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PUBLIC HEALTH ASSESSMENT

HAMILTON/LABREE ROADS GROUNDWATER CONTAMINATION

CHEHALIS, LEWIS COUNTY, WASHINGTON

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Prepared by:

Washington State Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Foreword

The Washington State Department of Health (DOH) has prepared this public health assessment in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health assessment was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health assessment is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health assessments are a means to provide health information on hazardous substances to agencies and the public. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

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Acronyms/Abbreviations

ATSDR ..... Agency for Toxic Substances and Disease Registry
bgs ..... below ground surface
CERCLA ..... Comprehensive Environmental Response, Compensation and Liability Act
COC ..... Contaminant of Concern
CREG ..... Cancer Risk Evaluation Guide
CSF ..... Cancer Slope Factor
CPF ..... Cancer Potency Factor
DCE ..... dichloroethylene
DOH ..... Washington State Department of Health
Ecology ..... Washington State Department of Ecology
EMEG ..... Environmental Media Evaluation Guide
EPA ..... Environmental Protection Agency
LOAEL ..... Lowest Observed Adverse Effect Level
LTHA ..... Lifetime Health Advisory
MCL ..... Maximum Contaminant Level
MRL ..... Minimal Risk Level
mg/kg ..... milligram per kilogram
MW ..... Monitoring Well
NOAEL ..... No Observed Adverse Effect Level
NPL ..... National Priorities List
PCE ..... Tetrachloroethylene, Perchloroethylene
PHA ..... Public Health Assessment
PHAP ..... Public Health Action Plan
ppb ..... parts per billion
ppm ..... parts per million
RCRA ..... Resource, Conservation and Recovery Act
RfD ..... Oral Reference Dose
RI/FS ..... Remedial Investigation/Feasibility Study
RMEG ..... Reference Media Evaluation Guide
SVOC ..... Semi-Volatile Organic Chemical
TCE ..... Trichloroethylene
ug/L ..... microgram per liter
VOC ..... Volatile Organic Compounds

Glossary

Acute	Occurring over a short period of time. An acute exposure is one which lasts for less than two weeks.
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and the quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Aquifer	An underground formation composed of materials such as sand, soil, or gravel that can store and/or supply groundwater to wells and springs.
Cancer Risk Evaluation Guide (CREG)	The concentration of a chemical in air, soil or water that is expected to cause no more than one excess cancer in a million persons exposed over a lifetime. The CREG is a *comparison value* used to select contaminants of potential health concern and is based on the *cancer slope factor* (CSF).
Cancer Slope Factor	A number assigned to a cancer causing chemical that is used to estimate it's ability to cause cancer in humans.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one which lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air or, water which, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.
Contaminant	Any chemical that exists in the environment or living organisms that is not normally found there.
Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption, or inhalation. It is expressed as a mass of contaminant per kilogram of body weight per day

Environmental Media Evaluation Guide (EMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The EMEG is a *comparison value* used to select contaminants of potential health concern and is based on ATSDR's *minimal risk level* (MRL).
Epidemiology	The study of the occurrence and causes of health effects in human populations. An epidemiological study often compares two groups of people who are alike except for one factor, such as exposure to a chemical or the presence of a health effect. The investigators try to determine if any factor (i.e., age, sex, occupation, economic status) is associated with the health effect.
Exposure	Contact with a chemical by swallowing, breathing, or direct contact (such as through the skin or eyes). Exposure may be short-term (acute) or long-term (chronic).
Groundwater	Water found underground that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater often occurs in quantities where it can be used for drinking water, irrigation, and other purposes.
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typically, hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Indeterminate public health hazard	Sites for which no conclusions about public health hazard can be made because data are lacking.
Ingestion rate	The amount of an environmental medium which could be ingested, typically on a daily basis. Units for ingestion rate are usually expressed as liters/day for water, and milligrams/day for soil.
Inorganic	Compounds composed of mineral materials, including elemental salts and metals such as iron, aluminum, mercury, and zinc.
Lowest Observed Adverse Effect Level (LOAEL)	LOAEL's have been classified into "less serious" or "serious" effects. In dose-response experiments, the lowest exposure level at which there are statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control.

Maximum Contaminant Level (MCL)	A drinking water regulation established by the federal Safe Drinking Water Act. It is the maximum permissible concentration of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Minimal Risk Level (MRL)	An amount of chemical that gets into the body (i.e., dose) below which health effects are not expected. MRLs are derived by ATSDR for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
Monitoring wells	Special wells drilled at locations on or near a hazardous waste site so water can be sampled at selected depths and studied to determine the movement of groundwater and the amount, distribution, and type of contaminant.
No apparent public health hazard	Public health hazard category in which human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.
No Observed Adverse Effect Level (NOAEL)	The dose of a chemical at which there were no statistically or biologically significant increases in frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects may be observed at this dose but were judged not to be "adverse".
No public health hazard	Public health hazard category for which data indicate no current or past exposure or no potential for exposure, and therefore no health hazard.
Oral Reference Dose (RfD)	An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides which are not easily dissolved in water.

Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, one ounce of trichloroethylene (TCE) in 1 million ounces of water is one ppm. One ounce of TCE in one billion ounces of water is one ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about one ppb of TCE.
Plume	An area of contaminants in a specific media such as groundwater.
Reference Dose Media Evaluation Guide (RMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The EMEG is a *comparison value* used to select contaminants of potential health concern, and is based on EPA's oral reference dose (RfD).
Remedial Investigation	A study designed to collect the data necessary to determine the nature and extent of contamination at a site.
Risk	The probability that something will cause injury, linked with the potential severity of that injury. Risk is usually indicated by how many extra cancers may appear in a group of people who are exposed to a particular substance at a given concentration, in a particular pathway, and for a specified period of time. For example, a 1%, or 1 in 100 risk indicates that for 100 people who may be exposed, one person may experience cancer as a result of the exposure.
Route of exposure	The way in which a person my contact a chemical substance that includes ingestion, skin contact and breathing.
U.S. Environmental Protection Agency (EPA)	Established in 1970 to bring together parts of various government agencies involved with the control of pollution.
Volatile organic compound (VOC)	An organic (carbon-containing) compound that evaporates (volatilizes) easily at room temperature. Many solvents contain a significant number of VOCs.

Summary

Background

In 1993, DOH testing revealed that six drinking water wells near the intersection of Hamilton and Labree Roads in Lewis County were contaminated with tetrachloroethylene (PCE). PCE levels ranged from 3 μg/L to 2,165 μg/L; reportedly the highest level found in drinking water in the state.[1] Affected well owners were informed of the contamination, and were advised to obtain alternate sources of water for drinking and cooking purposes. Since the initial discovery of contaminated wells, additional at-risk wells in the vicinity of Hamilton and Labree Roads were identified and tested. The Washington State Department of Ecology (Ecology) has been providing bottled drinking water to some of the affected residences and businesses, and in one case, installed a residential water treatment system.[1]

Environmental Investigations

In 1996, Ecology began an extensive environmental investigation in the vicinity of Hamilton and Labree Roads in an attempt to locate the source(s) of contamination. Ecology's investigation resulted in the installation, sampling and analysis of groundwater from 15 monitoring wells, the collection of soil samples from dozens of soil borings, and the collection and analysis of numerous surface water samples (Figure 5). To date, 11 residential wells and 11 business wells have been tested one or more times (Table 5). PCE concentrations have been measured as high as 190,000 ppb in groundwater, and 3,740 ppb in drinking water (Tables 1 and 3).[2] The federal drinking water standard for PCE is 5 ppb. Other breakdown products of PCE have also been detected in groundwater and drinking water, but at considerably lower levels (Table 1, 4, and 5).[3]

The contaminated groundwater plume is reasonably well characterized, although additional investigation is ongoing. Drinking water wells considered to be at risk of contamination have been identified and tested. Two primary sources of groundwater contamination have been identified in the study area; one northeast of the intersection of Hamilton and Labree Roads, and the other about one quarter mile east of the first source area, on Hamilton Road near MW-3 (Figure 6).[1] To date, only wells in the shallow groundwater have been impacted. Deeper aquifer wells have been tested, but have not shown contamination.[2]

In September 1999, an excavation near one of the source areas revealed three layers of buried 55-gallon drums. A total of 64 drums were ultimately excavated. The contents of the drums were characterized, then transported to a licensed RCRA disposal facility. The contents revealed many of the same chemicals detected in area groundwater and drinking water.[4] A potentially liable party (PLP) has been identified, and negotiations between EPA and the PLP are ongoing.[5]

In July 2000, the Environmental Protection Agency (EPA) listed the Hamilton/Labree Roads groundwater contamination area as a National Priorities List (NPL) site, and assumed lead agency status from Ecology. In August 2000, EPA held meetings with community members, local health, and Lewis County Commissioners to hear community concerns about the site.[6] The Community

Health Concerns Evaluation section in the health assessment addresses health concerns generated at that meeting. Since the summer of 2000, the EPA has conducted additional environmental investigations in an attempt to locate other source areas and to provide information necessary for the development of a groundwater cleanup plan. The EPA is currently negotiating with the PLP to recover the costs of additional investigations and cleanup plan.

DOH, Ecology, Lewis County, and EPA involvement continues, although Ecology's involvement will end in June 2001.[7] The Public Health Action Plan at the end of this report lists the major agency site activities from 1993 to the present.

Health Evaluations

Between 1996 and 2000, DOH prepared a series of health consultation reports which evaluated the potential health impacts for persons who were exposed to chemicals detected in the six most contaminated wells. At the request of one area resident and the Department of Agriculture, DOH also prepared a health consultation evaluating raw milk samples collected from local dairy cows reported to have been exposed to PCE-tainted water. The health consultations are entitled:

1. Washington State Department of Health, Site Assessment Section. Health Consultation: *Hamilton Road PCE, Chehalis, Lewis County, Washington.* December 23, 1996.

2. Washington State Department of Health, Site Assessment Section. Health Consultation: *Evaluation of Contaminants: Residential Domestic Well Near the Hamilton/Labree Road PCE Site.* August 27, 1999.

3. Washington State Department of Health, Site Assessment Section. Health Consultation: *Evaluation of Raw Dairy Cow Milk Samples, Lewis County, Washington.* July 31, 2000.

Public Health Assessment Conclusions

1) No current public health hazard exists for persons exposed to drinking water in the Hamilton/Labree Roads area since affected residents and businesses began using bottled water, or in one case, received water treatment.

2) No current public health hazard exists for persons using drinking water from wells located at businesses and residences along Rice and Bishop Roads. Well test results from businesses and residences located on Rice Road showed either no chemical detections or very low detections. Well test results from businesses and residences located along Bishop Road on the east side of Interstate 5 showed no chemical detections.

3) Levels of PCE detected in soil samples and VOCs detected in Berwick Creek surface water samples do not pose a public health hazard.

4) An indeterminate public health hazard exists for persons potentially exposed to contaminants in indoor air as a result of volatilization from the groundwater or from tap water at some area businesses or residences.

5) A public health hazard existed for persons exposed in the past to elevated levels of PCE and other VOCs detected in five wells; two serving businesses along Hamilton Road, and three serving residences near Hamilton and Labree Roads.

Recommendations

1) Residences and businesses who have been provided with alternate water sources should not to use their well water for household purposes.

2) EPA should conduct indoor air sampling at residence HL-9, and evaluate other at-risk businesses and residences where levels of VOCs in indoor air could pose a health hazard.

3) EPA should verify that residents living in the mobile home across from residence HL-9 are using the deeper of the two wells located on the property. This deeper well should be sampled and analyzed for VOCs.

4) A long-term, safe drinking water supply should be implemented for businesses and residents within the Hamilton/Labree Road site.

5) Previous recommendations by DOH and Ecology to restrict well drilling in the area of groundwater contamination should be adhered to.

Purpose and Health Issues

After a number of years of involvement by Ecology and the local and state Health Departments, in May 2000, the EPA proposed the Hamilton/Labree Road Groundwater Contamination site to its National Priorities List (NPL). After a public comment period, in July 2000, the site was formally listed on the NPL. This health assessment was prepared by DOH under a cooperative agreement with ATSDR to address past, present, and potential future exposures to hazardous substances in the environment, to recommend actions to protect public health, and to address community health concerns.

