Public Health Assessment

Cenex Supply and Marketing, Inc.
Quincy, Washington

CERCLIS # WAD058619255

March 2000

Draft for Public Comment
Comment period ends April 15, 2000

Prepared by:

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

Washington State Department of Health

Foreword

The Washington State Department of Health (DOH) has prepared this Public Health Assessment in cooperation with the Agency for Toxic Substances 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 Public Health Assessment was prepared in accordance with methodologies and guidelines developed by ATSDR.[1]

The purpose of this Public Health Assessment is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. The Public Health Assessment provides a means for DOH to respond to a request from agencies and concerned residents for health information on hazardous substances. It provides advice on specific public health issues. DOH evaluates available environmental sampling data, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

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List of Abbreviations/Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
DOH	Washington State Department of Health
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
CSMI	Cenex Supply and Marketing, Inc.
VOC	Volatile Organic Compound
SVE	Soil Vapor Extraction
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
LOAEL	Lowest Observed Adverse Effect Level
MCL	Safe Drinking Water Act Maximum Contaminant Level
MRL	ATSDR Minimal Risk Level
NOAEL	No Observed Adverse Effect Level
PHA	Public Health Assessment
PPB	part per billion
PPM	part per million
RfD	Oral Reference Dose
CREG	ATSDR Cancer Risk Evaluation Guide
EMEG	ATSDR Environmental Media Evaluation Guide
RMEG	ATSDR Reference Dose Media Evaluation Guide
USGS	United States Geological Survey
MTCA	Department of Ecology Model Toxics Cleanup Act Regulation
ASIL	Ambient Source Impact Level
1,2-DCP	1,2-Dichloropropane
1,1-DCE	1,1-Dichloroethylene
PAHs	Polycyclic Aromatic Hydrocarbons
CLHA	Child Long Term Health Advisory
MCLG	Safe Drinking Water Act Maximum Contaminant Level Goal
CV	Comparison Value
µg	Microgram
mg	milligram

Glossary

Acute

Occurring over a short time, usually a few minutes or hours. An acute exposure can result in short-term or long-term health effects. Acute health effects occur a short time (up to 1 year) after exposure.

Agency for Toxic Substances and Disease Registry

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 quality of life. ATSDR is part of the U.S. Department of Health and Human Services.

Cancer Risk Evaluation Guide (CREG)

The concentration of a chemical in air, water, or soil (or other environmental media), that is expected to cause no more than one additional cancer in a million persons exposed over a lifetime. The CREG is a comparison value used to select contaminants of potential health concern.

Cancer slope factor

The slope factor is used to estimate an upperbound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a carcinogen.

Carcinogen

Any substance that can cause or contribute to the production of cancer.

Chronic

Occurring over a long period of time (more than 1 year).

Comparison value

A concentration of a chemical used to select contaminants of concern which require further evaluation in the Health Assessment process. The terms comparison value and screening level are often used synonymously.

Contaminant

Any substance or material that enters a system (the environment, human body, food, etc.) where it is not normally found.

Dose

The amount of substance to which a person is exposed. It often takes body weight into account.

Environmental Media Evaluation Guide (EMEG)

A concentration in air, soil, or water (or other environmental media), below which adverse non-cancer health effects are not expected to occur. Separate EMEGs can be derived to account for acute, intermediate, or chronic exposure durations.

Exposure

Contact with a chemical by ingesting, inhaling, or by direct contact (such as through the skin or eyes). Exposure may be short-term (acute) or long-term (chronic).

Exposure Pathway

An exposure pathway is the process by which an individual is exposed to contaminants that originate from a source of contamination. It consists of five elements: 1) Source of contamination, 2) Environmental Media/Transport, 3) Point of Exposure, 4) Route of Exposure, 5) Receptor Population.

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.

Ingestion Rate

The amount of an environmental medium which could be ingested typically on a daily basis. Units for IR are usually expressed in liters/day for water, and mg/kg/day for soil.

Lowest Observed Adverse Effect Level (LOAEL)

LOAELs 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.

MCL

Maximum Contaminant Level. A drinking water regulation established by the 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.

MRL

ATSDR's Minimal Risk Level. The dose of a substance below which adverse non cancer health effects are not expected to occur. MRLs are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration via a given route of exposure. MRLs can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.

Media

Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.

Model Toxics Control Act (MTCA)

The hazardous waste cleanup law for Washington State.

Monitoring Wells

Wells developed to collect groundwater samples for the purpose of physical, chemical, or biological analysis to determine the amounts, types, and distribution of contaminants.

No Apparent Public Health Hazard

A conclusion category used when 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 are no statistically or biologically significant increases in the frequency or severity of adverse effects observed between the exposed population and its appropriate control. Effects may be observed at this dose, but were judged not to be "adverse".

Oral Reference Dose (RfD)

RfD's are levels of chemical exposure, derived by the Environmental Protection Agency, below which non cancer health effects are not expected. An RfD is derived by dividing a LOAEL or NOAEL by "safety factors" to account for uncertainty and to provide added health protection.

Plume

An area of chemicals in a given media, such as groundwater.

Public Health Assessment

The evaluation of data and information on the release of hazardous substances into the environment in order to assess past, current or future impacts on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and prevent human health effects.

RMEG

ATSDR's Reference Dose Media Evaluation Guide. A concentration in air, soil, or water (or other environmental media), which is derived from EPA's RfD, and below which adverse non cancer health effects are not expected to occur. RMEGs account only for chronic exposure.

Remedial Investigation

A study designed to collect the data necessary to determine the nature and extent of contamination at a site.

Risk

In risk assessment, the probability that something will cause injury, combined with the potential severity of that injury.

Route of Exposure

The way in which a person may contact a chemical. Drinking (ingestion) and bathing (skin contact) are two different routes of exposure to contaminants that may be found in water.

Source

Origin of a contaminant released into the environment. If the source is unknown, the environmental media through which contaminants are presented at a point of exposure.

Volatile Organic Compound (VOC)

An organic (carbon-containing) compound that evaporates (volatilizes) easily at room temperature. Many commonly used cleaning solvents contain VOCs.

Summary

In 1997, the Washington State Department of Ecology (Ecology) requested that the Department of Health (DOH) evaluate available environmental sampling data and prepare a Health Assessment for the Cenex Supply and Marketing, Inc. (CSMI) site, located in Quincy, Washington. DOH has since reviewed and evaluated the results of all samples collected by the U.S. EPA, Ecology, and CSMI through 1998. Samples have been collected from site surface and subsurface soils, on and offsite subsurface soil gas, on- and off-site air, and on- and off-site groundwater. After careful review and evaluation of these data, DOH concluded the following:

- No *current* health threat exists for persons who could come into contact with soil *on* the CSMI site;

- *A very low past health risk existed* for CSMI site workers who could have been exposed to contaminated soil. The low risk would have resulted from chronic (long-term) exposure to some of the herbicides/pesticide compounds detected in site soil prior to excavation, removal, and capping with clean gravel.

- *A very low past health risk existed* for children noted to have occasionally passed through the site who could have been exposed to contaminated soil prior to installation of the fence in 1990. The low risk would have resulted from incidental exposure to some of the herbicides/pesticide compounds detected in site soil prior to excavation, removal, and capping with clean gravel.

- The concentration of 1,2-Dichloropropane (1,2-DCP) detected in air in the Quincy High School staff lounge in February 1998 poses a very low health risk. The low risk would exist only for persons exposed continuously over many years. Because of the limited scope of the 1998 school air sampling investigation, DOH is recommending more extensive follow-up air testing.

- *A future public health hazard would exist* if persons were to become exposed, from drinking water and showering, to elevated levels of volatile organic compounds and nitrate in the shallow groundwater underneath, and immediately downgradient of the CSMI site. *No current health risk exists,* as the contaminated groundwater is not being used for domestic purposes.

- DOH reviewed the most recent Cancer Registry data for the ten cancer types which some area residents had expressed concern. For all ten of these cancer types, the number of cases occurring in Quincy was not different than what would be expected in a community of the same size and age structure.

Purpose and Health Issues

This Public Health Assessment was prepared at the request of the Washington State Department of Ecology (Ecology) to evaluate potential exposures of workers and residents living near the Cenex Supply and Marketing, Inc. (CSMI) facility to hazardous substances released into the environment. CSMI and previous owners/operators at this location have a history of controlled and uncontrolled releases of fumigants and other pesticides to the environment that may have resulted in exposure of workers and residents. This assessment evaluates the potential past, present, and future health threats.

Background

A. Site Description and History

CSMI is located in the city of Quincy, Grant County, Washington, south of the Burlington Northern railroad tracks, on the north side of Division Street, between Fourth Avenue S.E. and Sixth Avenue S.E. Quincy (population 3,715) is located in the east-central part of the state, in the northwest portion of the Columbia Basin Irrigation Project, at the southern base of the Beezley Hills. CSMI employs approximately 27 people at the Quincy facility. Adjacent facilities include other agri-chemical and fertilizer businesses, and seed, grain, and fresh pack potato processing facilities. The nearest residential area is approximately 160 yards southeast of the site.[2]

Quincy has five municipal supply wells that draw water from a deep (from 381 to 409 feet below ground surface) basalt aquifer. The closest municipal well (Well # 5) is approximately one-quarter to one-half mile east-southeast (hydrologically downgradient) of the CSMI site. The nearest known domestic well is a closed well at the railroad depot, approximately 170 yards from the site. A public high school and a junior high school are located 195 yards and 225 yards from the site, respectively.[2] Population demographics within a 1-mile radius of the site are presented in Appendix B.

The site was occupied by a livestock operation in the 1950s that later closed, and then was vacant until 1974. At that time, a liquid fertilizer and soil fumigant storage and distribution facility was established by Western Farmers Cooperative. A storage area at the site, consisting of multiple tanks, was constructed on a concrete slab and surrounded by an earthen berm. Fumigants stored at the site included DD (dichloropropane, 1,3-dichloropropene), DD with chloropicrin (dichloropropane, 1,3-dichloropropene, and trichloronitromethane), Telone (1,3-dichloropropene and related C3 hydrocarbons), and Telone C-17 (1,3-dichloropropene, trichloronitromethane). Several fertilizers were also stored at the site. The tanks were plumbed to an electric pump within the earthen dike, and from the pump to hoses which were located beyond the dike for loading and unloading trucks, nurse tanks, and application apparatus at street level outside the containment area. Spillage from these hoses may have occurred onto the soil outside the earthen berm, on the south side of the containment facility.[3, 4]

The facility was taken over by CSMI in 1982, and used for storage and distribution of fumigants including Telone, Telone II, Telone C-17, and Metham-Sodium (sodium N-methyldithiocarbamate). Some tanks were used for liquid fertilizer storage until 1985 and included UAN 32-0-0 (urea ammonia nitrate, 32% free ammonia, 0% ammonium nitrate, 0% urea), Aqua Ammonia, and 9-30-00 (9% nitrogen, 30% phosphorous and 0% potassium).[3]

The extent of past releases by Western Farmers Cooperative and CSMI is unknown. In 1986, fumigant hoses were fitted with dry connections to prevent releases into the environment. Once the dry connections were fitted in 1986, the potential for release from the hoses was significantly reduced. No record exists of other herbicides being handled or stored on the site prior to 1986.[3, 4]

Interviews with CSMI employees suggest that an undocumented fumigant spill occurred shortly before CSMI acquired the site property in 1982.[4, 5] Reportedly, approximately 2,000 gallons of Telone was released during this incident. Although the product was contained within the bermed area, it reportedly soaked into the ground under the fumigant storage facility. No known effort was made to recover the product.[4]

In 1986, CSMI installed a rinsate collection system to contain herbicide, pesticide, and fertilizer rinsate water generated while cleaning and rinsing application equipment and pesticide containers prior to disposal. The collection system consisted of an elevated concrete containment pad which drained to a concrete containment pond. The rinsate pond was located directly west of the fumigant storage facility and had a capacity of approximately 55,000 gallons. No records exist of any disposal activities for tank residual mixtures or rinsate waters prior to the installation of the rinsate collection pad and evaporation pond.[3, 4] Release of rinsate water may have occurred at the pond location prior to construction of the containment facility. The method of sealing the joints between the walls and floor of the pond is unknown. The pond was fenced, with a gate on the south side for cleanout.

After application equipment and pesticide containers were washed, contents of the pond were allowed to evaporate. However, because evaporation rates were slower than the fill rates, an aeration system was installed in 1986 to enhance evaporation. The system operated for about six months, but was ineffective. It was replaced by a spray system to enhance evaporation. The effectiveness of the spray evaporation system was marginal, and rinsate collection continued until 1988, when use of this facility ceased. In the spring of 1990, contents of the pond were tested and applied to a 100-acre CSMI-leased agricultural field, located outside of Quincy. Approximately 30,000 gallons of pond sludge was applied.[4, 6, 7] Rinse water was used to clean the pond. This rinse water was also applied to the CSMI-leased field. The concrete walls were then pushed over and onto the rinsate pond floor, and surface soil surrounding the pond was used to fill it to grade. *The site was fenced in 1990 to prevent non-employees access*.

Operation of the fumigant storage facility ceased in 1991. Shortly thereafter, some of the tanks were moved from the containment area to an area just west of the rinsate pond site pending decontamination

and salvaging.

B. Regulatory History

In August 1991, the Washington State Department of Ecology inspected the CSMI facility, and in April 1992, issued CSMI an Administrative Order requiring development and implementation of a Site Assessment Plan (SAP) for the area in and around the former rinsate pond.[4, 5]

The U.S. Environmental Protection Agency (EPA) conducted a site assessment of the former rinsate pond area on May 10-11, 1993, to determine whether there had been violations of the Resource Conservation and Recovery Act (RCRA) and/or the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Results of the site assessment investigation were also used to derive a Hazard Ranking System (HRS) score for possible National Priorities List (NPL) ranking.[8] The site assessment included collection of four on-site surface soil samples, one background surface soil sample, and five sludge/soil samples from the excavated rinsate pond and from the perimeter of the pond. Samples were analyzed by standard EPA methods for the 45 herbicides present or previously used at the site, and for 63 volatile organic compounds (VOCs). One sample was also submitted for Target Analyte List (TAL) metals. Sample results are presented in Appendix A. *Based on the soil and sludge sampling results*, EPA determined that no further involvement was necessary. Since 1993, the EPA has not been involved at the CSMI site.

On May 19, 1993, Ecology requested that CSMI properly dispose of the fumigant tanks and the sludge contained within the tanks. From August 1994 to February 1995, CSMI contractors, with Ecology oversight, decontaminated and removed all tanks of the former fumigant storage facility. A revised SAP that included the fumigant storage facility area and adjacent soil was completed on April 7, 1995.[9] On June 6, 1995, soil sampling was conducted at the site to address requirements of the SAP. Sampling locations included the rinsate pond, comprising soil above and below the concrete floor, the rinsate pond concrete floor and walls, concrete and soils within the fumigant storage facility containment area, soils surrounding the rinsate pond, and fumigant storage facility. A total of 85 soil samples were collected. Samples were analyzed for site-related herbicides, fumigants, and metals.[3, 5] Sample results are presented in Appendix A.

