Public Health Assessment

Initial/Public Comment Release

VAN DER HORST USA CORPORATION

TERRELL, KAUFMAN COUNTY, TEXAS

EPA FACILITY ID: TXD007357932

Prepared by
Texas Department of State Health Services

DECEMBER 9, 2010

COMMENT PERIOD ENDS: JANUARY 9, 2011

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR's Cooperative Agreement Partner will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR's Cooperative Agreement Partner. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Use of trade names is for identification only and does not constitute endorsement by the U.S. Department of Health and Human Services.

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
Attn: Records Center
1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

You May Contact ATSDR Toll Free at
1-800-CDC-INFO or
Visit our Home Page at: http://www.atsdr.cdc.gov

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Foreword

The Agency for Toxic Substances and Disease Registry (ATSDR) was established under the mandate of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. This act, also known as the "Superfund" law, authorized the U. S. Environmental Protection Agency (EPA) to conduct clean-up activities at hazardous waste sites. EPA was directed to compile a list of sites considered potentially hazardous to public health. This list is termed the National Priorities List (NPL). Under the Superfund law, ATSDR is charged with assessing the presence and nature of health hazards to communities living near Superfund sites, helping prevent or reduce harmful exposures, and expanding the knowledge base about the health effects that result from exposure to hazardous substances [1].

In 1984, amendments to the Resource Conservation and Recovery Act of 1976 (RCRA) – which provides for the management of hazardous waste storage, treatment, and disposal facilities – authorized ATSDR to conduct public health assessments at these sites when requested by the EPA, states, tribes, or individuals. The 1986 Superfund Amendments and Reauthorization Act broadened ATSDR's responsibilities in the area of public health assessments and directed ATSDR to prepare a public health assessment (PHA) document for each NPL site. In 1990, federal facilities were included on the NPL. ATSDR also conducts Public Health Assessments or Public Health Consultations when petitioned by concerned community members, physicians, state or federal agencies, or tribal governments [1].

The aim of these evaluations is to determine if people are being exposed to hazardous substances and, if so, whether that exposure is potentially harmful and should be eliminated or reduced. PHAs are carried out by environmental health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. Because each NPL site has a unique set of circumstances surrounding it, the PHA process allows flexibility in document format when ATSDR and cooperative agreement scientists present their findings about the public health impact of the site. The flexible format allows health assessors to convey important public health messages to affected populations in a clear and expeditious way, tailored to fit the specific circumstances of the site. [Note: Appendix A provides a list of abbreviations and acronyms used in this report and Appendix B provides information regarding the PHA process.]

Comments

If you have any questions, comments, or unanswered concerns after reading this report, we encourage you to send them to us. Letters should be addressed as follows:

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Summary

INTRODUCTION

The Van der Horst USA Corporation (Van der Horst) site is an inactive chromium and iron plating facility. The site is located at 410 and 419 East Grove Street in Terrell, Kaufman County, Texas. The site sits on approximately 4 acres of land and is located 300 yards from the center of downtown on the southeast boundary of the city. The Van der Horst site was proposed to the National Priorities List (NPL) on September 23, 2009, and was added to the final NPL on March 4, 2010.

Finished products associated with plating operations at the facility included pipeline cylinders used for transporting natural gas and cylinder bores for large diesel engines such as ones found in railroad locomotives. Plating operations resulted in chromium-contaminated wastewater and sludge.

Van der Horst ceased operations in December 2006. The facility was abandoned in April 2007. A fire occurred at the facility on May 28, 2008, which led to the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (EPA) conducting further investigations to identify and remove a large quantity of liquid wastes remaining on the site.

In addition to removing the liquid wastes, the EPA demolished the main Van der Horst building, collected on-site soil samples, and removed contaminated topsoil. Topsoil was replaced with clean fill, and grass was planted to prevent the movement of soil. EPA additionally collected off-site sediment samples from nearby Frazier Creek and Kings Creek.

Data evaluated in this Public Health Assessment (PHA) include 2008 and 2009 sampling results for creek and drainage ditch (between the site and Frazier Creek) sediment and soil samples collected from the on-site lagoons, drums, sumps, vats, and monitoring wells. Based upon the data and information provided by EPA and TCEQ, the contaminants and the primary routes of exposure that warranted closer evaluation in this PHA were the intentional ingestion of on-site chromium-contaminated water, the incidental ingestion of chromium-contaminated creek and drainage ditch (located between the site and Frazier Creek) sediment and skin absorption from contact with chromium-contaminated creek and drainage ditch sediment.

Conclusions	The Texas Department of State Health Services (DSHS) and the Agency for Toxic Substances and Disease Registry (ATSDR) reached four conclusions in this Public Health Assessment (PHA):
Conclusion 1	DSHS and ATSDR conclude that dermal exposure (skin contact) to sediment in Frazier Creek and the drainage ditch (located between the site and Frazier creek) could harm people's health because people could be exposed to levels that were found to result in health effects.
Basis for Conclusion	A study conducted in 1994 found hexavalent chromium concentrations above 450 milligrams per kilogram (mg/kg) in soil led to dermal health effects in 99.99% of the population. Analysis of sediment samples collected from Frazier Creek and the drainage ditch found total chromium at concentrations greater than 450 mg/kg, while analysis of sediment samples collected from Kings Creek found concentrations below 450 mg/kg.
Next Steps	People should not trespass into Frazier Creek and the drainage ditch. Restrict access to Frazier Creek and the drainage ditch to ensure people will not come into contact with chromium-contaminated sediment.
Conclusion 2	DSHS and ATSDR conclude that incidental ingestion of sediment from Frazier Creek, Kings Creek, and the drainage ditch (located between the site and Frazier Creek) will not cause health effects in people.
Basis for Conclusion	People who ingest chromium-contaminated sediment from Frazier Creek, Kings Creek, and the drainage ditch (located between the site and Frazier Creek) will not have an exposure dose (ED) that exceeds health-based screening values.
Next Steps	No public health actions are needed if people were to incidentally ingest chromium-contaminated sediment from Frazier Creek, Kings Creek, and the drainage ditch (located between the site and Frazier Creek).
Conclusion 3	DSHS and ATSDR conclude that chromium concentrations detected in two groundwater monitoring wells on the former facility property will not likely cause health effects in people.
Basis for Conclusion	If people come into contact with the chromium-contaminated groundwater, DSHS and ATSDR found that the levels are not high enough to result in health effects.
Next Steps	No public health actions are needed.