Background

A. Site Description and History

The Hamilton/Labree Roads Ground Water Contamination site (site) is located 3 miles southwest of the City of Chehalis, Washington in the south quarter of section 10, Township 13 North, Range 2 West of the Napavine Quadrangle (USGS 1985).[2] The study area encompasses about 32 acres in the vicinity of Hamilton and Labree roads (Figure 1).

In 1993, DOH testing revealed that six drinking water wells in the vicinity of the intersection of Hamilton and Labree Roads were contaminated with PCE. PCE levels ranged from 3 µg/l to 2,165 µg/l; reportedly the highest level found in drinking water in the state. Affected businesses and residences were notified of the results, and were advised to obtain alternate water sources. Ecology began supplying some of the affected businesses and residences with bottled water, and in

one case, a water treatment system. Since the initial discovery of contaminated drinking water wells, a number of other business and residential wells have been tested. Based on extensive area-wide groundwater and drinking water well testing since 1993, all at-risk wells in the vicinity of the known contaminated groundwater plume appear to have been identified.

Because of the high levels of VOCs in groundwater, and information indicating that drums of solvents may have been buried or released on the property located northeast of the Hamilton and Labree Roads intersection, in 1999, Ecology conducted geophysical investigations in the area. In September 1999, the investigation lead to the discovery of approximately sixty-four 55-gallon drums buried underneath the Bulldog Trailer building. All the drums contained sludge and water, and most were leaking at the time of removal. Sampling results indicated the presence of PCE, cis-1,2-dichloroethylene (cis-1,2-DCE), 1,1,1-trichloroethane (1,1,1-TCA), trichloroethylene (TCE), and vinyl chloride; many of the same chemicals detected in area groundwater.[4] A second source area ("B-2") , about one quarter mile east of the Bulldog Trailer building on Hamilton Road, is currently being investigated. Between 1996 and 2000, Ecology conducted extensive environmental sampling, continued to provide bottled water for area residents and businesses, maintained a water treatment system for one residence, and prepared numerous reports and site updates.

In the summer of 2000, EPA replaced Ecology as the lead regulatory agency, and added the site to its National Priorities List. EPA is continuing to locate source areas, identify PLPs, determine the extent of groundwater contamination, and ultimately begin remediating contaminated groundwater sources.

B. Demographics and Land Use

Approximately 800 people live within one mile of the site (Figure 3). The surrounding area consists of mixed light industrial, residential, and agricultural properties. Currently, no large public water system exists in the immediate area.

C. Regional/Site Hydrogeology

The Hamilton/Labree Road Groundwater Contamination site lies within the Newaukum River Valley. Generally, the valley is underlain by approximately 40 feet of alluvium on top of bedrock. The alluvium is unconsolidated fine to course-grained glaciofluvial and recent alluvial sediments. A thin remnant of the Newaukum terrace unit underlies the alluvial deposits in some parts of the river valley. The Newaukum terrace unit is generally a poorly sorted mixture of sand and gravel, bound in a matrix of clay and silt. The bedrock is composed of a sequence of fine-grained nonmarine sedimentary deposits.[1, 2]

Based on recent drill logs, the study area consists of about 30 to 35 feet of poorly sorted gravel with varying amounts of fine to medium sand in a matrix of silt, clay, and cobbles. Interbedded within the gravel unit are several discontinuous silt lenses ranging in thickness from one to seven feet. The unit in which most of the wells are screened (the shallow wells), consists of poorly sorted fine to medium sand with silt, some fine to medium gravel, and a trace of cobbles. At the base of this sand unit, a thick bluish-grey clayey silt layer is located at a depth of 45 to 48 feet bgs. Elevations of the upper surface of the clay layer suggest that the unit is dipping in a west-northwest

direction, with about three feet of relief across the site. Within the study area, the clay layer is believed to act as an aquitard separating the shallow, unconfined aquifer from the deep, nonmarine aquifer (Figure 7).[2, 4]

Data suggest that regional groundwater flow in the shallow aquifer is toward the west-northwest, and possibly discharges to the Newaukum River, located approximately 2,000 feet northwest of the study area. Groundwater level contours indicate that seasonal groundwater table variation has no significant influence on the groundwater flow direction. The shallow aquifer is believed to be locally connected to surface waters, such as Berwick Creek.[1, 4]

The known contaminated drinking water wells are located in the shallow aquifer. Depth to groundwater in the shallow aquifer ranges from 0.5 feet bgs to 8.8 feet bgs, depending on the season. Groundwater level fluctuations are influenced directly by surface recharge during precipitation cycles.[2] To date, VOC contamination has not been found in wells completed in the deeper aquifer, located approximately 150 to 200 feet bgs. There are a total of 252 drinking water wells within four miles of the site screened within the shallow aquifer.[4] Eleven drinking water wells have been identified and tested in the shallow aquifer in the immediate vicinity of Hamilton and Labree Roads; wells HL-2 through HL-5, HL-7, HL-9, and another residential well. Four wells on Rice Road were also tested; HL-16, HL-17, and two others (Figures 4-6, and Table 5).

D. Environmental Investigations

Since the initial discovery of contaminated wells in the Hamilton and Labree roads study area in 1993, a number of environmental investigations have occurred, and are discussed below.

1. DOH collected and tested water samples from a total of 18 area business and residential drinking water wells in September, October, and November 1993, March 1994, June 1996, and October 1997.

2. Ecology completed four quarterly environmental sampling events (October 1997, and January, April, and July 1998), and three semi-annual sampling events (February and July 1999, and February 2000). These sampling events included the collection of water samples from 15 monitoring wells which Ecology installed, and from numerous domestic wells in the study area.

3. Between 1997 and 2000, Ecology tested a total of 13 drinking water wells one or more times. The wells serviced three businesses and 10 residences in the Hamilton/Labree Road area.

4. Ecology conducted extensive geophysical investigations in an attempt to locate source areas

5. Ecology collected and analyzed dozens of site surface and subsurface soil samples in the Hamilton/Labree Road study area

6. Ecology collected and analyzed surface water samples from four locations in Berwick Creek, and one from a culvert across Interstate I-5.

7. EPA conducted a Phase I Removal Assessment in the summer of 2000. The investigation included the collection of 151 soil samples, 25 groundwater samples from existing monitoring wells, water samples from three drinking water wells, and installation of six new monitoring wells.

8. EPA conducted a Phase II Removal Assessment in the summer of 2000. The investigation included the collection of 30 soil samples, 24 groundwater samples, three private well samples, and a background sample.

9. EPA conducted a round of sampling in January 2001, which included the collection water samples from all existing monitoring wells, six new monitoring wells, and four drinking water wells.

E. Nature and Extent of Contamination

Since 1997, DOH, Ecology and EPA have collected hundreds of environmental samples from the soil, groundwater, drinking water, and surface water. To date, the only media in which contaminants have been detected at levels of health concern is the groundwater and drinking water. The following sections discuss the nature and extent of contamination these media.

Groundwater and Drinking Water

Although the full nature and extent of groundwater contamination is still being investigated, it has been fairly well characterized in the study area, and appears to encompass approximately 32 acres (Figure 1). Sampling locations and a geologic cross section across a portion of the Hamilton/Labree Road site are presented in Appendix A. PCE concentrations in the shallow aquifer have been measured as high as 190,000 ppb near the United Rentals property. To date, no VOCs have been detected in the deeper aquifer. Concentrations of PCE in drinking water wells have been measured as high as 3,740 ppb (residence HL-9). Maximum concentrations and locations of PCE and other VOCs detected in monitoring wells and drinking water wells are presented in Figures 1 through 4 in Appendix A. The aquifer depth (shallow or deep) in which each of the domestic wells were sampled, the average PCE concentrations detected in the six most contaminated wells, and the type of well (business or residential), are presented in Table 5.

To date, contamination appears to be concentrated in two areas within the Hamilton/Labree Roads site; one on the Bulldog Trailer property, immediately northeast of the intersection of Hamilton and Labree Roads, and the other about one quarter mile east of Hamilton and Labree Roads, near boring B-2, between Hamilton Road and I-5, across from the United Rentals property.[1] EPA is continuing to assess the upgradient source of PCE contamination and the extent of the PCE plume near the B-2 source area. Geophysical investigations have revealed subsurface anomolies in other area locations, but have not been further investigated.[7]

The known contaminated groundwater plume is bounded roughly by the area just west of Hamilton and Labree roads to the west, monitoring well MW-1 and boring 16 to the north, Interstate 5 to the east, and wells HL-5 and HL-6 to the south (Figures 5 and 6). Because of past ingestion and inhalation exposures to elevated levels of VOCs in drinking water, and current potential inhalation exposures due to the potential migration of VOCs from the groundwater to indoor air, these pathways will be discussed in more detail in the Discussion section.

Soil

Both Ecology and EPA collected and tested dozens of soil samples from locations throughout the Hamilton/Labree site. Samples were submitted for analysis and tested for specific halogenated hydrocarbons and BTEX (EPA methods 8010/8020, and 8260). Some soil samples were also tested in an on-site mobile field laboratory.[1, 2]

PCE was the only contaminant detected in the soil. The maximum PCE concentration detected was an estimated concentration of 53 mg/kg from a sample collected 40 feet below ground surface near the United rentals property along Hamilton Road (Table 6). PCE concentrations in surface soil were considerably lower than this, or were not detected at all. Since contact with the maximum PCE concentration is highly unlikely, the PCE concentration was well below a level of health concern, and no other contaminants were detected in the soil, this pathway will not be discussed further in the health assessment.

Surface Water

Surface water samples were collected from three stations in the study area along Berwick Creek. An additional surface water sample was collected at the culvert entrance on the east side of I-5. Samples were collected starting downstream and moving upstream to avoid disturbance and possible cross-contamination.[1] The results are presented in Table 7.

A total of four VOCs were detected in surface water from Berwick Creek; TCE, cis-1,2-dichloroethylene, and styrene at individual locations, and PCE at two locations. Only PCE was detected at a concentration slightly exceeding a health comparison value (the 5 ppb drinking water standard, or MCL). The source of PCE at sample location BERSW1 is believed to be an adjacent residential septic system reference. The location of the other PCE detection was from a surface water sample adjacent to Hamilton Road, near United Rentals (BERSW3).[7] Because Berwick Creek is not used as a source of drinking water, and because prolonged exposure (i.e., ingestion) to the surface water in the creek at this location is very unlikely, DOH does not consider it to be a pathway of concern at this site, and it will not be discussed further in the health assessment.

Discussion

A. Introduction

The following sections discuss the potential health effects associated with exposure to PCE in drinking water and resulting health effects. Health effects are separated into cancer and non-cancer endpoints. Methods for assessing these types of health effects are also described.

RfDs and MRLs

Oral reference doses (RfDs) and minimal risk levels (MRLs) are levels of daily exposure to chemicals below which non-cancer health effects are not expected. MRLs are set by ATSDR for acute, intermediate, and chronic exposure. EPA sets RfDs based on chronic exposure only. An MRL or RfD is derived by dividing a LOAEL or NOAEL by "safety factors" to account for uncertainty and provide added health protection.

Evaluating Non-cancer Risk

In order to evaluate the potential for *non-cancer* adverse health effects that might result

from exposure to contaminated media (i e., air, water, soil, and sediment), a dose is estimated for each contaminant of concern. These doses are calculated for situations (scenarios) in which residents might come into contact with the contaminated media. The estimated dose for each contaminant under each scenario is then compared to ATSDR's minimal risk level (MRL) or EPA's oral reference dose (RfD). MRLs and RfDs are doses below which non-cancer adverse health effects are not expected to occur (so called "safe" doses). They are derived from toxic effect levels obtained from human population and laboratory animal studies. These toxic effect levels can be either the lowest observed adverse effect level (LOAEL) or a no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse health effect is seen, while the NOAEL is the highest dose that does not result in any adverse health effects.

Because of the uncertainty in these data, the toxic effect level is divided by "safety factors" giving the lower and more protective MRL or RfD. If a dose exceeds the MRL or RfD, this indicates only the potential for adverse health effects. The magnitude of this potential can be inferred from the degree to which this value is exceeded. If the estimated exposure dose is only slightly above the MRL or RfD, then that dose will fall well below the toxic effect level. The higher the estimated dose is above the MRL or RfD, the closer it will be to the toxic effect level. The combined effect of the contaminants of concern was considered by *adding* the estimated doses. *Past exposures to VOCs detected in several drinking water wells were estimated to exceed a "combined" RfD* (also known as a hazard index).