A total of 360 tons (277 cubic yards) of soil and concrete removed from the rinsate pond was stockpiled onsite, then transported to the Rabanco Landfill (a permitted hazardous waste facility) in Roosevelt, Washington on May 1 and 2, 1997. The site was then wetted down with a water truck, and clean gravel was placed over the site to suppress dust emissions.[3, 4, 5] To date, CSMI has installed and sampled numerous on- and off-site groundwater monitoring wells, site and background soil samples, on- and off-site subsurface soil gas samples, and on- and off-site air samples. A draft Feasibility Study was prepared in the summer of 1998 which evaluated cleanup alternatives. In September 1998, Ecology and Cenex signed an Agreed Order, which required Cenex to install and operate a Soil Vapor Extraction (SVE) system, institute a supplementary site investigation and pilot study, and perform

groundwater monitoring to evaluate both the effectiveness of the air sparging technology and gather information on the nature and extent of chemicals in the groundwater. Between August and December 1998, all of the interim actions were completed (the installation of five additional monitoring wells, a SVE system, and an air sparging system). In November 1998, the SVE system and air sparging system began operating. These systems are intended to help remove contaminants from the shallow soils and to expedite degradation of contaminants in the groundwater underneath the site. Additional remedial investigation and pilot testing is ongoing.

C. Site Visits and DOH Activities

DOH has conducted numerous site visits, attended several public meetings, and mailed community update notices since becoming involved with the site in 1997. DOH has observed the installation and sampling of monitoring wells, gas probes, and the collection of indoor and outdoor air samples. DOH has met with concerned residents, Quincy officials, CSMI environmental consultants, and agency representatives to share and discuss information relevant to the site. DOH has also provided written comments on draft documents prepared by CSMI. In 1998, update letters were mailed to area residents summarizing the preliminary findings of the Health Assessment. At a public meeting in Quincy in August 1998, DOH summarized the preliminary results of the Health Assessment. A more detailed list of activities conducted by DOH and other agencies is located in the Public Health Action Plan section at the end of this report.

Discussion

Environmental investigations conducted since 1993 have confirmed the presence of contaminants in CSMI site soils, on- and off-site shallow groundwater, and on- and off-site subsurface soil gas. A limited air sampling investigation was also conducted in and around the Quincy High School. The following section discusses how DOH evaluates risk, the *nature and extent of the contamination*, the *pathways of exposure*, and *the public health implications* from exposure to the contaminants of concern. In other words, what contaminants are present, how people might come into contact with them, and the potential health effects that could result from exposure to the contaminants.

Contaminants of concern were assessed using various state (MTCA method B)[10] and federal (ATSDR and EPA)[11, 12] health-based criteria (comparison values). Comparison values are media-specific concentrations used to select environmental contaminants for further evaluation. Contaminant concentrations below comparison values are unlikely to pose a health threat. Contaminant concentrations exceeding comparison values do not necessarily pose a health threat, but are further evaluated to determine whether they are at levels observed to cause toxic effects (referred to as toxic effect levels) in human population and/or laboratory animal studies.

Evaluating Non-cancer Risk

To evaluate the potential for non cancer health effects, a dose was estimated for each contaminant exceeding a comparison value. In estimating exposure doses, *it was conservatively assumed that residents and workers were chronically exposed to the maximum detected contaminant concentrations in soil at the CSMI site, without regard to sample depth.* In some cases, these contaminant concentrations were below ground surface, where exposure would have been unlikely to occur. The estimated child and adult exposure doses for each contaminant were then compared to ATSDR's minimal risk level (MRL) or EPA's oral reference dose (RfD). MRLs and RfDs are estimates of daily exposure of a human to a chemical that is likely to be without an appreciable non-cancer risk over a specified exposure duration. They are derived from toxic effect levels obtained from human and laboratory animal studies. The toxic effect levels are expressed as either the lowest adverse effect level (LOAEL) or the no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse effect is seen, while the NOAEL is the highest dose that did not result in any adverse health effects.

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.

To account for uncertainty (i.e., intraspecies variability, interspecies variability and extrapolation of a subchronic effect level to its chronic equivalent), the toxic effect levels are divided by safety factors (typically from 100 to 1,000) to provide the more protective MRL or RfD. If a dose exceeds the MRL or RfD, the *potential* exists for adverse health effects. Thus, a dose only slightly exceeding the MRL or RfD would 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.

Evaluating Cancer Risk

For screening of chemicals which are known or expected to cause cancer, it is assumed that no "safe" level exists, and EPA cancer slope factors are used to calculate an "estimated" increased cancer risk. The slope factor is used to estimate an upperbound probability of an individual developing cancer as a result of exposure(s) to a particular level of a carcinogen(s). An exposure which results in an estimated increased cancer risk of one additional cancer in a population of one million people exposed, averaged over a 70-year lifetime, is considered an acceptable risk, and is used as the comparison value. In a population of one million men in the U.S., approximately 333,000 (one in three) are expected to develop cancer from all causes in their lifetime. For U.S. woman, the figure is one in five.[13] The additional estimated cancer risk means that if those one-million men are exposed for 30 years to this level of the chemical, 333,001 would be expected to develop cancer. For those one-million woman exposed, 200,001 would be expected to develop cancer.

A. Groundwater

A1. Nature and Extent of Contamination

For the general area encompassing Quincy, the United States Geological Survey (USGS) classifies the groundwater system as part of the Columbia Lava Plateau groundwater region. Two basic aquifers exist in the region, a shallow, unconsolidated aquifer zone and a deeper aquifer. However, restricting or confining layers in the unconsolidated materials result in perched water tables much closer to the soil surface. Due to input from irrigation project waters, shallow groundwater elevation levels have increased significantly. Quincy's five municipal wells are screened in the deeper aquifer, at depths ranging from 381 to 409 feet below ground surface (BGS). Groundwater flow in the unconsolidated shallow zone in this region is toward the southeast.[3]

Since June 1996, CSMI has installed numerous on- and off-site groundwater monitoring wells in the upper and lower parts of the shallow aquifer zone. Numerous VOCs and nitrates exceeding health-based comparison values and state and federal drinking water standards (Maximum Contaminant Levels, or MCLs) were detected in the shallow groundwater. 1,2-dichloropropane (1,2-DCP) has been consistently detected at the highest concentration (up to 4,000 times the drinking water standard), although other VOCs have also been detected. Nitrate has been detected in site shallow groundwater up to twenty-eight times the drinking water standard. Monitoring well 9, an on-site well, was sampled

for a full range of pesticides (EPA method 507 modified for pesticides) in September 1997, but none were detected. A list of wells, including detected contaminants and contaminant concentrations for the June 1998 sampling event is presented in Table 7. Groundwater contaminant concentrations in subsequent events were similar. The contaminated groundwater plume has migrated off-site, across Division Street and Sixth Avenue to the southeast (Figures 6 - 8).

A2. Pathways Analysis and Public Health Implications

Although the shallow groundwater has been significantly contaminated by past site activities, *to date, the contaminants do not appear to have impacted the city's municipal supply wells.* Whereas a few private wells in the vicinity of the site were identified during a preliminary records search of Grant County's well logs, none were located in the field (Letter from Burr McPhail, Grant County Health District, September 2, 1997). No other private wells have been identified or are known to exist in the vicinity of the site. Residents downgradient of the site (and most, if not all, residents within the city limits) obtain their domestic water from the city's municipal wells (Personal communications with Grant County and City of Quincy, 1997). No VOCs were detected in the most recent Quincy well #5 (the well downgradient, and closest to the CSMI site) samples.

B. Air: Onsite

B1. Nature and Extent of Contamination

VOC levels in ambient air on the CSMI site prior to site remediation activities in 1997 were limited to qualitative measurements taken with an Organic Vapor Analyzer (OVA). These measurements did not detect VOCs in ambient air onsite. 1,2-DCP was also tested during a limited-scale air sampling event in February 1998 conducted at the CSMI fence-line. A 3-M passive sampling badge was used.[14] The badge was placed for five days in an effort to achieve the required detection limit. No 1,2-DCP was detected during this event. On-site air sampling for pesticides or metals was not conducted.

An air model was used to predict concentrations of VOC emissions prior to startup of an on-site SVE system employed in November 1998.[15] Air modeling results indicated that VOC concentrations would be below levels of health concern (ATSDR health comparison values). The maximum modeled ground level concentration for these VOCs was estimated to be 24 meters from the stack.[15]

The SVE system was designed to remove VOCs, including the four primary contaminants of concern in the vadose zone vapors; 1,2-dichloropropane, chlorobenzene, chloroform, and vinyl chloride (i.e., VOCs previously detected during site subsurface soil gas tests). Removal of the vapors was intended to prevent further migration of VOCs into the groundwater and volatilization into the atmosphere.

After the SVE system became operational, air sampling for VOCs was conducted. Sampling results indicated that no VOCs were present in the stack effluent (i.e., the carbon system removed all VOCs).

Modeled and measured air VOC concentrations, soil gas VOC concentrations, and applicable health-based comparison values are presented in Table 11.

B2. Pathways Analysis and Public Health Implications

On-site air sampling for VOCs was conducted on several occasions, as described above. *Based upon the results of limited on-site ambient air sampling*, VOCs in ambient air do not appear to be a health concern to workers or residents at the site. Additionally, site soil gas remediation has been in effect for over a year, and is ongoing. This soil gas removal effort is intended to further reduce the likelihood of VOCs present in subsurface soil gas from entering the groundwater and ambient air. VOC sampling results are presented in Table 11.

C. Air: Off-Site

C1. Nature and Extent of Contamination

Because of concerns expressed about the potential for exposure to 1,2-DCP at the Quincy high school, CSMI conducted a limited-scale air monitoring investigation for 1,2-DCP there. The sampling was performed from February 18-23, 1998. CSMI installed eleven 3-M passive organic vapor monitoring badges in and around the high school to determine the levels, if any, of this compound.[14] The badges were placed for five days in an effort to achieve the required detection limit. 1,2-DCP, a chemical of concern, had been detected in soil, soil gas, and groundwater at the CSMI site, and in soil gas underneath the high school property and adjacent Desert Electric property. Off-site air sampling for pesticides was not conducted.

RfCs

Inhalation reference concentrations (RfCs) are concentrations in air below which adverse non cancer health effects are not expected to occur. RfCs are set by EPA based on continuous (i.e., 24-hour/day) exposure.

One of the eleven badge samples (staff lounge) detected the presence of 1,2-DCP. The concentration in the staff lounge exceeded EPA's inhalation reference concentration (RfC), by 4 times and was further evaluated by DOH to determine the potential for adverse health effects.

C2. Pathways Analysis and Public Health Implications

Evaluation of Non-cancerous Health Effects

Before the early 1980s, 1,2-DCP was used in farming as a soil fumigant and was found in some paint strippers, varnishes, and furniture finish removers. 1,2-DCP has also been used as a solvent, photographic processing chemical, and as an intermediate in the formation of other chemicals.[16]

Breathing high levels of 1,2-DCP by humans can cause dizziness, headache, nausea, eye and throat irritation, and injury to the liver and kidneys.[16] There are no reports of health effects in humans following low-level exposure to 1,2-DCP for either short-or long-term time periods. Some animal studies indicate that inhalation of 1,2-DCP causes liver and kidney damage, as well as effects on the respiratory system.

EPA has developed an RfC of 4 µg/m^3 for 1,2-DCP. The RfC is based on increased cell growth in rat nasal mucosa following chronic high dose inhalation exposure.[17] RfCs are levels of contaminants in air below which adverse non cancer health effects are unlikely to result. The level in the staff lounge exceeded the RfC, indicating the possibility that continuous exposure over many years could result in adverse health effects. However, the level detected in the staff lounge was over 700 times lower than the lowest concentration at which health effects were observed in animals. As a result, non-cancer health effects are unlikely.

Evaluation of Cancerous Health Effects

Although data exist on the carcinogenic potential from *oral* exposure to 1,2-DCP, data regarding the carcinogenic potency of 1,2-DCP following *inhalation* exposure are insufficient for estimation of carcinogenic potency.[16, 17] No studies were located in the scientific literature regarding carcinogenic effects in humans following inhalation exposure to 1,2-DCP. A 1948 mouse study examined the hepatocarcinogenic effects of 1,2-DCP from intermediate (25-30 weeks) duration inhalation exposure. In the study, some hepatomas were observed, but the results were inconclusive.[16, 17] Although inconclusive, the concentration of 1,2-DCP administered in this study was over 100,000 times higher than the concentration measured in the high school staff lounge.

Based on exposure and toxicological information, it is unlikely that exposure to 1,2-DCP at levels detected in the high school staff lounge would result in cancerous or non-cancerous health effects. 1,2-DCP air monitoring results, sampling locations, and health comparison values are presented in Table 12.

D. Soil Gas Pathway

D1. Nature and Extent of Contamination

VOCs were detected in subsurface soil gas, both on- and off-site, approximately eight feet below ground surface (the only depth tested). The highest on-site VOC concentrations were detected between the former fumigant tank area and rinse pad. Lower concentrations were detected off-site, to the south and southeast, underneath the high school property, and underneath the Desert Electric facility. The highest concentration of 1,2-DCP detected in subsurface soil gas underneath the high school property was 5.9 mg/m^3 (vapor point 2). The highest concentration of 1,2-DCP in subsurface soil gas underneath the CSMI site was 3,010 mg/m^3, or 651 ppm (vapor point 5). Chlorobenzene,

chloroform, 1,1-DCE, and vinyl chloride were also detected, but at considerably lower concentrations in one or more CSMI site vapor points. Soil gas results are presented in Table 10.

D2. Pathways Analysis and Public Health Implications

Site remediation workers are the most likely persons to come into direct contact with subsurface soil gas. It is presumed they are aware of the soil gas conditions, and are taking the appropriate precautions to protect themselves from potential exposures. In order to mitigate further VOC contamination of the groundwater, and to reduce or eliminate the possibility of further migration into soil gas or air, CSMI employed a soil vapor extraction system in the Fall of 1998. As of March 2000, the system continues to remove VOCs from site soil. 1,2-dichloropropane has not been detected in air samples collected after the system's carbon units, indicating that all of the VOCs being removed from the soil are being contained within the system's carbon media, and not being released into the air.

E. Soil Pathway

E1. Nature and Extent of Contamination

Contaminated soil was excavated and removed from the site during the summer of 1997. DOH evaluated results of confirmation soil samples collected after the excavation and removal (current levels), and determined that they are below levels of health concern (Tables 8 and 9). Therefore, *no current health threat exists for persons who might come into contact with CSMI site surface soils*.

For this Health Assessment, exposures to site soils were assumed to have occurred prior to site remediation in 1997. The higher of either the 1993 EPA or 1995 CSMI soil sample results were evaluated in the Health Assessment, *regardless of the depth of the soil sample.* Persons assumed to be exposed included CSMI employees and children noted to occasionally have played on ramps and walked or bicycled across the site to and from school (personal communication with CSMI, 1997). The site was fenced in 1990, which effectively eliminated the potential for further non employee ingestion and dermal exposures. No dust sampling was conducted. Pre and post-remediated soil contaminant concentrations are presented in Tables 3 through 6, and 8 through 9.

Three herbicides (trifluralin, vernolate, and ethalfluralin), one insecticide (chlorpyrifos), one pesticide (disulfoton), and three metals (chromium, beryllium, and cadmium) exceeded one or more health-based comparison values in CSMI soil, and were further evaluated in the Health Assessment. These eight contaminants are discussed below relative to pathways of exposure and public health implications. Numerous VOCs and phenoxyherbicides were also detected in site soils, but their concentrations in soil were below health comparison values, and were not further

evaluated. Ammonia and nitrate concentrations from some onsite borehole samples were elevated, but

were below health comparison values.