Conclusion 4	DSHS and ATSDR conclude that hazardous waste materials and chromium-contaminated soil once on the former facility property will not harm people's health because these materials have been removed from the Van der Horst USA Corporation site.
Basis for Conclusion	In 2008 and 2009 EPA removed hazardous materials from the Van der Horst site such as drums, vats and their contents, and the sumps and their contents, preventing anyone from coming into contact with harmful materials from the site
Next Steps	No public health actions are needed.
FOR MORE INFORMATION	If you have concerns about your health, you should contact your health care provider. You may also call Texas Department of State Health Services at (800) 588-1248 and ask to speak with Amanda Kindt for more information on the Van der Horst USA Corporation Superfund Site.

Purpose and Health Issues

This PHA was prepared for the Van der Horst USA Corporation (Van der Horst) site in accordance with the Interagency Cooperative Agreement between ATSDR and DSHS. In this PHA, DSHS and ATSDR evaluated sample data collected by the U.S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ). The primary contaminant of concern associated with the Van der Horst site is chromium. The primary routes of exposure evaluated in this PHA are the intentional ingestion of on-site chromium-contaminated water and the incidental ingestion of chromium-contaminated creek and drainage ditch (located between the site and Frazier Creek) sediment and dermal (skin) contact with chromium-contaminated creek and drainage ditch sediment. This PHA presents conclusions about whether exposure to the site contaminants at the levels found in the environment would be expected to harm people's health.

Background

Site Description

The Van der Horst site is located in Terrell, Kaufman County, Texas (Appendix C: Figure 1). The main building was located at 419 East Grove Street and was demolished by EPA in 2009 [2]. The former facility wastewater treatment building is located at 410 East Grove Street [3]. The site is located on approximately 4 acres of unfenced land and is 300 yards from the center of downtown on the southeast boundary of the city [4]. North of the Van der Horst property lies a Union Pacific Railroad right-of-way. The south end of the site is bordered by East Grove Street while the east end of the site is bordered by General Chemical Corporation's property. To the west, the site is bordered by South Delphine Street [5].

There are two creeks within close proximity to the site. A drainage ditch connects the site to Frazier Creek. Frazier Creek runs closest to the site and is an intermittent creek. Frazier Creek is located about 500 feet north of the nearest residential area. Approximately 1.2 miles southeast of the site, water in Frazier Creek enters Kings Creek. Kings Creek is not used for drinking water purposes; however, portions of Kings Creek are designated for aquatic life, swimming, and fish consumption [5]. A Texas Parks and Wildlife Department (TPWD) Kaufman County Game Warden confirmed that Kings Creek is fished for catfish, brim, and largemouth bass for human consumption [4].

There are no known surface water intakes within 15 miles of the site along the surface water pathway. The City of Terrell purchases its water from the North Texas Municipal Water District, who obtains their water from lakes upstream from the site (Lake Lavon, Lake Texoma, and Jim Chapman Lake) [5].

There are seven schools and one park within 1 mile of the site. The closest residential area is located in the Stallings Addition, less than 1 mile southeast of the site. Additionally, two churches are located less than 1 mile from the site [5].

Site Operations and History

The Van der Horst facility was a hard-chrome (trivalent and hexavalent chromium) and iron electroplating facility in the 1950s. The facility operated until December 2006 and was abandoned in April 2007. Finished products associated with plating operations at the facility included pipeline cylinders used for transporting natural gas and cylinder bores for large diesel engines found in railroad locomotives [4].

Historical records indicate that Van der Horst had environmental regulatory violations. TCEQ records from 1968 indicate that the facility was discharging an estimated 43,200 gallons of wastewater per day into the drainage ditch located between the site and Frazier Creek. This drainage ditch empties into nearby Frazier Creek and then into Kings Creek. TPWD documented levels of chromium in Van der Horst's discharged wastewater up to 353.6 parts chromium per million parts water (ppm or milligrams per Liter (mg/L)). Under Texas Water Quality Board (TWQB)[1] rules, discharged wastewater should not contain more than 1.0 mg/L of hexavalent chromium and 5.0 mg/L of trivalent chromium [4].

In order to meet TWQB's discharge limits, Van der Horst requested approval to put the waste into unlined lagoons on their property, but was denied. In July 1969, records indicate that the City of Terrell was receiving all Van der Horst's wastewater. However, in September 1969 the

[1] The Texas Water Quality Board is a predecessor agency of TCEQ.

City of Terrell no longer accepted wastewater from Van der Horst unless it was treated. Van der Horst continued discharging wastewater into Frazier Creek until December 1969, when two settling lagoons were constructed to collect and hold their wastewater. These lagoons operated until May 1984 when the Texas Department of Water Resources[2] initiated closure of the lagoons. Soil was removed from both lagoons and a closure certificate was issued in September 1986 [4].

Beginning in July 2005, Van der Horst received violations relating to the management of wastes inside the wastewater treatment building. The violations included failure to keep hazardous containers closed, failure to keep containers properly labeled and dated, and failure to maintain the facility to prevent the release of hazardous wastes [6].

In March and September 2006, TCEQ conducted complaint investigations at the facility. The complaint stated that the facility had been abandoned, local contractors had been entering the building and removing equipment, liquid was on the floor of the building, and wastes were left behind. At the time of the March 2006 complaint investigation, the facility had three employees and the site had not been in operation since March 3, 2006 [6].

On May 4, 2006, the facility phoned TCEQ to inform them that Van der Horst had reopened with 12 employees [6]. The facility operated until December 26, 2006, when the owner filed for bankruptcy [7]. The buildings and the site were fully abandoned in April 2007 [4].

On May 27, 2008, TCEQ performed a follow-up and complaint investigation at the abandoned facility. During the visit the main building was found to be in bad condition. There were missing areas in the roof, debris lying throughout the building, wastes on the floor, and a gutter downspout on the west side of the building was draining into the building. At the time of the investigation they observed liquid in the basement sump; the liquid appeared yellow. A second sump contained dark liquid [6].