Evaluating Cancer Risk

Some chemicals have the ability to cause *cancer*. Cancer risk is estimated by calculating a dose and multiplying it by a cancer potency factor, also known as the cancer slope factor. Some cancer potency factors are derived from human population data; others are derived from laboratory animal studies involving doses much higher than are encountered in the environment. Use of animal data require extrapolation of the cancer potency obtained from these high dose studies to "real-world" exposures. This process involves much uncertainty. Current thinking suggests that there is no "safe dose" of a carcinogen and that a very small dose of a carcinogen will give a very small cancer risk. Cancer risk estimates are, therefore, not *yes/no* answers but measures of chance (probability). Such measures, however uncertain, are useful in determining the magnitude of a cancer threat since any level of a carcinogenic contaminant carries an associated risk. The validity of the "no safe dose" assumption for cancer-causing chemicals is not clear. Some evidence suggests that certain chemicals considered to be carcinogenic must exceed a threshold of tolerance before initiating cancer.

This document describes cancer risk qualitatively using terms like *moderate, low, very low, slight* and *no significant* increase in cancer risk. These terms can be better understood by considering the population size required for such an estimate to result in a single cancer case. For example, a low increase in cancer risk indicates an estimate in the range of one cancer case per ten thousand persons exposed over a lifetime. A very low increase might result in one cancer case per several tens

Cancer Risk

Cancer risk estimates do not reach zero no matter how low the level of exposure to a carcinogen. Terms used to describe this risk are defined below as the number of additional cancers expected in a lifetime:

Term		# of Additional Cancers
moderate	is approximately equal to	1 in 1,000
low	is approximately equal to	1 in 10,000
very low	is approximately equal to	1 in 100,000
slight	is approximately equal to	1 in 1,000,000

of thousands exposed over a lifetime while a slight increase would require an exposed population of several hundreds of thousands to result in a single case. DOH considers cancer risk to be not significant when the estimate results in less than one cancer per one million exposed over a lifetime. The reader should note that these estimates are for *excess* cancers that might result in addition to those normally expected in an unexposed population.

Cancer is a common illness and its occurrence in a population increases with age. Depending on the type of cancer, a population with no known environmental exposure could be expected to have a substantial number of cancer cases. There are many different forms of cancer that result from a variety of causes. Some forms of cancer are more serious than others and not all are fatal. Approximately one quarter to one third of people living in the United States will develop cancer at some point in their lives.[8]

Since PCE accounted for the overwhelming majority of the risk from ingestion and inhalation, it is discussed in detail below. Other contaminants of concern listed in Table 4 (primarily PCE degradation products) were detected less frequently, in fewer drinking water wells, and at considerably lower concentrations.[3] Additionally, exposure to these other contaminants of concern have been shown to produce similar toxic effects as PCE. Toxicological references for the other site-related contaminants of concern are listed in the Reference section at the end of the health assessment. PCE toxicity is discussed below.

B. Health Implications: Tetrachloroethylene (PCE) Exposure

PCE is a manufactured compound widely used for dry cleaning fabrics and as a metal degreaser. It is also used as an intermediate in the manufacturing of other products. It is a nonflammable liquid at room temperature, evaporates easily into the air, and has a sharp, sweet odor. Most people can smell tetrachloroethylene when it is present in the air at a level of one part per million (ppm) or more. In an experiment, some people could smell tetrachloroethylene in water at a level of 300 part per billion (ppb).[9] Cancer and noncancer toxicity is discussed below.

Non-cancer Effects

Information on systemic, non cancerous health effects associated with oral exposure by humans to PCE is limited.[9]

The nervous system is a major target organ in humans exposed to tetrachloroethylene by inhalation. Acute exposure, depending on concentration, can result in reversible mood and behavioral changes, impairment of coordination, or anesthetic effects.[9, 10]

PCE Toxicity

In 1987, the Environmental Protection Agency (EPA) proposed PCE as a probable human carcinogen. In light of more recent data, EPA reclassified PCE as a possible human carcinogen - probable human carcinogen continuum. An EPA workgroup is currently reassessing PCE carcinogenicity. Some studies suggest an association between exposure to PCE and

Some immunological abnormalities were found in 23 adults in Woburn, Massachusetts who were exposed to contaminated water and who were family members of children with leukemia. In the Woburn population, there was also a suggestion of an association between cumulative exposure to contaminated wells and increased urinary tract infections and respiratory disorders (asthma, bronchitis, pneumonia) in children.[9] The study had significant limitations, however, and the association between the drinking water exposures and these health effects was inconclusive.

Liver and kidney damage have been observed in laboratory animals after exposure to high doses of PCE. Liver weight/body weight ratios were significantly higher than controls for animals treated with 100 mg/kg/day of PCE. At higher doses, hepatotoxic effects included decreased DNA content and hepatocellular necrosis, degeneration, and polyploidy.[10] The doses used in these animal studies were much higher than those estimated for the most highly exposed residents at the Hamilton/Labree site.

The oral RfD of 0.01 mg/kg/day is based on liver toxicity in mice and weight gain in rats, and is reported to be protective of the most mild effects observed in humans [diminished odor perception/modified Romberg test scores in volunteers exposed to 100 ppm for 7 hours; roughly equivalent to 20 mg/kg/day].[10]

The dose estimated for children chronically exposed to the average level of PCE detected in well HL-9 (the most contaminated well) was 37 times higher than the oral RfD, while the estimated dose for adults was 12 times higher. These dose estimates indicate the potential for noncancer health effects. The RfD was derived from a NOAEL of 14 mg/kg/day, and a LOAEL of 71 mg/kg/day, based on hepatotoxicity in mice and weight gain in rats.[10] Although the estimated exposures were above the RfD, they were 38 and 117 times lower than the NOAEL for a child and adult, respectively.

Cancer Effects

Studies of persons exposed PCE and other chlorinated solvents in drinking water in Massachusetts, New Jersey, and Finland were evaluated for possible associations between exposure to PCE and cancer effects. Although some of these studies suggested a possible association between exposure to PCE and various cancers, including bladder cancer, kidney cancer, and leukemia, the studies had limitations which precluded definitive conclusions.[10]

Cancer has been reported in experimental animals after oral exposure to PCE. Statistically significant increases in hepatocellular carcinomas occurred in the treated mice of both sexes. A cancer effect level (CEL) of 386 mg/kg/day was derived from a chronic mouse study. The cancer effects in this study were hepatocellular carcinomas.[9] Estimated exposures for children and adults chronically exposed to PCE from well HL-9 were 1,000 times to over 3,000 times below *this CEL, respectively.*

An EPA workgroup is currently reassessing PCE carcinogenicity, and so has removed the oral slope factor. Completion of the reassessment, which was announced in the January 2, 1998 Federal Register notice, was planned for FY 1999 or FY 2000, but is still being evaluated. In 1987, an EPA carcinogen assessment proposed PCE as a probable human carcinogen. In light of new data, EPA reviewed findings that suggest the weight-of-evidence for PCE as a possible human carcinogen - probable human carcinogen continuum. Presently, the agency has not adopted a final position on the classification of human carcinogenicity for this chemical. However, the International Agency for Research on Cancer (IARC) lists PCE as a Class 2A carcinogen (probably carcinogenic to humans, based on limited human evidence and sufficient evidence in animals).[9, 10]

In order to estimate the cancer risk from exposure to PCE, the former oral slope factor was used. *A moderate increase in cancer risk was estimated for adults and children chronically exposed to the average concentration (3,200 µg/l) of PCE in drinking water from well HL-9. Exposure was*

assumed to occur via both ingestion and inhalation over a period of 11 years. This estimate can be approximated as one additional cancer expected in a population of 1,000 persons exposed.

Multiple Chemical Exposure

In almost every situation of environmental exposure, there are multiple contaminants to consider. The potential exists for these chemicals to interact in the body and increase or decrease the potential for adverse health effects. The vast number of chemicals in the environment make it impossible to measure all of the possible interactions between these chemicals. Individual cancer risk estimates can be *added* since they are measures of probability. When estimating non-cancer risk, however, similarities must exist between the chemicals if the doses are to be added. Groups of chemicals that have similar toxic effects can be added such as volatile organic compounds (VOCs) which cause liver toxicity. Polycyclic aromatic hydrocarbons (PAHs) are another group of chemicals that can be assessed as one added dose based on similarities in chemical structure and metabolites. Although some chemicals can interact to cause a toxic effect that is *greater than* the added effect, there is little evidence demonstrating this at concentrations commonly found in the environment.

Some effort has been made to assess the toxicity of chemical mixtures commonly found in groundwater. One group of researchers selected a mixture of 25 chemicals that are frequently found in groundwater at hazardous waste sites for administration to mice via drinking water. One study of this mixture examined effects on the immune system while the other looked for reproductive toxicity.[11, 12] No adverse reproductive effects were seen while some immune responses were suppressed at the higher doses. Based on previous studies, the authors concluded that these contaminants given alone at the same doses would not have shown immune suppression activity. Although this result is suggestive of potential interactions between contaminants present in drinking water, the doses used in this study were still relatively high compared to what is often found in contaminated water supplies.

The studies noted above provide some evidence that interactions between chemicals in a mixture can result in toxicity that is not apparent from a single agent. However, the mechanisms of these interactions are poorly understood and have not been demonstrated in humans at environmentally relevant exposures. Finally, the study of chemical mixtures is in its infancy and is a recognized deficiency in the toxicological database. The limited information cited above suggests that immunological endpoints could be a target of such an exposure.

Since the chemicals of concern detected in drinking water wells at this site (PCE and its degradation byproducts) have similar toxicological endpoints (i.e., liver, kidney, and central nervous system effects), the cancer and non-cancer risks were assumed to be additive. As a result, cancer and non cancer risk estimates from past exposure to PCE may be higher than those discussed in the previous section.

Child Health

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children deserve special emphasis with regard to exposures to environmental contaminants. Infants, young children, and the unborn may be at greater risk than adults from exposure to particular contaminants. Exposure during key periods of growth and development may lead to malformation of organs (teratogenesis), disruption of function, and even premature death. In certain instances, maternal

exposure, via the placenta, could adversely effect the fetus. After birth, children may receive greater exposures to environmental contaminants than adults. Children are often more likely to be exposed to contaminants from playing outdoors, ingesting food that has come into contact with hazardous substances, or breathing soil and dust. Pound-for-pound of body weight, children drink more water, eat more food, and breathe more air than adults. For example, in the United States, children in the first 6 months of life drink seven times as much water per pound as the average adult. The implication for environmental health is that, by virtue of children's lower body weight, given the same exposures, they can receive significantly higher relative contaminant doses than adults.

Reproductive health effects

Adverse reproductive health effects in women have been reported to be associated with occupational exposures to PCE in the drycleaning industry. These effects included menstrual disorders and spontaneous abortions. However, limitations of these studies precluded a definitive association between PCE exposure and these health effects.[9]

Developmental health effects

The developing fetus, children, and especially the developing nervous system may be particularly susceptible to the toxic effects of PCE. Animal studies suggest that PCE can cross the placenta and that TCA, a metabolite of both PCE and TCE, concentrates in the fetus. Unmetabolized PCE has been excreted in breast milk, and in one health study, was detected in an exposed infant with liver damage. Rats that were given oral doses of tetrachloroethylene when they were very young, while their brains were still developing, were hyperactive when they became adults. It is not known whether tetrachloroethylene may have similar effects on the developing brain in human babies.[9]

In Woburn, Massachusetts, studies of residents exposed to drinking water contaminated with solvents, including PCE, suggest the possible association of exposure to PCE and eye/ear anomolies and central nervous system/chromosomal/oral cleft anomolies.[9] However, it is unclear whether other confounding factors might have influenced these health outcomes.