E2. Pathways Analysis and Public Health Implications

Trifluralin

Trifluralin is a selective preemergent herbicide used to control annual grasses and some broadleaf annual weeds. Trifluralin was detected in soil during both the 1993 EPA and 1995 CSMI sampling events. The highest concentration (349 mg/kg) was from a subsurface sample collected underneath the former rinsate pond (EPA sample #RPS4). The highest concentration of trifluralin detected during the June 1997 (post-remediation) sampling event was 0.298 mg/kg, well below health comparison values (Table 9).

Non-cancer Toxicity

Acute-duration animal tests have demonstrated trifluralin to have low to moderate acute toxicity by oral or dermal exposure, and moderate acute toxicity by inhalation.[17, 18] EPA has not established an RfC for Trifluralin. High doses of trifluralin are associated with increases in kidney, bladder, and thyroid tumors. Dogs chronically exposed to trifluralin in their diet showed decreased weight gain, changes in hematological parameters, and increased liver weight.[17] Skeletal abnormalities were observed in the offspring of mice exposed via gavage (experimentally introducing trifluralin into the stomach). The RfD for trifluralin is based on increased liver weights and an increase in methemoglobinemia in dogs.[17] The estimated doses for the adult and child exposure scenarios were 20 to 25 times below the chronic oral RfD, suggesting that non cancer health effects are unlikely.

Cancer Toxicity

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

EPA has classified trifluralin as a Group C (possible human) carcinogen. No studies were located in the scientific literature regarding the carcinogenicity of trifluralin in humans. Classification is based on the induction of urinary tract tumors (renal pelvis carcinomas and urinary bladder papillomas) and thyroid tumors (adenomas/carcinomas combined) in one rat study.[17] Trifluralin did not produce statistically significant increases in tumors in other studies.[17] For this Health Assessment, the estimated increased cancer risk for children and adults assumed to be exposed to trifluralin in soil was slight; approximately one additional cancer in a population of one million persons exposed. Because of the highly conservative exposure assumptions (i.e., that 100% of soil ingestion

was at the highest detected concentration over many years), the actual risk is likely even lower.

Ethalfluralin

Ethalfluralin is a selective preemergent herbicide, structurally similar to trifluralin. Like trifluralin, it is a dinitroaniline compound. Ethalfluralin is readily degraded in soil, both by microorganisms and by photodecomposition. Ethalfluralin was detected in site soil during both the 1993 EPA and 1995 CSMI sampling events. The highest concentration (1,530 mg/kg) was from a subsurface sample collected from the excavation on the north side of the former rinsate pond (EPA sample #RPS3). The highest concentration of ethalfluralin detected during the June 1997 sampling event, after soil removal, was 0.363 mg/kg, well below health comparison values (Table 9).

Non-cancer Toxicity

Although no health comparison values exist for ethalfluralin, toxicological references suggest that, because of its chemical similarity to trifluralin, exposure would be expected to cause similar toxicological effects. Limited rat studies have demonstrated several structurally similar urinary metabolites for these two compounds.[17] Because of this similarity, the cancer slope factor established for trifluralin was also used to assess the cancer risk for exposure to ethalfluralin in the Health Assessment. Likewise, the RfD established for trifluralin was used to assess the potential for non-cancer health effects from exposure to ethalfluralin. EPA has not established an RfC for Ethalfluralin.

The child and adult estimated exposure doses were one fifth the oral RfD, and were well below doses observed to cause toxic health effects in animal studies, suggesting that non-cancer health effects are unlikely.

Cancer Toxicity

Chronic mouse and rat-feeding studies indicate ethalfluralin has a low potential for carcinogenicity.[18] One study demonstrated an increase in benign mammary tumors in female rats after high doses were administered over a 2-year period.[18, 19] In addition, ethalfluralin produced a common urinary metabolite in rats [Dow specimen label for Ethalfluralin, Pesticide Dictionary]. The estimated increased cancer risk for children and adults assumed to be exposed to ethalfluralin in soil at the CSMI site was slight; from one to four additional cancers in a population of one million persons exposed. Because of the highly conservative assumptions used (100% of assumed soil ingestion was at the highest detected concentration over many years), the actual risk is likely much lower. For example, the highest detected concentration of ethalfluralin in site *surface* soil, where exposure would be more likely to occur, was only one third the maximum detected concentration evaluated in this Health Assessment (from a subsurface sample).

Disulfoton

Disulfoton is an organophosphate pesticide used to control a variety of harmful pests that attack many

field and vegetable crops. Disulfoton binds moderately well to soil and typically does not readily migrate deep into the soil.[17, 20, 21] Disulfoton was detected in soil during both the 1993 EPA and 1997 CSMI sampling events. The highest concentration (146 mg/kg) was from a subsurface sample collected in the excavation on the north side of the former rinsate pond (EPA sample #RPS2). Disulfoton was not detected after the June 1997 soil removal (Table 9).

Non-cancer Toxicity

Health effects from exposure to high levels of disulfoton (much higher than levels detected in CSMI soil) include effects on the nervous system, narrowing of the pupils, vomiting, diarrhea, drooling, difficulty in breathing, tremors, convulsions, and even death.[20, 21] The chronic oral MRL for disulfoton is based on a LOAEL of 0.06 mg/kg/day for decreased cholinesterase activity in female rats in a chronic feeding study.[17] Although estimated adult and child exposure doses exceeded the chronic oral MRL and RfD by a factor of three to four, they were 350 to 450 times lower than the lowest dose observed to cause adverse health effects. Disulfoton levels detected in surface soil, where exposures would have been more likely to occur, were much lower (from 3.4 mg/kg to 8.8 mg/kg). Estimated doses from exposure to disulfoton at these levels is below the oral RfD, suggesting that adverse non-cancer health effects are unlikely. EPA has not established an RfC for disulfoton.

Cancer Toxicity

No studies were located in the scientific literature regarding cancer in humans after oral exposure to disulfoton.[17, 20] There was no evidence of carcinogenicity in Beagle dogs fed disulfoton for two years at doses many times higher than estimated doses for children or adult exposures in this Health Assessment.[20] As a result, cancer effects would not be expected.

Vernolate

Vernolate is a thiocarbamate compound used as a selective soil-incorporated herbicide to control broadleaf and grassy weeds. Vernolate is registered in the U.S. for use on corn.[17, 22, 23] Vernolate was detected in soil during both the 1993 EPA and 1995 CSMI sampling events. The highest concentration (112 mg/kg) was from a subsurface sample in the excavation on the north side of the former rinsate pond (EPA sample #RPS3). The highest concentration of vernolate detected during the June 1997 sampling event, after soil remediation, was 0.295 mg/kg, well below the health comparison value (Table 9).

Non-cancer Toxicity

The RfD established for vernolate is based on a two-generation reproduction rat study which showed a statistically significant depression in the mean body weight of rats fed vernolate in their diet.[17, 22] The RfD is based on a NOAEL of 1 mg/kg/day and a LOAEL of 5 mg/kg/day.[15] The

estimated doses for both the adult and the child exposure scenarios were one tenth the chronic oral RfD, suggesting that non cancer health effects are unlikely. EPA has not established an RfC for vernolate.

Cancer Toxicity

No studies were located in the scientific literature regarding human carcinogenicity from exposure to vernolate. In a 24-month mouse study, no oncogenic/carcinogenic effects were observed at vernolate concentrations as high as 100 mg/kg/day (thousands of times higher than exposure doses estimated for this Health Assessment).[17, 23] Based on the available toxicological information, cancerous health effects would not be expected for persons assumed to be exposed to the detected concentration of vernolate at the site.

Chlorpyrifos

Chlorpyrifos is an organophosphorus insecticide that has been widely used in the home and on farms. In the home, it has been used to control cockroaches, fleas, and termites. It has also been an active ingredient in some flea and tick collars. On farms, it is used to control ticks on cattle, and as a spray to control crop pests.[24] In 1997, chlorpyrifos was voluntarily withdrawn from most indoor and pet uses by the manufacturer, DowElanco.

Chlorpyrifos adheres tightly to soil particles. Volatilization is the major way in which chlorpyrifos disperses after it is applied. Once in the environment, chlorpyrifos is broken down by sunlight, bacteria, or other chemical processes.[24]

Chlorpyrifos was detected in soil during the 1993 EPA sampling event. The highest concentration (162 mg/kg) was from a surface sample collected between the former rinse pad and old telone plant (EPA sample # SS2).

Non-cancer Toxicity

Short-term exposure to moderate levels of chlorpyrifos can cause dizziness, fatigue, runny nose or eyes, salivation, nausea, intestinal discomfort, sweating, and changes in heart rate. Short-term exposure to much higher levels of chlorpyrifos may cause paralysis, seizures, loss of consciousness, and death. Short-term exposure at high concentrations may cause muscle weakness weeks after the original symptoms have disappeared. Other effects include changes in behavior or sleeping patterns, mood changes, and effects on the nerves and/or muscles in the limbs.[24] The EPA has not established an RfC for chlorpyrifos.

The MRL is based on a NOAEL of 0.1 mg/kg/day for acetylcholinesterase inhibition in rats. The estimated doses for both the adult and the child exposure scenarios were approximately twenty times below the chronic oral RfD, suggesting that non-cancer health effects are unlikely.

Cancer Toxicity

No information was located in the scientific literature regarding carcinogenic effects of chlorpyrifos in humans following oral exposure. Chronic-duration exposure studies have shown no carcinogenicity in animals.[24] The EPA has not classified chlorpyrifos for carcinogenicity (Class D).

Cadmium

Cadmium is an element that occurs naturally in the Earth's crust. It is one of many elements that are commonly called "heavy metals." Most cadmium in the U.S. is extracted as a by-product during the production of other metals such as zinc, lead, or copper. Cadmium is used in batteries, pigments, metal coatings, plastics, and some metal alloys.

Long-term exposure to lower levels of cadmium leads to a build up of cadmium in the kidney and possible kidney disease. Other potential long term effects are lung damage and fragile bones. Skin contact with cadmium is not known to affect the health of people or animals.[25]

The highest concentration of cadmium (25.2 mg/kg) was from EPA soil sample # RPS4, collected at the former rinsate pond. This concentration slightly exceeded a non-cancer health comparison value and exceeded the 0.5 mg/kg mean background concentration of cadmium for the Yakima Basin region.

Non-cancer Toxicity

The EPA has established separate oral RfDs for cadmium in food and water. The oral RfD for food was used to assess the potential for non cancer health effects in this Health Assessment, and is based on renal effects in humans. The estimated doses for both the adult and child exposure scenarios were approximately forty times below the oral RfD, suggesting that non-cancer health effects are unlikely. The EPA has not established an RfC for cadmium.

Cancer Toxicity

The EPA classifies cadmium as a probable human carcinogen by the inhalation route. Neither human nor animal studies provide conclusive evidence to determine whether or not cadmium is carcinogenic by the oral route. A few studies of cancer rates among humans orally exposed to cadmium have been performed. However, there is little evidence of an association between oral exposure to cadmium and increased cancer rates in humans. [25] In a 1992 rat study, oral exposure to very high doses of cadmium was associated with tumors of the prostate, testes, and hematopoietic (blood forming) system.[25] The child and adult cadmium exposure dose estimated for this Health Assessment is well below the cancer effect level (CEL) derived from the 1992 rat study. As a

result, cancer effects would not be expected from exposure to cadmium at even the highest detected concentration.

Chromium

Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms. Trivalent chromium in small amounts is an essential nutrient.[26] For this Health Assessment, it was conservatively assumed that 100% of the detected chromium was in the more toxic hexavalent form.

Chromium was detected in soil samples collected during both the 1993 and 1997 sampling events. One sample (sample # RPS4), collected at the former rinsate pond, slightly exceeded a non- cancer comparison value (Table 5).

Non-cancer Toxicity

Although ingesting small amounts of hexavalent chromium at low concentrations is not believed to be harmful, ingestion of large amounts of hexavalent chromium has caused stomach upsets, ulcers, convulsions, kidney and liver damage, and even death.[26] There are no *long-term* studies of ingested hexavalent chromium. The respiratory system and the skin are the primary target organs for exposure to chromium and its compounds. Workers exposed to hexavalent chromium have developed skin ulcers and allergic reactions consisting of severe redness and swelling of the skin.[26] The oral RfD for hexavalent chromium is 0.003 mg/kg/day, and is based on a NOAEL for systemic effects in rats exposed to hexavalent chromium in drinking water over a 1-year period.[17, 26] The oral RfD for trivalent chromium is 1.5 mg/kg/day, and is also based on a NOAEL for systemic effects in rats. The estimated safe and adequate daily dietary intake for chromium of 50-200 µg/day has been established by the National Research Council, corresponding to 0.71-2.9 µg/kg/day for an adult.[17] ATSDR has adopted the upper range of the estimated safe and adequate daily dietary intake of 200 µg/day as an interim guidance for oral exposure to hexavalent and trivalent chromium.[26]

The child and adult estimated exposure doses were well below the oral RfDs established for hexavalent and trivalent chromium, suggesting that non cancer health effects are unlikely.

Cancer Toxicity

EPA classifies hexavalent chromium as a Class A (human) carcinogen by the inhalation route of exposure, based upon both animal studies and studies of worker exposures in the chrome plating industry. Long-term exposure to chromium has been associated with lung cancer in workers. Animal studies have not shown hexavalent chromium to be carcinogenic by the oral route of exposure.[17, 26] No other studies were located in the scientific literature that suggests hexavalent chromium is carcinogenic by the oral route of exposure.

The levels of chromium detected at the site were not at levels expected to result in either cancerous or non cancerous health effects.

Beryllium

Pure beryllium is a hard, grayish metal. In nature, beryllium can be found in compounds in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and the beryllium purified for use in electrical parts, machine parts, ceramics, aircraft parts, nuclear weapons, and mirrors. The greatest potential for exposure to beryllium is from occupational exposure (primarily in the form of beryllium oxide). Exposure to high levels of beryllium in air can cause lung damage and a disease that resembles pneumonia. Long-term exposure to beryllium or beryllium oxide at much lower levels has been reported to cause Chronic Beryllium Disease in sensitive individuals, characterized by shortness of breath, scarring of the lungs, and berylliosis. In addition, a skin allergy has been shown to develop when soluble beryllium compounds come in contact with the skin of sensitized individuals. Animal studies have shown that only small amounts of beryllium are absorbed after ingestion of beryllium or its compounds.[27]

Beryllium was detected in soil samples collected during both the 1993 and 1997 sampling events. One sample (EPA sample # RPS4), collected at the former rinsate pond in 1993, slightly exceeded the *former* ATSDR cancer comparison value (currently, no ATSDR oral cancer comparison value exists). All detected concentrations, however, were within the 0.39 mg/kg to 2.79 mg/kg range of natural background beryllium concentrations for the Yakima Basin.[28]

Non-cancer Toxicity

An oral RfD has been established by EPA, and is based on a 1976 study which resulted in small intestinal lesions in male and female dogs. Both the adult and child estimated exposure doses in this Health Assessment were between 1,300 and 1,700 times lower than the chronic oral RfD, suggesting that non-cancer health effects are unlikely.

Cancer Toxicity

No studies were located in the scientific literature regarding cancer in humans after oral exposure to beryllium or its compounds. Chronic oral ingestion studies did not result in increased incidences of tumors in rodents.[27] The EPA recently re-classified beryllium from a B2 (probable human carcinogen, sufficient evidence in animals and inadequate or no evidence in humans) to a B1 (probable human carcinogen, limited human data are available) carcinogen *based on the inhalation route of exposure*.[17] There is currently no oral slope factor in which to quantify cancer risks, so the former oral slope factor was used. The estimated increased child and adult cancer risk from exposure to the highest detected concentration of beryllium in soil (1.39 mg/kg) is slight; approximately one additional cancer in a population of one million persons exposed. This slight increased cancer risk can be attributed to natural background beryllium concentrations in the native soil.