On May 28, 2008, a pit containing spent kerosene in the main building of the Van der Horst facility caught fire and was extinguished by the Terrell Fire Department. The fire department had concerns about chemicals at the facility and requested assistance from TCEQ to assess the site. On May 30, 2008, TCEQ employees conducted a site investigation. Because of the severity of the hazard and unknown chemical contamination on site, TCEQ contacted EPA-Region 6 to help assist in responding to the contamination at the facility [8].

During June 2008 EPA began categorizing hazardous waste contained in abandoned drums on the site. The drums were staged within various locations inside the main Van der Horst building according to what they contained. Also in June 2008, EPA transported contents of the larger sump off the site. EPA began remedial action (RA) in January 2009 and the drum contents were bulked with other waste from the site for disposal. In February 2009 EPA removed the contents in the smaller sump and transported it off site by licensed waste disposal companies (Clean Harbors Baton Rouge, Louisiana and Chemical Reclamation Services, LLC Avalon, Texas). In

[2] The Texas Department of Water Resources is a predecessor agency of TCEQ.

March 2009 the drum and vat contents left on the site were transported to Texas Molecular in Deer Park, Texas [4].

Off-site sediment samples were collected by EPA's START-3 (Superfund Technical Assessment and Response Team)[3] Program for the 2008 Site Inspection Report and during EPA's RA activities in March 2009. TCEQ collected three additional sediment samples from Frazier Creek. On the site, START-3 collected 22 soil boring samples from 0 to 60 inches below the surface at the former lagoon locations [4]. The main Van der Horst building was completely demolished in August 2009. More than 450 tons of concrete with and without rebar was transported off-site to Skyline RDF Landfill in Ferris, Texas [2]. Hazardous solid waste associated with the building was transported off-site to Waynoka, Oklahoma [10].

On September 23, 2009, the Van der Horst site was proposed to the National Priorities List (NPL) [11], and it was added to the final NPL on March 4, 2010 [12].

Site Visits

In April 2009, DSHS visited the site and attended a community meeting. During the meeting DSHS was approached by a concerned community member and was asked to look into cancer incidence within the surrounding community.

On January 24, 2010, DSHS staff visited the former Van der Horst plating facility. The main building had been demolished and removed from the site along with the contaminated soil, lagoons, drums, sumps, and vats. This portion of the former facility is now an empty, grass covered lot. Across East Grove Street, to the south, are two unfenced, abandoned buildings. One building is the former wastewater treatment building where wastewater from plating operations was treated and discharged. At the time of the site visit, the wastewater treatment building was open and not secured. Next to the second building were several 55-gallon drums with labels indicating they contained waste from removal activities at the site. Staff did not attempt to enter this building so it is not known if it is secured.

We were not able to access Frazier Creek or Kings Creek to observe whether recreational use was occurring at the time of this site visit.

Demographics

According to the 2000 U.S. Census, the total population of Terrell, Texas was 13,606. The population was comprised of 6,531 males and 7,075 females with a median age of 32.8 years. There were 1,068 children 5 years of age and under; 9,733 individuals who were 18 years and over; and 1,764 individuals 65 years and over [13]. The North Central Texas Council of Governments estimated the 2009 population of Terrell to be 15,500 [14].

[3] The START program provides technical support to the EPA's site assessment activities. These activities include response, prevention, and preparedness, and include gathering and analyzing technical information, preparing technical reports on oil and hazardous substance investigations, and technical support for cleanup efforts [9].

Within 1 mile of the site, there are 2,396 total housing units with a population of 6,854 individuals, which include 1,524 females between the ages 15 to 44 and 753 children aged 6 and younger. For more detailed demographic information surrounding the Van der Horst site, see Figure 2.

Land and Natural Resource Use

The surface soil in the area consists of moderately well drained, moderately permeable, silty loam from 0 to 5 inches below ground surface (bgs). Deeper soil consists of silty clay [5].

The depth to shallow groundwater at the site is approximately 6 feet bgs. Shallow groundwater follows the topography and flows in an eastward direction away from the site towards Kings Creek [5].

Information provided by the Texas Water Development Board (TWDB) indicates that within 4 miles of the site, there are 16 groundwater wells. These wells range from a depth of 50 feet to 403 feet bgs. Ten of these wells are unused, three are being used for domestic purposes and range from 57 to 165 feet bgs, two are being used for industrial and aquaculture purposes, and one is being used as a stock well [5].

Surface water at the Van der Horst site flows eastward into the drainage ditch along East Grove Street then into Frazier Creek. Approximately 1.2 miles from the site, the intermittent Frazier Creek enters the perennial Kings Creek, which flows south more than 20 miles into Cedar Creek Reservoir. Surface water north (upstream) of the site is a source of public drinking water for the City of Terrell. Some of the communities downstream use surface water as their source of public drinking water but the intakes for these water supplies are more than 15 miles south-southeast of the site [5].

Community Health Concerns

As part of the public health assessment process, DSHS and ATSDR try to learn what health-related concerns people in the area might have about the site. We gathered concerns from people who live or work near the site, from city officials, and from state and federal government.

At a community meeting that EPA held in March 2009, a community member mentioned that children sometimes swim in a pond that is located within 1 mile of the site [15]. This pond is located off of Vine Street and lies southeast of the Van der Horst site. DSHS has determined that the pond is located east of Frazier Creek and will not be affected by creek sediment because EPA collected sediment samples along Frazier Creek to determine the water migration pathway and determined that water in the creek flows to the southeast away from the pond's location [4].

In April 2009, DSHS attended a community meeting. During the meeting, DSHS was approached by a concerned community member and was asked to look into cancer incidence within the surrounding community.

Health Outcome Data

Health outcome data record certain health conditions that occur in populations. These data can provide information on the general health of communities living near a hazardous waste site. They also can provide information on patterns of specific health conditions. Some examples of health outcome databases are cancer registries, birth defects registries, and vital statistics. Information from local hospitals and other health care providers also can be used to investigate patterns of disease in a specific population. DSHS and ATSDR look at appropriate and available health outcome data when a completed exposure pathway or community concern exists. For the Van der Horst site, DSHS worked with the Texas Cancer Registry (TCR) to address the community's concern of excess cancer.