ATSDR's 0.05 mg/kg/day acute-duration oral minimal risk level (MRL) for PCE is based on a 5 mg/kg/day lowest observed adverse effect level (LOAEL). The LOAEL is based upon developmental effects observed in mice.[9] Although estimated past child exposures to PCE from well HL-9 were below the LOAEL, they exceeded the acute-duration MRL. *As a result, past child exposures to PCE at levels detected in drinking water at this residence could have posed a developmental health risk, particularly since the resident at this location was pregnant at the time of exposure.*

Health Outcome Data Evaluation

Health outcome data are investigated when the concentrations of the chemicals of concern are at levels where we might expect to find adverse health effects. Studies indicate that chronic exposure to levels of PCE and several other contaminants detected in some of the business and residential drinking water wells in the Hamilton/Labree area could result in a moderate increased risk of developing cancer, and may have posed a non-cancer health risk for some residents. These risks were discussed in this health assessment, and in previous health consultations prepared by DOH. All businesses and residents whose wells had detectable levels of contaminants are currently

receiving bottled water or water treatment. Currently, only two contaminated wells serving two businesses (HL-2 and HL-3) are still in use. In both cases, bottled drinking water is being used, so current drinking water exposures have been eliminated. DOH is currently evaluating the potential threat that VOCs in groundwater might pose to indoor air at residences and businesses located above the groundwater plume.

One major problem associated with investigating small exposed populations such as the population in the vicinity of the Hamilton/Labree site is that increases in cancer rates must be very high for them to be detected by epidemiological methods. Any future analysis of cancer rates associated with exposure to PCE or other VOCs in the Hamilton/Labree Roads contaminated groundwater site groundwater would have to include other exposed populations in order to enhance the statistical power to the study. Since all persons known to have been exposed have been identified and informed about the risks, and drinking water exposures have been eliminated, DOH does not feel it would be useful to conduct an epidemiological study evaluating cancer incidences in this area at this time. Additionally, DOH has already worked closely with the most effected residents to assist them in obtaining follow-up medical evaluations, and has offered to continue this service.

Community Health Concerns

The following community health concerns were gathered from meetings held in August 2000 between the EPA and the Lewis County Commissioners, the Lewis County Health Department, and several area residents. EPA also spoke with DOH.[6] The questions and comments received by DOH are listed below, and are followed by a response.

1. Some people asked if PCE is passed through the food chain, and if a person can be effected by eating the meat of an animal who drank contaminated water.

DOH response: Experimentally measured bioconcentration factors (BCFs), which provide an indication of the tendency of a chemical to partition to the fatty tissue of organisms, are fairly low, and suggestive of a low tendency to bioconcentrate in animals. Studies of PCE in the tissues of a wide range of organisms also suggest that the tendency for PCE to bioaccumulate in animals is low.[9] Because of it's rapid breakdown in the body, we would not expect to find PCE at high levels in the meat of an animal who drank contaminated water. Studies have shown the presence of PCE in dairy products, meat, and fruits and vegetables at very low levels; but below levels which we would expect to see cause health problems for exposed individuals. Because of community concerns, DOH prepared a health consultation evaluating the results of raw milk samples collected from cows from an area dairy farm.. No PCE was detected in the raw milk samples.[13]

2. Concerns were expressed about PCE contamination in local wells.

DOH response: PCE contamination in groundwater and some area drinking water wells has been a significant problem since its initial discovery in 1993, and is what prompted the extensive ongoing investigation. Since 1993, a concerted effort by all involved agencies has been made to identify and test all potentially at-risk wells in the vicinity of the Hamilton/Labree Roads site, including wells along Rice Road and along Bishop Road on the east side of Interstate 5. To date, a total of 22 domestic wells have been tested one or more times; 11 residential wells, and 11 business wells (Table 5). Of these, some have since been taken out of service, others are only used for non-drinking purposes, and one has a treatment system in place. Based on information collected from all areawide environmental investigations conducted to date, DOH has no reason to believe at this time

that other drinking water wells are at risk in this area. If your well has not been tested, if you are concerned, and if live in this area, DOH encourages you to call the Lewis County Department of Public Health or DOH to evaluate whether your well may be at risk.

As a precaution, DOH is currently evaluating the potential for VOCs in the groundwater to migrate into indoor air where people could become exposed through inhalation, and is recommending follow-up on this issue.

3. The Lewis County Health Department indicated that elevated levels of nitrates and tannins are present in wells.

DOH response: DOH has received no specific information or requests for evaluation of the wells in question, so cannot make any health conclusions about them at this time. The federal limit for nitrate in public water systems, known as the MCL, is 10 ppm. DOH has adopted this standard and considers it to be health protective. Infants exposed to nitrate above the MCL in their drinking water or formula mixed with water containing nitrate above the MCL could experience a condition known as methemoglobinemia. Pregnant women should not drink water with nitrate levels above the MCL due to the risk of adverse birth outcomes.

Conclusions

1. No current public health hazard exists for persons exposed to drinking water in the Hamilton/Labree Roads area since affected residents and businesses began using bottled water, or in one case, received water treatment

2. A public health hazard existed for persons previously exposed to elevated levels of PCE (and in some cases, PCE degradation byproducts) detected in wells servicing two businesses and four residences in the Hamilton/Labree Roads study area.

   Ingestion of drinking water and inhalation of vapors during showering were the primary routes of exposure. Long-term exposure to VOCs at the levels detected in these wells can pose both non-cancer and cancer health risks. Elevated levels of PCE, and PCE degradation products detected in one business well and three residential wells in the Hamilton/Labree Roads area are of concern for non-cancer adverse health effects. For persons exposed to contaminants in the majority of domestic wells tested in the area, non-cancer health effects are not anticipated.

   A moderate increase in cancer risk was estimated for persons exposed to levels found in residential well HL-9. These estimates of cancer risk are based primarily on animal experiments involving doses well above those estimated for persons previously exposed in the Hamilton/Labree area. Although most of the contaminants of concern are considered possible or probable human carcinogens, the limited human studies available have not *proven* that they cause cancer in humans.[9, 10] Levels of VOCs detected in other wells pose a much lower cancer risk. The exposures have stopped, and the residents most exposed were referred to environmental and occupational health physicians for medical follow-up.

3. An indeterminate public health hazard currently exists for residents and businesses in the vicinity of Hamilton and Labree Roads due to the *potential* for migration of VOCs from groundwater to indoor air. An indeterminate health hazard also exists for businesses along

Hamilton Road (i.e., Smith Tractor and United Rentals) due to volatilization of contaminants still present at elevated levels in tap water.

4 The low levels of PCE detected in water samples collected from one residential and one business well on Rice Road were below levels of health concern, and pose no apparent public health hazard.

5. No contaminants were detected in the seven residential and business wells sampled on the east side of Interstate 5, and therefore pose no public health hazard.

6. Maximum concentrations of PCE detected in the soil were from samples collected 40 feet below ground surface, were well below levels of health concern, and do not pose a health hazard.

7. Four VOCs were detected in surface water samples collected from Berwick Creek. Although PCE concentrations from two samples slightly exceeded the 5 ppb drinking water standard, long-term exposure in the creek is very unlikely, and therefore pose no public health hazard. Concentrations of the other three VOCs were well below their respective drinking water standards.

8. All potentially at risk wells within the Hamilton/Labree Roads groundwater contamination site appear to have been identified.

Recommendations

1) Businesses along Hamilton Road currently using bottled water due to elevated levels of PCE and other VOCs in their domestic water supply wells should continue doing so until these contaminants drop below levels of health concern, or until treatment or a long-term safe water supply is provided.

- DOH understands that the two businesses whose shallow wells remain contaminated with VOCs above drinking water standards (Hamilton/Smith Tractor and High Reach/United Rentals), are being supplied bottled water (High Reach/United Rentals) or are using their own bottled water for drinking (Hamilton/Smith Tractor).

2) Employees at High Reach/United Rentals should continue not to use the shower per previous DOH and Ecology recommendations, and should continue to maintain adequate ventilation to reduce the build up of VOCs inside the building.

- DOH will follow-up to assure that owners and employees of this business are adhering to these recommendations. DOH understands that water from a well screened in the deep, uncontaminated aquifer currently services the Hamilton/Smith Tractor business, so ventilation for VOCs from well water at this business would not be necessary.

3) Modeling and/or monitoring should be conducted for residence HL-9 to assess whether current levels of VOCs (PCE, TCE, DCE, vinyl chloride, and chloroform) in groundwater pose an inhalation health risk to residents at this location.

- DOH has discussed this issue with EPA, ATSDR, Ecology, and the residents who use this well. DOH is currently evaluating a model which estimates the concentrations of VOCs in indoor air at this residence based on groundwater VOC concentrations. If modeling and/or testing indicate a potential inhalation health hazard, DOH will work with EPA to assure that inhalation exposures are reduced or eliminated. DOH is also evaluating the need for indoor air monitoring at other area residences and for businesses along Hamilton Road where indoor air exposures are still occurring as a result of volatilization from domestic water (hand washing and cleaning).

4) DOH recommends verifying that the deep well is currently being used at the trailer across from residence HL-9. Water from the well being used should be tested to ensure that it is not contaminated.

- DOH or Lewis County will follow-up with the residents at this location to make sure the contaminated shallow well is not being used.

5) DOH should be notified if additional drinking water wells become threatened as a result of further migration of the contaminated groundwater plume, or if contaminant levels in Rice Road residential wells reach levels of health concern. EPA should continue the current domestic well sampling program and provide the results to DOH for review and evaluation.

- VOC levels from the most recent Rice Road domestic well tests were below levels of health concern, and no VOCs have been detected in wells on the east side of Interstate 5 to date. DOH will continue to evaluate domestic well sampling results.

6) EPA should investigate long term water supply options for businesses and residences in the vicinity of the Hamilton/Labree Roads groundwater contamination site.

- Interim measures, including bottled water and filtration systems, have been provided to some businesses and residences in this area.

7) County and local planning departments should ensure that no new wells are constructed in the Hamilton/Labree Roads groundwater contamination site.

- DOH will follow-up with Lewis County Public Works and EPA to assure that area well drillers are aware of the groundwater contamination. A copy of this report will be provided to Lewis County and area well drillers, among others.

8) The extent of the groundwater plume should be defined to assure that additional domestic wells are not threatened, and to provide the information necessary to develop a long term remedial action plan.

- DOH will keep appraised of the ongoing site investigation to assure that potential exposure to contaminants in additional wells do not occur.

Public Health Action Plan

The Public Health Action Plan (PHAP) for the Hamilton and Labree Roads Groundwater Contamination site is outlined below. The purpose of the PHAP is to ensure that this health assessment not only identifies public health hazards, but also provides a plan of action designed to prevent or mitigate adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and DOH to ensure that these actions are taken.

*Actions Taken by DOH/*ATSDR

- Between September 1993 and October 1997, conducted numerous rounds of domestic well-testing in the area of concern.
- Several health consultations were prepared and distributed to affected residents, businesses, and agencies. The health consultations evaluated the potential health effects associated with past exposure contaminated drinking water for the six most contaminated wells, and evaluated samples of raw dairy cow milk from an area dairy farm. The health consultations are listed in the Reference section of this report
- Provided health information and referred two families in the Hamilton/Labree area exposed to elevated levels of PCE to environmental and occupational health physicians for medical evaluation.
- In January 1996, sponsored an environmental health seminar at Providence Hospital in Chehalis to inform staff about community health concerns related to the site.
- Prepared and mailed numerous letters and health update notices to agencies and affected residences.
- Requested that one well owner stop supplying residents water from his shallow, contaminated well, and switch to his deep, uncontaminated well.
- Reminded residents, whose past exposures were highest, of DOH's continued willingness to assist with additional medical follow-up, if requested.

Actions Taken by Ecology

- From 1996 to 2000, conducted extensive environmental investigations to identify source areas, which included sampling and analysis of soil, groundwater, and surface water.
- Supplied bottled water to a number of affected businesses and residences in the study area..
- Installed and maintained water treatment system for one residence.
- Collected, analyzed, and reported the results of well samples from many area domestic wells.
- Prepared numerous news releases and community site update notices.
- Provided letters to area well-drillers recommending restrictions on well drilling in the area of groundwater contamination.

Actions taken by Lewis County

- Notified affected residents after initial discovery of PCE in area wells.
- Provided DOH and Ecology information on area wells and well owners.
- Prepared joint agency fact sheets about site activities and findings.
- Currently evaluating the feasibility of a permanent, public water supply to area residences.