Multiple Chemical Exposure

A person can be exposed by more than one pathway and to more than one chemical. Exposure to multiple pathways occurs if a contaminant is present in more than one medium (i.e., air, soil, surface water, groundwater, and sediment). For example, the dose of a contaminant received from drinking water may be combined with the dose received from contact with that same contaminant in soil.

For many chemicals, much information is available on how the individual chemical produces effects. It is much more difficult, however, to assess exposure to multiple chemicals. The vast number of chemicals in the environment make it impossible to measure all of the possible interactions between these chemicals. The potential exists for these chemicals to interact in the body and increase or decrease the potential for adverse health effects. 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 combined 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.

Table 1 below summarizes individual and total cancer and non-cancer risks for adults and for children, assuming exposure to the highest concentrations of all eight contaminants of concern detected in site soil. *The estimated total increased cancer risk is very low; approximately three to seven additional cancers in a population of one million persons exposed*.

In a like manner, individual non-cancer risk estimates (hazard quotients) were added to assess the likelihood of adverse non cancer health effects. Although the total non cancer risk estimates slightly exceeded a hazard quotient of one (suggesting the possibility of non cancerous health effects), upon careful review of the relevant non-cancer toxicity studies, for those compounds which might exhibit additive effects when combined, adverse health effects would not be expected. In other words, the combined exposure doses were still many times lower than toxic effect levels observed in relevant animal and/or human studies. Also, disulfoton was the only contaminant responsible for the hazard quotient exceedence, but it was detected in a *subsurface* soil sample, where exposure is unlikely to occur.

Table 1

Individual and Total Estimated Child Cancer and Non-Cancer Risks

Contaminant	Maximum Concentration (mg/kg)	Ingestion Rate (mg/day)	Exposure Duration (years)	i Hazard Quotient (non cancer)	Increased Cancer Risk
Trifluralin	349	50	10	0.04	3.5×10^{-7}
Ethalfluralin	1,530	50	10	0.18	1.5×10^{-6}
Disulfoton	146	50	10	3.3	N/A
Chlorpyrifos	162	50	10	0.05	N/A
Vernolate	112	50	10	0.1	N/A
Beryllium	1.39	50	10	0.0006	7.7×10^{-7}
Cadmium	25.2	50	10	0.02	N/A
Chromium	360	50	10	0.1	N/A
				Total (Hazard Index) = 3.8	***Total = 2.6×10^{-6}***

i Hazard Quotient less than 1 indicates that non-cancer health risks are unlikely to result from exposure

NA = Cancer slope factor not available.

Individual and Total Estimated Adult Cancer and Non-Cancer Risks

Contaminant	Maximum Concentration (mg/kg)	Ingestion Rate (mg/day)	Exposure Duration (years)	i Hazard Quotient (non cancer)	Increased Cancer Risk
Trifluralin	349	100	23	0.05	9.6×10^{-7}
Ethalfluralin	1,530	100	23	0.22	4.2×10^{-6}
Disulfoton	146	100	23	4	N/A
Chlorpyrifos	162	100	23	0.06	N/A
Vernolate	112	100	23	0.12	N/A
Beryllium	1.39	100	23	0.0008	2.1×10^{-6}
Cadmium	25.2	100	23	0.03	N/A
Chromium	360	100	23	0.13	N/A
				Total (Hazard Index) = 4.6	***Total = 7.3×10^{-6}***

Child Health/Developmental and Reproductive Effects

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 7 times as much water per pound as the average adult.[29] 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.

DOH evaluated the likelihood of adverse health effects for young children who could have been exposed to site-related contaminants of concern. The scientific literature was reviewed on studies evaluating reproductive and developmental effects for the eight contaminants of concern detected in site soils. *Levels of contaminants detected in site soils were well below levels observed to result in adverse reproductive or developmental health effects for all eight contaminants of concern.* The following section summarizes the available information regarding developmental and reproductive effects associated with *high dose* exposures to these contaminants.

Trifluralin

No information is available on the acute or chronic, reproductive or developmental effects of trifluralin in humans. In rats and rabbits exposed via gavage (experimentally placing the chemical in the stomach), depressed fetal weight and an increased number of fetal runts was observed. Skeletal abnormalities were observed in the offspring of mice exposed via gavage.[18] Fetotoxic effects have been observed in other rodent studies. The observed effects, however, occurred at doses much higher than estimated doses in this Health Assessment. A 2-generation reproductive effects study conducted on rats demonstrated that trifluralin does not impair reproductive ability.[17, 18]

Ethalfluralin

There is no evidence of a direct effect of ethalfluralin on fetal development with a dose that does not produce maternal toxicity. No teratogenic potential was indicated in a teratology study in rats at doses as high as 250 mg/kg/day (over 100,000 times higher than the estimated child exposure dose).

Disulfoton

No studies were located in the scientific literature regarding reproductive or developmental effects in

humans after oral exposure to disulfoton. In chronic-duration rat studies, decreased reproductive performance, decreased weight, decreased litter counts, and an increased percentage of dead births occurred after exposure to doses of 0.09 mg/kg/day (450 times higher than the estimated child exposure dose). In an intermediate-duration rat study, exposure to disulfoton at even higher doses resulted in the failure of two of five females to become pregnant. In an intermediate-duration study, rats fed disulfoton at 0.5 mg/kg/day (2,500 times higher than the estimated child exposure dose) resulted in a depression in fetal brain cholinesterase activity.[20]

Vernolate

In a two-generation reproduction study in rats exposed to technical vernam, decreased body weight was noted at the maternal lowest effect level (5 mg/kg/day); over 30,000 times higher than the estimated child exposure dose. Vernolate is not listed as a reproductive toxin in the Weed Science Society of America Herbicide Handbook.[23]

Developmental effects in animals exposed to vernolate included increased incidences of urinary tract variants at the 1 mg/kg/day level (6,000 times the estimated child exposure dose).

Chlorpyrifos

No information was located in the scientific literature concerning reproductive or developmental effects in humans following oral acute, intermediate, or chronic-duration exposure to chlorpyrifos. Despite maternal toxicity at high exposure doses, chlorpyrifos did not effect the ability of surviving dams to maintain pregnancy. No reproductive effects were observed in rats exposed to doses much higher than estimated child exposure doses.[24] Likewise, no adverse effects on fertility, mating, or gestation were observed in multi generation studies conducted using rats exposed to doses much higher than doses estimated for this Assessment.

No data were located in the scientific literature on developmental effects in animals following chronic-duration oral exposure to chlorpyrifos. There were significant increases in skeletal variations in litters exposed to high doses of chlorpyrifos. In the same study, a decrease in cholinesterase activity was noted. Rats exposed to chlorpyrifos at varying doses showed no effect on pregnancy rate, number of implantations, preimplantation loss, resorption, number of dead fetuses, litter size, fetal body weight, or sex ratio in any treatment group.[24]

Estimated child exposure doses were well below doses observed to cause reproductive and developmental effects in the relevant animal studies.

Cadmium

No studies were located in the scientific literature regarding reproductive effects in humans after oral exposure to cadmium. A number of animal studies have shown adverse reproductive effects to male

and female reproductive capacity from intermediate-duration cadmium exposure studies, but at doses much higher than estimated child exposure doses for this Health Assessment. Effects included increased duration of estrus cycle, necrosis and atrophy of semineferous tubule epithelium, decreased sperm count and motility, fewer pregnant females, and a reduction in the number of live fetuses.[25] Higher doses of cadmium were generally needed to produce a reproductive toxic response in females compared to the males.

At high exposure doses, developmental effects were observed, including delayed development of sensory motor coordination reflexes, increased motor activity, decreased fetal body weight, body length, and hematocrit, decreased pup brain and body weight, and anemia.

The estimated child exposure doses were much lower than doses observed to produce reproductive or developmental effects in the studies referenced above.

Chromium

No studies were located in the scientific literature regarding reproductive or developmental studies in humans after oral exposure to chromium or its compounds. In animal studies, chromium (III) does not appear to cause fetotoxic effects. At doses much higher than estimated exposure doses, exposure to hexavalent chromium compounds caused severe developmental effects in mice, including increased resorption, reduced ossification, and gross abnormalities.[26]

Reproductive effects included increased fetal resorption and postimplantation loss and decreased spermatogenesis. Exposure to chromium (III) did not cause reproductive effects in rats.

Estimated child exposures were well below levels observed to cause either reproductive or developmental effects in relevant animal studies.

Beryllium

No studies were located in the literature regarding reproductive or developmental effects in humans after oral exposure to beryllium or its compounds. Only one study was located regarding reproductive effects in animals after oral exposure to beryllium. In that study, rats exposed chronically to beryllium sulfate had a significantly decreased average testes-to-body weight ratio at concentrations of 0.3 and 2.8 mg/kg/day (much higher than estimated exposure doses for this Health Assessment).[27]

No reproductive or developmental effects would be expected for persons assumed to be exposed to the concentrations of beryllium detected at the site.

Health Outcome Data Evaluation for Quincy

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. DOH evaluated all of the environmental sampling data collected to date at the CSMI site to assess the likelihood that persons living near the site would experience higher rates of disease. In high dose animal studies, some of the contaminants of concern have been associated with specific cancers, such as renal pelvis cancer, thyroid tumors, and bladder cancer (see the Discussion section). However, under very conservative exposure scenarios (assuming exposure to the highest detected concentrations of all of the contaminants of concern at the site over many years), the *total* increased lifetime cancer risk for children and adults was estimated to only be slight; less than one additional cancer in a population of 100,000 persons exposed for many years. Using more realistic exposure scenario (using surface soil contaminant concentrations instead of subsurface soil contaminant concentrations, where the levels were generally lower, and shorter, more realistic exposure durations), the potential for developing cancer is substantially less. There was no evidence that exposure to the chemicals at this site would result in other chronic health conditions.

While the Health Assessment indicates that there is only a slight increased health risk, some area residents have expressed strong concerns. For example, at a DOH-sponsored Open House in Quincy in 1997, some residents were concerned that the population living near the site had experienced higher rates of a number of cancers, including cancer of the brain, breast, lymph, throat, colon, liver, kidney, bladder, lung and thyroid. In addition to cancer concerns, some Quincy area residents expressed concerns about non-cancer health conditions, including asthma, coughs, sinus problems, chronic fatigue syndrome, rashes, fetal deaths, Alzheimer's disease, and nerve damage. While the contaminants of concern may, under conservative exposure estimates, pose a slight increased risk of cancer, none of the non-cancer conditions would be expected to occur as a result of exposure to any of the contaminants found at the site. Future health problems attributable to the CSMI site are not expected, as the contaminated soil at the site was removed in 1997.

In response to the community's concern about cancer, data from the Washington State Cancer Registry were evaluated to determine if there were more cases of cancer among Quincy area residents (i.e., zip code 98848) than would be expected. To calculate the expected number of cases, we multiplied the population in a specific age range and sex category in the Quincy zip code by the rate of cancer for the specific cancer in the same age range and sex category in Washington State. We then added the results for all the age and sex categories together to get a total number of expected cases of that cancer for the zip code area. This analysis was carried out for each of the ten cancers specifically mentioned by area residents (brain, breast, lymph, throat, colon, liver, kidney, bladder, lung and thyroid) using the most recent data (1995-1997). Since the number of cases of cancer which occur in any small area varies from year to year, we calculated 95% confidence intervals for the observed number of cases. These intervals represent the range of values we might expect to see due to random variation alone (Table 2). The number of cases occurring in Quincy was not different than what would be expected in a community of the same size and age structure.

There are limitations to this type of analysis. The biggest problem is that since the analysis was carried out for the entire zip code area, it includes residents who do not live near the facility. Including residents who were not exposed to the site contaminants can affect the analysis in two ways. Most commonly, the

inclusion of unexposed persons in the study population can eliminate an otherwise measurable cancer increase in the exposed population. Measuring cancer in only the population with potential exposure (i.e., those living very close to the facility) greatly reduces the number of people in the analysis, making it very difficult to accurately estimate and interpret the expected number of cases. For example, in very small areas, it is difficult to estimate the population for non-census years, and even one case of cancer may represent a statistically significant increase. For the entire Quincy zip code, there were generally fewer than 10 people with a specific type of cancer for the three-year period. If we limit the analysis to a smaller geographic area, we will most likely encounter difficulties in interpreting very small numbers. This being the case, we do not think it is useful to conduct these analyses at an area smaller than the Quincy zip code.

There can also be problems if those people living outside the area of exposure are included in the study population and have cancer risk factors not found in the exposed population. Under these conditions, a cancer increase unrelated to the exposure in question may be found. A further limitation is that most cancers have a long-latency period; it is often 10 or 20 years before exposure to a carcinogen might result in observable tumors. People often move from place to place during such time periods, complicating the analysis.

Conclusions

Based on the review of all available site contaminant data, the chances of developing cancer from past exposure to site soil contaminants was estimated to be slight. There was no indication that past exposures would have resulted in chronic non-cancer conditions. However, due to community concerns about cancer risks, the number of reported cancer cases were evaluated. *For the ten cancer types which area residents expressed concern, all were within the range expected for the area encompassing the Quincy zip code for the most recent three-year reporting period*. Since the contaminated soil at the site has been removed, there is no reason to believe that area residents would experience any future adverse health impacts attributable to soil at this site.

Community Health Concerns

An Open House was hosted by the Washington State Department of Health (DOH) on April 23, 1997, to gather community health concerns related to the site. DOH received comments from approximately 20 residents, four whose primary language was Spanish. A Spanish-speaking interpreter was present to document concerns from those residents. Several residents attended the session, but did not comment. The following health concerns were heard:
1. Resident expressed concern about asthma. The resident also knows of 3 or 4 children with brain cancer and requested a door-to-door health survey.

A number of causative agents are known or suspected to trigger asthma, although the specific reasons can vary from person to person. Common triggers include infections, lung irritants, inherited factors, allergens, sinusitus, cigarette smoke, cold weather, and occupational and environmental irritants. Although exposures to some environmental toxicants may trigger a preexisting asthma condition, DOH

found nothing in the scientific literature that suggests that exposure to the detected concentrations of site contaminants, in and of themselves, would *cause* asthma.

Brain cancers can have both environmental and non environmental etiologies (causes). There is evidence to suggest a link between adult workers exposed to chemicals used in certain industries (vinyl, rubber production, oil refining, and chemical manufacturing), and an increased risk of developing brain cancer. Considerably less information exists about the causes of childhood brain cancers, particularly from environmental exposures. Some studies have suggested an association between increased incidences of certain brain cancers and exposure to pesticides by pesticide applicators, and in children living in agricultural areas.[30, 31] After careful evaluation of the potential health effects from past exposure to CSMI site contaminants, brain cancer would not be expected. DOH also studied the Washington State Cancer Registry to observe whether there was an increase in the number of brain cancers reported for the Quincy area compared to the number expected.

Review of the most recent Cancer Registry data indicate that the number of brain cancers reported for the Quincy area were within the range expected during this time period (see Table 2).

Upon request, DOH provided a resident an application form for a Health Study after the April 1997 Open House. To date, ATSDR has no record of having received an application to consider a Health Study for the Quincy area. If the resident is still concerned, a Health Study can be requested by petitioning ATSDR's Division of Health Studies. ATSDR uses seven criteria when considering whether or not to conduct a Health Study, the first of which is the public health significance. Based upon the evaluation of all available site-specific environmental and community health outcome data, DOH determined that the site posed a low health risk. Should conditions change, or if new environmental sampling information becomes available, DOH can reevaluate the potential health risk.