The DSHS TCR prepared a cancer cluster report for zip codes 75160 and 75161. The analysis of incidence data for the zip codes from January 1, 1997-December 31, 2006 (the most current information available) found cancers of the prostate, breast, lung, colon and rectum, bladder, corpus and uterus, kidney and renal pelvis, non-Hodgkin's lymphoma, and stomach to be within expected ranges in both males and females. Based on these findings, TCR does not recommend further examination of cancers within zip codes 75160 and 75161. As new data become available, consideration will be given to updating or re-evaluating this investigation [16].

Children's Health Considerations

In communities faced with air, water, or soil contamination, children could be at greater risk than adults from certain kinds of exposure to hazardous substances. A child's lower body weight and higher intake rate result in a greater dose of hazardous substance per unit of body weight. Sufficient exposure levels during critical growth stages can result in permanent damage to the developing body systems of children. Children are dependent on adults for access to housing, for access to medical care, and for risk identification. Consequently, adults need as much information as possible to make informed decisions regarding their children's health.

ATSDR and DSHS evaluated the likelihood for children to be exposed to the site contaminants at levels of health concern. Children could be exposed to chromium by the intentional ingestion of on-site chromium-contaminated water concentrations, the incidental ingestion of contaminated creek and drainage ditch (located between the site and Frazier Creek) sediment or by skin absorption through dermal contact with contaminated sediment. DSHS tries to protect children from the possible negative effects of toxicants in sediment by considering exposure scenarios specific to children.

Environmental Contamination

The following sections discuss monitoring well and sediment sample data collected by EPA's START-3 and TCEQ during their field activities in 2008 and 2009. There are data available for drums, sumps, vats, and lagoons; however, their contents have been transported off site, thus people cannot be exposed. All results for chromium are reported as "total chromium" (the sum of all chromium detected in a sample), but to assess the "worst-case scenario", the "total chromium" result was assumed to be all hexavalent chromium, thus was compared to screening values for hexavalent chromium (the more toxic form of chromium).

In preparing this report, DSHS and ATSDR relied on the data provided by the EPA and TCEQ as having been collected according to approved quality assurance project plans. Thus, we have assumed adequate quality assurance/quality control procedures were followed with regard to data collection, chain of custody, laboratory procedures, and data reporting.

Groundwater

In June 2008, TCEQ installed and sampled two monitoring wells on the Van der Horst USA property. Contaminants sampled for included arsenic, barium, cadmium, chromium, hexavalent chromium, lead, mercury, selenium, and silver. Chromium and hexavalent chromium were found to be the only contaminants of concern. In a sample collected from Monitoring Well (MW)-4, concentrations of 0.2 mg/L and 0.399 mg/L were found for hexavalent chromium and total chromium, respectfully. In a sample collected from MW-2, the total chromium concentration was found to be 0.029 mg/L. All three concentrations exceed ATSDR's health-based screening values. The potential public health implications of exposure to chromium concentrations found in on-site monitoring wells are discussed below.

Sediment

During July 2008, TCEQ collected three sediment samples from Frazier Creek [5]. In August of 2008, EPA collected four sediment samples from Frazier Creek. One of these samples was collected as a background sample and the total chromium concentration was 15.2 J[4] milligrams per kilogram (mg/kg). In August 2008, EPA also collected three sediment samples from Kings Creek. One of these samples was collected as a background sample, and the total chromium concentration was 16.8 J mg/kg [5]. During March 2009, EPA collected eight sediment samples from Frazier Creek and seven sediment samples from Kings Creek. In total, 25 sediment samples were collected throughout the creeks. In addition to the creek samples collected in March 2009, EPA also collected eight sediment samples from a drainage ditch that is located between the site and Frazier Creek [17].

Sediment samples were analyzed for aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc [17]. DSHS compared the sediment sample concentrations with ATSDR's health-based screening values and found the only contaminant of concern to be chromium. The potential public health implications of exposure to chromium in creek and drainage ditch sediment are discussed below.

[4] J represents that the analyte was positively identified and the associated value is an estimate [4].

Pathways Analysis

Exposure to on-site chromium-contaminated water concentrations through intentional ingestion and exposure to sediment via ingestion or dermal (skin) contact are currently the only exposure pathways of concern for this site and will be the basis for the public health conclusions and recommendations reached in this PHA. Although air samples were not collected, because of chromium's low volatility and its ability to bind to soil particles, it is not likely that people are currently being exposed to chromium in the air.

Exposure to contaminants in lagoons, drums, sumps, and vats could have occurred in the past, but have been eliminated as a current exposure pathway because these hazardous substances are no longer located on or around the facility. EPA removed the top layer of soil from the site and replaced it with clean fill, thus eliminating exposure to contamination in on-site soil [18].

In the past, site workers and trespassers could have been exposed to on-site contamination, but evaluating the potential for health hazards relating to past on-site exposures is difficult. We do not have information to tell us how long, how often, or what substances people may have come into contact with in the past; thus, we cannot fully determine if those exposures could lead to health effects.

Public Health Implications

Using on-site monitoring well samples and sediment samples collected from nearby Frazier Creek, Kings Creek, and the drainage ditch, DSHS determined the potential public health implications of exposure to chromium-contaminated groundwater and sediment. Exposure to chromium-contaminated water could occur by the intentional ingestion of the on-site groundwater. Exposure to chromium-contaminated sediment could occur by intentional or incidental ingestion or by dermal (skin) contact with creek and drainage ditch (located between the site and Frazier Creek) sediment.

Chromium

Background

Chromium is a naturally occurring element that can be found throughout the environment in rocks, plants, soil, and volcanic dust and gases. Chromium is both colorless and tasteless, and in its elemental state, it is a steel gray solid with a high melting point. There are several different forms of chromium in the environment, but the most common are chromium 0 (elemental chromium), chromium III (trivalent chromium), and chromium VI (hexavalent chromium) [19].

Trivalent chromium is used as a brick lining for high-temperature industrial furnaces that are used to make metals, alloys, and chemical compounds. Trivalent chromium is also an essential nutrient required by the human body. Trivalent chromium helps the body use sugars, proteins, and fats [19].

Both trivalent and hexavalent chromium compounds are produced by the chemical industry for use in chrome plating, the manufacture of dyes and pigments, leather tanning, and wood preservation. A smaller amount of these two forms of chromium may be used in drilling mud, rust and corrosion inhibitors, textiles, and toner for copying machines [19].

