Results of 1998-2001 Sampling
for EDB, 1,2-DCP and DBCP Pesticide Contamination Near Pattison Lake and Lake St. Clair, Thurston County, Washington

Including a summary of historical sampling data

A joint study by the Thurston County Health Department and the City of Olympia, funded by the Local Toxic Control Account through the Washington State Department of Ecology

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THURSTON COUNTY
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Summary

The purpose of this study was to obtain current environmental data on groundwater conditions with respect to the existing pesticide contamination of ground water in north-eastern Thurston County, Washington. The pesticides were initially detected in drinking water wells in 1984. Sampling was conducted around Pattison Lake and Lake St. Clair in late 1998, through 2001, to determine if existing pesticide-contaminated ground water plumes around the lakes had spread, moved, or changed in concentration. The contaminants previously identified included EDB, 1,2-DCP and DBCP. Lake and well sample results suggest that the contaminant plumes have not moved or spread northward (in the direction of groundwater flow) and that contaminant concentrations have decreased.

History

EDB (ethylene dibromide or 1,2-dibromoethane) was used as a soil fumigant and pesticide in the United States between the late 1940's and the banning of its use on crops in 1984 by the U.S. Environmental Protection Agency (EPA). Its main use was as a soil fumigant to control nematodes (root worms) on strawberries, raspberries, seed potatoes and other row crops. It was commonly accompanied by the similar compounds 1,2-DCP (1,2-dichloropropane) and DBCP (1,2-dibromo-3-chloropropane). The sole manufacturer of 1,2-DCP stopped production of the chemical in 1991. In 1979 the EPA stopped the use of DBCP as a soil fumigant in the continental US. All three chemicals are known or suspected carcinogens. The EPA has required Group A public water suppliers (those serving more than 14 connections) to sample for these and other chemicals, at least once every three years since 1995 (EPA, 2001).

These chemicals were used at a number of sites in Thurston County, particularly along the Yelm Highway. Available records are generally not adequate to determine exactly where they were used, in what quantities, or for what time period.

The first EDB-related groundwater contamination in Thurston County was found southeast of Lake St. Clair near the Yelm Highway in 1984 in a study by the Washington Department of Health (DOH) and the Thurston County Health Department. This contamination was detected as part of a follow-up study to contamination discovered around strawberry fields in Whatcom and Skagit Counties. Extensive groundwater monitoring identified 14 contaminated wells in an area of several square miles in Thurston County; ten wells exceeded drinking water standards for either 1,2-DCP or EDB. Immediately after the contamination was confirmed, affected residents were offered bottled water by the Washington Department of Ecology until a water line from a public water supply outside the contaminated area was brought in to supply affected homes.

The second EDB-related groundwater contamination in Thurston County was found southwest of Pattison Lake along the Yelm Highway in 1989. This contamination was detected as part of the sampling for a U.S. Geological Survey cooperative study with the Thurston County Health Department (Health) of northern Thurston County (Drost and others, 1998). Extensive groundwater monitoring identified 24 contaminated wells in an

area of several square miles; 17 wells exceeded drinking water standards, primarily for EDB. After the contamination was confirmed, residents were informed and water lines from the City of Lacey and the Pattison Water Company were brought in to supply affected homes in 1991.

Hydrogeology

Northern Thurston County has been affected by several glaciations. The most recent one, termed the Vashon glacier, advanced into Thurston County approximately 15,000 years ago and retreated around 13,500 years ago (Drost and others, 1998). The results of the glaciation included the deposit of several hundred feet of sediments in distinct layers. Depending upon the materials (*i.e.*, clays, sands or gravels), these layers can be productive gravelly aquifers, or confining layers of clay or cemented sands and gravels ("till").

The area around Pattison Lake and Lake St. Clair has several layers of alternating aquifers (the Qva and the deeper Qc) and confining layers. Most of the wells in the area are in either the Qva or Qc aquifers. Both of these aquifers flow northward (Figure 1). Most individual wells are around 100 feet deep, while public supply wells are generally deeper in this area (between 200 and 300 feet deep).

The groundwater in this vicinity of Thurston County is an important regional resource as it supplies water to the McAllister Springs. The springs are the major source of high-quality drinking water for the City of Olympia; serving approximately 30,000 people.

Sampling Design

This sampling effort had two main goals: to determine if the groundwater contamination had spread, and to determine the current contaminant concentration in wells. To answer the question of spread, lake water and sediment samples were taken from Pattison Lake and Lake St. Clair, as the aquifers feed both lakes. In addition, wells north (downgradient) of historically contaminated wells, and wells between Pattison Lake and Lake St. Clair were sampled. Historically contaminated wells were also sampled to determine if concentrations had changed.

Health Effects

The following is an excerpt from the summary of the Public Health Assessment of pesticide contaminated groundwater in Whatcom County (Duff, 2000). 1,2-DCP, DBCP and EDB were detected in the groundwater there in similar concentrations as those found in Thurston County.

Exposure to the pesticides found...can occur though ingestion, inhalation and dermal absorption. Non-cancer adverse health effects are not anticipated to result from exposure to the maximum levels of pesticides detected in...groundwater. However, a moderate to low cancer risk was estimated for long-term exposure to the maximum level of EDB detected in area drinking water. Maximum levels of the other pesticides found in area drinking water represent a lower cancer risk. While the MCLs [maximum

contaminant levels – drinking water standards]for these pesticides are protective against non-cancer adverse health effects, some cancer risk does exist for residents using wells with EDB and/or multiple pesticides below their respective MCLs. It is important to note that cancer risk estimates made here are based on a worst-case scenario. More realistic exposure assumptions result in considerably lower cancer risk estimates. In addition, pesticide levels are declining in area groundwater indicating that future cancer risk is declining as well.

Whatcom County Health and Human Services found 1,2-DCP, DBCP and EDB contaminated groundwater in 1983. Their response followed the same pattern as Thurston County's; public notification, delivery of bottled water and connection to non-contaminated water sources. Those wishing more information regarding the potential health effects of exposure to the pesticide contaminated groundwater should read the Whatcom County Public Health Assessment Report. The report describes in detail the potential cancer risk calculations and exposure routes (see also Allred, Mike, 1998). Technical factsheets about the pesticides are also available on-line (references EPA, 2001, A, B and C).

The respective MCLs for the pesticides are listed below in Table 1. The contaminant concentrations were similar to those seen in northern Whatcom County (table structure and reference from Duff, 2000).

Table 1 – Contaminants Detected in Drinking Water Wells Around Pattison Lake and Lake St. Clair between 1984 and 2001

Contaminant	Maximum Contaminaut Level (MCL) (parts per billion- µg/L)	Number of Samples	Number of Detections	Number of Detections Above MCL	Maximum Concentration (µg/L)	Average Concentrations[a] (µg/L)
All Samples (1984-2001)						
1,2-Dichloropropane (1,2-DCP)	5.0	108	42	16	19	6.39
1,2-dibromo,3-chloropropane (DBCP)	0.2	113	11	0	0.2	0.14
Ethylene dibromide (EDB)	0.05	195	63	52	1.20	0.34
1984-1995 Contaminants Detected						
1,2-Dichloropropane (1,2-DCP)	5.0	67	37	16	19.0	7.21
1,2-dibromo,3-chloropropane (DBCP)	0.2	62	10	0	0.2	0.15
Ethylene dibromide (EDB)	0.05	144	62	51	1.2	0.35
1998-2001 Contaminants Detected						
1,2-Dichloropropane (1,2-DCP)	5.0	41	5	0	1.0	0.38
1,2-dibromo,3-chloropropane (DBCP)	0.2	51	1	0	0.05	0.05
Ethylene dibromide (EDB)	0.05	51	1	1	0.2	0.2

a=Average calculated with non-detects as zero.

1998-2001 Sampling

Thurston County Health staff initiated a review of EDB, 1,2-DCP and DBCP contamination around Pattison Lake and Lake St. Clair in 1999. In conjunction with the City of Olympia, and with funds from the Local Toxic Control Account through the Washington Department of Ecology, samples from a variety of sources were analyzed for 1,2-DCP, EDB and DBCP.

The monitoring effort included water and sediment samples from Pattison Lake and Lake St. Clair and samples from 43 private wells, public water supplies and monitoring wells. The well samples were collected between October 1998 March 2001.

Well Sampling – Health and City of Olympia staff collected samples from 17 wells during an initial sampling round between December 1999 and January 2000. The Cities of Olympia and Lacey, Pattison Water Company and Washington Water Service also provided sampling results for their public water supply wells in the area. A total of 43 wells were sampled for the pesticides.

At the beginning of this study, homeowners with contaminated wells were sent a letter describing the study and requesting their permission to sample their wells. A very low response rate to the letter and attempted phone contacts hampered efforts to sample the contaminated wells. Additionally, a number of wells were either fully decommissioned (casing pulled and back-filled) or de-powered. The Lacey Fire Department well located off Yelm Highway (17N/01E-05F01) was one of the decommissioned wells. A total of six historically-contaminated wells were eventually sampled.

Samples collected by City and County staff followed DOH sampling procedures (DOH, 1990). The wells were purged for three casing volumes, for fifteen minutes, or until pH, temperature and conductivity readings stabilized, which ever came first. Samples were collected in 40 ml glass vials with Teflon septums, preserved with 2 drops of HCl. These samples were analyzed using USEPA method 504.1. Samples collected directly by the water purveyors were either analyzed using either USEPA method 504.1 or 524.2.

To fill data gaps along the northern edge of Pattison Lake and the western side of Lake St. Clair, a second round of six well samples was collected in July 2000. Due to a laboratory error, the samples were tested only for EDB and DBCP, not for 1,2-DCP. These six wells were sampled again between February and March 2001 and analyzed for 1,2-DCP, in addition to EDB and DBCP. A seventh well (17N/01E-06CA) on the southern shore of Lake Saint Clair was included in the March 2001 sampling.

The irrigation and domestic wells at the Washington Department of Natural Resources (DNR) Meridian Seed Orchard were sampled for pollutants in 1999 as part of a separate effort. A low-level detection of 1,2-DCP, 0.08 µg/L, was reported for the DNR Central irrigation well (Tetra Tech,1999). The Central well was sampled in March 2001 for this report.

A total of 43 wells were sampled for the contaminants 1,2-DCP, DBCP and EDB. Figure 1 shows the location of recent EDB sampling, while Figures 2 and 3 show the recent sampling results, along with the historical sampling results. Table 2 lists the 1998-2001 results and all of the results are listed in Appendix A.

In the figures, private wells are designated by their abbreviated local ID number. All of the sampled wells are assigned a local ID number, although the public water supplies and monitoring wells were labeled by name in the following figures. The local ID number references the well's location by township, range, section, and ¼ ¼ section, and follows the pattern established by the U.S. Geological Survey (Drost and others, 1998). For example, 18N/01W-35L02 is located in Township 18 North, Range 1 West, Section 35, and ¼ ¼ Section L. The 02 means it is the second well in that "L" section to be assigned a local ID number. Some local ID numbers use a letter to differentiate between wells in the same ¼ ¼ section, such as 18N/01W-35N*A*. The two wells listed above are located just north of Pattison Lake. The local ID numbers were truncated in order to make the figures more legible. The township and range boundaries are labeled on the figures to assist in determining the complete local ID number for the private wells.

Lake Sampling - In October 1999, two water and two bottom-sediment samples were collected from both Pattison Lake and Lake St. Clair to examine whether lake water and sediments were impacted by the contaminated groundwater plume. Samples were collected from the southern basin of Pattison Lake and the southwestern basin of Lake St. Clair. The water samples were collected with a Kemmerer sampler near the lake bottom (4.5 meters [14.7 ft] depth at Pattison Lake and 29 meters [95.1 ft] at Lake St. Clair). Sediment samples were collected with a WildCo petite ponar dredge at the same locations as the water samples.

All of the lake samples were analyzed for EDB, 1,2-DCP and DBCP with method 8021B. None of the analyzed compounds were detected in either the water or sediment samples. The water samples had a reporting limit of 5 parts per billion (µg/L), while the sediment samples had a reporting limit of 250 parts per billion (µg/kg) for the three pesticides. A reporting limit is the lowest concentration of a substance that the laboratory is willing to report with confidence. Currently, there are no surface water quality standards for these chemicals.