Actions taken by EPA

- Conducted a Preliminary Assessment and Site Investigation which resulted in NPL listing for the study area.
- Continuing where Ecology left off in an attempt to delineate source areas. Extensive environmental investigations of soil, groundwater, domestic wells, and surface water to help define the extent of contamination.
- Invited community members to participate in interviews with representatives of EPA to voice their health concerns, and general concerns about the site.
- Prepared several fact sheets for the community near the site.
- Developed a website which summarizes site activities.
- Prepared various environmental investigation reports and a Community Involvement Plan.
- Currently evaluating interim remedial actions to limit or prevent the spread of contaminated groundwater.
- Drafting an Agreed Order to one Potentially Liable Party (PLP).

Actions Planned

- DOH will work closely with EPA to evaluate the potential groundwater and tap water indoor air pathway for area residences and businesses.
- DOH will continue to work with Lewis County to ensure that no new residential drinking water wells are constructed in the vicinity of the Hamilton/Labree groundwater contamination site.
- DOH will work with EPA and Lewis County to update the community about ongoing activities, and to follow-up with any remaining community health concerns.
- EPA will continue its efforts to define source areas and the extent of the groundwater contamination, and develop a cleanup plan for the site.
- DOH will work closely with EPA to follow-up on recommendations made in this health assessment.
- DOH will evaluate the results of the January 2001 Phase II investigation, when they become available.

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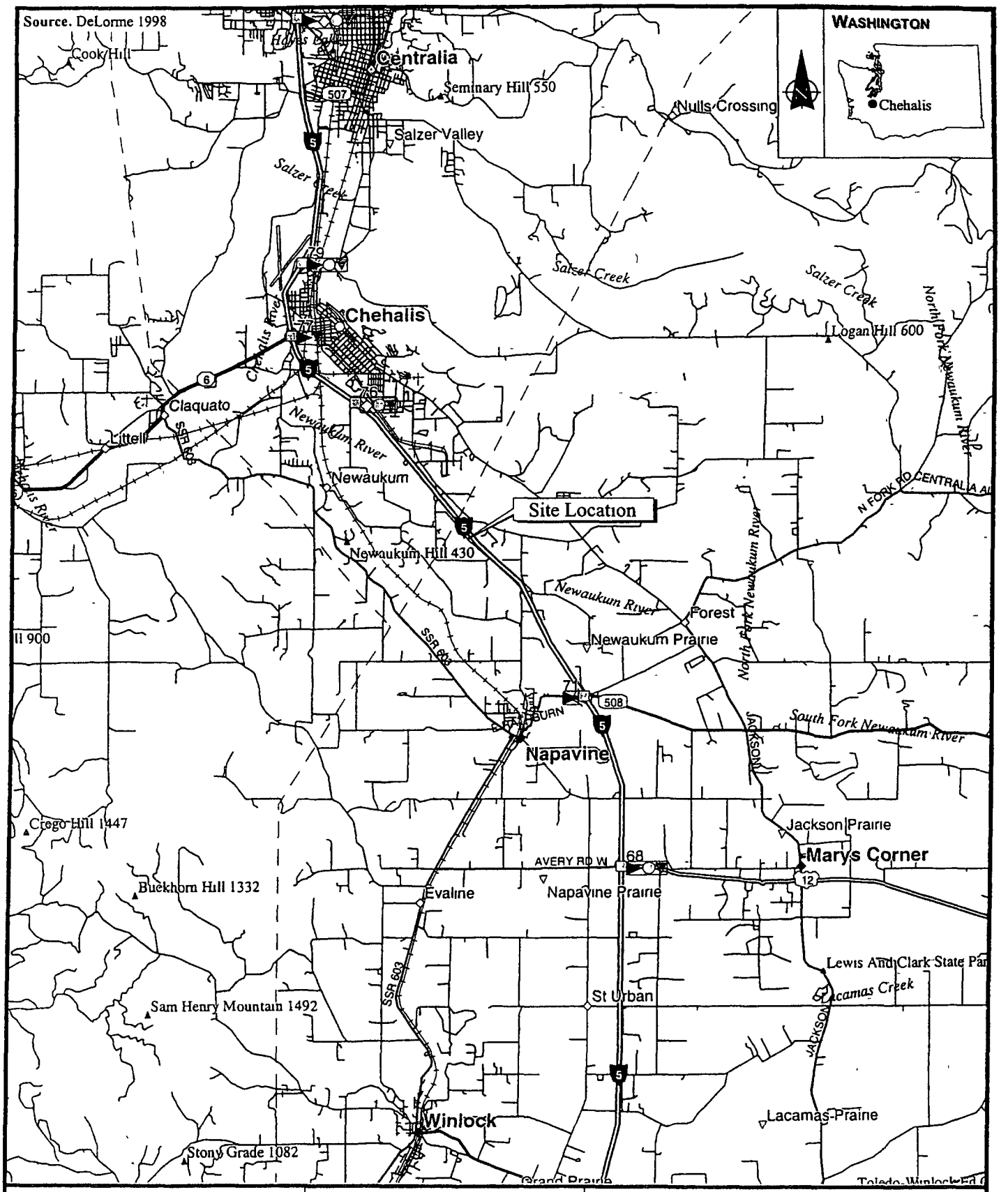
Appendix A

Figures



ecology and environment, inc.
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Seattle Washington

HAMILTON - LABREE
Chehalis, Washington

SITE LOCATION MAP

0 1 2
Approximate Scale in Miles

Date	TDD No	PAN No	Dwg No	Pubs No
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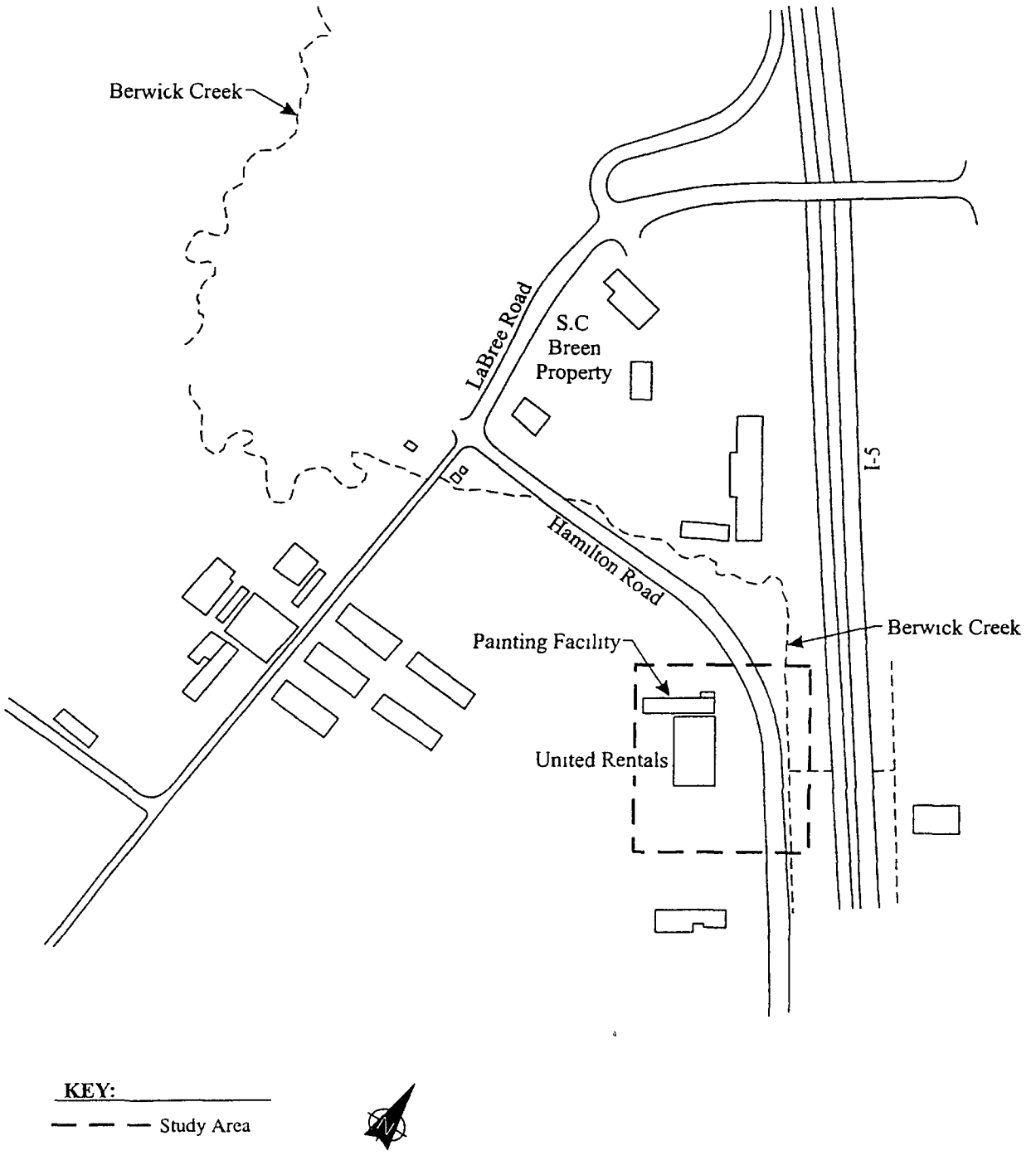
Drawn by AES

Figure 1

Source SAIC, 1997



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HAMILTON - LABREE
Chehalis, Washington

STUDY AREA

0 450 900
Approximate Scale in Feet

Date	TDD No	PAN No	Dwg No	Pubs No
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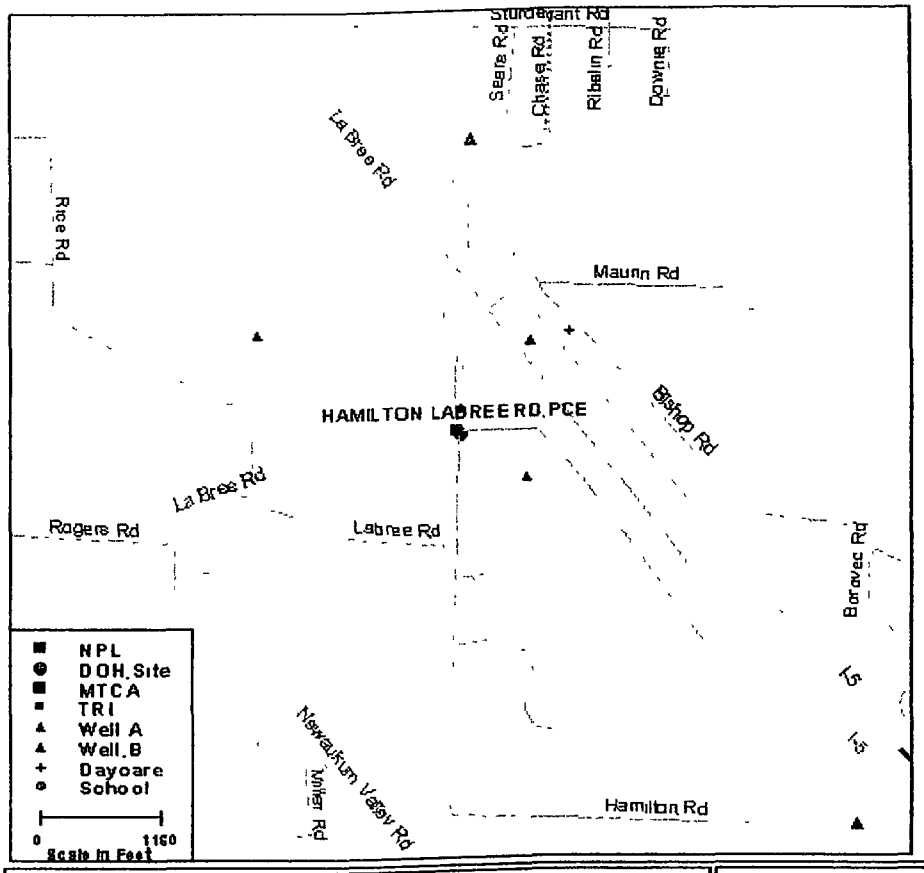
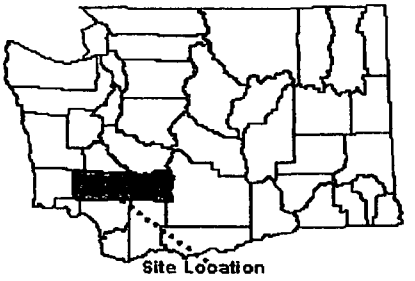
Drawn by AES

