg/L (Ref. 6-3).

Based on TOXNET, EDC was detected in groundwater samples collected in 13 U.S. cities at an average concentration of 0.2 µg/L. TOXNET also contains information about particular states and areas. For example, TOXNET contains average annual concentrations of EDC in California’s public drinking water sources; these concentrations are summarized in Table 6-5 (Ref. 6-3).

Table 6-5: EDC Concentrations in California’s Public Drinking Water Sources (1989 to 1992)

Year	Average Annual Concentration (µg/L)
1989	3.43
1990	3.32
1991	3.65
1992	3.86

Source: Ref. 6-3

6.5 EPA STORET

EPA’s STORET database contains water quality data collected since January 1999 as well as data collected prior to 1999 that have been properly documented and migrated from an earlier version of the database (Legacy Data Center). Raw biological, chemical, and physical data for surface water and groundwater collected by various sources (federal agencies, states, Indian tribes, volunteer groups, academics, and others) are included; these data are not limited to groundwater-supplied drinking water. Database queries were conducted for EDB and EDC in samples that had “water” as a medium and that were collected from January 1980 through September 2004. The query results are presented in Table 6-6. These results indicate that 57 sites detected EDB at concentrations ranging from 0.012 to 270 µg/L and that 251 sites detected EDC at concentrations ranging from 0.1 to 2,300 µg/L (Ref. 6-10).

6.6 ATSDR HAZDAT DATABASE

The ATSDR HazDat database includes information on releases of hazardous substances at Superfund sites or during emergency events. The “site contaminant query” allows database users to find sites associated with a particular contaminant. Searches were conducted for EDB and EDC concentrations in groundwater samples collected from 1979 to 2003; these data are not

limited to groundwater-supplied drinking water. Table 6-6 summarizes the results of these searches. These results indicate that 41 sites reported EDB concentrations ranging from 0.02 to 4,500,000 µg/L and that 433 sites reported EDC concentrations ranging from 0.1 to 110,000,000 µg/L (Ref. 6-1).

Table 6-6: Summary of EDB and EDC Data in EPA STORET (1980 to 2004) and ATSDR HazDat (1979 to 2003)

Contaminant: Data Source:	EDB		EDC	
	<i>EPA STORET</i>	<i>ATSDR HazDat</i>	<i>EPA STORET</i>	<i>ATSDR HazDat</i>
Number of sites/stations reporting data	1,598	53	2,406	621
Number of sites/stations with concentrations reported as nondetect	1,238	NA	1,762	NA
Number of sites/stations with concentrations reported as “present<quantitative limit”	362	NA	686	NA
Number of sites/stations with detections	57	41	251	433
Concentration ranges (µg/L)	0.012-270	0.02- 4,500,000	0.1-2,300	0.1- 110,000,000

NA – Not available

Source: Refs. 6-10 and 6-1

6.7 REFERENCES

- 6-1 Agency for Toxic Substances and Disease Registry (ATSDR). 2004. HazDat Database. Website Accessed on September 12, 2004. On-Line Address: <http://www.atsdr.cdc.gov/hazdat.html>
- 6-2 Florida Department of Environmental Protection. 2004. Drinking Water Database. Website Accessed on September 10, 2004. On-Line Address: <http://www.dep.state.fl.us/water/drinkingwater/download.htm>
- 6-3 U.S. Department of Health and Human Services. 2004. National Institutes of Health. National Library of Medicines TOXNET. Website Accessed on September 17, 2004. On-Line Address: <http://www.toxnet.nlm.nih.gov/>
- 6-4 U.S. Environmental Protection Agency (EPA). 1999. “A Review of Contaminant Occurrence in Public Water Systems.” EPA 816-R-99-006. November.
- 6-5 EPA. 2001. “Occurrence of Unregulated Contaminants in Public Water Systems – A National Summary.” EPA 815-P-00-002. June.
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- 6-7 EPA. 2004. Consumer Fact Sheet on Ethylene Dichloride. Website Accessed on October 5, 2004. On-Line Address:
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