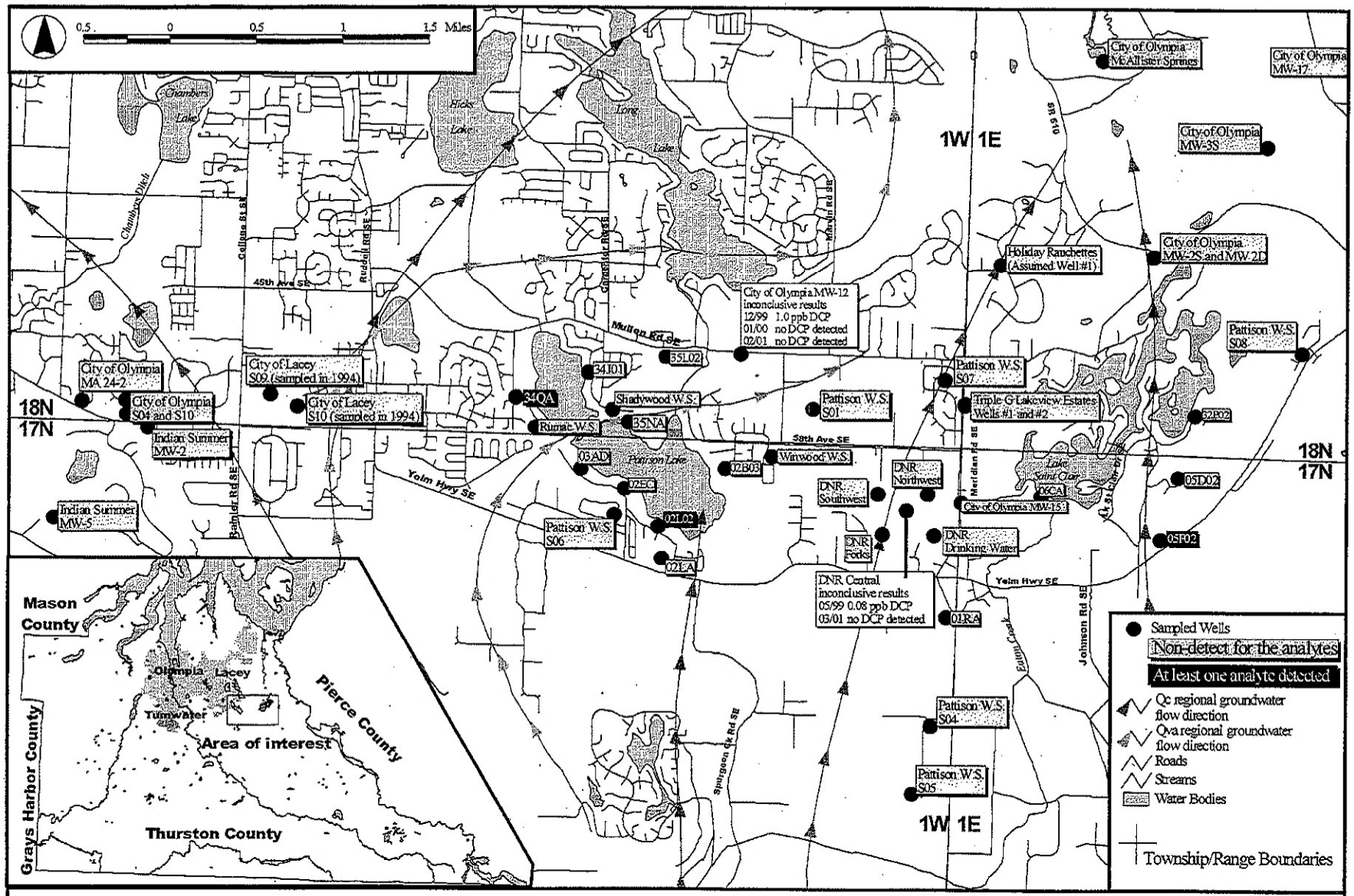
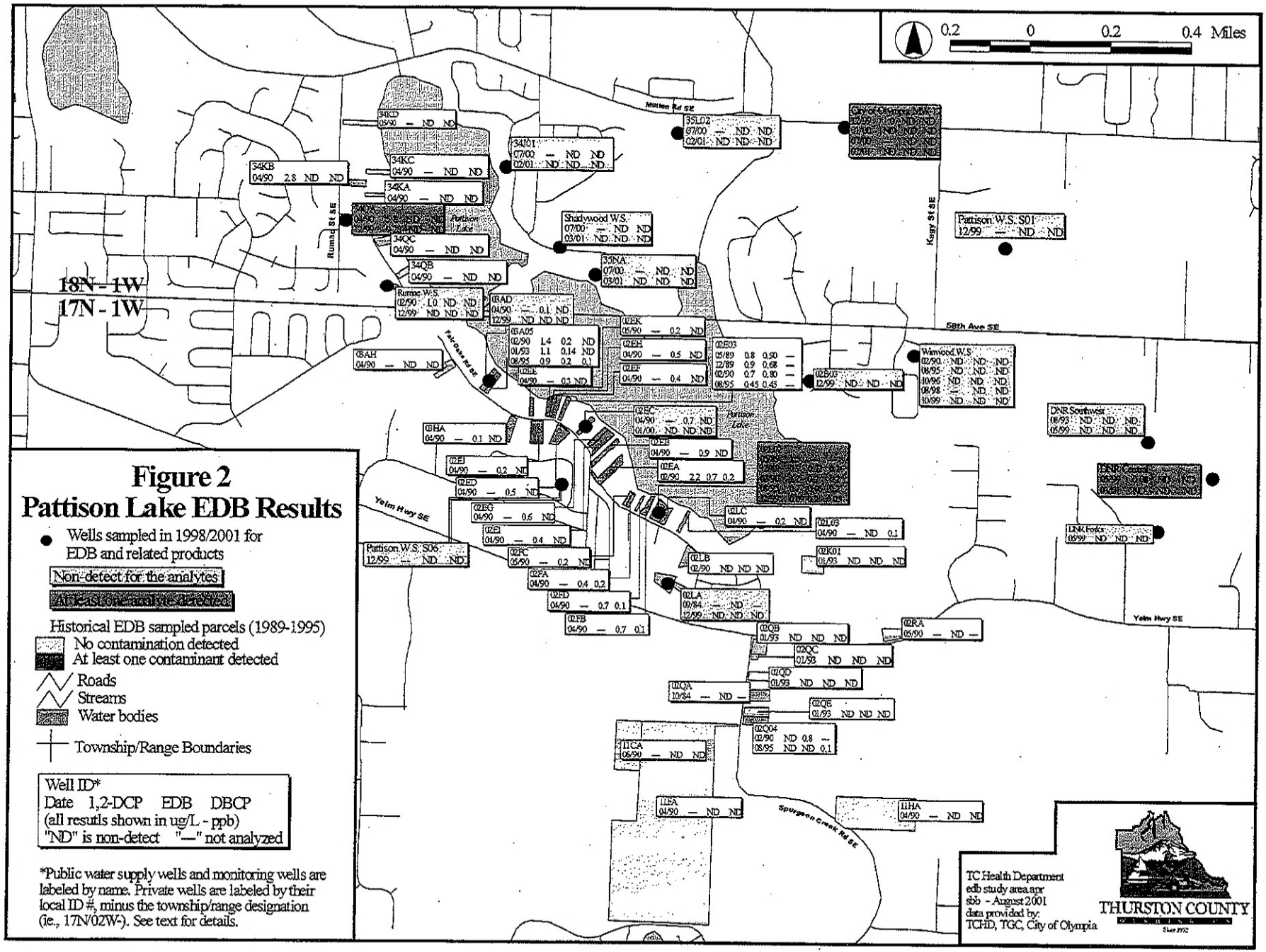


Figure 1 - Location of 1998-2001 sampling wells (sampled for 1,2-DCP, EDB, and DBCP) and regional groundwater flow patterns

Public water supply wells and monitoring wells are labeled by name. Private wells are labeled by their local ID #, minus the township/range designation (ie., 17N/02W-). See text for details.

THURSTON COUNTY

TC Health Department
edb study area.apr
sbb - August 2001
data provided by:
Thurston County Health Dept,
Thurston Geodata Center,
City of Olympia


0.2 0 0.2 0.4 Miles
18N - 1W
17N - 1W
Figure 2
Pattison Lake EDB Results
Wells sampled in 1998/2001 for EDB and related products
Non-detect for the analytes
At least one analyte detected
Historical EDB sampled parcels (1989-1995)
No contamination detected
At least one contaminant detected
Roads
Streams
Water bodies
Township/Range Boundaries
Well ID*
Date 1,2-DCP EDB DBCP
(all results shown in ug/L - ppb)
"ND" is non-detect "—" not analyzed
*Public water supply wells and monitoring wells are labeled by name. Private wells are labeled by their local ID #, minus the township/range designation (ie., 17N/02W-). See text for details.
Pattison Lake
Pattison W.S. S01 12/99 — ND ND
Pattison W.S. S06 12/99 — ND ND
Shadywood W.S. 07/00 — ND ND 03/01 ND ND ND
Runnoe W.S. 02/90 1.0 ND ND 12/99 ND ND ND
Winwood W.S. 02/90 ND ND ND 06/95 ND ND ND 10/96 ND ND ND 08/98 — ND ND 10/99 ND ND ND
DNR Southwest 08/93 ND ND ND 05/99 ND ND ND
DNR Forks 05/99 ND ND ND
Yelm Hwy SE
58th Ave SE
Mullen Rd SE
Rumac St SE
Kagy St SE
Fir Oaks Rd SE
Spurgeon Creek Rd SE
TC Health Department
edb study area.apr
sbb - August 2001
data provided by:
TCHD, TGC, City of Olympia
THURSTON COUNTY