Figure 2

Health



Lewis County



Demographic Statistics Within One Mile of the Site*

Total Population	370
White	360
Black	0
American Indian, Eskimo, Aleut	0
Asian or Pacific Islander	0
Other Race	10
Hispanic Origin	12
Children Aged 6 and Younger	36
Adults Aged 65 and Older	58
Females Aged 15 - 44	72
Total Aged over 18	284
Total Aged under 18	86
Total Housing Units	154

* Calculated using the area proportion technique Source. 1990 U S. CENSUS

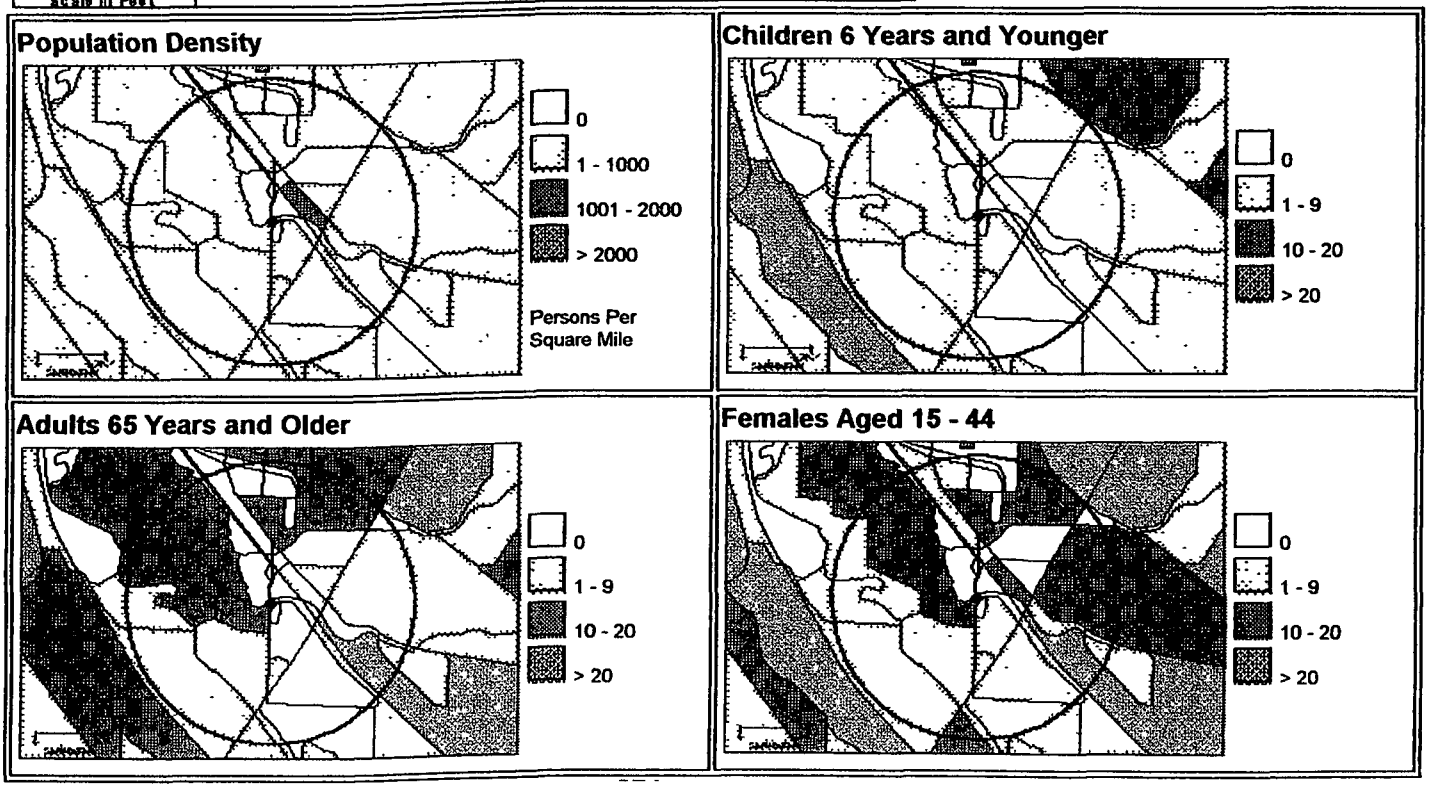
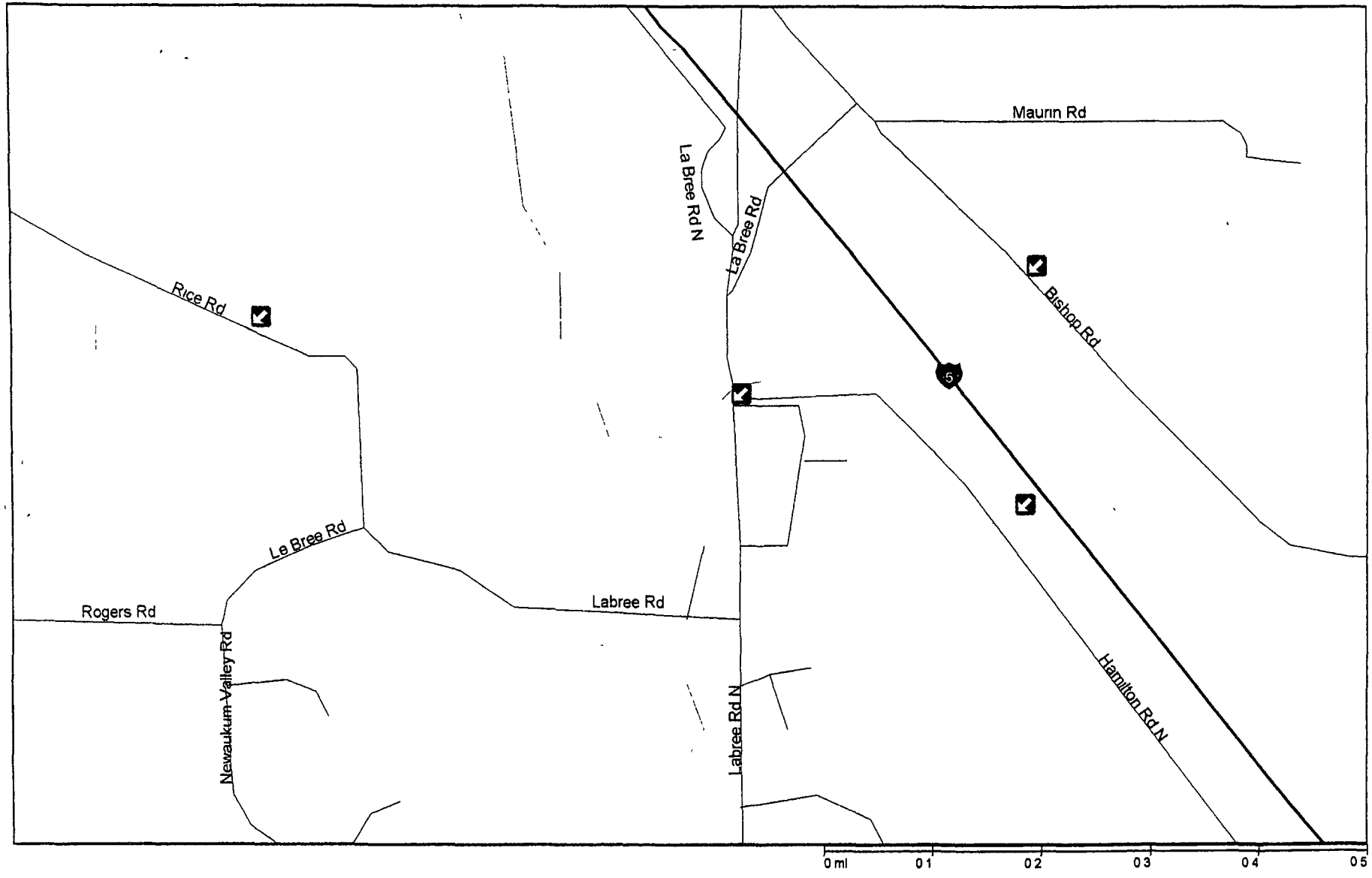
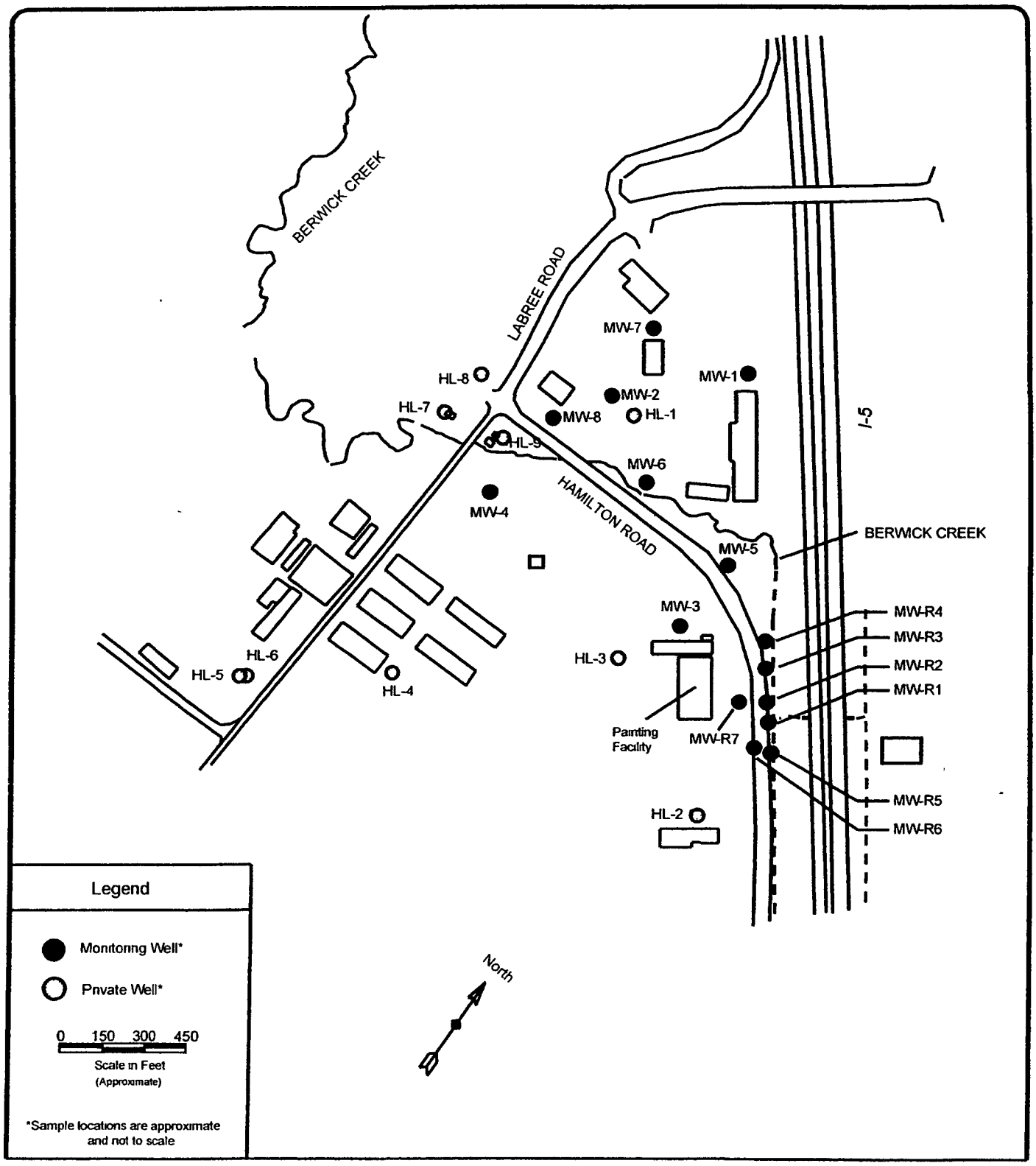