When chromium enters the environment, it will be released into air, soil, and water mostly in trivalent and hexavalent forms. In air, it is present mostly as fine dust particles for about 10 days or less. Rain and snow will help remove the chromium particles from the air by bringing it out of the atmosphere and onto the ground or into a body of water. Most chromium that enters into water will bind to sediment and settle to the bottom, while a small amount will dissolve into the water [19].

Most hexavalent chromium released into the environment is reduced and converted into the less toxic trivalent form of chromium. This process is facilitated by the presence of organic compounds such as oxygen, manganese oxide, and moisture [19].
However, because the samples collected were measured as total chromium, we cannot determine the concentration of trivalent chromium or compare our exposure doses (ED) to trivalent health-based screening values at this time, which is why we assumed a "worst case scenario" and compared estimated ED to hexavalent chromium health-based screening values.

People can be exposed to chromium by breathing air, drinking contaminated water, or eating food containing chromium. It can also be absorbed through the skin when an individual comes into contact with substances containing chromium. The most likely way for the general population to be exposed is through eating foods that contain chromium. On average, adults in the United States consume approximately 60 micrograms of chromium from food daily. Other sources of chromium exposure can be from using consumer products such as household utensils, wood preservatives, cement, cleaning products, textiles, and tanned leather [19].

Once ingested, almost all of the chromium will pass through the digestive tract and be eliminated. Only a very small amount (0.4-2.1%) will pass through the intestinal lining and enter the bloodstream. When chromium is inhaled, particles that are present in the upper portion of the lungs are most likely coughed up and swallowed. Particles deep in the lungs are more likely to remain long enough for some of the chromium to pass through the lung lining into the bloodstream. Once this chromium enters the bloodstream, it will pass through the kidneys and be eliminated [19].

Adverse Health Effects

In adults inhalation of high levels of hexavalent chromium can cause irritation to the respiratory tract. Symptoms may include runny nose, sneezing, itching, nosebleeds, ulcers, and holes in the nasal septum. These effects primarily occur in factory workers who make or use hexavalent chromium for several months to several years. In the workplace, long-term chromium exposure has been linked to lung cancer in workers who are exposed to levels in air 100 to 1,000 times higher than levels found in the environment [19].

The incidental or intentional ingestion of large amounts of hexavalent chromium have been known to cause stomach upsets, stomach ulcers, convulsions, kidney and liver damage, and possibly death [19].
Some hexavalent chromium compounds are known to result in rashes and burns if they come into contact with a person's skin. Burns on the skin resulting from chromium compounds can encourage more absorption of the chromium into the body and bloodstream. Dermal effects in the form of rashes (dermatitis) can happen through the ingestion and inhalation of chromium compounds [19].

Children are more likely to be exposed to a higher dose of chromium through inhalation, dermal contact, and ingestion of chromium-contaminated soil and sediment because they have a lower body weight and higher intake rate. It is likely that the health effects seen in children exposed to high amounts of chromium are similar to the health effects seen in adults; however, it is not known if children differ from the adult population in their susceptibility. In animal studies it has been found that if high levels are breathed in, the animal's ability to fight disease is reduced. It has not yet been determined if exposure to chromium results in birth defects or developmental effects in children [19].

More animal studies need to be performed before we have more information about birth defects and chromium. There is evidence in one animal study (Sullivan et al. 1984) showing that more trivalent chromium will enter the body of a newborn than an adult body. It is not known if this is the same for hexavalent chromium. Mice studies have demonstrated that chromium can pass through the placenta to a fetus where it can concentrate into tissue. As a result, pregnant women who are exposed to chromium at home or in the workplace may transfer chromium in their blood to their baby where it has the potential to accumulate [19].

The EPA has determined that hexavalent chromium is a human carcinogen by the inhalation route; however, because Van der Horst is no longer in operation, chromium-contaminated soil has been removed from the site, and chromium has a low volatility and binds to soil particles, the inhalation of chromium-contaminated soil and sediment is not a likely route of exposure for this site [20].

The National Toxicology Program (NTP) has determined there is strong evidence that hexavalent chromium is a human carcinogen when it is consumed in drinking water. This evidence is based on a rodent research study in which rats and mice were given varying amounts of sodium dichromate dehydrate (14.3 parts per billion (ppb) up to 516 ppb) in their drinking water [21].

The International Agency for Research on Cancer (IARC) has classified hexavalent chromium as a Group 1 human carcinogen. There is sufficient evidence to suggest that there is a link between hexavalent chromium compounds and cancer in people who work in and around chromate production, chromate pigment production, and chromium plating industries [22].

Chromium associated with the Van der Horst USA Corporation site

For a complete description of the process of evaluating sample data and more information about health-based screening values, please see Appendix B.

Groundwater

Total chromium was detected in two on-site groundwater monitoring well samples, while hexavalent chromium was detected in one groundwater monitoring well sample.

Table 1. Collected Hexavalent and Total Chromium Concentrations Compared to Health-Based Screening Values

Contaminant Concentration (mg/L)	Health-Based Screening Values for Water (mg/kg)	Exceeds ATSDR Screening Value (Yes/No)
Chromium (0.029)	0.010 (Chronic EMEG Child) 0.050 (Intermediate EMEG Child) 0.040 (Chronic EMEG Adult) 0.2 (Intermediate EMEG Adult)	Yes No No No
Chromium (0.399)	0.010 (Chronic EMEG Child) 0.050 (Intermediate EMEG Child) 0.040 (Chronic EMEG Adult) 0.2 (Intermediate EMEG Adult)	Yes Yes Yes Yes
Hexavalent Chromium (0.2)	0.010 (Chronic EMEG Child) 0.050 (Intermediate EMEG Child) 0.040 (Chronic EMEG Adult) 0.2 (Intermediate EMEG Adult)	Yes Yes Yes Yes

mg/L = milligram per liter
mg/kg = milligram per kilogram
EMEG (Environmental Media Evaluation Guide) = Estimates a contaminant concentration at which non-carcinogenic health effects are unlikely [1]

Chromium detected in all of the groundwater monitoring well samples exceeded ATSDR’s health-based screening values for hexavalent chromium, thus the samples will be evaluated further.

Ingestion of Chromium-Contaminated Groundwater

We chose to evaluate all age groups (Adult, Adolescent, Elementary, and Preschool) exposed 7 days per week for 1 year to on-site monitoring well chromium concentrations. Seven days per week was used to demonstrate a worst-case scenario.