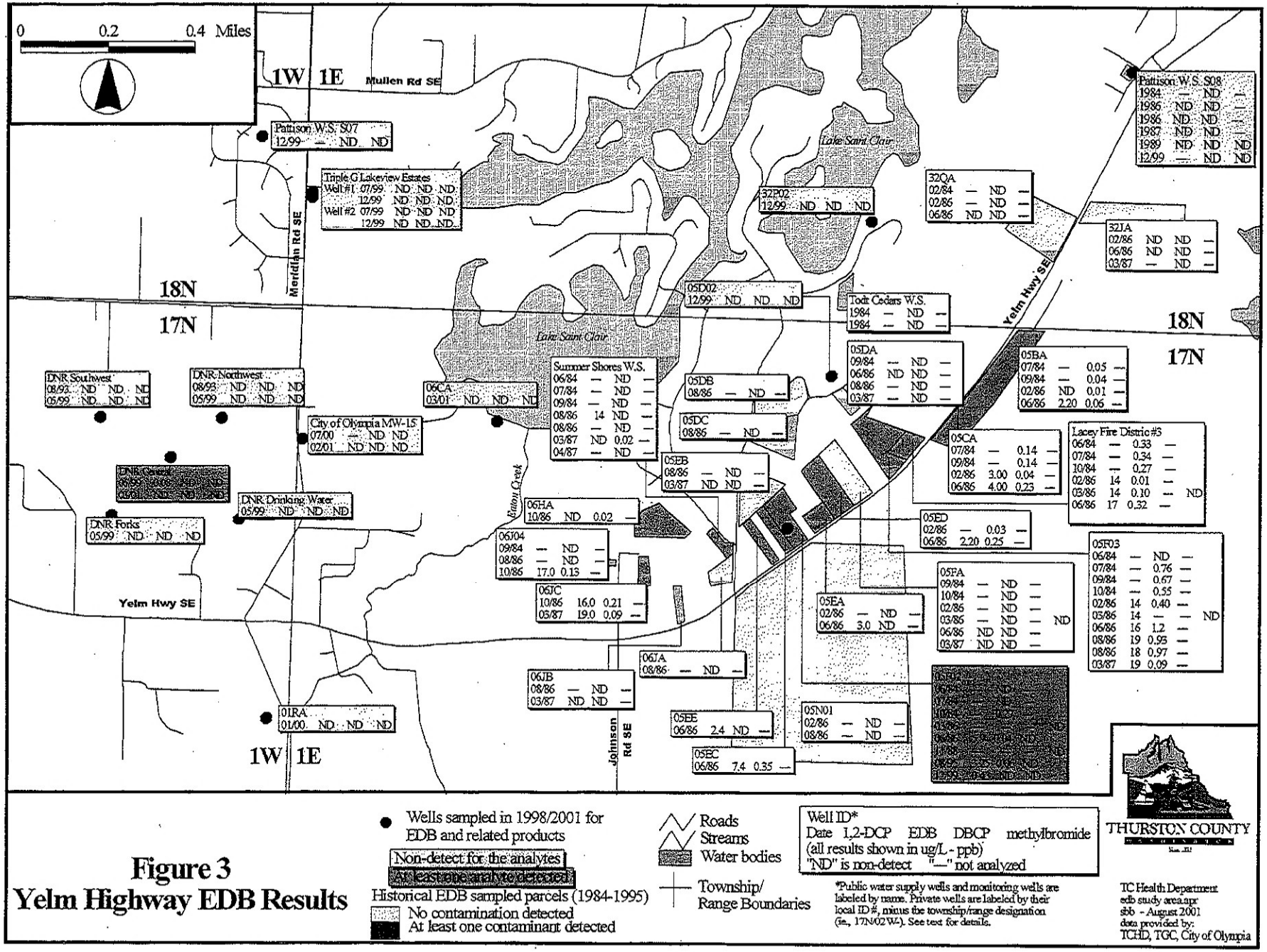


Figure 3
Yelm Highway EDB Results

Table 2 – 1998-2001 1,2-DCP, EDB and DBCP sampling results, listed by local ID#

Local ID#	Well Owner Name*	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (ug/L)	EDB (ug/L)	DBCP (ug/L)
State and Federal Drinking water standards for the three chemicals are:					5.0	0.05	0.2
17N/01E-05D02	Private*	10626 Danico Ln SE	220	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01E-05F02	Private	10640 Yelm Highway SE	144	12/21/99	**0.43**	(<0.20)	(<0.20)
17N/01E-06CA	Private	9938 62nd Ave SE	60	03/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01E-06E02	City of Olympia MW-15		151	07/18/00		(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01W-01G01	DNR Southwest Irr. Well	Meridian Seed Orchard	232	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01G02	DNR Forks Irr. Well	Meridian Seed Orchard	212	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01GA	DNR Central Irr. Well	Meridian Seed Orchard	218	05/11/99	**0.08**	(<0.17)	(<0.32)
				03/06/01	(<0.02)	(<0.02)	(<0.04)
17N/01W-01H01DUP	DNR Domestic Water	Meridian Seed Orchard	236	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01H02	DNR Northwest Irr. Well	Meridian Seed Orchard	225	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01RA	Private	7225 Meridian Rd SE	?	01/07/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02A03	Washington Water Service	Winwood	231	10/27/99	(<0.50)	(<0.50)	(<0.50)
17N/01W-02B03	Private	6015 Hansen St SE	106	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-02E04	Pattison W.S. S06	Fair Oaks Lp	542	12/22/99		(<0.02)	(<0.04)
17N/01W-02EC	Private	7628 Fair Oaks Rd SE	?	01/07/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02L02	Private	7844 Kelly Beach Rd SE	78	12/14/99	**0.09**	**0.20**	**0.05**
17N/01W-02LA	Private	7934 Kelly Beach Rd SE	?	12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-03AD	Private	7406 Fair Oaks Rd SE	?	12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-05BA	Indian Summer MW-2		23	02/01/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-06JA	Indian Summer MW-5		20	02/01/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-12J02	Pattison W.S. S04		186	12/22/99		(<0.02)	(<0.04)
17N/01W-12RA	Pattison W.S. S05	Reservoir Well	224	12/22/99		(<0.02)	(<0.04)
18N/01E-19J01S	City of Olympia	McAllister Springs	0	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01E-21NA	City of Olympia MW-17		300	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29B02S	City of Olympia MW-3 Sh		101	12/27/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29N02S	City of Olympia MW-2 Sh		122	12/20/99	(<0.11)	(<0.20)	(<0.20)
18N/01E-29N02DUP	City of Olympia MW 2-D		204	12/20/99	(<0.11)	(<0.20)	(<0.20)
18N/01E-30N02	Washington Water Service	Holiday Ranchettes #2	190	04/14/99	(<0.50)	(<0.50)	(<0.50)
18N/01E-31MA	WA Water Service Triple G Well#1	9509 Glory Dr SE	191	07/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-31MB	WA Water Service Triple G Well#2	9509 Glory Dr SE	192	07/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-32H02	Pattison W.S. S08	Gallup Drive	216	12/22/99		(<0.02)	(<0.04)
18N/01E-32P02	Private		81	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01W-32NA	City of Olympia MA 24-2		35	01/31/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-32P01	City of Olympia S04	Shana Park #4	56	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01W-32P03	City of Olympia S10	Shana Park #11	88	10/27/98	(<0.40)	(<0.01)	(<0.02)
				01/31/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-34J01	Private	5121 Atchinson Dr SE	55	07/17/00		(<0.02)	(<0.02)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-34Q01	Rumac W.S.	5645 Rumac Dr SE	109	01/07/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-34QA	Private	6815 54th Ave SE	?	01/31/00	**0.28**	(<0.02)	(<0.02)
18N/01W-35H02	City of Olympia MW-12	Near 8231 Mullen Rd SE	67	12/21/99	**1.00**	(<0.02)	(<0.02)
				01/31/00	(<0.11)	(<0.02)	(<0.02)
				07/17/00		(<0.02)	(<0.02)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35L02	Private	7825 Mullen Rd SE	56	07/17/00		(<0.02)	(<0.02)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35NA	Private	7639 Atchinson Ln SE	60	07/17/00		(<0.02)	(<0.02)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35NB	Shadywood W.S.		?	07/17/00		(<0.02)	(<0.04)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-36JA	Pattison W.S. S07	Tri-Lakes	185	12/22/99		(<0.02)	(<0.04)
18N/01W-36N01	Pattison W.S. S01	Well #1	217	12/22/99		(<0.02)	(<0.04)

*Private well owner names were withheld to avoid confusion between who owned the property at the time the sample was taken and who owns the property now.

[1]1,2-DCP – 1,2-dichloropropane / EDB – 1,2-dibromoethane or ethylene dibromide / DBCP – 1,2-dibromo-3-chloropropane

[t] reporting limits varied between laboratories and sampling rounds

Bold values are positive results and values listed as " <" indicate that the chemical was not detected at that concentration ("non-detect")

Shaded values exceed the MCL

Results

- None of the three contaminants tested for (1,2-DCP, EDB and DBCP) were detected in either the lake water or lake-bottom sediments [*laboratory reporting limits were much higher for lake-water and lake-sediment samples than for drinking water samples due to analytical method differences*];
- Of the wells sampled to determine if groundwater contamination had spread northward, only two had contaminants present; City of Olympia monitoring well MW-12 and the DNR Central irrigation well, both discussed below in more detail;
- Six historically contaminated wells were resampled; three still had contaminants present;
- One well had contaminant levels that exceeded drinking water standards; a domestic well (17N/01W-02L02), not currently being used for drinking water, exceeded the standard for EDB.

Thirty-eight of the 43 wells sampled between 1998 and 2001 had no reportable concentrations of the three pesticides. Three samples with pesticides present were taken from private wells where contamination was historically present. The two other wells where pesticides were detected are the City of Olympia monitoring well MW-12, and an irrigation well at the Washington Department of Natural Resources Meridian Seed Orchard. These wells are discussed in more detail on the following page.

Appendix A lists all of the recent EDB related sampling results as well as the historical sampling results. The combined results are also shown on Figures 2 and 3.

It is important to note that none of the three contaminants were detected in any public drinking water sources.

For the samples with pesticides detected, 1,2-DCP was present in five samples, while EDB and DBCP were detected in only one sample (well 17N/01W-02L02). Of the three positive samples taken from historically contaminated wells, the pesticide concentrations were generally lower by almost an order of magnitude than last round of samples taken in 1990 and 1995 (Table 3).

Table 3 – Results from presently contaminated wells with historical data showing general decrease in contaminant levels

Local ID#	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP†‡ (µg/L)	EDB (µg/L)	DBCP (µg/L)
Drinking water standards for the three chemicals are:					**5.0**	**0.05**	**0.2**
17N/01E-05F02	Private	10640 Yelm Highway SE	144	6/25/84		(<0.01)*	
				7/23/84		(<0.01)	
				10/26/84		**0.27**	
				6/18/86	**5.9**	**0.04**	(<0.20)
				8/2/95	**3.25**	**0.06**	(<0.20)
				12/21/99	**0.43**	(<0.20)	(<0.20)
17N/01W-02L02	Private	7844 Kelly Beach Rd SE	78	5/16/89	**1.50**	(<0.20)	(<0.20)
				12/13/89	**0.90**	**0.12**	**0.16**
				2/13/90	**1.20**	**0.20**	**0.20**
				8/2/95	**0.70**	**0.06**	**0.20**
				12/14/99	**0.09**	**0.20**	**0.05**
18N/01W-34QA	Private	6815 54th Ave SE	?	4/23/90	**5.8**	(<0.01)	(<0.10)
				1/31/00	**0.28**	(<0.02)	(<0.02)

*values listed as " <" indicate that the chemical was not detected at that concentration ("non-detect")
Shaded values exceed the MCL

Based on the data from the three wells with historical contamination, rough half-life calculations were estimated for EDB and 1,2-DCP (a half-life is an estimate of the time it takes for half of the quantity of a chemical to break-down). Table 2 lists the chemical concentrations for the three wells. For EDB, the estimated half-life is 8.2 years. Published half-life calculations for EDB range from 6 to 13.2 years (EPA, 2001). Assuming a half-life rate of 8.2 years, EDB concentrations would be below detection limits in 11 years. The estimated half-life (based on data from Table 2) for 1,2-DCP is 7.3 years and it is assumed to be in concentrations below detection limits in under four years. The half-life for DBCP in groundwater is 141 years (EPA, 2001).

1,2-DCP was detected at 1.0 µg/L at the City of Olympia monitoring well 12 (MW-12) in December 1999. An additional sample was taken in January and 1,2-DCP was not detected (detection limit was 0.11 µg/L). A third round was taken in July; however, as a result of a laboratory error, the samples were not analyzed for 1,2-DCP. As 1,2-DCP was the most prevalent contaminant detected in this sampling effort, another round of samples was taken in February 2001. 1,2-DCP was not detected (detection limit was 0.023 µg/L).

The DNR Meridian Seed Orchard has been in operation for over 20 years. Before that, the fields were used to grow strawberries. In August 1993, the Southwest and Northwest wells were sampled for a variety of contaminants, including the three pesticides and none were detected. All five wells at the Orchard were sampled on May 11, 1999. The Central well was the only one with a contaminant detected, 1,2-DCP, at a concentration of 0.077 µg/L; this was below the laboratory's normal reporting limit of 0.09 µg/L but was confirmed with a gas-chromatograph/mass spectrometer. [Tetra Tech, 1999]. The Central well was sampled again in March 2001; 1,2-DCP was not detected (detection limit was 0.023 µg/L).

Conclusions

As presented in Figure 1, the regional groundwater flow patterns for the Vashon advance (Qva) and the penultimate deposits (Qc) aquifers are northward around Lake St. Clair and north to northeast around Pattison Lake (Drost, *et al*, 1998). Samples on the north side of Pattison Lake and samples between the contaminant plume and Lake St. Clair had no pesticide detections. **Therefore, the area of pesticide-contamination does not appear to have increased or migrated northward.**

EDB, 1,2-DCP and DBCP concentrations, in three wells with historical contamination, are decreasing. Similar decreases of EDB and related contaminants were reported in Whatcom County, Washington (O'Herron, 1999)[1]. Based on limited information, rough half life calculations indicate that the concentrations of EDB and 1,2-DCP could be below current laboratory reporting limits by 2011. That is, the pesticide concentrations may be below current detection limits, and well below drinking water standards, by 2011.

By 2011, 1,2-DCP, EDB and DBCP will have been known contaminants of local drinking water aquifers for nearly a quarter-century. Their presence resulted in the abandonment of hundreds of individual wells and required the extension of public water supplies at significant public and private expense.

[1] Washington State Department of Ecology is currently drafting two additional reports on EDB in Whatcom County, Washington. "(draft)2000 Site Investigation, Northern Whatcom County, Washington" and "(draft)Developing a Long-Term Solution, EDB- and 1,2-DCP-Contaminated Drinking Water, Whatcom County, Washington."

The City of Olympia monitoring well MW-12 is currently one of their wellhead protection monitoring plan wells and will be sampled yearly for pesticides, including 1,2-DCP.

The 0.08 µg/L of 1,2-DCP found at the DNR Central irrigation well was not found at the four surrounding DNR wells. There are no previous samples from the DNR Central well; however, the Southwest and the Northwest wells were sampled in August 1993, with no detection of the contaminants. It is unknown if the 1,2-DCP detection was part of the regional contaminant plume or a result of historical activities on the property. The Washington Department of Natural Resources will consult with Thurston County about appropriate monitoring frequencies for 1,2-DCP.

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Appendix A – All EDB related monitoring data, listed by local ID# and sample date.							
Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (ug/L)	EDB (ug/L)	DBCP (ug/L)
Drinking water standards for the three chemicals are:					**5.0**	**0.05**	**0.2**
17N/01E-05BA	Private*	11021 Yelm Highway SE	203	7/23/84		**0.05**	
				9/11/84		**0.04**	
				2/ 4/86	(<1.00)	**0.01**	
				6/18/86	**2.20**	**0.06**	
17N/01E-05CA	Private	10925 Yelm Highway SE	190	7/23/84		**0.14**	
				9/10/84		**0.14**	
				2/ 4/86	**3.00**	**0.04**	
				6/18/86	**4.00**	**0.23**	
17N/01E-05D02	Private	10626 Danico Ln SE	220	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01E-05DA	Private	10625 Danico Ln SE	219	9/10/84		(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
				8/15/86		(<0.01)	
				3/26/87		(<0.01)	
17N/01E-05DB	Private	10537 Danico Ln SE	215	8/15/86		(<0.01)	
17N/01E-05DC	Private	10623 Danico Ln SE	204	8/15/86		(<0.01)	
17N/01E-05EA	Private	10706 Yelm Highway SE	160	2/ 4/86		(<0.01)	
				6/18/86	**3.00**	(<0.01)	
17N/01E-05EB	Private	6402 Rehklau Rd SE		8/15/86		(<0.01)	
				3/24/87	(<1.00)	(<0.01)	
17N/01E-05EC	Private	10612 Yelm Highway SE	153	6/18/86	**7.40**	**0.35**	
17N/01E-05ED	Private	10736 Yelm Highway SE	192	2/ 4/86		**0.03**	
				6/18/86	**2.20**	**0.25**	
17N/01E-05EE	Private	10544 Yelm Highway SE		6/18/86	**2.40**	(<0.01)	
17N/01E-05F01	Lacey Fire Department	10910 Yelm Highway SE	180	6/25/84		**0.33**	
				7/23/84		**0.34**	
				10/26/84		**0.27**	
				2/ 4/86	**14.00**	**0.01**	
				3/14/86	**14.00**	**0.10**	
				6/18/86	**17.00**	**0.32**	
17N/01E-05F02	Private	10640 Yelm Highway SE	144	6/25/84		(<0.01)	
				7/23/84		(<0.01)	
				10/26/84		**0.27**	
				6/18/86	**5.90**	**0.04**	(<0.20)
				8/ 2/95	**3.25**	**0.06**	(<0.20)
				12/21/99	**0.43**	(<0.20)	(<0.20)