Figure 3

Figure 4

General Domestic Well Sampling Locations near the Hamilton/Labree Roads Site

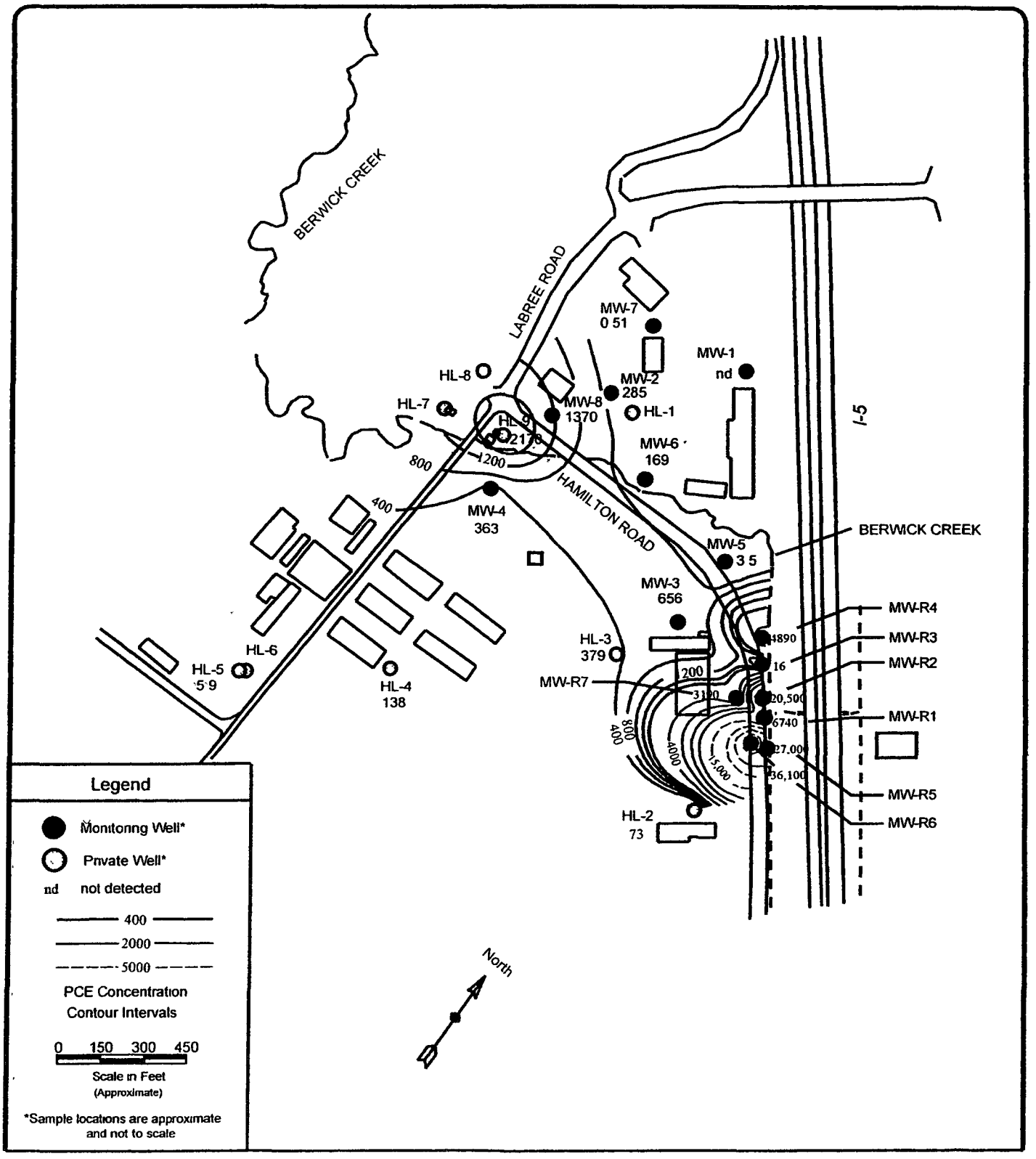




Base Map Provided By SAIC

Hamilton/Labree Roads PCE Site
Sample Locations

Figure 5



Base Map Provided By SAIC

Hamilton/Labree Roads PCE Site

PCE (ug/L) in Groundwater - July 1999

Figure 6

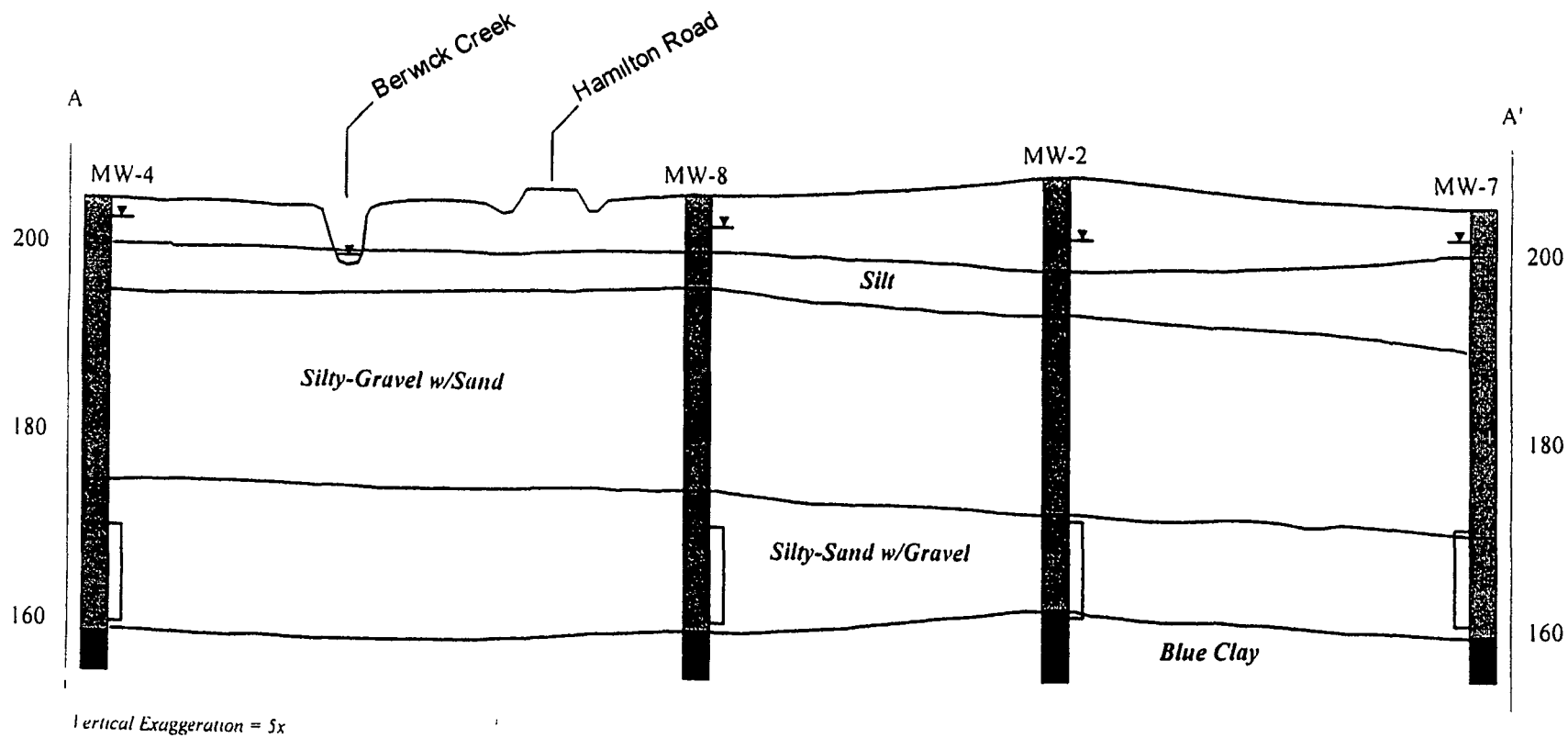


Figure 7

Hamilton/Labree Roads Chlorinated Solvents Site
Geologic Section

Appendix B

Data Tables

Table 1
Maximum Concentrations of Volatile Organic Compounds Detected in Shallow Groundwater (Monitoring Wells and Borings) 1997-2001

Contaminant	Highest Concentration	Units	Cancer Screening[14] Value	Non-Cancer screening[14] value	MCL
Tetrachloroethylene (PCE)	190,000 (geoprobe)	µg/l		100 (child RMEG)	5
Trichloroethylene (TCE)	393 (J)	µg/l			5
Vinyl chloride	280 (boring B14)	µg/l	0.03	0 2 (child chronic EMEG)	2
Cis 1,2-dichloroethylene	610 (boring B14)	µg/l		3,000 (child Int. EMEG)	70
1,3-Dichloropropane	6 9 (J)	µg/l			
Chloroform	0 67 (J)	µg/l	6	100 (chronic child EMEG)	80 (proposed)
Trans 1,2-dichloroethylene	5.4 (boring B14)	µg/l		2,000 (Int. Child EMEG)	100
1,1,1-trichloroethane	0 18 (J)	µg/l			200
Dichlorodifluoromethane (Freon 12)	200 (J)	µg/l		2,000 (child RMEG)	1,000 (LTHA)
Toluene	0 8	µg/l		200 (child Int. EMEG)	1,000

child RMEG = ATSDR's Child Reference Dose Media Evaluation Guide
Int EMEG = ATSDR's Intermediate-duration Environmental Media Evaluation Guide
MCL = Maximum Contaminant Level
LTHA = Lifetime Health Advisory for Drinking water (EPA)
(J) = estimated value
µg/L = micrograms of chemical per liter of water

Table 2
Chronology of PCE Detections
Monitoring Wells in Vicinity of Hamilton/Labree Roads
(units are in µg/L)

Date Tested	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-R1	MW-R2	MW-R3	MW-R4	MW-R5	MW-R6	MW-R7
March/May 1997	ND	300	640	250	3	170	ND	1,500							
October 1997	ND	257	1,280	304	3 1	196	0 74 (J)	1,700							
January 1998	0 66 (J)	285	811	344	4 2	200	1 2	1,850							
April 1998	0 87 (J)	229	1,350	396	7	170	1 8	2,000							
July 1998	ND	142	1,170	264	3 5	119	0 76 (J)	--							
February 1999	ND	407	751	385	4 4	251	0 73 (J)	1,910							
July 1999	ND	285	656	363	3 5	169	0 51 (J)	1,370	6,740	20,500	16	4,890	27,000	36,100	3,190
February 2000	ND	287	675	340	3 6	182	1 9	1,540	22,800	25,400	239	5,330	57,600	33,800	2,890

Table 3
Chronology of PCE Detections
Private Wells in Vicinity of Hamilton/Labree Roads
(units are in µg/L)

Date Tested	Well 2 (HL-2)	Well 3 (HL-3)	Well 4 (HL-4)	Well 5 (HL-5)	Well 7 (HL-7)	Well 9 (HL-9)
Fall 1993	119	122	204	3 3	572	--
March 10, 1994	--	--	--	--	--	2,165
June 25, 1996	130	284	204	5 8	--	3,009
March & May 1997	130	270	210	7	570	2,700
October 1997	--	347	219	7 7	613	3,740
January 1998	140	380	188	7.6	708	rej
April 1998	87	381	242	11	762	rej
July 1998	62	349	151	7 9	540	2,690
February 1999	93	368	rej	7 1	--	2,540
July 1999	73	379	138	5.9	--	2,170
February 2000	75	292	--	--	--	2,340

Table 4
Maximum Contaminant Concentrations Detected in Domestic Wells

Contaminant	Maximum Concentration	Units	Well ID	Health Comparison Value	Cancer Class	MCL
Tetrachloroethylene (PCE)	3,740 (10/97)	µg/L	HL-9	100 (child RMEG)	IARC 2A	5
Trichloroethylene (TCE)	350, 37	µg/L	HL-9		IARC 2A	5
Vinyl chloride	1.5	µg/L	HL-9	0 03 (CREG)	EPA Class A	2
Cis 1,2-dichloroethylene	591, 8	µg/L	HL-9	3,000 (child intermediate EMEG)	EPA Class D	70
1,3-dichloropropane	3 1 (J)	µg/L	HL-9 (EFF)			
Chloroform	44	µg/L	HL-9	6 (CREG)	EPA Class B2	80 (proposed)
Trans-1,2-dichloroethylene	3 5 (J)	µg/L	HL-9	2,000 (child intermediate EMEG)		100
1,1,1-trichloroethane	0 14 (J)	µg/L	HL-2			200
1,4-dichlorobenzene	4.2 (J)	µg/L	HL-9	4,000 (child intermediate EMEG)		75
Toluene	10	µg/L	HL-9	200 (child intermediate EMEG)		1,000

CREG = ATSDR's cancer risk evaluation guide
(EFF) = post-carbon treatment system effluent
IARC2A = International Agency for Research on Cancer Probably carcinogenic to humans (limited human evidence, sufficient evidence in animals)
EPA Class A = human carcinogen
EPA Class B2 = Possibly carcinogenic to humans (limited human evidence; less than sufficient evidence in animals)
EPA Class D = not classifiable as to carcinogenicity

Table 4
Maximum Contaminant Concentrations Detected in Domestic Wells (cont.)