2. *A resident living on a farm indicated that aerial pesticide spraying occurs on fields surrounding his home, and is concerned about their cumulative effects on health. The resident had breast cancer and surgery in 1990. The resident's daughter and son-in-law also live on the property. The resident's daughter's baby was born with Rubenstein-Taybi Syndrome. The resident also stated that their homes are a half mile from the city's waste disposal area. Resident is also concerned that waste and urine from a feedlot may be contaminating the groundwater.*

The primary purpose of this Health Assessment was to evaluate the potential health effects from exposure to *site-specific* contaminants. DOH concluded that a very low past health risk existed as a result of elevated herbicide/pesticide compounds in CSMI site soil. The low risk only existed for persons assumed to ingest the most contaminated soil over many years (i.e., under a "completed exposure pathway" scenario). Based on available environmental sampling data, no current health threat exists. However, because of the limited scope of the previous high school air sampling investigation, DOH is recommending follow-up air sampling there. A public health hazard was found to exist under a future exposure scenario, *if people were to become exposed to current levels of contaminants in the shallow groundwater underneath, and immediately downgradient of the site. The risk would be from drinking the contaminated groundwater and inhaling the vapors from the contaminated*

groundwater, such as during showering. However, after extensive records searches followed by field inspections, no residences were located in the vicinity of the contaminated groundwater plume which access the contaminated groundwater for domestic purposes.

The cause of Rubinstein-Taybi Syndrome (RTS) is unknown.[32] Although some type of genetic origin is possible, no definite genetic pattern has been identified. There have been no consistent chemical or other environmental exposures reported during pregnancy for children born with RTS.

Exposures to pesticides from aerial application have the potential to pose a health risk, depending on the duration, type, and concentration of pesticides one is exposed to. DOH was not provided specific information on the aerial pesticide exposures in question, and did not evaluate the associated health implications. The purpose of this Health Assessment was to evaluate potential health risks associated with exposure to CSMI site-specific contaminants, not to evaluate health risks related to area wide aerial pesticide spraying. For additional information concerning pesticide poisoning issues, Lynden Baum, Manager of the DOH Pesticide Investigation and Surveillance Unit (360-236-3361, or toll free at 1-888-586-9427) can be contacted. The Washington State Department of Agriculture, Pesticide Management Compliance Unit, Yakima Branch (509-225-2640) and the Washington State Department of Labor and Industries Compliance Unit (509-886-6505) can be contacted for issues relating to pesticide application regulations and worker health and safety issues, respectively.

If the resident suspects the nearby feedlot or city waste disposal area are impacting the groundwater, DOH recommends contacting the Grant County Health District to request an inspection. If residential wells are at risk, follow-up testing of the wells should be considered. DOH is available to evaluate the results of any such testing.

3. *Resident is concerned about the possibility of ambient chemicals in the air causing lung disease. The resident also asked whether there would be enough time to move people away from the site if there was a major problem. The resident asked about the types of chemicals in the ground. Resident is also concerned that the schools are too close to the surrounding chemical plants and if the plants can be moved away from the schools.*

Lung disease can be caused by many factors (see DOH response to question # 1, above). Ambient air sampling at the CSMI site, prior to installation of the SVE system, was limited. Only 1,2-dichloropropane and a small number of other volatile organic compounds (VOCs) of concern which were present in CSMI site soil gas were tested. Air sampling conducted after the soil vapor extraction system carbon units has not detected 1,2-dichloropropane. Potential contribution of airborne contaminants originating from other area sites is unknown. If additional air sampling is conducted at the site, DOH is available to evaluate the results. For the reasons described previously in this report, DOH is recommending follow-up air sampling at the high school.

In general, it is prudent to zone public institutions, such as schools and residences, away from industrial areas. DOH recommends contacting the local or state agency responsible for emergency response in your area (most likely the Fire Department or Department of Ecology) regarding inquiries about the

readiness of adjacent facilities to respond to accidental releases. Depending upon the nature and quantity of hazardous materials used at facilities bordering the schools, state and/or federal law may require appropriate notification and evacuation plans in the event of an unplanned release. Staff with the Department of Ecology's Hazardous Waste and Toxics Reduction Program routinely inspect hazardous waste generation and storage facilities. They can also be contacted for additional information, or to request a facility inspection. Additionally, under the Superfund Amendments and Reauthorization (SARA) Title III - Emergency Planning and Community Right-To-Know Act, some of the neighboring facilities may have been required to prepare emergency response and training plans, chemical inventory lists, and/or toxic chemical release forms. If they were so required, the information is supposed to be available for public review.

The types and concentrations of contaminants detected in the ground, and the respective health comparison values, are listed in Appendix A of this report.

4. *A resident stated that his wife and daughter have a recurring cough and that one of his daughters has asthma. Their young son has behavior problems. The resident wants to know what materials were dumped at the site, at what concentrations, and from what sources. Resident is concerned that CSMI built the site poorly and illegally and their record keeping and materials tracking was poor.*

Based on the limited information provided by the commenter, DOH cannot assess the reasons for the recurring coughs. Behavioral problems can be associated with many different factors. Similarly, without more information, DOH has no way of evaluating the reasons for the son's behavioral problems. DOH recommends asking your primary care physician about these conditions.

The primary contaminants of concern released at the CSMI site were fumigants (primarily Telone), solvents, and pesticide/herbicide compounds. The reader can refer to the Background section of this report for a brief description of activities at the site which resulted in the contamination. The types and concentrations of contaminants detected are located in the Data Tables in Appendix A. The References section lists the primary documents available regarding the site investigation and cleanup, which are available for public review.

CSMI has acknowledged that past site activities have resulted in the release of hazardous chemicals into the environment. CSMI, proceeding under an Ecology Administrative Order, continues to evaluate and cleanup the site. Guy Gregory, Site Manager with the Department of Ecology (509-456-6387), can be contacted for additional information about CSMI's past practices and record keeping.

5. *Resident used to live near the CSMI site, has no health problems, and thought the announcement was alarming. Resident has no concerns and has seen no health effects.*

Comment has been noted.

6. *Resident has lived in Quincy for 30 years and used to live upriver from the Hanford reservation. Her husband died of cancer and a friend had lymph and kidney cancer. She wants to know if there is a connection with those cancers and site contaminants. Resident wants to know if there is a large number of cancers in the area.*

After careful review and evaluation of all available site environmental sampling data, DOH concluded that exposure to contaminants detected at the CSMI site are unlikely to result in adverse systemic health effects. Under a very conservative exposure scenario (ingestion and skin contact with the most contaminated soil over many years), DOH estimated a very low increased cancer risk. The reader can refer to the Discussion and Conclusion sections of this report for a more complete analysis of the health risks.

The reader can refer to the Health Outcome Data Evaluation for Quincy section of this report for a summary of cancer incidences reported for the Quincy area, compared to the number of cancers expected. For the ten cancers of concern which some area residents had expressed concern, none exceeded the number expected for the Quincy area for the most recent reporting period *(the reported number of these cancer types for the Quincy area were within the range of cancer incidences expected)*.

This Health Assessment was intended to summarize the potential health impacts from exposure to *CSMI site contaminants only*. The Department of Health's Hanford Health Information Network (HHIN) was created to provide information on the known and potential health effects of the radioactive releases from the Hanford Nuclear Reservation, located in south central Washington State, from 1944 to 1972. For further information, or to obtain a copy of their most recent report, HHIN can be contacted toll free at 1-800-522-HHIN (4446).

There were a number of concerns expressed by some area residents about the possible health impacts as a result of contaminants detected at the CSMI site. This section (Community Health Concerns) is a summary of all of the concerns, and DOH's responses to the concerns.

7. *Resident's office has been located 200 feet southeast of the site for the past 15 years. He has had sinus problems for the past 4-5 years and wants to know if dust exposure from the site could be the cause. The resident is also concerned about health risks of his employees, whether his property is contaminated, and is concerned that the contaminated soil piles at the site were not adequately covered.*

After evaluating all available site environmental sampling data, DOH concluded that the site did not pose a significant health risk to persons assumed to be exposed. DOH noted the contaminated soil piles stockpiled on site after excavation occurred in 1997, and the fact that the cover was not always effective in containing dust emissions from those piles. The soil piles were eventually taken to a licensed hazardous waste landfill in Roosevelt, Washington. Although concentrations of some contaminants in the excavated soil piles were elevated, they were only moderately elevated, and in and of themselves, would not be expected to result in sinus problems to exposed individuals. However, it is possible that the *particulates*

frequently generated from windblown dust in the area generally, could initiate or aggravate pre-existing sinus problems.

CSMI, under Ecology supervision, has investigated some properties to the south and southeast of the site, particularly to determine the nature and extent of off-site groundwater and subsurface soil gas contamination originating from the CSMI site. Groundwater contamination is the most serious environmental problem associated with the site, although exposure to the contaminated groundwater is not occurring, nor is it believed to have occurred in the past.

DOH has evaluated the results of numerous soil, soil gas, groundwater, and air samples which were collected at various offsite locations, including the adjacent school property, Desert Electric facility, and a background site. DOH is not recommending further offsite soil testing. However, although DOH does not anticipate the finding of VOCs in ambient air at levels of health concern, because of the limited nature of the Quincy high school air sampling conducted in 1998, the presence of 1,2-DCP in subsurface soil gas, and the low detection of 1,2-DCP in the High school staff lounge, *DOH is recommending more comprehensive follow-up air sampling at the high school*. If more comprehensive air sampling is conducted, DOH recommends that the samples be analyzed for additional VOCs, and that the sampling should be conducted during different seasons to reflect differences in ambient temperature and pressure (i.e., summer and winter). DOH would be available to evaluate the results of such tests, if conducted.

8. *Resident has worked at Quincy Jr. High and is concerned that students and teachers are affected by the site. He wants to know what is being done and what the timeframes are for site cleanup?*

Guy Gregory, Site Manager with the Department of Ecology, can be contacted for information concerning current site cleanup activities, and timelines for cleanup.

DOH understands that the rinsate pond spray evaporation system, which operated at the site for a short time in the late 1980s, reportedly generated overspray which occasionally drifted onto the neighboring Jr. High School. Although rinsate pond sludge sampling data was available, rinsate pond water sampling data was not. No air sampling of the overspray mist was conducted during the operation of the spray system. As a result, precise quantification of the school exposures is not possible. However, based on the limited number of herbicide/pesticide compounds reported for the sludge (five), their generally low concentrations, the limited timeframe in which exposure would have occurred, and the likelihood of some dilution between the sludge and water phase, and between the site and school, a significant long-term health risk would not be expected. However, if students or employees of the Jr. High School have health concerns they feel are related to exposures from the overspray, DOH recommends consulting with their primary care physicians. DOH can also consult with Occupational Health physicians who specialize in the medical evaluation of environmental and occupational exposures to determine if a follow-up medical evaluation should be considered.

In early 1998, DOH spoke with an employee of the Jr. High School regarding concerns he expressed about air quality there. Specific concerns included exposures to the rinsate pond overspray, the possibility of pesticides in the school's ventilation system, and diesel fume exhaust odors. The conversation was followed up with a letter in January 1998. Included with the letter was a list of Washington State private air quality consulting firms, indoor air quality guides, an exposure history guidance form, an Environmental Health Resource Directory, an application for additional Air Quality Tools for Schools kits, and additional indoor air quality references. DOH also referred the employee to our program's indoor air quality specialist and the Washington State Department of Labor and Industries consultative branch for additional information. DOH is recommending follow- up ambient air sampling at the high school, and is available to evaluate the results of such tests.

9. *Resident is concerned that little has been done, yet the site has been a known problem for a long time.*

In August 1991, Ecology inspected the CSMI facility, and in April 1992, issued CSMI an Administrative Order requiring development and implementation of a Site Assessment Plan for the area in and around the former rinsate pond. In 1993, EPA conducted a site assessment of the former rinsate pond area. Tank removals occurred in 1995 and cleanup began in 1997. The draft Cleanup Action Plan for the site is expected to be available by the summer of 2000. At that time, Ecology will seek public input. DOH became aware of the CSMI site in late 1996. In 1997, Ecology requested that DOH prepare a report evaluating the health implications as a result of contaminants detected at the site. DOH has been involved ever since. Guy Gregory, Ecology Site Manager (509-456-6387) can be contacted for information on current activities and timelines for cleanup. A more detailed description of the site, regulatory history, and DOH activities is located in the Background section of this report.

10. *Resident wants to know whether chemicals at the site could have caused his throat cancer. Wants to know if there is an exposure pathway and whether the site is currently safe. Resident is concerned about possible higher-than-normal cancer rates among potato plant workers near the CSMI site.*

Exposure pathways were evaluated as part of the Health Assessment process. Based on the available sampling data, completed exposure pathways were assumed to be from ingestion and skin contact with contaminants detected in CSMI site soil (pesticides/herbicides/metals), and inhalation (1,2-dichloropropane detected in indoor air in the Quincy High School staff lounge). The 1998 high school air sampling event was very limited in scope, and the source of the high school detection is not known. It was the only sample (of eleven total air samples collected at the school) which detected 1,2-DCP. The sample concentration exceeded EPA's Reference Concentration for long-term exposure, but was over 700 times lower than the lowest concentration at which health effects were observed in animals. Although the available sampling data do not suggest that volatile contaminants are present in ambient air at levels of health
concern, DOH is recommending more comprehensive, follow-up air sampling at the high school for the reasons discussed previously.

Based on the types of chemicals of concern detected at the site, throat cancer would not be expected to result from exposure. Contaminated groundwater poses the only significant health risk at the site, although nobody is believed to be using it for domestic purposes. Since removal of the rinsate pond, fumigant tanks, and contaminated soil, the site does not currently pose a health threat to site workers or residents.

DOH was not provided the details of the potato plant workers' cancers, nor was DOH provided any information about chemicals used at the potato plant to which employees might have been exposed. A discussion of reported and expected cancer incidences for various cancers of concern for the Quincy area is located in the Health Outcome Data Evaluation section of this report.

11. *Resident expressed concerns about dust exposure to surrounding schools and residences. Resident is also concerned about whether there are adequate school evacuation plans due to the surrounding chemical plants. Resident is concerned about contaminated mist from site spraying operations and about contaminated sludge spread onto a farm. Resident is concerned about EDB-contaminated water at the Nielson Trailer Park water system. Resident wanted to know which lab would analyze subsequent groundwater samples - wants door-to-door survey.*

The commenter can refer to DOH response to comments # 7 and #18 regarding dust exposures. Undoubtedly, windblown dust is generated from the CSMI site *and numerous other area sources, including surrounding fields*. The intent of this Health Assessment was to assess exposures to CSMI site-related contaminants only.

The commenter can refer to DOH response to comment # 3 concerning recommendations on contacts for inquiries about evacuation/emergency response. In general, it is prudent to have appropriate notification and evacuation plans in place in the event of an unplanned hazardous chemical release(s), particularly for facilities located near at-risk populations, such as residences and schools. DOH recommends contacting the local fire department, school administrator, and/or Grant County Health District for facility-specific information.

The commenter can refer to comment # 8 regarding the spray evaporation system which operated at the site for a short time in the late 1980s. Two Case Investigation reports were prepared by the Washington State Department of Agriculture; one in July 1991, and one in May 1992. The reports summarized the Department of Agriculture's investigation of CSMI sludge disposal on the farm property, and are listed in the Reference section.