Appendix A – All EDB related monitoring data, listed by local ID# and sample date.							
Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (ug/L)	EDB (ug/L)	DBCP (ug/L)
17N/01E-05F03	Private	10820 Yelm Highway SE	174	6/25/84		(<0.01)	
				7/23/84		**0.76**	
				9/11/84		**0.67**	
				10/26/84		**0.55**	
				2/ 4/86	**14.00**	**0.40**	
				3/14/86	**14.00**		
				6/18/86	**16.00**	**1.20**	
				8/ 6/86	**19.00**	**0.93**	
				8/16/86	**18.00**	**0.97**	
				3/25/87	**19.00**	**0.09**	
17N/01E-05FA	Private	10740 Yelm Highway SE	210	9/10/84		(<0.01)	
				10/29/84		(<0.01)	
				2/ 4/86		(<0.01)	
				3/14/86		(<0.01)	
				6/18/86	(<1.00)	(<0.10)	
				3/25/87	(<1.00)	(<0.10)	
17N/01E-05N01	Private	10447 Yelm Highway SE	305	2/ 4/86		(<0.01)	
				8/15/86		(<0.01)	
17N/01E-06CA	Private	9938 62nd Ave SE	60	03/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01E-06E02	City of Olympia MW-15		151	7/15/00	(<0.02)	(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01E-06HA	Private	10220 66th Ave SE	249	10/16/86	(<1.00)	**0.02**	
17N/01E-06J03D1	Summer Shores W.S.	6103 St. Clair Dr. SE	425	6/25/84		(<0.01)	
				7/23/84		(<0.01)	
				9/10/84		(<0.01)	
				8/ 6/86	**14.00**	(<0.01)	
				8/15/86		(<0.01)	
				3/24/87	(<1.00)	**0.02**	
				4/ 8/87		(<0.01)	
17N/01E-06J04	Private	6611 St. Clair Dr.	75	9/11/84		(<0.01)	
				8/15/86		(<0.01)	
				10/16/86	**17.00**	**0.13**	
17N/01E-06JA	Private	6645 Rehklau Rd SE	98	8/15/86		(<0.01)	
17N/01E-06JB	Private	10346 Yelm Highway SE	248	8/15/86		(<0.01)	
				3/24/87	(<1.00)	(<0.01)	
17N/01E-06JC	Private	10221 66th Ave SE		10/16/86	**16.00**	**0.21**	
				3/24/87	**19.00**	**0.09**	
17N/01E-07HA	Private	7648 Johnson Rd. SE	60	7/23/84		(<0.01)	
				2/ 4/86		(<0.01)	
17N/01W-01G01	DNR Southwest Irr.	Meridian Seed Orchard	232	08/?/93	(<0.5)	(<0.02)	(<0.02)
				5/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01G02	DNR Forks Irr. Well	Meridian Seed Orchard	212	5/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01GA	DNR Central Irr. Well	Meridian Seed Orchard	218	5/11/99	**0.08**	(<0.17)	(<0.32)
				03/06/01	(<0.02)	(<0.02)	(<0.04)
17N/01W-01H01DUP	DNR Domestic Water	Meridian Seed Orchard	236	5/11/99	(<0.09)	(<0.17)	(<0.32)

Appendix A – All EDB related monitoring data, listed by local ID# and sample date.

Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (ug/L)	EDB (ug/L)	DBCP (ug/L)
17N/01W-01H02	DNR Northwest Irr.	Meridian Seed Orchard	225	08/7/93	(<0.5)	(<0.02)	(<0.02)
				5/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01RA	Private	7225 Meridian Rd SE		1/ 7/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02A03	WA Water Service	Winwood	231	2/13/90	(<0.20)	(<0.02)	(<0.20)
				8/ 2/95	(<0.50)		
				8/ 2/95	(<0.20)	(<0.02)	(<0.20)
				10/ 9/96		(<0.05)	(<0.05)
				8/13/98		(<0.02)	(<0.04)
				10/27/99	(<0.50)	(<0.50)	(<0.50)
17N/01W-02B03	Private	6015 Hansen St SE	106	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-02CA	Private	7305 Spurgeon Creek Rd		6/ 5/90		(<0.10)	(<0.10)
17N/01W-02E03	Private	7602 Fair Oaks Rd SE	49	5/16/89	**0.80**	**0.90**	(<0.20)
				12/13/89	**0.90**	**0.68**	(<0.03)
				2/12/90	**0.70**	**0.80**	(<0.20)
				8/ 2/95	**0.45**	**0.45**	
17N/01W-02E04	Pattison W.S. S06	off Meridian Rd SE	542	12/22/99		(<0.02)	(<0.04)
17N/01W-02EA	Private	7704 Fair Oaks Rd SE		2/13/90	**2.20**	**0.70**	**0.20**
17N/01W-02EB	Private	7648 Fair Oaks Rd SE	240	4/ 9/90		**0.90**	(<0.10)
17N/01W-02EC	Private	7628 Fair Oaks Rd SE		4/24/90		**0.70**	(<0.10)
				1/ 7/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02ED	Private	7627 Fair Oaks Rd SE		4/10/90		**0.50**	(<0.05)
17N/01W-02EE	Private	7522 Fair Oaks Rd SE		4/16/90		**0.30**	(<0.10)
17N/01W-02EF	Private	7548 Fair Oaks Rd SE		4/ 9/90		**0.40**	(<0.10)
17N/01W-02EG	Private	7640 Fair Oaks Rd SE		4/16/90		**0.60**	(<0.10)
17N/01W-02EH	Private	7546 Fair Oaks Rd SE		4/ 9/90		**0.50**	(<0.10)
17N/01W-02EI	Private	7642 Fair Oaks Rd SE		4/16/90		**0.40**	(<0.10)
17N/01W-02EJ	Private	7525 Fair Oaks Rd SE		4/17/90		**0.20**	(<0.10)
17N/01W-02EK	Private	7540 Fair Oaks Rd SE		5/ 8/90		**0.20**	(<0.10)
17N/01W-02FA	Private	7738 Kelly Beach Rd SE	57	4/17/90		**0.40**	**0.20**
17N/01W-02FB	Private	7826 Kelly Beach Rd SE		4/17/90		**0.70**	**0.10**
17N/01W-02FC	Private	7734 Kelly Beach Rd SE		5/ 8/90		**0.20**	(<0.10)
17N/01W-02FD	Private	7802 Kelly Beach Rd SE		4/17/90		**0.70**	**0.10**
17N/01W-02K01	Private	8138 Yelm Highway SE	146	1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02L02	Private	7844 Kelly Beach Rd SE	78	5/16/89	**1.50**	(<0.20)	(<0.20)
				12/13/89	**0.90**	**0.12**	**0.16**
				2/13/90	**1.20**	**0.20**	**0.20**
				8/ 2/95	**0.70**	**0.06**	**0.20**
				12/14/99	**0.09**	**0.20**	**0.05**
17N/01W-02L03	Private	7916 Kelly Beach Rd SE	67	04/17/90		(<0.01)	**0.10**
17N/01W-02LA	Private	7934 Kelly Beach Rd SE		9/10/84		(<0.01)	
				12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-02LB	Private	7933 Kelly Beach Rd SE		2/13/90	(<0.10)	(<0.01)	(<0.10)
17N/01W-02LC	Private	7846 Kelly Beach Rd SE		4/16/90		**0.20**	(<0.10)
17N/01W-02Q04	Private	7226 Spurgeon Ck Rd SE	79	2/12/90	(<0.20)	**0.80**	(<0.20)
				8/ 2/95	(<0.20)	(<0.20)	**0.10**
17N/01W-02QA	Private	7134 Spurgeon Creek Rd		10/29/84		(<0.01)	
17N/01W-02QB	Private	8031 Yelm Highway SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)

Appendix A – All EDB related monitoring data, listed by local ID# and sample date.							
Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (ug/L)	EDB (ug/L)	DBCP (ug/L)
17N/01W-02QC	Private	7032 Spurgeon Ck Rd SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02QD	Private	7126 Spurgeon Ck RD SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02QE	Private	7222 Spurgeon Ck Rd SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02RA	Private	8406 Yelm Hwy SE		5/ 2/90		(<0.10)	
17N/01W-03A05	Private	7412 Fair Oaks Rd SE	80	2/13/90	**1.40**	**0.20**	(<0.10)
				1/ 7/93	**1.10**	**0.14**	(<0.05)
				8/ 2/95	**0.90**	**0.20**	**0.10**
17N/01W-03AD	Private	7406 Fair Oaks Rd SE		4/ 9/90		**0.10**	(<0.10)
				12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-03AH	Private	7335 Fair Oaks Rd SE		4/24/90		(<0.05)	(<0.05)
17N/01W-03HA	Private	7449 Fair Oaks Rd SE		4/ 9/90		**0.10**	(<0.10)
17N/01W-05BA	Indian Summer MW-2		23	2/ 1/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-06JA	Indian Summer MW-5		20	2/ 1/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-11CA	Private	7305 Spurgeon Ck Rd SE		06/05/90		(<0.01)	(<0.10)
17N/01W-11FA	Private	7307 Spurgeon Ck Rd SE		4/10/90		(<0.01)	(<0.10)
17N/01W-11HA	Private	7446 Spurgeon Ck Rd SE				(<0.01)	(<0.10)
17N/01W-12J02	Pattison W.S. S04		186	12/22/99		(<0.02)	(<0.04)
17N/01W-12RA	Pattison W.S. S05	Reservoir Well	224	12/22/99		(<0.02)	(<0.04)
18N/01E-19J01S	City of Olympia	McAllister Springs	0	6/19/89	(<0.20)	(<0.20)	(<0.20)
				10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01E-21NA	City of Olympia MW-17		300	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29B02S	City of Olympia MW-3 Sh		101	12/27/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29N02S	City of Olympia MW-2 Sh		122	12/20/99	(<0.11)	(<0.20)	(<0.20)
18N/01E-30N02	Washington Water Service	Holiday Ranchettes #2	190	4/14/99	(<0.50)	(<0.50)	(<0.50)
18N/01E-31MA	WA Water Triple G Well#1	9509 Glory Dr SE	191	7/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-31MB	WA Water Triple G Well#2	9509 Glory Dr SE	192	7/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-32H02	Pattison W.S. S08	Gallup Drive	216	10/29/84		(<0.01)	
				2/ 4/86	(<0.20)	(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
				3/26/87	(<1.00)	(<0.01)	
				6/21/89	(<0.20)	(<0.20)	(<0.20)
				12/22/99		(<0.02)	(<0.04)
18N/01E-32JA	Private	11310 Yelm Highway SE		2/ 4/86	(<0.20)	(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
				3/24/87		(<0.01)	
18N/01E-32N03	Todt-Cedars W.S.	10650 Todtkarle Rd SE	158	7/23/84		(<0.01)	
				9/10/84		(<0.01)	
18N/01E-32P02	Private		81	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-32QA	Private	11211 Yelm Highway SE	201	10/29/84		(<0.01)	
				2/ 4/86		(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
18N/01W-32NA	City of Olympia MA 24-2	unknown		1/31/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-32P01	City of Olympia S04	Shana Park #4	56	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01W-32P03	City of Olympia S10	Shana Park #11	88	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01W-32P03	City of Olympia S10	Shana Park #11	88	1/31/00	(<0.11)	(<0.02)	(<0.02)

Appendix A – All EDB related monitoring data, listed by local ID# and sample date.							
Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[†‡] (ug/L)	EDB (ug/L)	DBCP (ug/L)
18N/01W-33N01	City of Lacey S09	Well #9	283	6/ 8/94		(<0.05)	(<0.20)
18N/01W-33N02	City of Lacey S10	Well #10	208	6/ 8/94		(<0.05)	(<0.20)
18N/01W-34J01	Private	5121 Atchinson Dr SE	55	7/17/00		(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-34KA	Private	5302 Rumac Dr SE		4/23/90		(<0.01)	(<0.10)
18N/01W-34KB	Private	3035 College St SE		4/24/90	**2.80**	(<0.01)	(<0.10)
18N/01W-34KC	Private	5205 Rumac Dr SE		4/23/90		(<0.01)	(<0.10)
18N/01W-34KD	Private	4940 Rumac Dr SE		5/ 8/90		(<0.01)	(<0.10)
18N/01W-34Q01	Rumac W.S.	5645 Rumac Dr SE	109	02/14/90	**1.0**	(<0.01)	(<0.10)
				01/07/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-34QA	Private	6815 54th Ave SE		4/23/90	**5.8**	(<0.01)	(<0.10)
				1/31/00	**0.28**	(<0.02)	(<0.02)
18N/01W-34QB	Private	5634 Rumac Dr SE		4/23/90		(<0.10)	(<0.10)
18N/01W-34QC	Private	5508 Rumac Dr SE		4/23/90		(<0.10)	(<0.10)
18N/01W-35H02	City of Olympia MW-12	near 8231 Mullen Rd SE	67	12/21/99	**1.00**	(<0.02)	(<0.02)
				1/31/00	(<0.11)	(<0.02)	(<0.02)
				07/17/00		(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35L02	Private	7825 Mullen Rd SE	56	7/17/00		(<0.02)	(<0.02)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
8N/01W-35NA	Private	7639 Atchinson Ln SE	60	7/17/00		(<0.02)	(<0.02)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-36JA	Pattison W.S. S07	Tri-Lakes	185	12/22/99		(<0.02)	(<0.04)
18N/01W-36N01	Pattison W.S. S01	Well #1	217	12/22/99		(<0.02)	(<0.04)

*Private well owner names were withheld to avoid confusion between who owned the property at the time the sample was taken and who owns the property now.

[†]1,2-DCP – 1,2-dichloropropane

EDB – 1,2-dibromoehtane

DBCP – 1,2-dibromo-3-chloropropane

[‡]detection limits varied between laboratories and sampling rounds; in some cases they were assumed based upon available information.