Contaminant	Maximum Concentration	Units	Well ID	Health Comparison Value	Cancer Class	MCL
Bromodichloromethane	2 5	µg/L	HL-9 (INF)	200 (child chronic EMEG)		80 (proposed)
Tetrahydrofuran	0 21, 75 9	µg/L	HL-7, HL-9 (EFF)		EPA Class D	50 (Wisconsin DHSS)
Ethylmethacrylate	2 1 (J)	µg/L	HL-9 (EFF)			
Copper	7 3	µg/L	HL-5			1,300
Zinc	5.7	µg/L	HL-5	3,000 (child chronic EMEG)		2,000 (LTHA)
Nitrite-Nitrate	2.5	mg/L	HL-5			10
Base/Neutral/Acids	Not detected	µg/L	HL-5			
Chlorophenoxy Herbicides	Not detected	µg/L	HL-5			
Chlorinated Pesticides	Not detected	µg/L	HL-5			
Organophosphorous Pesticides	Not detected	µg/L	HL-5			
Nitrogen Containing Pesticides	Not detected	µg/L	HL-5			

Wisconsin DHSS = Wisconsin Department of Health and Social Services Drinking Water Enforcement Standard
LTHA = Lifetime Health Advisory for drinking water (EPA)

Table 5
Domestic Wells Tested Since 1993 in Vicinity of the Hamilton/Labree Roads Site

Well Number	Name	Type/Population Served	Average PCE Concentration 1993 to 1998 (µg/l)	Comments
HL-1 (deep)	Chehalis Livestock Market (Balmelli)	Business	No detections	DOH tested in 1993
HL-2 (shallow)	Hamilton/Smith Tractor	Group B business (3)	96	DOH tested in 1993 and1996 Ecology testing **PCE, TCE, 1,1,1-TCA, and cis-1,2-DCE** detected in 1/98 and 9/2000 No longer used Supplying own bottled water Drilled through shallow to deep well Serves Smith tractor rental DOH health consultation
HL-3 (shallow)	High Reach/United Rentals	Business (11) Group B	364	DOH tested in 1993 and 1996 Ecology well testing and paying for bottled water **PCE, TCE, DCE, 1,1,1-TCA, and toluene** detected Past, but no current showering Currwntly, only hand and face washing Recommended ventilation No deep well on site DOH health consultation
HL-4 (shallow)	Veenhouwer	Residence (1)	200	DOH tested in 1993 and 1996 Ecology testing **PCE, TCE, and DCE detected.** No longer used DOH health consultation
HL-5 (shallow)	Veenhouwer	Residence	9	DOH tested in 1993 and 1996 Ecology testing Tested for VOCs, SVOCs, Chlorophenoxy Herbicides, Chlorinated Pesticides, OP Pesticides, Nitrogen pesticides, metals, nitrate, and inorganics **PCE detected** No longer used DOH letter recommending not to use this well Delineates plume extent? DOH health consultation
HL-6 (deep)	Veenhouwer	Residence	No detections	Switched to this well for domestic uses Ecology testing Bottled water for drinking Serves 3 residences No VOC detections
HL-7 (shallow)	Veenhouwer	Residence (7)	656	DOH tested in 1993 and 1996 Ecology testing **PCE, TCE, and tetrahydrofuran** detected DOH worked w/exposed families and their doctor Blood samples and liver function test were "Normal" Family also referred to Environmental Health physicians at U W Well pump electrical problems No longer used or tested DOH health consultation
HL-8 (deep)	Veenhouwer	Irrigation	No detections	Ecology testing Not currently used ?
HL-9 (shallow)	Residence	Residence (6)	3,215	DOH tested in 1994 and 1996 Ecology testing **DCE, PCE, VC, chloroform, bromodichloromethane, TCE, toluene, 1,4-dichlorobenzene, p-isopropyltoluene detected** Still used, but treatment system in place Provided health information and medical follow-up with family DOH health consultation

Table 5
Domestic Wells Tested Since 1993 in the Vicinity of the Hamilton/Labree Road Site (cont.)

Well Number	Name	Type	Average PCE Concentration 1993 to 1998 (µg/l)	Comments
HL-10 (shallow)	Residence	Residence	No detections	East side of Interstate DOH tested in 1993, 1996, and 1997
HL-11 (shallow)	Stihl	Business	No detections	East side of Interstate DOH tested in 1993
HL-12 (shallow)	Webster Mobile Home Park	Residences	No detections	East side of Interstate DOH tested in 1993
HL-13 (shallow)	Showcase	Business	No detections	East side of Interstate DOH tested in 1993
HL-14 (shallow)	Web Joist	Business	No detections	East side of Interstate DOH tested in 1993 and 1997
HL-15 (shallow)	BC&C	Business	No detections	East side of Interstate DOH tested in 1993
HL-16 (shallow)	Rice Rd	Residence	0 22 (2/17/99) 0 46 (9/7/2000)	DOH tested in 1994 Ecology testing and supplying bottled water Low PCE detection
HL-17 (shallow)	Rice Rd	Residence	No detections	DOH tested in 1994 and 1997 Ecology testing
Residential (shallow)	Rice Rd	Residence	No detections	Ecology testing Low chloroform detection
Giske Image (shallow)	Rice Rd	Business/Group B	2 2 (2/2/99) 3 3 (9/7/2000)	DOH tested in 1997 Ecology testing Low VOCs Giske using bottled water
Residential (shallow)	Hamilton/Labree Rd	Residence	No detections	Reported oily sheen prompted 1 sample by Ecology
Jesus Name Pentecostal Church	Business	Church	No detections ?	East side of Interstate DOH tested in 1994
Empire Gas		Business	No detections ?	DOH tested in 1997

Table 6
Soil VOC Concentrations

Contaminant	Highest Concentration	Depth	Health-Based Screening Value
Tetrachloroethylene	53 mg/kg (J) near United Rentals	40 feet bgs	500 mg/kg (child RMEG)
Trichloroethylene	ND		
Cis-1,2-dichloroethene	ND		
Trans-1,2-dichloroethene	ND		
Vinyl chloride	ND		

Table 7
Berwick Creek Surface Water Contaminants

Contaminant	Highest Concentration	Units	Health-Based Screening Value	MCL
Tetrachloroethylene (PCE)	16 (BERSW1) 15 (BERSW3)	µg/l	100	5
Trichloroethylene (TCE)	0.98 (J) (BERSW1)	µg/l		5
Styrene	0.13 (J) (BERSW1)	µg/l	2,000	100
Cis 1,2-dichloroethylene	4 (BERSW3)	µg/l	3,000	70

APPENDIX C
ATSDR Public Health Conclusion Categories

CATEGORY A : URGENT PUBLIC HEALTH HAZARD

This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention

This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision This does not necessarily imply that the available data are complete, in some cases additional data may be required to confirm or further support the decision made

Criteria

Evaluation of available relevant information* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention Such site-specific conditions or exposures may include the presence of serious physical or safety hazards, such as open mine shafts, poorly stored or maintained flammable/explosive substances, or medical devices which, upon rupture, could release radioactive materials.

** Such as environmental and demographic data, health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data*

ATSDR Actions

ATSDR will expeditiously issue a health advisory that includes recommendations to mitigate the health risks posed by the site. The recommendations issued in the health advisory and/or health assessment should be consistent with the degree of hazard and temporal concerns posed by exposures to hazardous substances at the site

Based on the degree of hazard posed by the site and the presence of sufficiently defined current, past, or future completed exposure pathways, one or more of the following public health actions can be recommended:

- biologic indicators of exposure study
- biomedical testing
- case study
- disease and symptom prevalence study
- community health investigations
- registries
- site-specific surveillance
- voluntary residents tracking system
- cluster investigation
- health statistics review
- health professional education
- community health education
- substance-specific applied research

CATEGORY B: PUBLIC HEALTH HAZARD

This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects

This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.

Criteria:

Evaluation of available relevant information* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical hazards, such as open mine shafts, poorly stored or maintained flammable/ explosive substances, or medical devices which, upon rupture, could release radioactive materials

**Such as environmental and demographic data, health outcome data; exposure data, community health concerns information; toxicologic, medical, and epidemiologic data.*

ATSDR Actions

ATSDR will make recommendations in the health assessment to mitigate the health risks posed by the site. The recommendations issued in the health assessment should be consistent with the degree of hazard and temporal concerns posed by exposures to hazardous substances at the site. Actions on the recommendations may have occurred before the actual completion of the public health assessment

Based on the degree of hazard posed by the site and the presence of sufficiently defined current, past, or future completed exposure pathways, one or more of the following public health actions can be recommended.

- biologic indicators of exposure study
- biomedical testing
- case study
- disease and symptom prevalence study
- community health investigations
- registries
- site-specific surveillance
- voluntary residents tracking system
- cluster investigation
- health statistics review
- health professional education
- community health education
- substance-specific applied research

CATEGORY C: INDETERMINATE PUBLIC HEALTH HAZARD

This category is used for sites when a professional judgement on the level of health hazard cannot be made because information critical to such a decision is lacking

Criteria·

This category is used for sites in which "*critical*" data are *insufficient* with regard to extent of exposure and/or toxicologic properties at estimated exposure levels The health assessor must determine, using professional judgement, the "criticality" of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision

ATSDR Actions:

ATSDR will make recommendations in the health assessment to identify the data or information needed to adequately assess the public health risks posed by the site.

Public health actions recommended in this category will depend on the hazard potential of the site, specifically as it relates to the potential for human exposure of public health concern. Actions on the recommendations may have occurred before the actual completion of the public health assessment

If the potential for exposure is high, initial health actions aimed at determining the population with the greatest risk of exposure can be recommended. Such health actions include·

- community health investigation
- health statistics review
- cluster investigation
- symptom and disease prevalence study

If the population of concern can be determined through these or other actions, any of the remaining follow-up health activities listed under categories A and B may be recommended.

In addition, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring or has occurred in the past, ATSDR will reevaluate the need for any follow-up

CATEGORY D: NO APPARENT PUBLIC HEALTH HAZARD

This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects.

This determination represents a professional judgement based on critical data which ATSDR considers sufficient to support a decision This does not necessarily imply that the available data are complete, in some cases additional data may be required to confirm or further support the decision made

Criteria·

Evaluation of available relevant information* indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.

**Such as environmental and demographic data; health outcome data, exposure data, community health concerns information; toxicologic, medical, and epidemiologic data; monitoring and management plans.*

ATSDR Actions:

If appropriate, ATSDR will make recommendations for monitoring or other removal and/or remedial actions needed to ensure that humans are not exposed to significant concentrations of hazardous substances in the future Actions on the recommendations may have occurred before the actual completion of the public health assessment.

The following health actions, which may be recommended in this category, are based on information indicating that no human exposure is occurring or has occurred in the past to hazardous substances at levels of public health concern One or more of the following health actions are recommended for sites in this category:

- community health education
- health professional education
- community health investigation
- voluntary residents tracking system

However, if data become available suggesting that human exposure to hazardous substances at levels of public health
concern is occurring, or has occurred in the past, ATSDR will reevaluate the need for any follow-up

CATEGORY E: NO PUBLIC HEALTH HAZARD

This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard

Criteria.

Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future

ATSDR Actions:

No public health actions are recommended at this time because no human exposure is occurring, has occurred in the past, or is likely to occur in the future that may be of public health concern.