DOH was not provided with Nielson Trailer Park water system sampling results, but is available to evaluate any results provided. EDB was used extensively in the past as a soil fumigant pesticide and as a leaded-gasoline additive. Cancer is the primary health effect of concern for EDB exposure. EDB was detected in one CSMI site monitoring well, and in one off-site monitoring well. Ecology can be contacted for additional information regarding the monitoring well detections.

Ecology can be contacted for information on the labs used to analyze the water samples. The commenter can refer to DOH response to comment # 1 regarding the request for a Health Survey.

12. *Resident is concerned about her health, has colon and liver cancer, and thyroid problems. Resident used to work at nearby potato plant. Resident wants to know health problems of others in the area and local cancer rates compared to national rates.*

For the most recent (1995-1997) reporting period, the number of colorectal cancers reported for the Quincy area were within the range expected. No liver cancers were reported for this area for this time period. For all of the cancer types which some residents expressed concern, none exceeded the number expected for this area.

No information was provided to DOH regarding potential chemical exposures of potato plant employees. Occupational exposures are regulated by the Department of Labor and Industries, although DOH is available to assist in evaluating the results of any such exposure monitoring.

Cancer is the most common cause of death in Washington adults, aged 45 to 74. Be it breast, lung or prostate, cancer of some form will likely strike one in three Washington residents in their lifetime. DOH's *1997 Cancer in Washington* report, released in late October 1999, summarizes data on the state's 24 most common types of cancer. In 1997, there were 26,517 new cases of cancer overall. Breast cancer is the most common type of cancer, followed by prostate, lung and colorectal cancer and melanoma. Lung cancer accounts for almost 30 percent of all cancer deaths in Washington State.

13. *Resident's 28-year-old child has chronic fatigue syndrome and attended local schools. Resident's second child (18 years old) has chronic headaches, chronic fatigue syndrome, and has twice had mono. He was tested and had elevated levels of aluminum. Their drinking water was tested and was high in nitrates, but not high in aluminum.*

Currently, there is no known cause or a specific biological indicator for the illness commonly referred to as chronic fatigue syndrome. An estimated 90 percent of mononucleosis cases are caused by the Epstein-Barr virus (EBV), a member of the herpesvirus group. Most of the remaining cases are caused by certain other herpesviruses, particularly cytomegalovirus.[33] Exposure to environmental chemicals is not a likely cause of mononucleosis. DOH was not provided specific information about the elevated aluminum levels, although aluminum was not a contaminant of concern at the site.

Ingestion of drinking water containing nitrate at or above the Federal drinking water standard (Maximum Contaminant Level, or MCL) of 10 ppm may pose a health hazard for infants due to the risk of methemoglobinemia. A risk also exists for pregnant woman drinking water that contains nitrate above the MCL. Although high nitrate levels were found in the shallow groundwater underneath the site, DOH is not aware of any exposures to the contaminated groundwater. It is not uncommon to find elevated nitrate levels in the groundwater in heavily farmed areas, such as Grant County. Water treatment systems and bottled water are effective in reducing exposure to nitrate in drinking water.

14. *Resident stated their horses became sick and died as a result eating hay that was grown on the field where the CSMI rinsate pond sludge was spread. She had a bad cough while handling the hay and was diagnosed with chronic fatigue syndrome.*

DOH has reviewed two reports prepared by the Washington State Department of Agriculture, which included a discussion of crop impacts after field application of the rinsate pond sludge (see DOH response to comment # 11). Although one of the reports concluded that "the contents of the Cenex waste pond applied to the 100-acre circle had deleterious effects on plant growth," no attempt was made to assess the impact, if any, the sludge application may have had on the horses. The reports are listed in the Reference section, and should be available for public review. Residual contaminants detected in the field soil samples included atrazine, chlorpyrifos, ethalfluralin, propachlor, dichlobenil, and trifluralin. The residual levels of these contaminants measured in the field soil at the time of the sampling, however, were low (levels ranged from 0.001 ppm to 0.17 ppm - below human health-based levels for soil ingestion). Administrative penalties were issued to CSMI as a result of the sludge application.

DOH was not provided with specific information (i.e., the levels of pesticides/herbicides in the hay), whereby an estimation of health risk could be made. As noted above, the residual levels of pesticides and herbicides measured in the field after the sludge application were quite low, suggesting that exposure would unlikely have resulted in adverse health effects. If the resident is still concerned about the health effects he or she feels may be related to handling of the hay, DOH recommends contacting your primary health care physician. The commenter can refer to response to comment # 13 regarding chronic fatigue syndrome.

15. *Resident wants to know when the site will be contained and cleaned up and feels there has been inadequate community responsiveness. Resident owns house "downwind" of the site. A friend who passes by the site is losing his hair. Resident does not like the groundwater testing procedures and wants to know if the tests were for specific chemicals. Wants to know the source of the "elevated levels of beryllium" found on the site. Is concerned about winter runoff from the site. Feels there is insufficient information available to the public and wants a health survey conducted, especially for the migrant population and a mobile home park near the high school. Concerned about Hanford wastes in Quincy.*

Ecology's Site Manager can be contacted for an update on current site activities and timeframes for cleanup. Since 1997, there have been numerous community Open Houses and meetings to update area residents about site investigation and cleanup activities. DOH presented the findings of the preliminary Public Health Assessment at a Public Meeting in 1998. Notices were mailed out well in advance of the meeting.

DOH could not find anything in the scientific literature which suggests that exposure to the types of contaminants found at the site would result in hair loss.

The groundwater testing procedures were conducted in accordance with an Ecology-approved sampling plan. The testing included the analysis of a broad range of chemicals which were known or suspected to be present at the site.

There were no elevated levels of beryllium detected at the CSMI site. An initial sample analysis report prepared in early 1996 indicated an elevated level of beryllium in a site soil sample. In a letter from Cascade Analytical (the lab which conducted the analysis) to the Department of Ecology dated March 14, 1996, the lab indicated there had been an error in the initial analysis. The error resulted from an electronic failure with the instrument used to analyze the sample batch. Subsequent analysis was conducted which indicated that the beryllium concentration was much lower than the initial analysis had reported. The corrected results were submitted to Ecology on May 15, 1996. DOH evaluated all sample results, including the beryllium results. The highest concentration was from a sample collected by the EPA in 1993. The concentration (1.39 mg/kg) was within the range of natural background concentrations for the area and does not pose a health threat (see Appendix A, Table 5).

The commenter can refer to DOH's response to comment # 1 regarding the Health Survey. DOH is not aware of Hanford wastes in the Quincy area in general, or at the CSMI site, in particular. DOH evaluated the results of all environmental samples collected during the site investigation. This report summarizes the public health findings.

16. *Resident has lived in Quincy since 1956, has no health problems, wants to know if there is still a problem with the site, and the status of the cleanup.*

Comment noted. Since removal of the fumigant storage tanks, rinsate pond, and contaminated soil, the site has not posed a direct contact health threat. Most of the remaining contamination is in the shallow groundwater underneath the site, where exposure is not occurring. A public health hazard would exist under a future scenario, if people were to become exposed to the contaminated groundwater. Groundwater cleanup is being addressed by CSMI, with Ecology oversight. The commenter can contact Guy Gregory, Ecology's site manager, regarding the status of the cleanup. Because of the limited scope of the 1998 high school air sampling investigation, DOH is recommending a more comprehensive follow-up air sampling investigation there.

17. *Resident is concerned about pesticides getting into the drinking water, and is concerned about soil and air exposure to pesticides. Wants to know how contaminated the site is, why the site is so close to the school, how long it will take to clean it up, and how the site might effect the family.*

Ecology directed CSMI to investigate and cleanup the site because of the threat to human health and the environment. Pesticide contamination was one of the concerns, and was evaluated during the Remedial Investigation. Although numerous pesticide/herbicide compounds were detected in site soil and rinsate pond sludge samples, none were detected in the shallow groundwater (although other contaminants *were* detected in groundwater). DOH determined that, based on the presence of some

pesticides/herbicides in site soil samples, a very low estimated increased cancer health risk existed. The risk would have existed only from long-term ingestion and skin contact. The reader can refer to the Discussion and Conclusion sections of this report for a detailed summary of the health risks.

Based on the types and concentrations of contaminants detected in site soil, DOH is not recommending air sampling for pesticides. However, because of the limited nature of the 1998 high school air sampling event, DOH is recommending follow-up air sampling there. DOH is available to review and evaluate any air sampling plans, air dispersion model results, or air sampling test results which CSMI, agencies, or individuals may wish to develop and collect.

DOH does not know the reasons for citing the schools in their current locations. Quincy's Planning/Zoning Department is probably the best source of information on this.

No VOCs (the primary class of contaminants of concern detected in site groundwater) were detected in recent Quincy well samples. The owner/operator of the resident's water system can be contacted for the most current water testing information. DOH is available to evaluate the results of such tests.

18. *Resident wants to know whether the rash on their daughter's neck is related to the site. Resident wants to know the concentration of contaminants in the groundwater. Also wants to know if her son, who attends the school, might be exposed to the site contamination. Resident wants site cleaned up and wants to be assured that her family will not be harmed.*

Groundwater contaminant concentrations for June 1998 are summarized in Table 7 of this report. Groundwater testing since then has revealed similar contaminant concentrations.

Some studies have shown that rodents exposed to high concentrations (much higher than levels detected at the site) of some of the detected contaminants developed redness and/or skin sensitization. Trifluralin, for example, may produce allergic reactions in certain people at high concentrations. However, skin contact with even the highest levels of contaminants found at the site would not be expected to result in skin rashes.

Although it is *possible* that exposure to contaminants could have occurred through periodic fugitive dust emissions from the CSMI site, based on the location, types, and concentrations of contaminants detected on the site, DOH believes the risk to students or staff at the schools would have been low. Since air sampling or air modeling for pesticides was not conducted, actual exposures (and therefore risk) cannot be quantified. Many potential sources of fugitive dust exist in the vicinity of the schools, which would make it very difficult to establish the precise origin of contaminants, even if detected.

Since 1997, under an Ecology Order, the site has undergone extensive investigation and cleanup.

19. *Resident is concerned that his school-aged children are being exposed to the site and that chemicals from the site could contaminate the drinking water.*

Past releases of chemicals at the site *did* contaminate the groundwater, although the groundwater in the area of contamination is not believed to be used as a source of drinking water. Residents in the area obtain their water from Quincy municipal wells, which, to date, do not appear to have been impacted by the site. Under an Ecology Order, CSMI has been directed to clean up the site, including the contaminated groundwater. The commenter can refer to DOH's previous responses concerning exposures at the adjacent schools. Groundwater, soil gas, and limited air sampling has been conducted on the high school property. Although the available (albeit limited) air sampling information does not suggest that 1,2-DCP is present at levels of health concern at the high school, because of the limited scope of the air sampling investigation upon which these conclusions are based, DOH is recommending more comprehensive air sampling at the high school.

20. *Resident wants to know if her renal problems are related site contaminants, the levels of site contaminants, and whether her drinking water is contaminated. She also wants to know if her family's health is at risk from site contaminants and whether the contaminants could effect pregnancies. She has had two miscarriages and wants the site cleaned up and moved out of the area.*

The levels of site contaminants are summarized in Appendix A of this report. Those contaminants which were found at levels high enough to require further evaluation by DOH are highlighted in the Tables, and are discussed in the report.

DOH was not provided with a water sample analysis report for the well in question, so cannot evaluate the results. Extensive groundwater testing in the immediate vicinity of the CSMI site has revealed substantial shallow groundwater contamination (predominantly volatile organic compounds and nitrate). However, after extensive records searches, followed by field investigations, DOH and the Local Health District were unable to locate any private wells which are being used for domestic purposes in the impacted area. If concerned about possible well contamination, DOH or the Local Health District can provide the names of laboratories certified to analyze well water samples. DOH is available to evaluate the results of any such tests.

After careful evaluation of available sampling results from the CSMI site, DOH concluded that chronic non-cancerous health effects (such as kidney or liver disease) are unlikely to result from exposure. Under a very conservative exposure scenario (long-term ingestion and skin contact with the most contaminated soil), DOH estimated there was a slight additional chance of developing cancer. Although animal studies demonstrated some reproductive or developmental effects after being exposed to very high doses of some of the detected pesticide/herbicide compounds of concern, the levels required to produce these effects were much higher than estimated child and adult exposure doses for this Health

Assessment. The commenter can refer to the Discussion section and Child Health/Developmental and Reproductive Effects section of this report for a more complete summary of the findings.

The site is being cleaned up under an Ecology Administrative Order. Although DOH can *recommend* actions to protect public health, DOH has no regulatory authority regarding CSMI's future plans.

21. *Resident lived in Quincy from 1969-96, including locations near the site, and has renocell carcinoma. She currently works at Simplot. She feels there are an unusually high number of rare cancers.*

The commenter can refer to previous DOH responses and the Health Outcome Data Evaluation section of this report concerning cancer incidences reported for the Quincy area. Upon evaluation of the cancer registry data for this area, *no increased incidences of cancer were found, compared to the numbers that would be expected in a community of the same size and age structure*. DOH has not been provided any information in which to enable evaluation of potential health risks for the Simplot site. The Ecology site Manager can be contacted to obtain whatever sampling information is available for the Simplot facility. DOH is available to evaluate the results of any such information.

22. *A resident is concerned about a substance he and school kids ran through and inhaled. The substance had a salty/acidic taste and was on their arms, face, and clothing. He is concerned that the school's ventilation system lets in diesel fumes and is concerned about the drinking water.*

A rinsate pond spray evaporation system operated for a short period of time at the CSMI site in the late 1980s. Reportedly, overspray from that system periodically migrated toward the school and came into contact with some students for a short period of time during track. Although rinsate pond sludge samples were collected and analyzed, pond water or spray samples were not. As a result, DOH cannot quantify the potential health risk (if any) from exposures that may have occurred to the resident and students. The commenter can refer to DOH response to question # 8 for further discussion.

The Department of Labor and Industries can be contacted if there is reason to believe there is a chronic indoor air problem at the school. If vehicles are responsible for the diesel exhaust, the school should consider simply having the vehicles park in a different location. (i.e., further from ventilation intakes). Tim Hardin, an Indoor Air Specialist with the Department of Health (360-236-3363), can be contacted for additional information. Indoor Air Quality: Tools for Schools Action Kit, provides useful information and additional contacts on indoor air quality issues. Tim Hardin can be contacted for information on how to obtain copies.

State drinking water regulations require the school's drinking water to be tested periodically. It is DOH's understanding that the school uses water supplied by the city's municipal wells. To date, these wells do not appear to have been impacted by the site. DOH is available to evaluate results of school drinking water samples, if requested.

23. *Resident's father has liver problems, Alzheimers disease, bladder cancer, nerve and heart damage, bronchial asthma, and a hernia. He worked at the site for about one year in 1976. Resident cannot find records of chemicals her father was exposed to while he cleaned the inside of pesticide tanks. He had a chemical injury in 1976. Resident states that many of her father's medical records are gone.*

DOH is not routinely provided with employee medical records, nor has DOH been provided with the details of the employee's workplace exposure. Employers are required to provide access to employee medical records. Occupational chemical exposures in the workplace can be (and usually are) more significant than environmental exposures. Without proper respiratory protection, the potential for significant chemical exposures while cleaning the inside of pesticide tanks is high. Under existing state and federal Occupational Health and Safety, and Employee Right-to-Know laws, employees are entitled to know the types and hazards of the chemicals they are exposed to in the workplace. Chemical-specific Material Safety Data Sheets are one such source of information. If the potential exists for significant workplace exposures, employers are also required to provide employees with appropriate personal protective equipment. The employee can contact the Washington State Department of Labor and Industries (Compliance Branch), if he feels there were health and safety violations. If more detailed occupational exposure data is provided which suggests that a workplace hazard exists(ed), DOH can consult with occupational health physicians who specialize in the medical evaluation of environmental and occupational exposures to determine if a follow-up medical evaluation should be considered.