Bold values are positive results and values listed as " <" indicate that the chemical was not detected at that concentration

Shaded values exceed the MCL

Results of 1998-2001 Sampling for EDB, 1,2-DCP and DBCP Pesticide Contamination Near Pattison Lake and Lake St. Clair, Thurston County, Washington

Including a summary of historical sampling data

A joint study by the Thurston County Health Department and the City of Olympia, funded by the Local Toxic Control Account through the Washington State Department of Ecology

August 2001

THURSTON COUNTY
WASHINGTON
Since 1852

City of OLYMPIA

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Summary

The purpose of this study was to obtain current environmental data on groundwater conditions with respect to the existing pesticide contamination of ground water in north-eastern Thurston County, Washington. The pesticides were initially detected in drinking water wells in 1984. Sampling was conducted around Pattison Lake and Lake St. Clair in late 1998, through 2001, to determine if existing pesticide-contaminated ground water plumes around the lakes had spread, moved, or changed in concentration. The contaminants previously identified included EDB, 1,2-DCP and DBCP. Lake and well sample results suggest that the contaminant plumes have not moved or spread northward (in the direction of groundwater flow) and that contaminant concentrations have decreased.

History

EDB (ethylene dibromide or 1,2-dibromoethane) was used as a soil fumigant and pesticide in the United States between the late 1940's and the banning of its use on crops in 1984 by the U.S. Environmental Protection Agency (EPA). Its main use was as a soil fumigant to control nematodes (root worms) on strawberries, raspberries, seed potatoes and other row crops. It was commonly accompanied by the similar compounds 1,2-DCP (1,2-dichloropropane) and DBCP (1,2-dibromo-3-chloropropane). The sole manufacturer of 1,2-DCP stopped production of the chemical in 1991. In 1979 the EPA stopped the use of DBCP as a soil fumigant in the continental US. All three chemicals are known or suspected carcinogens. The EPA has required Group A public water suppliers (those serving more than 14 connections) to sample for these and other chemicals, at least once every three years since 1995 (EPA, 2001).

These chemicals were used at a number of sites in Thurston County, particularly along the Yelm Highway. Available records are generally not adequate to determine exactly where they were used, in what quantities, or for what time period.

The first EDB-related groundwater contamination in Thurston County was found southeast of Lake St. Clair near the Yelm Highway in 1984 in a study by the Washington Department of Health (DOH) and the Thurston County Health Department. This contamination was detected as part of a follow-up study to contamination discovered around strawberry fields in Whatcom and Skagit Counties. Extensive groundwater monitoring identified 14 contaminated wells in an area of several square miles in Thurston County; ten wells exceeded drinking water standards for either 1,2-DCP or EDB. Immediately after the contamination was confirmed, affected residents were offered bottled water by the Washington Department of Ecology until a water line from a public water supply outside the contaminated area was brought in to supply affected homes.

The second EDB-related groundwater contamination in Thurston County was found southwest of Pattison Lake along the Yelm Highway in 1989. This contamination was detected as part of the sampling for a U.S. Geological Survey cooperative study with the Thurston County Health Department (Health) of northern Thurston County (Drost and others, 1998). Extensive groundwater monitoring identified 24 contaminated wells in an

area of several square miles; 17 wells exceeded drinking water standards, primarily for EDB. After the contamination was confirmed, residents were informed and water lines from the City of Lacey and the Pattison Water Company were brought in to supply affected homes in 1991.

Hydrogeology

Northern Thurston County has been affected by several glaciations. The most recent one, termed the Vashon glacier, advanced into Thurston County approximately 15,000 years ago and retreated around 13,500 years ago (Drost and others, 1998). The results of the glaciation included the deposit of several hundred feet of sediments in distinct layers. Depending upon the materials (*i.e.*, clays, sands or gravels), these layers can be productive gravelly aquifers, or confining layers of clay or cemented sands and gravels ("till").

The area around Pattison Lake and Lake St. Clair has several layers of alternating aquifers (the Qva and the deeper Qc) and confining layers. Most of the wells in the area are in either the Qva or Qc aquifers. Both of these aquifers flow northward (Figure 1). Most individual wells are around 100 feet deep, while public supply wells are generally deeper in this area (between 200 and 300 feet deep).

The groundwater in this vicinity of Thurston County is an important regional resource as it supplies water to the McAllister Springs. The springs are the major source of high-quality drinking water for the City of Olympia; serving approximately 30,000 people.

Sampling Design

This sampling effort had two main goals: to determine if the groundwater contamination had spread, and to determine the current contaminant concentration in wells. To answer the question of spread, lake water and sediment samples were taken from Pattison Lake and Lake St. Clair, as the aquifers feed both lakes. In addition, wells north (downgradient) of historically contaminated wells, and wells between Pattison Lake and Lake St. Clair were sampled. Historically contaminated wells were also sampled to determine if concentrations had changed.

Health Effects

The following is an excerpt from the summary of the Public Health Assessment of pesticide contaminated groundwater in Whatcom County (Duff, 2000). 1,2-DCP, DBCP and EDB were detected in the groundwater there in similar concentrations as those found in Thurston County.

Exposure to the pesticides found...can occur though ingestion, inhalation and dermal absorption. Non-cancer adverse health effects are not anticipated to result from exposure to the maximum levels of pesticides detected in...groundwater. However, a moderate to low cancer risk was estimated for long-term exposure to the maximum level of EDB detected in area drinking water. Maximum levels of the other pesticides found in area drinking water represent a lower cancer risk. While the MCLs [maximum

contaminant levels – drinking water standards]for these pesticides are protective against non-cancer adverse health effects, some cancer risk does exist for residents using wells with EDB and/or multiple pesticides below their respective MCLs. It is important to note that cancer risk estimates made here are based on a worst-case scenario. More realistic exposure assumptions result in considerably lower cancer risk estimates. In addition, pesticide levels are declining in area groundwater indicating that future cancer risk is declining as well.

Whatcom County Health and Human Services found 1,2-DCP, DBCP and EDB contaminated groundwater in 1983. Their response followed the same pattern as Thurston County's; public notification, delivery of bottled water and connection to non-contaminated water sources. Those wishing more information regarding the potential health effects of exposure to the pesticide contaminated groundwater should read the Whatcom County Public Health Assessment Report. The report describes in detail the potential cancer risk calculations and exposure routes (see also Allred, Mike, 1998). Technical factsheets about the pesticides are also available on-line (references EPA, 2001, A, B and C).

The respective MCLs for the pesticides are listed below in Table 1. The contaminant concentrations were similar to those seen in northern Whatcom County (table structure and reference from Duff, 2000).

Table 1 – Contaminants Detected in Drinking Water Wells Around Pattison Lake and Lake St. Clair between 1984 and 2001

Contaminant	Maximum Contaminant Level (MCL) (parts per billion-µg/L)	Number of Samples	Number of Detections	Number of Detections Above MCL	Maximum Concentration (µg/L)	Average Concentrations[a] (µg/L)
All Samples (1984-2001)						
1,2-Dichloropropane (1,2-DCP)	5.0	108	42	16	19	6.39
1,2-dibromo,3-chloropropane (DBCP)	0.2	113	11	0	0.2	0.14
Ethylene dibromide (EDB)	0.05	195	63	52	1.20	0.34
1984-1995 Contaminants Detected						
1,2-Dichloropropane (1,2-DCP)	5.0	67	37	16	19.0	7.21
1,2-dibromo,3-chloropropane (DBCP)	0.2	62	10	0	0.2	0.15
Ethylene dibromide (EDB)	0.05	144	62	51	1.2	0.35
1998-2001 Contaminants Detected						
1,2-Dichloropropane (1,2-DCP)	5.0	41	5	0	1.0	0.38
1,2-dibromo,3-chloropropane (DBCP)	0.2	51	1	0	0.05	0.05
Ethylene dibromide (EDB)	0.05	51	1	1	0.2	0.2

a=Average calculated with non-detects as zero.

1998-2001 Sampling

Thurston County Health staff initiated a review of EDB, 1,2-DCP and DBCP contamination around Pattison Lake and Lake St. Clair in 1999. In conjunction with the City of Olympia, and with funds from the Local Toxic Control Account through the Washington Department of Ecology, samples from a variety of sources were analyzed for 1,2-DCP, EDB and DBCP.

The monitoring effort included water and sediment samples from Pattison Lake and Lake St. Clair and samples from 43 private wells, public water supplies and monitoring wells. The well samples were collected between October 1998 March 2001.

Well Sampling – Health and City of Olympia staff collected samples from 17 wells during an initial sampling round between December 1999 and January 2000. The Cities of Olympia and Lacey, Pattison Water Company and Washington Water Service also provided sampling results for their public water supply wells in the area. A total of 43 wells were sampled for the pesticides.

At the beginning of this study, homeowners with contaminated wells were sent a letter describing the study and requesting their permission to sample their wells. A very low response rate to the letter and attempted phone contacts hampered efforts to sample the contaminated wells. Additionally, a number of wells were either fully decommissioned (casing pulled and back-filled) or de-powered. The Lacey Fire Department well located off Yelm Highway (17N/01E-05F01) was one of the decommissioned wells. A total of six historically-contaminated wells were eventually sampled.

Samples collected by City and County staff followed DOH sampling procedures (DOH, 1990). The wells were purged for three casing volumes, for fifteen minutes, or until pH, temperature and conductivity readings stabilized, which ever came first. Samples were collected in 40 ml glass vials with Teflon septums, preserved with 2 drops of HCl. These samples were analyzed using USEPA method 504.1. Samples collected directly by the water purveyors were either analyzed using either USEPA method 504.1 or 524.2. . .

To fill data gaps along the northern edge of Pattison Lake and the western side of Lake St. Clair, a second round of six well samples was collected in July 2000. Due to a laboratory error, the samples were tested only for EDB and DBCP, not for 1,2-DCP. These six wells were sampled again between February and March 2001 and analyzed for 1,2-DCP, in addition to EDB and DBCP. A seventh well (17N/01E-06CA) on the southern shore of Lake Saint Clair was included in the March 2001 sampling.

The irrigation and domestic wells at the Washington Department of Natural Resources (DNR) Meridian Seed Orchard were sampled for pollutants in 1999 as part of a separate effort. A low-level detection of 1,2-DCP, 0.08 µg/L, was reported for the DNR Central irrigation well (Tetra Tech,1999). The Central well was sampled in March 2001 for this report.

A total of 43 wells were sampled for the contaminants 1,2-DCP, DBCP and EDB. Figure 1 shows the location of recent EDB sampling, while Figures 2 and 3 show the recent sampling results, along with the historical sampling results. Table 2 lists the 1998-2001 results and all of the results are listed in Appendix A.

In the figures, private wells are designated by their abbreviated local ID number. All of the sampled wells are assigned a local ID number, although the public water supplies and monitoring wells were labeled by name in the following figures. The local ID number references the well's location by township, range, section, and ¼ ¼ section, and follows the pattern established by the U.S. Geological Survey (Drost and others, 1998). For example, 18N/01W-35L02 is located in Township 18 North, Range 1 West, Section 35, and ¼ ¼ Section L. The 02 means it is the second well in that "L" section to be assigned a local ID number. Some local ID numbers use a letter to differentiate between wells in the same ¼ ¼ section, such as 18N/01W-35N*A*. The two wells listed above are located just north of Pattison Lake. The local ID numbers were truncated in order to make the figures more legible. The township and range boundaries are labeled on the figures to assist in determining the complete local ID number for the private wells.

Lake Sampling - In October 1999, two water and two bottom-sediment samples were collected from both Pattison Lake and Lake St. Clair to examine whether lake water and sediments were impacted by the contaminated groundwater plume. Samples were collected from the southern basin of Pattison Lake and the southwestern basin of Lake St. Clair. The water samples were collected with a Kemmerer sampler near the lake bottom (4.5 meters [14.7 ft] depth at Pattison Lake and 29 meters [95.1 ft] at Lake St. Clair). Sediment samples were collected with a WildCo petite ponar dredge at the same locations as the water samples.

All of the lake samples were analyzed for EDB, 1,2-DCP and DBCP with method 8021B. None of the analyzed compounds were detected in either the water or sediment samples. The water samples had a reporting limit of 5 parts per billion (µg/L), while the sediment samples had a reporting limit of 250 parts per billion (µg/kg) for the three pesticides. A reporting limit is the lowest concentration of a substance that the laboratory is willing to report with confidence. Currently, there are no surface water quality standards for these chemicals.