Table 2. Estimated Exposure Doses Compared to the Intermediate Oral MRL and NOAEL for Hexavalent Chromium

Contaminant Concentration (mg/L)	Exposed Population (years)	Estimated Exposure Doses (mg/kg/day)	Intermediate Oral MRL (mg/kg/day)	Intermediate Oral NOAEL (mg/kg/day)	Does ED Exceed MRL/ NOAEL?
Chromium (0.029)	Adult	0.0008	0.005	0.21	No/No
	Adolescent (12-17)	0.0012			No/No
	Elementary (7-11)	0.00096			No/No
	Preschool (1-6)	0.002			No/No
Chromium (0.399)	Adult	0.0114	0.005	0.21	Yes/No
	Adolescent (12-17)	0.02			Yes/No
	Elementary (7-11)	0.01			Yes/No
	Preschool (1-6)	0.02			Yes/No
Hexavalent Chromium (0.2)	Adult	0.006	0.005	0.21	Yes/No
	Adolescent (12-17)	0.008			Yes/No
	Elementary (7-11)	0.006			Yes/No
	Preschool (1-6)	0.01			Yes/No

mg/L = milligram per liter
mg/kg/day = milligram per kilogram per day
MRL (Minimal Risk Level) = An estimate of the daily human exposure to a hazardous substance that is not likely to result in adverse non-cancer health effects [1]
NOAEL (No Observed Adverse Effect Level) = The concentration level at which no health effects have been observed [1]

We first compared the estimated EDs to the intermediate oral MRL for hexavalent chromium (0.005 milligrams per kilograms per day (mg/kg/day)). We found that the sample concentrations of 0.399 mg/L and 0.2 mg/L exceed the intermediate oral MRL for hexavalent chromium. We further compared the EDs for these two sample concentrations to the intermediate No Obeserved Adverse Effect Level (NOAEL) for hexavalent chromium (0.21 mg/kg/day) and found that the EDs do not exceed the intermediate oral NOAEL. This NOAEL is based on a rodent study conducted by the National Toxicology Program (2007 and 2008a) in which male and female rats and mice were exposed to sodium dichromate dihydrate from 23 days up to 6 months. This NOAEL is at a level at which hematological effects were not observed in the male rats used in the study [19]. Health effects are not likely if a person is exposed to the on-site chromium-contaminated groundwater 7 days per week for 1 year.

Sediment

Chromium detected in 14 samples collected from Frazier Creek (excluding the background sample) ranged from 7.79-638 mg/kg. The chromium concentration in 10 of the 14 samples exceeded the chronic Environmental Media Evaluation Guide (EMEG)[5] for a child, and one of the samples exceeded the intermediate EMEG for a child, thus Frazier Creek will be evaluated further (Table 3).

Chromium detected in nine samples collected from Kings Creek (excluding the background sample) ranged from 14.8-136 mg/kg. Approximately five of the samples exceeded the chronic EMEG for a child, thus Kings Creek will be evaluated further (Table 3).

Chromium detected in the eight samples collected from the drainage ditch located between the site and Frazier Creek ranged from 169-1,770 mg/kg. All eight samples exceeded the chronic EMEG for a child, four of the samples exceeded the chronic EMEG for an adult, and five of the samples exceeded the intermediate EMEG for a child; thus, the drainage ditch will be evaluated further (Table 3).

[5] Estimates a contaminant concentration at which non-carcinogenic health effects are unlikely [1].

Table 3. Collected Hexavalent Chromium Concentrations Compared to Health-Based Screening Values				
Location	**Range (mg/kg)**	**Geometric Mean (mg/kg)**	**Health-Based Screening Values for Soil (mg/kg)**	**Number exceeding Screening Value/Total Samples**
Frazier Creek	7.79-638	78.5	50 (Chronic EMEG Child) 300 (Intermediate EMEG Child) 700 (Chronic EMEG Adult) 4,000 (Intermediate EMEG Adult)	10/14 1/14 0/14 0/14
Kings Creek	14.8-136	48.7	50 (Chronic EMEG Child) 300 (Intermediate EMEG Child) 700 (Chronic EMEG Adult) 4,000 (Intermediate EMEG Adult)	5/9 0/9 0/9 0/9
Drainage Ditch	169-1,770	544	50 (Chronic EMEG Child) 300 (Intermediate EMEG Child) 700 (Chronic EMEG Adult) 4,000 (Intermediate EMEG Adult)	8/8 5/8 4/8 0/8

mg/kg = milligram per kilogram
EMEG (Environmental Media Evaluation Guide) = Estimates a contaminant concentration at which non-carcinogenic health effects are unlikely [1]

Dermal Exposure to Chromium-Contaminated Creek and Drainage Ditch Sediment

Currently there have not been enough studies conducted in order to calculate a Minimal Risk Level (MRL)[6], Lowest Observed Adverse Effect Level (LOAEL)[7] or a No Observed Adverse Effect Level (NOAEL)[8] for dermal exposure to chromium and chromium compounds. There have been several studies which suggest that levels of 4-25 mg/kg (ppm) can produce chromium-induced contact dermatitis in people [19].

A study conducted in 1994 by Nethercott et al. used 54 volunteers to determine a dose-response relationship between potassium chromate and contact dermatitis. The study concluded that soil concentrations above 450 mg/kg hexavalent chromium and 165,000 mg/kg trivalent chromium resulted in contact dermatitis in 99.99% of the population [19].

DSHS compared the highest total (hexavalent) chromium concentrations measured in the collected sediment samples from each location (Frazier Creek 638 mg/kg, Kings Creek 136 mg/kg, and the drainage ditch 1,770 mg/kg) to the dose-response value (450 mg/kg) in the study

[6] An estimate of the daily human exposure to a hazardous substance that is not likely to result in adverse non-cancer health effects [1].
[7] The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals [1].
[8] The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals [1].

mentioned above. As stated earlier, as a protective precaution, DSHS is assuming that all chromium detected is hexavalent chromium. DSHS determined that contact with chromium-contaminated sediment in Frazier Creek and the drainage ditch (located between the site and Frazier Creek) is likely to result in dermal health effects such as contact dermatitis in people.