DOH determined that exposures to contaminants found *in the environment*, at the CSMI site, were not at levels expected to result in the kinds of health effects the resident described.

24. *Resident's family is healthy and feels there is unsubstantiated blame by the media and inaccurate information being communicated by the media and some residents about the site.*

Comment noted.

TABLE 2
Cancer Incidences Reported and Expected for the Quincy Area (1995-1997)

Cancer Incidence for Quincy, WA (Zip Code 98848)				Observed # of Cases	Expected Range*		Expected # of Cases
Primary Site Category	**1995**	**1996**	**1997**	**1995-97**	**Lower**	**Upper**	**1995-97**
Bladder	2	1	0	3	0.6	8.8	5.0
Brain	1	0	1	2	0.2	7.2	1.5
Breast (female)	8	4	8	20	12.2	30.9	18.2
Colorectal	1	5	1	7	2.8	14.4	11.2
Kidney and Renal Pelvis	2	0	3	5	1.6	11.7	2.5
Liver	0	0	0	0	0.0	3.0	0.7
Lung and Bronchus	3	4	1	8	3.5	15.8	15.8
Hodgkins Lymphoma	1	0	0	1	0.0	5.6	0.7
Non-Hodgkins Lymphoma	1	3	5	9	4.1	17.1	4.4
Larynx	0	0	0	0	0.0	3.0	1.0
Oral Cavity and Pharynx	1	0	0	1	0.0	5.6	2.7
Thyroid	0	1	0	1	0.0	5.6	1.5
*** 95% Poisson Confidence Interval**							

Conclusions

1. *After careful evaluation of all available environmental sampling data, DOH determined that no apparent public health hazard* existed for adults or children who could have been exposed, through ingestion and skin contact, to contaminants detected in CSMI site soil*. Contaminant concentrations in CSMI site soils were not at levels expected to result in adverse non-cancerous health effects, although a slight increased cancer risk was estimated.

2. *An indeterminate public health hazard exists due to high levels of VOCs and nitrate in shallow groundwater underneath, and immediately downgradient of the CSMI site.* No current public health hazard exists, as the contaminated groundwater is not believed to be used for domestic purposes. A future public health hazard would exist if exposures to current groundwater contaminant levels occurred through domestic uses, such as drinking and showering.

3. *No apparent public health hazard exists for persons exposed to the concentration of 1,2-dichloropropane detected in indoor air in the Quincy High school staff lounge.* This conclusion is based upon the results of a limited-scale air sampling investigation conducted in 1998 at the high school.

4. For those cancers which some residents expressed concern, the number of cases occurring in Quincy for the most recent 3-year reporting period were not different than what would be expected in a community of the same size and age structure.

* This health hazard category is used when human exposure to contaminated media is occurring, or has occurred in the past, but the exposure is below a level of health hazard.

Recommendations

1. CSMI should continue to assess the extent of the contaminated groundwater plume, and cleanup the groundwater, per Ecology's requirements.

2. CSMI should continue to remove VOCs from site soil gas, per Ecology's requirements.

3. Because of the limited scope of the February 1998 high school air sampling event, the presence of VOCs in subsurface soil gas underneath the CSMI site and high school property, and the low detection of 1,2-Dichloropropane in air in the high school staff lounge, more comprehensive follow-up air sampling should be conducted at the Quincy high school. The sampling should be conducted during different seasons (i.e., during summer and winter) to provide information on possible differences that ambient temperature and pressure might have on sampling results. In addition, active, rather than passive air sampling should be conducted. Besides 1,2-Dichloropropane, the samples should include analysis for the other VOCs previously detected in subsurface soil gas at the CSMI site (vinyl chloride, chloroform, DCE, and chlorobenzene). Results of any such testing should be provided to DOH for evaluation.

4. Grant County Health District or Ecology should inform DOH of the discovery of any area domestic supply wells that could be threatened by the contaminated groundwater plume.

5. The city of Quincy should continue to provide DOH with the results of all subsequent municipal well test results for evaluation.

6. Applications for development of new domestic wells in the vicinity of the contaminated groundwater plume should not be approved by the Grant County Health District.

7. Upon request, DOH is available to evaluate the results of additional environmental samples (air, water, or soil) collected by CSMI, Ecology, or a third party, to determine the threat to public health.

Public Health Action Plan

The Public Health Action Plan (PHAP) for the CSMI site is outlined below. The purpose of the PHAP is to ensure that this Health Assessment not only identifies public health hazards, but provides a plan of action designed to prevent or mitigate adverse human health effects resulting from exposure to hazardous substances in the environment.

Actions Taken by CSMI, Ecology, and EPA:

1. The U.S. Environmental Protection Agency conducted a site assessment of the former rinsate pond area on May 10-11, 1993.

2. From August 1994 to February 1995, CSMI contractors, with Ecology oversight, decontaminated and removed all tanks of the former fumigant storage facility.

3. A total of 360 tons (277 cubic yards) of soil and concrete removed from the rinsate pond was transported to the Rabanco Landfill on May 1 and 2, 1997. The site was then wetted down with a water truck, and clean gravel was placed over the site to suppress dust emissions.

4. Since 1997, CSMI has conducted extensive on- and off-site environmental sampling in various media, including soil, soil gas, groundwater, and air.

5. Since 1997, Ecology and CSMI have sponsored several Open Houses to update the community about the status of the site investigation and cleanup activities.

6. In February 1998, a limited-scale air sampling investigation was conducted by CSMI in and around the Quincy High school.

7. Between August and December 1998, CSMI completed all of the interim actions (the installation of five additional monitoring wells, a vapor extraction system, and an air sparging system).

8. Ecology and CSMI signed an Agreed Order requiring CSMI to perform various activities (see Background section for details).

Actions Taken by DOH:

1. On April 23, 1997, DOH sponsored an Open House to meet with area residents, and to document their health concerns.

2. On June 5, 1997, DOH sponsored a meeting with CSMI, Ecology, Grant County, and Washington State University to review site information, and to assess the existence of private wells in the vicinity of the CSMI site that could potentially be impacted by the contaminated groundwater plume.
3. In October 1997, DOH prepared a letter summarizing all site activities since early summer 1997, and activities planned for the future. The letter was mailed to attendees of the Quincy Open House, CSMI, area residents, and agency representatives.

4. As a result of concerns expressed by several Quincy area residents, DOH studied the Washington State Cancer Registry to evaluate if there had been any increase in specific cancer types reported for the Quincy area for the most recent reporting period.

5. On December 16, 1997, DOH attended an Open House in Quincy to share the results of the preliminary Health Assessment, to provide site-specific chemical information, and to address questions from the community, media, and agencies.

6. In April 1998, DOH mailed update letters to area residents summarizing the findings of the preliminary CSMI Health Assessment.

7. At an Ecology-sponsored public meeting in Quincy on August 18, 1998, DOH presented the findings of the Health Assessment.

8. The Washington State Department of Health has evaluated potential links between contaminants detected both on- and off-site, and health concerns expressed by some area residents. The results of the evaluation were presented at a public meeting in Quincy on August 18, 1998, and are presented in this Public Health Assessment.

Actions Planned:

1. Ecology anticipates a draft Cleanup Action Plan for the site will be available in late spring or early summer 2000. At that time, Ecology will seek public input.

2. DOH is available to review and evaluate new environmental sampling data that is presented, such as additional air sampling and performance monitoring data, or residential domestic well sampling results.

Preparer of Report

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Appendix A
Data Tables

Table 3
1993 EPA & 1995 CSMI Soil Volatile Organic Compound (VOC) Concentrations (mg/kg) [

	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sample		
COMPOUND	RPS1 EPA	RPS2 EPA	RPS3 EPA	RPS4 EPA	RPS5 EPA	*SS1 EPA	SS2 EPA	SS3 EPA	SS4 EPA	SS5 EPA	1995 CSMI	i CV child	CV adult
Acetone			0.059				0.04	0.042		0.07		5,000 RMEG	70,000 RMEG
Benzene		0.001						0.0003				20 - CREG	20 - CREG
Chloroform			0.002									100 - CREG 500 - EMEG	100 - CREG 7,000 - EMEG
1,2-Dichloropropane	0.006	0.003	1	0.2	0.052		0.005		0.0004		1.5	5,000 - EMEG	60,000 - EMEG
1,2,4-Trimethylbenzene (pseudocumene)	0.015		0.022	0.01								3,900 - EPA	3,900 - EPA
1,3,5-TMB (mesitylene)	0.006		0.036	0.009								3,900 - EPA	3,900 - EPA
Chlorobenzene	0.092	0.008	0.22	0.034	0.026				0.019			1,000 - RMEG	10,000 - RMEG
1,3-Dichloropropane	0.002		0.076	0.019	0.009							N/A	N/A
Total Xylenes	0.068	0.002	0.152	0.045	0.003							10,000 - EMEG	100,000 - EMEG
cis-1,3-Dichloropropene	0.005										0.009	20 - RMEG	200 - RMEG
trans-1,3-Dichloropropene	0.006										0.009	20 - RMEG	200 - RMEG
Chloromethane		0.002	0.002		0.002							76.9 - MTCA B	76.9 - MTCA B
Naphthalene		0.039	0.079	0.009								1,000 - EMEG	10,000 - EMEG
2-Butanone (MEK)			0.026				0.007	0.012				30,000 - RMEG	400,000 - RMEG
Ethylbenzene			0.009	0.002								5,000 - RMEG	70,000 - RMEG
2-Chlorotoluene	0.039	0.009	0.16	0.069	0.011							1,000 - RMEG	10,000 - RMEG
Tetrachloroethene (PERC)			0.003									10 - CREG 500 - RMEG	7,000 RMEG
1,1,1-TCA	0.008			0.001								1,600 - EPA	1,600 - EPA
Chloroethane (ethyl chloride)				0.001								220 - EPA	220 - EPA
1,1,2-TCA					0.001							10 CREG 200 - RMEG	10 - CREG 3,000 - RMEG
Carbon disulfide							0.008			0.028		5,000 - RMEG	70,000 - RMEG
1,2,3-Trichloropropane							0.002					300 - RMEG	4,000 - RMEG
1,1-Dichloroethene									0.0002			1 - CREG 500 - EMEG	1 - CREG 6,000 - EMEG

* Background sample
i CV = Health-Based Comparison Value
[No VOCs exceeded a health based comparison value in soil
EPA comparison values taken from Region III Risk-Based Concentration (RBC) Table, United States Environmental Protection Agency

Table 4
1993 EPA & 1995 CSMI Soil Herbicide/Pesticide Concentrations (mg/kg)

	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sample		
COMPOUND	**RPS1 EPA	RPS2 EPA	RPS3 EPA	RPS4 EPA	RPS5 EPA	*SS1 EPA	¢SS2 EPA	SS3 EPA	SS4 EPA	SS5 EPA	1995 CSMI	CV child	CV adult
Disulfoton (insecticide)	8.79	146	4.67	3.37							4.93	3 - EMEG	40 - EMEG
Diuron	0.295		0.764	0.753			0.93		3.79			100 - RMEG	1,000 - RMEG
Cycloate	0.79											N/A	N/A
Trifluralin (Treflan) (herbicide)	158	57.7	295	349	0.98		294				138	400 - RMEG 90 - CREG	5,000 - RMEG 90 - CREG
Atrazine	5.25	0.694	21.3	38.6			0.735				8.51	2,000 - RMEG	20,000 - RMEG
Vernolate (vernam) (herbicide)	42.2	2.89	112	78.3	0.347		6.87				89.7	50 - RMEG	700 - RMEG
Triallate (Fargo)	2.67	1.57	7	8.65			3.21					1,040 - MTCA B	1,040 - MTCA B
Chlorpyrifos (insecticide)	19.6	1.31	19.2	4.75			162					50 - EMEG	700 - EMEG
Tolban (profluralin)	3.51	19.7	192	92			3.92					480 - MTCA B	4,200 - MTCA B
Pendimethalin (Prowl)	14	8.68	20.5	24.8			9.12					2,000 - RMEG	30,000 - RMEG
Hexazinone (Velpar)	1.16	1	1.77	2.14	5.33				0.674			2,640 - MTCA B	2,640 - MTCA B
Ethalfluralin (Sonalan) (herbicide)	373	120	1,530	917			557				478	N/A	N/A
Eptam (EPTC)	45.7	3.47	406	98.4	0.565		2.36					1,000 - RMEG	20,000 - RMEG
Alachlor (Lasso)							19.8	0.529			3.4	500 - RMEG	7,000 - RMEG
Metolachlor							33.9					8,000 - RMEG	100,000 - RMEG
Bromacil								0.551				N/A	N/A
Terbacil									1.86			1,040 - MTCA B	1,040 - MTCA B

***** Background sample

** RPS = subsurface soil/sludge samples

¢ SS2-SS5 = Surface soil samples

Shaded cells = contaminants exceeding a comparison value that were further evaluated in the Health Assessment.

Table 5
Maximum Site Soil Metal Concentrations (mg/kg)

COMPOUND	1995 - CSMI	1993 - EPA (Sample # RPS4)	Non cancer CV Child	Non cancer CV Adult	Cancer CV	90th percentile Background (Yakima Basin)
Beryllium	0.979	1.39	100 - RMEG	1,000 - RMEG	0.233 (MTCA B)	1.57
*Chromium	181	360	200 - RMEG	2,000 - RMEG	NA	38.27
Cadmium	8	25.2	10 - EMEG	100 - EMEG	NA	0.93
Zinc		6,620	20,000 - EMEG	200,000 - EMEG	NA	78.71
Manganese		397	7,000 - RMEG	100,000 - EMEG	NA	1,105

* Assumes hexavalent chromium
Shaded cells = contaminants exceeding a comparison value that were further evaluated in the Health Assessment

Table 6
1993 EPA Soil Phenoxyherbicide Concentrations[34] (mg/kg) [

	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #	Sam #		
COMPOUND	RPS1 EPA	RPS2 EPA	RPS3 EPA	RPS4 EPA	RPS5 EPA	*SS1 EPA	SS2 EPA	SS3 EPA	SS4 EPA	SS5 EPA	Child CV	Adult CV
Dinoseb					0.066			0.035			50 - RMEG	700 - RMEG
+ MCPP (Mecoprop)					27						N/A	N/A
++ MCPA											30 - RMEG	400 - RMEG
2,4-D	3.7	8.5	27.5	20.3	14.1	0.065	1		0.45		500/ - RMEG	7,000 - RMEG
2,4-DB	0.48	0.5	4.6	0.48	1.52		0.87	0.49	0.69		400 - RMEG	6,000 - RMEG
Chloramben					0.068	0.42					N/A	N/A
Dacthal (DCPA)	0.35	0.3	0.17	0.17	0.39	4.6	0.058	0.015	0.022		500 - RMEG	7,000 - RMEG
Dicamba (Banvel)	0.33	1	3.3	2.68	0.6		0.095				2,000 - RMEG	20,000 - RMEG

+ 2-(4Chloro-2-methylphenoxy) propanoic acid
++ (4-Chloro-2-methylphenoxy) acetic acid
* Background sample
[No phenoxyherbicides exceeded a health based comparison value in soil

Table 7
June 1998 Quarterly Groundwater VOC & Nitrate Concentrations[35] (Fg/l)

COMPOUND	Well #	Well #	Well #	Well #	Well #	Well #	CV	MCL
	MW1	MW2	MW3	MW4	MW5	MW6		
Bromodichloromethane			2				0.6 - CREG	N/A
Carbon Tetrachloride			4				0.3 - CREG	5
Chlorobenzene			23				4,000 - Child EMEG	100
Chloroform			47				6 - CREG	100
Chloromethane			2				3 - LTHA	N/A
1,2-Dibromoethane (EDB)			1.4				0.0004 - CREG	0.05
1,1-Dichloroethane			14				800 - MTCA B	N/A
1,2-Dichloroethane			78				0.4 - CREG	5
1,1-Dichloroethene			14				0.06 - CREG	7
1,2-Dichloropropane		20	19,300	2.2	248	17	900 - EMEG	5
1,3-Dichloropropane			702		6.3		N/A	N/A
1,1-Dichloropropene			1.6				N/A	N/A
Methylene Chloride			1.3				5 - CREG	5
1,1,2-Trichloroethane			63		2		0.6 - CREG	5
1,2,3-Trichloropropane			610		6.6		40 - LTHA	N/A
Vinyl Chloride			5.9				0.2 - EMEG	2
Nitrate (mg/l)	38.4	42.6	279	58.6	130	101	20 - RMEG	10
Ammonia (mg/l)			0.2		2.4	0.5	210 - EPA	210 - EPA

Shaded cells = contaminants exceeding a health-based comparison value or drinking water standard
MCL = Safe Drinking Water Act Maximum Contaminant Level
CREG = Cancer Risk Evaluation Guide
EMEG = Environmental Media Evaluation Guide
LTHA = Long-Term Health Advisory
RMEG = Reference Dose Media Evaluation Guide
MTCA B = Ecology Model Toxics Control Act Method B cleanup level.