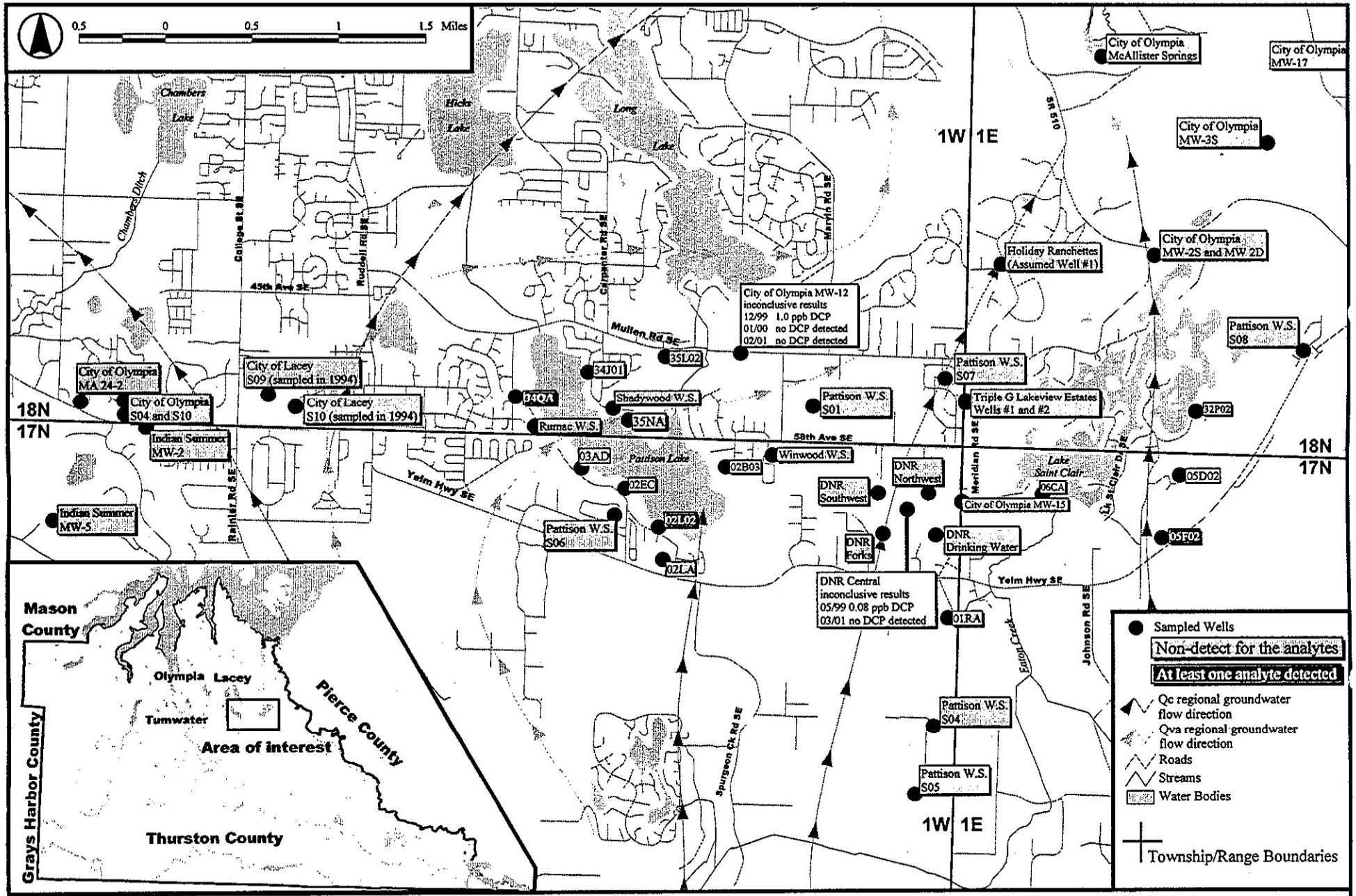

Figure 1 - Location of 1998-2001 sampling wells (sampled for 1,2-DCP, EDB, and DBCP) and regional groundwater flow patterns

Public water supply wells and monitoring wells are labeled by name. Private wells are labeled by their local ID #, minus the township/range designation (ie., 17N/02W-). See text for details.

THURSTON COUNTY

TC Health Department
edb study area.apr
sbb - August 2001
data provided by:
Thurston County Health Dept,
Thurston Geodata Center,
City of Olympia

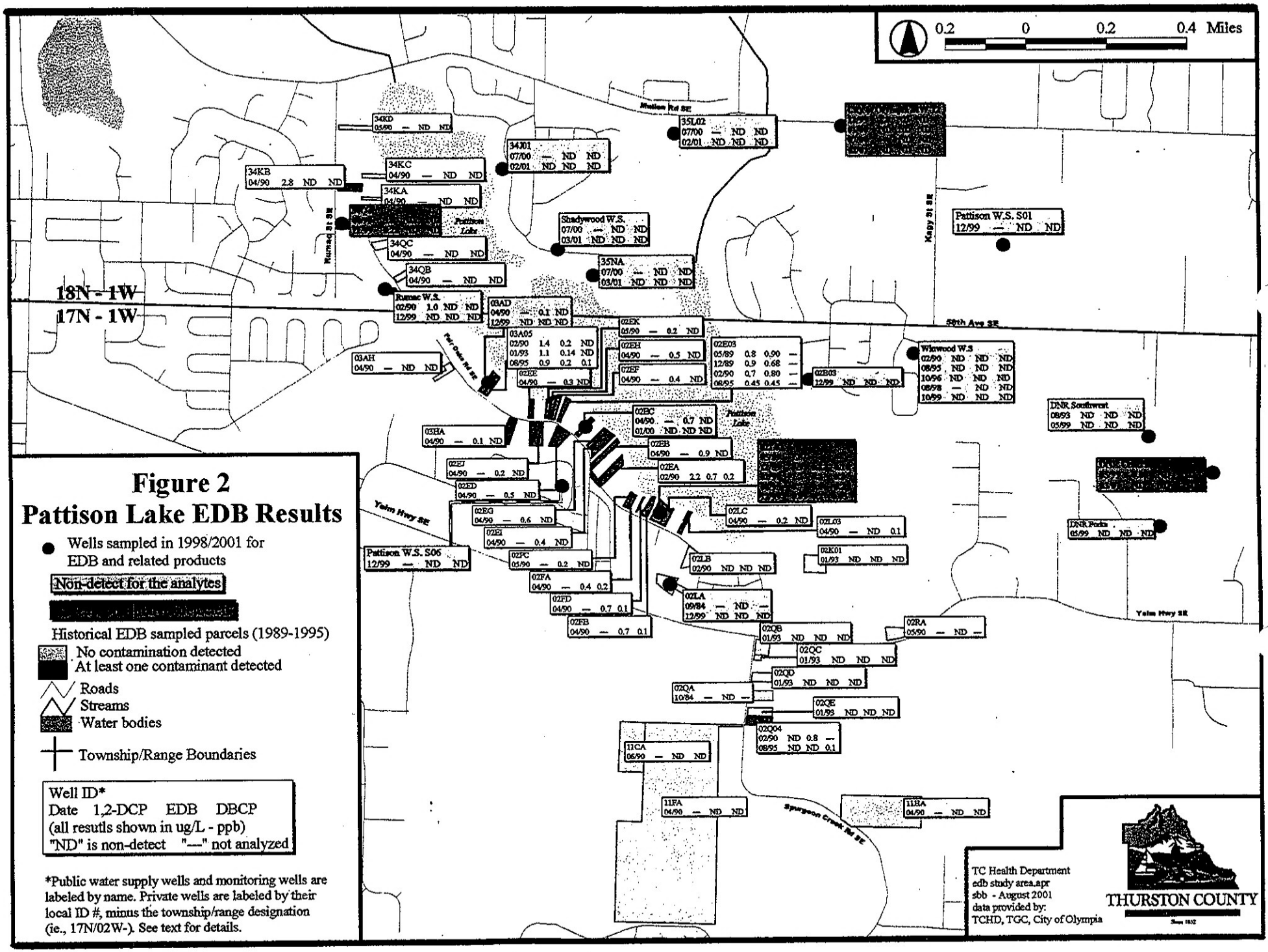

Figure 2
Pattison Lake EDB Results

- Wells sampled in 1998/2001 for EDB and related products

Non-detect for the analytes

Historical EDB sampled parcels (1989-1995)

No contamination detected

At least one contaminant detected

Roads

Streams

Water bodies

Township/Range Boundaries

Well ID*
Date 1,2-DCP EDB DBCP
(all resutls shown in ug/L - ppb)
"ND" is non-detect "—" not analyzed

*Public water supply wells and monitoring wells are labeled by name. Private wells are labeled by their local ID #, minus the township/range designation (ie., 17N/02W-). See text for details.

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data provided by:
TCHD, TGC, City of Olympia

THURSTON COUNTY

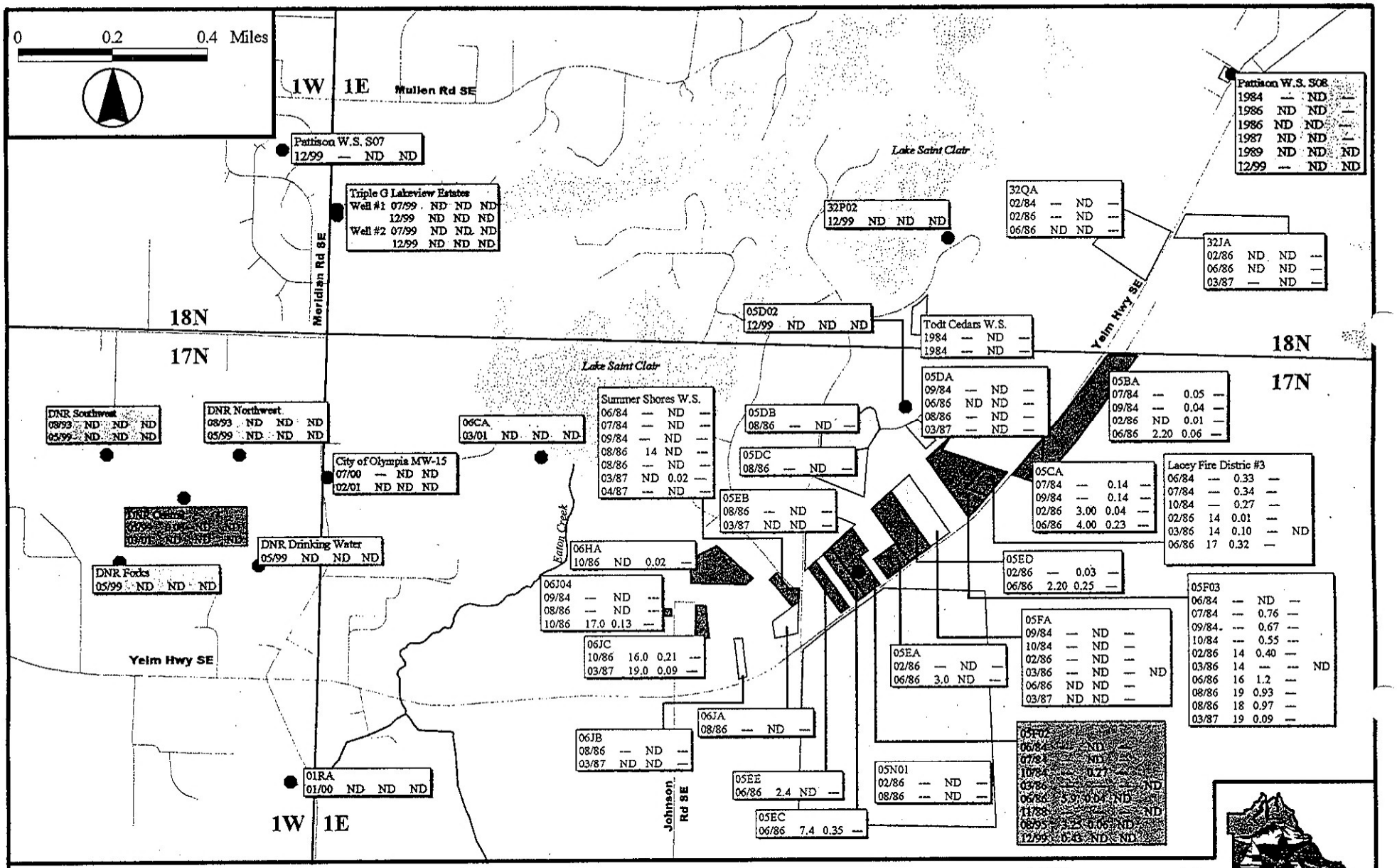

Figure 3
Yelm Highway EDB Results

Table 2 – 1998-2001 1,2-DCP, EDB and DBCP sampling results, listed by local ID.