Ingestion of Chromium-Contaminated Creek and Drainage Ditch Sediment
DSHS realizes that people will probably not be exposed 100% of the time or to the highest concentration of chromium collected. It is more likely that people would come into contact with a range of sediment-chromium concentrations; this is best represented through use of the geometric mean[9] concentration rather than using the average.

Based upon the above information, we chose to evaluate all age groups (Adult, Adolescent, Elementary, and Preschool) exposed 5 days per week for 30 years to the geometric mean total chromium concentration for each location (Frazier Creek 78.5 mg/kg, Kings Creek 48.7 mg/kg, and the drainage ditch 544 mg/kg). Using 5 days per week is a more realistic scenario because it represents a work or school schedule, rather than a daily exposure.

We first compared the estimated EDs to the chronic oral MRL for hexavalent chromium (0.001 milligrams per kilograms per day (mg/kg/day)). We found that EDs for elementary and preschool children exceed the chronic oral MRL if they are exposed to chromium-contaminated sediment in Frazier Creek and Kings Creek 5 days per week for 30 years. EDs for all age groups exceed the chronic oral MRL if exposed to chromium-contaminated drainage ditch (located between the site and Frazier Creek) sediment 5 days per week for 30 years.

Unlike intermediate exposures, a chronic NOAEL value for hexavalent chromium does not currently exist; therefore, we further compared these two EDs to the chronic oral LOAEL for hexavalent chromium (0.38 mg/kg/day), which is a level that is known to cause gastrointestinal and hepatic effects in mice [19]. Both of the samples that exceed the chronic oral MRL do not exceed the chronic oral LOAEL for hexavalent chromium. Health effects will not likely occur if people are exposed 5 days per week for 30 years, thus a cancer risk evaluation is not warranted.

Below, Table 4 compares the estimated EDs for each of the three locations (Frazier Creek, Kings Creek, and the drainage ditch) to the chronic oral MRL and LOAEL for hexavalent chromium.

[9] The geometric mean is a weighted average derived by multiplying data from all observations, then taking the root of the number of observations and is used when values are not evenly distributed. The geometric mean also gives a better representation of a truer distribution in the environment [1].

Table 4. Estimated Exposure Doses (ED) Compared to the Chronic Oral MRL and LOAEL for Hexavalent Chromium

Location (geometric mean mg/kg/day)	Exposed Population (years)	Estimated Exposure Doses (mg/kg/day)	Chronic MRL (mg/kg/day)	LOAEL (mg/kg/day)	Does ED Exceed MRL/ LOAEL?
Frazier Creek (78.5)	Adult	0.0008	0.001	0.38	No/No
	Adolescent (12-17)	0.001			Yes/No
	Elementary (7-11)	0.004			Yes/No
	Preschool (1-6)	0.006			Yes/No
Kings Creek (48.7)	Adult	0.0004	0.001	0.38	No/No
	Adolescent (12-17)	0.0006			No/No
	Elementary (7-11)	0.002			Yes/No
	Preschool (1-6)	0.004			Yes/No
Drainage Ditch (544)	Adult	0.005	0.001	0.38	Yes/No
	Adolescent (12-17)	0.007			Yes/No
	Elementary (7-11)	0.02			Yes/No
	Preschool (1-6)	0.04			Yes/No

MRL (Minimal Risk Level) = An estimate of the daily human exposure to a substance that is not likely to result in adverse non-cancer health effects [1]
LOAEL (Lowest Observed Adverse Effect Level) = The lowest concentration amount in which health effects are observed [1]
mg/kg/day = milligram per kilogram per day

For a complete description on how we calculated the estimated EDs, refer to Appendix D. We also chose to calculate EDs for each of the four groups (Adult, Adolescent, Elementary, and Preschool) exposed by incidental ingestion to the total chromium geometric mean collected from each location (Frazier Creek, Kings Creek, and the drainage ditch) 5 days per week for 1 year, demonstrating an intermediate exposure scenario. The EDs are as follows:

Table 5. Estimated Exposure Doses (ED) Compared to the Intermediate Oral MRL and NOAEL for Hexavalent Chromium

Location (geometric mean mg/kg/day)	Exposed Population (years)	Estimated Exposure Doses (mg/kg/day)	Intermediate MRL (mg/kg/day)	Intermediate NOAEL (mg/kg/day)	Does ED Exceed MRL/ LOAEL?
Frazier Creek (78.5)	Adult	0.0008	0.005	0.21	No/No
	Adolescent (12-17)	0.001			No/No
	Elementary (7-11)	0.004			No/No
	Preschool (1-6)	0.007			Yes/No
Kings Creek (48.7)	Adult	0.0004	0.005	0.21	No/No
	Adolescent (12-17)	0.0006			No/No
	Elementary (7-11)	0.002			No/No
	Preschool (1-6)	0.004			No/No
Drainage Ditch (544)	Adult	0.006	0.005	0.21	Yes/No
	Adolescent (12-17)	0.008			Yes/No
	Elementary (7-11)	0.02			Yes/No
	Preschool (1-6)	0.04			Yes/No

MRL (Minimal Risk Level) = An estimate of the daily human exposure to a substance that is not likely to result in adverse non-cancer health effects [1]
NOAEL (No Observed Adverse Effect Level) = The concentration level at which no health effects have been observed [1]
mg/kg/day = milligram per kilogram per day

We compared the estimated EDs to the Intermediate oral MRL for hexavalent chromium (0.005 mg/kg/day) and found that for all three locations (Frazier Creek, Kings Creek, and the drainage ditch), none of the EDs exceeded the intermediate MRL. If people ingest the geometric mean concentration of the samples found in Frazier Creek, Kings Creek and the drainage ditch (located between the site and Frazier Creek) 5 days per week for 1 year, health effects are not likely to occur.

Conclusions

DSHS and ATSDR reached four conclusions in this health assessment:

1. DSHS and ATSDR conclude that dermal (skin) contact to sediment in Frazier Creek and the drainage ditch (located between the site and Frazier Creek) will potentially cause health effects in children and adults when exposed to the highest collected total chromium sediment sample concentration. This is a public health hazard.

2. DSHS and ATSDR conclude that incidental ingestion of chromium-contaminated sediment collected from Frazier Creek, Kings Creek, and the drainage ditch (located between the site and Frazier Creek) will not likely cause health effects in people.