Table 7
June 1998 Quarterly Groundwater VOC & Nitrate Concentrations[35] (Fg/l)

COMPOUND	Well #	Well #	Well #	Well #	Well #	Well #	CV	MCL
	MW7	MW8	MW9	MW10	MW11	MW12		
Carbon Tetrachloride							0.3 - CREG	5
Chlorobenzene							4,000 - Child EMEG	100
Chloroform	1.8						6 - CREG	100
1,2-Dibromoethane (EDB)							0.0004 - CREG	0.05
1,1-Dichloroethane							800 - MTCA B	N/A
1,2-Dichloroethane							0.4 - CREG	5
1,1-Dichloroethene							0.06 - CREG	7
1,2-Dichloropropane	81		83			32	900 - EMEG	5
1,3-Dichloropropane	3.8		1.5				N/A	N/A
1,1-Dichloropropene							N/A	N/A
Methylene Chloride							5 - CREG	5
1,1,2-Trichloroethane	1.2						0.6 - CREG	5
1,2,3-Trichloropropane							40 - LTHA	N/A
Vinyl Chloride							0.2 - EMEG	2
Nitrate (mg/l)	107	26.6	94.4	16.2	63.3	78.2	20 - RMEG	10
Ammonia (mg/l)		0.4	32.9				210 - EPA	N/A

Shaded cells = contaminants exceeding a health-based comparison value or drinking water standard

Table 7
June 1998 Quarterly Groundwater VOC & Nitrate Concentrations[35] (Fg/l)

COMPOUND	Well #	Well #	Well #	Well #	Well #	Well #	CV	MCL
	MW13	MW14	MW15	MW16	MW17	MW18		
Carbon Tetrachloride							0.3 - CREG	5
Chlorobenzene	5.4			1.8	2.7		4,000 - Child EMEG	100
Chloroform	4.9				2.7		6 - CREG	100
1,2-Dibromoethane (EDB)							0.0004 - CREG	0.05
1,1-Dichloroethane							800 - MTCA B	N/A
1,2-Dichloroethane	4.4				2.7		0.4 - CREG	5
1,1-Dichloroethene							0.06 - CREG	7
1,2-Dichloropropane	1,490			310	703		900 - EMEG	5
1,3-Dichloropropane	62			14	22		N/A	N/A
1,1-Dichloropropene							N/A	N/A
Methylene Chloride							5 - CREG	5
1,1,2-Trichloroethane	8.3			6.1	2.8		0.6 - CREG	5
1,2,3-Trichloropropane	33			19	19		40 - LTHA	N/A
Vinyl Chloride							0.2 - EMEG	2
Nitrate (mg/l)	138	15.9	47.4	207	111	36.7	20 - RMEG	10
Ammonia (mg/l)	0.6			213	0.1		210 - EPA	N/A

Shaded cells = contaminants exceeding a health-based comparison value or drinking water standard

Table 7
June 1998 Quarterly Groundwater VOC & Nitrate Concentrations[35] (Fg/l)

COMPOUND	Well #	Well #	Well #	Well #	Well #	CV	MCL
	MW19	MW20	MW21	MW22	MW23		
Carbon Tetrachloride						0.3 - CREG	5
Chlorobenzene		17				4,000 - EMEG	100
Chloroform						6 - CREG	100
1,2-Dibromoethane (EDB)		23				0.0004 - CREG	0.05
1,1-Dichloroethane						800 - MTCA B	N/A
1,2-Dichloroethane						0.4 - CREG	5
1,1-Dichloroethene						0.06 - CREG	7
1,2-Dichloropropane		98				900 - EMEG	5
1,3-Dichloropropane		6.1				N/A	N/A
1,1-Dichloropropene						N/A	N/A
Methylene Chloride						5 - CREG	5
1,1,2-Trichloroethane						0.6 - CREG	5
1,2,3-Trichloropropane		1.8				40 - LTHA	N/A
Vinyl Chloride						0.2 - EMEG	2
Nitrate (mg/l)	18.7	135	153	14.4	98.4	20 - RMEG	10
Ammonia (mg/l)	0.3	140				210 - EPA	N/A

Shaded cells = contaminants exceeding a health-based comparison value or drinking water standard

Table 8
Soil VOC & Metal Concentrations (mg/kg)
June 1997

	Sample #	Sample #	Sample #	Sample #	Sample #	Sample #	
Compound	BH1	BH2	BH3	BH4	BH5	BH6	CV
Chlorobenzene	4.8						1,000 - child RMEG 10,000 - adult RMEG
1,2-Dichloropropane	15, 2.1	1.2, 1.7			1.5, 3.7	0.66, 0.81, 1.1	5,000 - child EMEG 60,000 - adult EMEG
1,3-Dichloropropane	6.8, 1.1	0.28, 0.26			0.77		N/A
cis 1,3-Dichloropropene							20 - child RMEG 200 - adult RMEG
trans 1,3-Dichloropropene							20 - child RMEG 200 - adult RMEG
1,1,2-Trichloroethane					0.21		200 - child RMEG 10 - CREG
1,2,3-Trichloropropane					0.69	0.2, 0.45	300 - child RMEG 4,000 - adult RMEG
+Beryllium	0.3, 0.2	0.4, 0.1	0.1, 0.3	0.4, 0.2	0.2, 0.2	0.2, 0.2	100 - child RMEG 0.233 - MTCA B
Cadmium	0.25, 0.47	0.65	0.59, 0.24	0.49, 0.32			10 - child EMEG 100 - adult EMEG
* Chromium	10.1, 14.2	10.9, 9.3	9.2, 17.9	12.8, 14.6	9.1, 12.9	8.7, 11.7	*200 - child RMEG

* For hexavalent chromium
+ All beryllium samples were below natural background concentrations [36]

Table 9
Soil Pesticide/Herbicide, Ammonia & Nitrate Concentrations (mg/kg)
June 1997 (Post soil remediation)

	Sample #	Sample #	Sample #	Sample #	Sample #	Sample #	Sample #	Sample #	Comparison Value
Compound	BH1	BH2	BH3	BH4	BH5	BH6	*BGS	**BGN	
Alachlor (Lasso)	0.031, 0.026				0.023		0.014		500 - child RMEG 7,000 - adult RMEG
Ethalfluralin					0.363	0.005			N/A
Trifluralin	0.003		0.01		0.298	0.001	0.001		90 - CREG 400 - child RMEG 5,000 - adult RMEG
Atrazine									2,000 - child RMEG 20,000 - adult RMEG
Disulfoton									3 - child EMEG 40 - adult EMEG
Vernolate					0.295				50 - child RMEG 700 - adult RMEG
Nitrate-N	40, 12	28.5, 6.4	35.5, 42.5	780, 200	24, 140	934, 242	16	8.5	80,000 - child RMEG 100,000 - adult RMEG
Ammonia-N	80, 21	480, 16	140, 1,100	320, 6.3	1,500, 1,500	3,500, 10	6.2	7.6	20,000 - child EMEG 200,000 - adult EMEG

* Sample was collected from the south border of the Quincy Jr. High School athletic field
** Background soil sample was collected from the Habitat for Humanity property, immediately NW of the CSMI site

Table 10
Site Soil Gas VOC Concentrations
(mg/m^3)

Location	Date	chlorobenzene	chloroform	1,1-DCE	1,2-DCP	vinyl chloride	PID
VP1	7/1/97	N/D	N/D	N/D	N/D	N/D	N/D
VP2	7/1/97	N/D	N/D	N/D	16	N/D	3
VP3	7/1/97	N/D	2.8	N/D	165	N/D	10
VP4	7/1/97	N/D	3.4 (. 0.7 ppm)	N/D	791(. 171 ppm)	N/D	30
VP5	7/1/97	4.3 (. 1 ppm)	3.1	3 (. 0.76 ppm)	3,010 (. 651 ppm)	3.7 (. 1.45 ppm)	88
VP6	7/1/97	3.4	2.6	N/D	197 (. 42.6 ppm)	N/D	49

Table 11
Maximum Modeled & Measured Site Ambient Air VOC Concentrations

Contaminant	**Modeled VOC Concentration (24 meters from stack)**	**Cancer CV**	**Non-Cancer CV**	**Measured Concentration**
Chloroform	0.00048 $\mu g/m^3$ (=0.0024 ppb)	0.04 $\mu g/m^3$ (CREG)	20 ppb (chronic EMEG)	ND
Vinyl chloride	0.00095 $\mu g/m^3$ (=0.0024 ppb)	N/A	30 ppb (Int. EMEG)	ND
1,2-DCP	0.1 $\mu g/m^3$ (=0.46 ppb)	N/A	7 ppb (Int. EMEG)	ND
Chlorobenzene	0.00095 (=0.0044 ppb)	N/A	18 $\mu g/m^3$ (EPA Region 3)[32]	ND
1,1-DCE	N/A	0.02 $\mu g/m^3$ (CREG)	20 ppb (Int. EMEG)	ND

n Ambient Source Impact Level
ND = not detected

Table 12
Air Monitoring Results
1,2-Dichloropropane
Quincy High School (February 18 - 23, 1998)

Location	Concentration (Fg/m^3)	Method Detection limit (Fg/m^3)	EPA RfC (Fg/m^3)	ATSDR EMEG (Fg/m^3)
W. side of school bldg.	< 4.6	4.6	4	32
Boiler Room	< 4.6	4.6	4	32
Boiler Room Sump Basket	< 4.6	4.6	4	32
Kitchen	< 4.6	4.6	4	32
Main Office	< 4.6	4.6	4	32
Staff Lounge	17 (3.7 ppb)	4.6	4	32 (7 ppb)
Cafeteria	< 4.6	4.6	4	32
Band Room	< 4.6	4.6	4	32
Library	< 4.6	4.6	4	32
Science Room	< 4.6	4.6	4	32
Outside Dugout	< 4.6	4.6	4	32

Shaded cell = contaminant exceeded a health-based comparison value

Table 13

Child Exposure Dose Estimates and Reference Doses

Contaminant	Maximum Concentration (mg/kg)	Ingestion Rate (mg/day)	Exposure Duration (years)	Estimated Exposure Dose (mg/kg/day)	EPA Reference Dose (mg/kg/day)
Trifluralin	349	50	10	0.0003	0.0075
Ethalfluralin	1,530	50	10	0.001	0.0075 (used RfD for Trifluralin)
Disulfoton	146	50	10	0.00013	0.00004
Chlorpyrifos	162	50	10	0.00015	0.003
Vernolate	112	50	10	0.0001	0.001
Beryllium	1.39	50	10	0.0000013	0.002
Cadmium	25.2	50	10	0.000023	0.001
Chromium	360	50	10	0.0003	0.003

Table 13

Adult Exposure Dose Estimates and Reference Doses

Contaminant	Maximum Concentration (mg/kg)	Ingestion Rate (mg/day)	Exposure Duration (years)	Estimated Exposure Dose (mg/kg/day)	EPA Reference Dose (mg/kg/day)
Trifluralin	349	100	23	0.0004	**0.0075**
Ethalfluralin	1,530	100	23	0.0017	**0.0075 (used RfD for Trifluralin)**
Disulfoton	146	100	23	0.00016	**0.00004**
Chlorpyrifos	162	100	23	0.00018	**0.003**
Vernolate	112	100	23	0.0001	**0.001**
Beryllium	1.39	100	23	0.0000015	**0.002**
Cadmium	25.2	100	23	0.000028	**0.001**
Chromium	360	100	23	0.0004	**0.003**

Appendix B
Figures

Appendix C
Exposure Assumptions

Both oral (ingestion) and dermal (skin contact) routes of exposure were evaluated for the eight contaminants of concern detected in site soil. Maximum detected contaminant concentrations were used to estimate exposure doses. Air monitoring results for 1,2 dichloropropane were also evaluated*. The following exposure assumptions were used in the Health Assessment:

1. 10 year child exposure duration; 23 year adult/worker exposure duration.

2. 50 milligrams of soil per day adult ingestion rate; 100 milligrams of soil per day child ingestion rate (Central Tendency rates - EPA Exposure Factors Handbook).

3. Five days per week, 50 weeks per year exposure frequency for adults; five days per week, 36 weeks per year exposure frequency for children.

4. 100% of exposure was at the highest detected concentration for each contaminant of concern.

5. 70 kg adult body weight; 40 kg child body weight.

* The only air sampling data available is for 1,2-dichloropropane. Based on the levels of contaminants detected in CSMI site soils, DOH is not recommending air sampling for pesticides or metals.

Appendix D
Exposure Dose Formulas

Soil Ingestion Exposure Dose

$ID_s = (C_s)\ (IR)\ (CF)\ (EF)\ (ED)\ /\ (BW)\ (AT)$

where:

ID_s = Soil ingestion exposure dose (mg/kg/day)
C_s = Contaminant concentration in soil (mg/kg)
IR = Soil ingestion rate (mg/day)
CF = Conversion factor for soil (0.000001 kg/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (duration over which exposure is averaged-days). For noncarcinogenic effects AT = (ED x 365 days/year); for carcinogenic effects AT = (70 years x 365 days/year), or 25,550 days

Soil Dermal Exposure Dose

AD = C x CF x SA x AF x ABS x EF x ED)/(BW x AT)

where:

AD = Absorbed dose (mg/kg/day)
C = Chemical concentration in soil (mg/kg)
CF = Conversion factor (10^{-6} kg/mg)
SA = Skin surface area available for contact (cm^2/event)
AF = Soil-to-skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure frequency (events/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (duration over which exposure is averaged-days). For noncarcinogenic effects AT = (ED x 365 days/year); for carcinogenic effects AT = (70 years x 365 days/year), or 25,550 days.

Appendix E

Interim Criteria of Actions for Levels of Public Health Hazard

from

PHA Guidance Manual, 1992

Revision Effective May 1, 1999

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 followup.

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 followup.

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.