Local ID#	Well Owner Name*	Address	Well Depth (ft)	Sample Date	1,2-DCP[†‡] (µg/L)	EDB (µg/L)	DBCP (µg/L)
State and Federal Drinking water standards for the three chemicals are:					5.0	0.05	0.2
17N/01E-05D02	Private*	10626 Danico Ln SE	220	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01E-05F02	Private	10640 Yelm Highway SE	144	12/21/99	**0.43**	(<0.20)	(<0.20)
17N/01E-06CA	Private	9938 62nd Ave SE	60	03/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01E-06E02	City of Olympia MW-15		151	07/18/00		(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01W-01G01	DNR Southwest Irr. Well	Meridian Seed Orchard	232	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01G02	DNR Forks Irr. Well	Meridian Seed Orchard	212	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01GA	DNR Central Irr. Well	Meridian Seed Orchard	218	05/11/99	**0.08**	(<0.17)	(<0.32)
				03/06/01	(<0.02)	(<0.02)	(<0.04)
17N/01W-01H01DUP	DNR Domestic Water	Meridian Seed Orchard	236	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01H02	DNR Northwest Irr. Well	Meridian Seed Orchard	225	05/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01RA	Private	7225 Meridian Rd SE	?	01/07/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02A03	Washington Water Service	Winwood	231	10/27/99	(<0.50)	(<0.50)	(<0.50)
17N/01W-02B03	Private	6015 Hansen St SE	106	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-02E04	Pattison W.S. S06	Fair Oaks Lp	542	12/22/99		(<0.02)	(<0.04)
17N/01W-02EC	Private	7628 Fair Oaks Rd SE	?	01/07/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02L02	Private	7844 Kelly Beach Rd SE	78	12/14/99	**0.09**	**0.20**	**0.05**
17N/01W-02LA	Private	7934 Kelly Beach Rd SE	?	12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-03AD	Private	7406 Fair Oaks Rd SE	?	12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-05BA	Indian Summer MW-2		23	02/ 01/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-06JA	Indian Summer MW-5		20	02/ 01/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-12J02	Pattison W.S. S04		186	12/22/99		(<0.02)	(<0.04)
17N/01W-12RA	Pattison W.S. S05	Reservoir Well	224	12/22/99		(<0.02)	(<0.04)
18N/01E-19J01S	City of Olympia	McAllister Springs	0	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01E-21NA	City of Olympia MW-17		300	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29B02S	City of Olympia MW-3 Sh		101	12/27/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29N02S	City of Olympia MW-2 Sh		122	12/20/99	(<0.11)	(<0.20)	(<0.20)
18N/01E-29N02DUP	City of Olympia MW 2-D		204	12/20/99	(<0.11)	(<0.20)	(<0.20)
18N/01E-30N02	Washington Water Service	Holiday Ranchettes #2	190	04/14/99	(<0.50)	(<0.50)	(<0.50)
18N/01E-31MA	WA Water Service Triple G Well#1	9509 Glory Dr SE	191	07/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-31MB	WA Water Service Triple G Well#2	9509 Glory Dr SE	192	07/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-32H02	Pattison W.S. S08	Gallup Drive	216	12/22/99		(<0.02)	(<0.04)
18N/01E-32P02	Private		81	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01W-32NA	City of Olympia MA 24-2		35	01/31/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-32P01	City of Olympia S04	Shana Park #4	56	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01W-32P03	City of Olympia S10	Shana Park #11	88	10/27/98	(<0.40)	(<0.01)	(<0.02)
				01/31/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-34J01	Private	5121 Atchinson Dr SE	55	07/17/00		(<0.02)	(<0.02)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-34Q01	Rumac W.S.	5645 Rumac Dr SE	109	01/07/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-34QA	Private	6815 54th Ave SE	?	01/31/00	**0.28**	(<0.02)	(<0.02)
18N/01W-35H02	City of Olympia MW-12	Near 8231 Mullen Rd SE	67	12/21/99	**1.00**	(<0.02)	(<0.02)
				01/31/00	(<0.11)	(<0.02)	(<0.02)
				07/17/00		(<0.02)	(<0.02)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35L02	Private	7825 Mullen Rd SE	56	07/17/00		(<0.02)	(<0.02)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35NA	Private	7639 Atchinson Ln SE	60	07/17/00		(<0.02)	(<0.02)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35NB	Shadywood W.S.		?	07/17/00		(<0.02)	(<0.04)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-36JA	Pattison W.S. S07	Tri-Lakes	185	12/22/99		(<0.02)	(<0.04)
18N/01W-36N01	Pattison W.S. S01	Well #1	217	12/22/99		(<0.02)	(<0.04)

*Private well owner names were withheld to avoid confusion between who owned the property at the time the sample was taken and who owns the property now.

†1,2-DCP – 1,2-dichloropropane / EDB – 1,2-dibromoethane or ethylene dibromide / DBCP – 1,2-dibromo-3-chloropropane

‡ reporting limits varied between laboratories and sampling rounds

Bold values are positive results and values listed as " <" indicate that the chemical was not detected at that concentration ("non-detect")

Shaded values exceed the MCL

Results

- None of the three contaminants tested for (1,2-DCP, EDB and DBCP) were detected in either the lake water or lake-bottom sediments [*laboratory reporting limits were much higher for lake-water and lake-sediment samples than for drinking water samples due to analytical method differences*];
- Of the wells sampled to determine if groundwater contamination had spread northward, only two had contaminants present; City of Olympia monitoring well MW-12 and the DNR Central irrigation well, both discussed below in more detail;
- Six historically contaminated wells were resampled; three still had contaminants present;
- One well had contaminant levels that exceeded drinking water standards; a domestic well (17N/01W-02L02), not currently being used for drinking water, exceeded the standard for EDB.

Thirty-eight of the 43 wells sampled between 1998 and 2001 had no reportable concentrations of the three pesticides. Three samples with pesticides present were taken from private wells where contamination was historically present. The two other wells where pesticides were detected are the City of Olympia monitoring well MW-12, and an irrigation well at the Washington Department of Natural Resources Meridian Seed Orchard. These wells are discussed in more detail on the following page.

Appendix A lists all of the recent EDB related sampling results as well as the historical sampling results. The combined results are also shown on Figures 2 and 3.

It is important to note that none of the three contaminants were detected in any public drinking water sources.

For the samples with pesticides detected, 1,2-DCP was present in five samples, while EDB and DBCP were detected in only one sample (well 17N/01W-02L02). Of the three positive samples taken from historically contaminated wells, the pesticide concentrations were generally lower by almost an order of magnitude than last round of samples taken in 1990 and 1995 (Table 3).

Table 3 – Results from presently contaminated wells with historical data showing general decrease in contaminant levels

Local ID#	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (µg/L)	EDB (µg/L)	DBCP (µg/L)
Drinking water standards for the three chemicals are:					**5.0**	**0.05**	**0.2**
17N/01E-05F02	Private	10640 Yelm Highway SE	144	6/25/84		(<0.01)*	
				7/23/84		(<0.01)	
				10/26/84		0.27	
				6/18/86	5.9	0.04	(<0.20)
				8/2/95	3.25	0.06	(<0.20)
				12/21/99	0.43	(<0.20)	(<0.20)
17N/01W-02L02	Private	7844 Kelly Beach Rd SE	78	5/16/89	1.50	(<0.20)	(<0.20)
				12/13/89	0.90	0.12	0.16
				2/13/90	1.20	0.20	0.20
				8/2/95	0.70	0.06	0.20
				12/14/99	0.09	0.20	0.05
18N/01W-34QA	Private	6815 54th Ave SE	?	4/23/90	5.8	(<0.01)	(<0.10)
				1/31/00	0.28	(<0.02)	(<0.02)

*values listed as "<" indicate that the chemical was not detected at that concentration ("non-detect")
Shaded values exceed the MCL

Based on the data from the three wells with historical contamination, rough half-life calculations were estimated for EDB and 1,2-DCP (a half-life is an estimate of the time it takes for half of the quantity of a chemical to break-down). Table 2 lists the chemical concentrations for the three wells. For EDB, the estimated half-life is 8.2 years. Published half-life calculations for EDB range from 6 to 13.2 years (EPA, 2001). Assuming a half-life rate of 8.2 years, EDB concentrations would be below detection limits in 11 years. The estimated half-life (based on data from Table 2) for 1,2-DCP is 7.3 years and it is assumed to be in concentrations below detection limits in under four years. The half-life for DBCP in groundwater is 141 years (EPA, 2001).

1,2-DCP was detected at 1.0 µg/L at the City of Olympia monitoring well 12 (MW-12) in December 1999. An additional sample was taken in January and 1,2-DCP was not detected (detection limit was 0.11 µg/L). A third round was taken in July; however, as a result of a laboratory error, the samples were not analyzed for 1,2-DCP. As 1,2-DCP was the most prevalent contaminant detected in this sampling effort, another round of samples was taken in February 2001. 1,2-DCP was not detected (detection limit was 0.023 µg/L).

The DNR Meridian Seed Orchard has been in operation for over 20 years. Before that, the fields were used to grow strawberries. In August 1993, the Southwest and Northwest wells were sampled for a variety of contaminants, including the three pesticides and none were detected. All five wells at the Orchard were sampled on May 11, 1999. The Central well was the only one with a contaminant detected, 1,2-DCP, at a concentration of 0.077 µg/L; this was below the laboratory's normal reporting limit of 0.09 µg/L but was confirmed with a gas-chromatograph/mass spectrometer. [Tetra Tech, 1999]. The Central well was sampled again in March 2001; 1,2-DCP was not detected (detection limit was 0.023 µg/L).

Conclusions

As presented in Figure 1, the regional groundwater flow patterns for the Vashon advance (Qva) and the penultimate deposits (Qc) aquifers are northward around Lake St. Clair and north to northeast around Pattison Lake (Drost, *et al*, 1998). Samples on the north side of Pattison Lake and samples between the contaminant plume and Lake St. Clair had no pesticide detections. **Therefore, the area of pesticide-contamination does not appear to have increased or migrated northward.**

EDB, 1,2-DCP and DBCP concentrations, in three wells with historical contamination, are decreasing. Similar decreases of EDB and related contaminants were reported in Whatcom County, Washington (O'Herron, 1999)[1]. Based on limited information, rough half life calculations indicate that the concentrations of EDB and 1,2-DCP could be below current laboratory reporting limits by 2011. That is, the pesticide concentrations may be below current detection limits, and well below drinking water standards, by 2011.

By 2011, 1,2-DCP, EDB and DBCP will have been known contaminants of local drinking water aquifers for nearly a quarter-century. Their presence resulted in the abandonment of hundreds of individual wells and required the extension of public water supplies at significant public and private expense.

[1] Washington State Department of Ecology is currently drafting two additional reports on EDB in Whatcom County, Washington. "(draft)2000 Site Investigation, Northern Whatcom County, Washington" and "(draft)Developing a Long-Term Solution, EDB- and 1,2-DCP-Contaminated Drinking Water, Whatcom County, Washington."

The City of Olympia monitoring well MW-12 is currently one of their wellhead protection monitoring plan wells and will be sampled yearly for pesticides, including 1,2-DCP.

The 0.08 µg/L of 1,2-DCP found at the DNR Central irrigation well was not found at the four surrounding DNR wells. There are no previous samples from the DNR Central well; however, the Southwest and the Northwest wells were sampled in August 1993, with no detection of the contaminants. It is unknown if the 1,2-DCP detection was part of the regional contaminant plume or a result of historical activities on the property. The Washington Department of Natural Resources will consult with Thurston County about appropriate monitoring frequencies for 1,2-DCP.

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Appendix A — All EDB related monitoring data, listed by local ID# and sample date.

Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[1] (ug/L)	EDB * (ug/L)	DBCP (ug/L)
	Drinking water standards for the three chemicals are:				**5.0**	**0.05**	**0.2**
17N/01E-05BA	Private*	11021 Yelm Highway SE	203	7/23/84		**0.05**	
				9/11/84		**0.04**	
				2/ 4/86	(<1.00)	**0.01**	
				6/18/86	**2.20**	**0.06**	
17N/01E-05CA	Private	10925 Yelm Highway SE	190	7/23/84		**0.14**	
				9/10/84		**0.14**	
				2/ 4/86	**3.00**	**0.04**	
				6/18/86	**4.00**	**0.23**	
17N/01E-05D02	Private	10626 Danico Ln SE	220	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01E-05DA	Private	10625 Danico Ln SE	219	9/10/84		(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
				8/15/86		(<0.01)	
				3/26/87		(<0.01)	
17N/01E-05DB	Private	10537 Danico Ln SE	215	8/15/86		(<0.01)	
17N/01E-05DC	Private	10623 Danico Ln SE	204	8/15/86		(<0.01)	
17N/01E-05EA	Private	10706 Yelm Highway SE	160	2/ 4/86		(<0.01)	
				6/18/86	**3.00**	(<0.01)	
17N/01E-05EB	Private	6402 Rehklau Rd SE		8/15/86		(<0.01)	
				3/24/87	(<1.00)	(<0.01)	
17N/01E-05EC	Private	10612 Yelm Highway SE	153	6/18/86	**7.40**	**0.35**	
17N/01E-05ED	Private	10736 Yelm Highway SE	192	2/ 4/86		**0.03**	
				6/18/86	**2.20**	**0.25**	
17N/01E-05EE	Private	10544 Yelm Highway SE		6/18/86	**2.40**	(<0.01)	
17N/01E-05F01	Lacey Fire Department	10910 Yelm Highway SE	180	6/25/84		**0.33**	
				7/23/84		**0.34**	
				10/26/84		**0.27**	
				2/ 4/86	**14.00**	**0.01**	
				3/14/86	**14.00**	**0.10**	
				6/18/86	**17.00**	**0.32**	
17N/01E-05F02	Private	10640 Yelm Highway SE	144	6/25/84		(<0.01)	
				7/23/84		(<0.01)	
				10/26/84		**0.27**	
				6/18/86	**5.90**	**0.04**	(<0.20)
				8/ 2/95	**3.25**	**0.06**	(<0.20)
				12/21/99	**0.43**	(<0.20)	(<0.20)

Appendix A – All EDB related monitoring data, listed by local ID# and sample date

Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP (ug/L)	EDB (ug/L)	DBCP (ug/L)
17N/01E-05F03	Private	10820 Yelm Highway SE	174	6/25/84		(<0.01)	
				7/23/84		**0.76**	
				9/11/84		**0.67**	
				10/26/84		**0.55**	
				2/ 4/86	**14.00**	**0.40**	
				3/14/86	**14.00**		
				6/18/86	**16.00**	**1.20**	
				8/ 6/86	**19.00**	**0.93**	
				8/16/86	**18.00**	**0.97**	
				3/25/87	**19.00**	**0.09**	
17N/01E-05FA	Private	10740 Yelm Highway SE	210	9/10/84		(<0.01)	
				10/29/84		(<0.01)	
				2/ 4/86		(<0.01)	
				3/14/86		(<0.01)	
				6/18/86	(<1.00)	(<0.10)	
				3/25/87	(<1.00)	(<0.10)	
17N/01E-05N01	Private	10447 Yelm Highway SE	305	2/ 4/86		(<0.01)	
				8/15/86		(<0.01)	
17N/01E-06CA	Private	9938 62nd Ave SE	60	03/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01E-06E02	City of Olympia MW-15		151	7/15/00	(<0.02)	(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
17N/01E-06HA	Private	10220 66th Ave SE	249	10/16/86	(<1.00)	**0.02**	
17N/01E-06J03D1	Summer Shores W.S.	6103 St. Clair Dr. SE	425	6/25/84		(<0.01)	
				7/23/84		(<0.01)	
				9/10/84		(<0.01)	
				8/ 6/86	**14.00**	(<0.01)	
				8/15/86		(<0.01)	
				3/24/87	(<1.00)	**0.02**	
				4/ 8/87		(<0.01)	
17N/01E-06J04	Private	6611 St. Clair Dr.	75	9/11/84		(<0.01)	
				8/15/86		(<0.01)	
				10/16/86	**17.00**	**0.13**	
17N/01E-06JA	Private	6645 Rehklau Rd SE	98	8/15/86		(<0.01)	
17N/01E-06JB	Private	10346 Yelm Highway SE	248	8/15/86		(<0.01)	
				3/24/87	(<1.00)	(<0.01)	
17N/01E-06JC	Private	10221 66th Ave SE		10/16/86	**16.00**	**0.21**	
				3/24/87	**19.00**	**0.09**	
17N/01E-07HA	Private	7648 Johnson Rd. SE	60	7/23/84		(<0.01)	
				2/ 4/86		(<0.01)	
17N/01W-01G01	DNR Southwest Irr.	Meridian Seed Orchard	232	08/?/93	(<0.5)	(<0.02)	(<0.02)
				5/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01G02	DNR Forks Irr. Well	Meridian Seed Orchard	212	5/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01GA	DNR Central Irr. Well	Meridian Seed Orchard	218	5/11/99	**0.08**	(<0.17)	(<0.32)
				03/06/01	(<0.02)	(<0.02)	(<0.04)
17N/01W-01H01DUP	DNR Domestic Water	Meridian Seed Orchard	236	5/11/99	(<0.09)	(<0.17)	(<0.32)

Appendix A – All EDB related monitoring data, listed by local ID# and sample date.

Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP (ug/L)	EDB (ug/L)	DBCP (ug/L)
17N/01W-01H02	DNR Northwest Irr.	Meridian Seed Orchard	225	08/?/93	(<0.5)	(<0.02)	(<0.02)
				5/11/99	(<0.09)	(<0.17)	(<0.32)
17N/01W-01RA	Private	7225 Meridian Rd SE		1/ 7/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02A03	WA Water Service	Winwood	231	2/13/90	(<0.20)	(<0.02)	(<0.20)
				8/ 2/95	(<0.50)		
				8/ 2/95	(<0.20)	(<0.02)	(<0.20)
				10/ 9/96		(<0.05)	(<0.05)
				8/13/98		(<0.02)	(<0.04)
				10/27/99	(<0.50)	(<0.50)	(<0.50)
17N/01W-02B03	Private	6015 Hansen St SE	106	12/21/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-02CA	Private	7305 Spurgeon Creek Rd		6/ 5/90		(<0.10)	(<0.10)
17N/01W-02E03	Private	7602 Fair Oaks Rd SE	49	5/16/89	**0.80**	**0.90**	(<0.20)
				12/13/89	**0.90**	**0.68**	(<0.03)
				2/12/90	**0.70**	**0.80**	(<0.20)
				8/ 2/95	**0.45**	**0.45**	
17N/01W-02E04	Pattison W.S. S06	off Meridian Rd SE	542	12/22/99		(<0.02)	(<0.04)
17N/01W-02EA	Private	7704 Fair Oaks Rd SE		2/13/90	**2.20**	**0.70**	**0.20**
17N/01W-02EB	Private	7648 Fair Oaks Rd SE	240	4/ 9/90		**0.90**	(<0.10)
17N/01W-02EC	Private	7628 Fair Oaks Rd SE		4/24/90		**0.70**	(<0.10)
				1/ 7/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-02ED	Private	7627 Fair Oaks Rd SE		4/10/90		**0.50**	(<0.05)
17N/01W-02EE	Private	7522 Fair Oaks Rd SE		4/16/90		**0.30**	(<0.10)
17N/01W-02EF	Private	7548 Fair Oaks Rd SE		4/ 9/90		**0.40**	(<0.10)
17N/01W-02EG	Private	7640 Fair Oaks Rd SE		4/16/90		**0.60**	(<0.10)
17N/01W-02EH	Private	7546 Fair Oaks Rd SE		4/ 9/90		**0.50**	(<0.10)
17N/01W-02EI	Private	7642 Fair Oaks Rd SE		4/16/90		**0.40**	(<0.10)
17N/01W-02EJ	Private	7525 Fair Oaks Rd SE		4/17/90		**0.20**	(<0.10)
17N/01W-02EK	Private	7540 Fair Oaks Rd SE		5/ 8/90		**0.20**	(<0.10)
17N/01W-02FA	Private	7738 Kelly Beach Rd SE	57	4/17/90		**0.40**	**0.20**
17N/01W-02FB	Private	7826 Kelly Beach Rd SE		4/17/90		**0.70**	**0.10**
17N/01W-02FC	Private	7734 Kelly Beach Rd SE		5/ 8/90		**0.20**	(<0.10)
17N/01W-02FD	Private	7802 Kelly Beach Rd SE		4/17/90		**0.70**	**0.10**
17N/01W-02K01	Private	8138 Yelm Highway SE	146	1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02L02	Private	7844 Kelly Beach Rd SE	78	5/16/89	**1.50**	(<0.20)	(<0.20)
				12/13/89	**0.90**	**0.12**	**0.16**
				2/13/90	**1.20**	**0.20**	**0.20**
				8/ 2/95	**0.70**	**0.06**	**0.20**
				12/14/99	**0.09**	**0.20**	**0.05**
17N/01W-02L03	Private	7916 Kelly Beach Rd SE	67	04/17/90		(<0.01)	**0.10**
17N/01W-02LA	Private	7934 Kelly Beach Rd SE		9/10/84		(<0.01)	
				12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-02LB	Private	7933 Kelly Beach Rd SE		2/13/90	(<0.10)	(<0.01)	(<0.10)
17N/01W-02LC	Private	7846 Kelly Beach Rd SE		4/16/90		**0.20**	(<0.10)
17N/01W-02Q04	Private	7226 Spurgeon Ck Rd SE	79	2/12/90	(<0.20)	**0.80**	(<0.20)
				8/ 2/95	(<0.20)	(<0.20)	**0.10**
17N/01W-02QA	Private	7134 Spurgeon Creek Rd		10/29/84		(<0.01)	
17N/01W-02QB	Private	8031 Yelm Highway SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)

Appendix A—All EDB related monitoring data, listed by local ID# and sample date.

Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP (ug/L)	EDB (ug/L)	DBCP (ug/L)
17N/01W-02QC	Private	7032 Spurgeon Ck Rd SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02QD	Private	7126 Spurgeon Ck RD SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02QE	Private	7222 Spurgeon Ck Rd SE		1/ 7/93	(<1.00)	(<0.05)	(<0.05)
17N/01W-02RA	Private	8406 Yelm Hwy SE		5/ 2/90		(<0.10)	
17N/01W-03A05	Private	7412 Fair Oaks Rd SE	80	2/13/90	**1.40**	**0.20**	(<0.10)
				1/ 7/93	**1.10**	**0.14**	(<0.05)
				8/ 2/95	**0.90**	**0.20**	**0.10**
17N/01W-03AD	Private	7406 Fair Oaks Rd SE		4/ 9/90		**0.10**	(<0.10)
				12/14/99	(<0.11)	(<0.02)	(<0.02)
17N/01W-03AH	Private	7335 Fair Oaks Rd SE		4/24/90		(<0.05)	(<0.05)
17N/01W-03HA	Private	7449 Fair Oaks Rd SE		4/ 9/90		**0.10**	(<0.10)
17N/01W-05BA	Indian Summer MW-2		23	2/ 1/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-06JA	Indian Summer MW-5		20	2/ 1/00	(<0.11)	(<0.02)	(<0.02)
17N/01W-11CA	Private	7305 Spurgeon Ck Rd SE		06/05/90		(<0.01)	(<0.10)
17N/01W-11FA	Private	7307 Spurgeon Ck Rd SE		4/10/90		(<0.01)	(<0.10)
17N/01W-11HA	Private	7446 Spurgeon Ck Rd SE				(<0.01)	(<0.10)
17N/01W-12J02	Pattison W.S. S04		186	12/22/99		(<0.02)	(<0.04)
17N/01W-12RA	Pattison W.S. S05	Reservoir Well	224	12/22/99		(<0.02)	(<0.04)
18N/01E-19J01S	City of Olympia	McAllister Springs	0	6/19/89	(<0.20)	(<0.20)	(<0.20)
				10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01E-21NA	City of Olympia MW-17		300	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29B02S	City of Olympia MW-3 Sh		101	12/27/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-29N02S	City of Olympia MW-2 Sh		122	12/20/99	(<0.11)	(<0.20)	(<0.20)
18N/01E-30N02	Washington Water Service	Holiday Ranchettes #2	190	4/14/99	(<0.50)	(<0.50)	(<0.50)
18N/01E-31MA	WA Water Triple G Well#1	9509 Glory Dr SE	191	7/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-31MB	WA Water Triple G Well#2	9509 Glory Dr SE	192	7/21/99	(<0.50)	(<0.50)	(<0.50)
				12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-32H02	Pattison W.S. S08	Gallup Drive	216	10/29/84		(<0.01)	
				2/ 4/86	(<0.20)	(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
				3/26/87	(<1.00)	(<0.01)	
				6/21/89	(<0.20)	(<0.20)	(<0.20)
				12/22/99		(<0.02)	(<0.04)
18N/01E-32JA	Private	11310 Yelm Highway SE		2/ 4/86	(<0.20)	(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
				3/24/87		(<0.01)	
18N/01E-32N03	Todt-Cedars W.S.	10650 Todtkarle Rd SE	158	7/23/84		(<0.01)	
				9/10/84		(<0.01)	
18N/01E-32P02	Private		81	12/21/99	(<0.11)	(<0.02)	(<0.02)
18N/01E-32QA	Private	11211 Yelm Highway SE	201	10/29/84		(<0.01)	
				2/ 4/86		(<0.01)	
				6/18/86	(<1.00)	(<0.01)	
18N/01W-32NA	City of Olympia MA 24-2	unknown		1/31/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-32P01	City of Olympia S04	Shana Park #4	56	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01W-32P03	City of Olympia S10	Shana Park #11	88	10/27/98	(<0.40)	(<0.01)	(<0.02)
18N/01W-32P03	City of Olympia S10	Shana Park #11	88	1/31/00	(<0.11)	(<0.02)	(<0.02)

Appendix A – All EDB related monitoring data; listed by local ID# and sample date.

Local ID number	Well Owner Name	Address	Well Depth (ft)	Sample Date	1,2-DCP[†] (ug/L)	EDB (ug/L)	DBCP (ug/L)
18N/01W-33N01	City of Lacey S09	Well #9	283	6/ 8/94		(<0.05)	(<0.20)
18N/01W-33N02	City of Lacey S10	Well #10	208	6/ 8/94		(<0.05)	(<0.20)
18N/01W-34J01	Private	5121 Atchinson Dr SE	55	7/17/00		(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-34KA	Private	5302 Rumac Dr SE		4/23/90		(<0.01)	(<0.10)
18N/01W-34KB	Private	3035 College St SE		4/24/90	**2.80**	(<0.01)	(<0.10)
18N/01W-34KC	Private	5205 Rumac Dr SE		4/23/90		(<0.01)	(<0.10)
18N/01W-34KD	Private	4940 Rumac Dr SE		5/ 8/90		(<0.01)	(<0.10)
18N/01W-34Q01	Rumac W.S.	5645 Rumac Dr SE	109	02/14/90	**1.0**	(<0.01)	(<0.10)
				01/07/00	(<0.11)	(<0.02)	(<0.02)
18N/01W-34QA	Private	6815 54th Ave SE		4/23/90	**5.8**	(<0.01)	(<0.10)
				1/31/00	**0.28**	(<0.02)	(<0.02)
18N/01W-34QB	Private	5634 Rumac Dr SE		4/23/90		(<0.10)	(<0.10)
18N/01W-34QC	Private	5508 Rumac Dr SE		4/23/90		(<0.10)	(<0.10)
18N/01W-35H02	City of Olympia MW-12	near 8231 Mullen Rd SE	67	12/21/99	**1.00**	(<0.02)	(<0.02)
				1/31/00	(<0.11)	(<0.02)	(<0.02)
				07/17/00		(<0.02)	(<0.04)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-35L02	Private	7825 Mullen Rd SE	56	7/17/00		(<0.02)	(<0.02)
				02/21/01	(<0.02)	(<0.02)	(<0.04)
8N/01W-35NA	Private	7639 Atchinson Ln SE	60	7/17/00		(<0.02)	(<0.02)
				03/02/01	(<0.02)	(<0.02)	(<0.04)
18N/01W-36JA	Pattison W.S. S07	Tri-Lakes	185	12/22/99		(<0.02)	(<0.04)
18N/01W-36N01	Pattison W.S. S01	Well #1	217	12/22/99		(<0.02)	(<0.04)

*Private well owner names were withheld to avoid confusion between who owned the property at the time the sample was taken and who owns the property now.

[†]1,2-DCP – 1,2-dichloropropane

EDB – 1,2-dibromoehtane

DBCP – 1,2-dibromo-3-chloropropane

[‡]detection limits varied between laboratories and sampling rounds; in some cases they were assumed based upon available information.

Bold values are positive results and values listed as "<" indicate that the chemical was not detected at that concentration

Shaded values exceed the MCL