3. DSHS and ATSDR conclude that chromium concentrations detected in two groundwater monitoring wells on the former facility property will not likely cause health effects in people.

4. DSHS and ATSDR conclude that hazardous substances and chromium-contaminated soil on the former facility property will not harm people’s health because these materials have been removed from the Van der Horst USA Corporation site.

Recommendations

1. DSHS and ATSDR recommend that children and adults should not trespass into Frazier Creek or the drainage ditch located between the site and Frazier Creek.

2. DSHS and ATSDR recommend restricting access to Frazier Creek and the drainage ditch located between the site and Frazier Creek in order to lessen exposure to chromium-contaminated sediment.

Public Health Action Plan

The public health action plan for the site contains a description of actions that have been or will be taken by DSHS, ATSDR, and other government agencies at the site. The purpose of the public health action plan is to ensure that this public health assessment both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from breathing, ingesting or skin contact with hazardous substances found in the environment. Included is a commitment on the part of DSHS and ATSDR to follow up on this plan to ensure that it is implemented.

Actions Completed

1. In June 2008, EPA categorized, sampled, and separated liquid waste on the Van der Horst Site.

2. In June 2008, EPA removed 140,000 gallons of chromium rinse water from the facility sump located in the basement of the main building.

3. On August 20, 2008, sediment samples were collected from Frazier Creek to help show overland water flow and contaminant migration.

4. On January 7, 2009, EPA began removal of waste products from the site.

5. In April 2009, DSHS personnel attended a meeting to hear the communities' concerns about the site.

6. On April 9, 2009, The TCR completed a cancer cluster report for zip codes 75160 and 75161.

7. On September 23, 2009, Van der Horst was proposed to EPA's NPL.

8. On January 24, 2010, DSHS personnel visited the Van der Horst NPL site.

9. On March 4, 2010, Van der Horst became finalized to the NPL.

Actions Planned

1. This document will be made available to EPA and TCEQ for technical review.

2. Following technical review, this document will be made available to the community and local government officials for public comment. Comments received during the

public comment period will be addressed by DSHS and ATSDR. Responses to comments will be incorporated into the final document.

3. The final version of this document will be made available to community members, city officials, the TCEQ, and the EPA, and other interested parties.

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Certification

This public health assessment for the Van der Horst USA Corporation site located in Terrell, Kaufman County, Texas was prepared by the Texas Department of State Health Services (DSHS) under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methods and procedures existing when the time the public health assessment was initiated. Editorial review was completed by the Cooperative Agreement partner.

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Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with its findings.

Alan Yarbrough
Team Lead, CAT, CAPEB, DHAC, ATSDR

Appendix A: Acronyms and Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below Ground Surface
CREG	Cancer Risk Evaluation Guide
DSHS	Texas Department of State Health Services
e.g.	[*exempli gratia*]: for example
ED	Exposure Dose
EMEG	Environmental Media Evaluation Guide
EPA	United States Environmental Protection Agency
GI	Gastrointestinal
IARC	International Agency for Research on Cancer
i.e.	[*id est*]: that is
IUR	Inhalation Unit Risk
kg	kilogram
LOAEL	Lowest Observed Adverse Effect Level
µg	microgram
µg/L	microgram per liter
$\mu g/m^3$	microgram per cubic meter
mg	milligram
mg/kg	milligram per kilogram
mg/kg/day	milligram per kilogram per day
mg/L	milligram per liter
MRL	Minimal Risk Level
MW	Monitoring Well
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
NTP	National Toxicology Program
PHA	Public Health Assessment
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act of 1976
RfD	Reference Dose
RMEG	Reference Dose Media Evaluation Guide
START-3	EPA Superfund Technical Assessment and Response Team-Region 3
TCEQ	Texas Commission on Environmental Quality
TCR	Texas Cancer Registry
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
TWQB	Texas Water Quality Board
Van der Horst	Van der Horst USA Corporation

Appendix B: The Public Health Assessment Process

The public health assessment process for NPL and other hazardous waste sites frequently involves the evaluation of multiple data sets. These data include available environmental data, exposure data, health effects data (including toxicologic, epidemiologic, medical, and health outcome data), and community health concerns.

Environmental Data

As the first step in the evaluation, ATSDR scientists review available environmental data to determine what contaminants are present in the various media to which people may be exposed (e.g., air, soil, sediment, dust, surface water, groundwater, vegetation, etc.) and at what concentrations. ATSDR generally does not collect its own environmental sampling data, but instead, reviews information provided by other federal or state agencies and/or their contractors, by individuals, or by potentially responsible parties [i.e., companies that may have generated the hazardous waste found at an NPL site, shippers that may have delivered hazardous waste to the site, and individuals or corporations that own (or owned) the property on which the site is located]. When the available environmental data is insufficient to make an informed decision about the public health hazard category of the site, the report will indicate what further sampling data is needed to fill the "data gaps."

Exposure Data

Pathway Analysis

The presence of hazardous chemical contaminants in the environment does not always mean that people who spend time in the area are likely to experience adverse health effects. Such effects are possible only when people in the area engage in activities that make it possible for a sufficient quantity of the hazardous chemicals to be transported into the body and absorbed into the bloodstream. This transport process is required in order for there to be a true exposure; thus, the assessment of real and potential exposures defines the real and potential health hazards of the site and drives the public health assessment process.

As the second step in the health assessment process, ATSDR scientists conduct an evaluation of the various site-specific pathways through which individuals may become truly exposed to site contaminants and be at risk for adverse health effects. Chemical toxicants can be transported into the body through the lungs, through the gastrointestinal (GI) tract, or directly through the skin by dermal absorption. People can be exposed to site contaminants by breathing air containing volatile or dust-borne contaminants, by eating or drinking food or water that contain contaminants from the site (or through hand-to-mouth activities with contaminated soil, dust, sediment, water, or sludge present on the hands), or by coming into direct skin-contact with contaminated soil, dust, sediment, water, or sludge resulting in dermal absorption of toxicants.

To conduct a pathways analysis ATSDR scientists review available information to determine whether people visiting the site or living nearby have been, currently are, or could be exposed (at some time in the future) to contaminants associated with this site. To determine whether people are exposed to site-related contaminants, investigators evaluate the environmental and human behavioral components leading to human exposure. The five (5) elements of each exposure pathway that agency scientists evaluate are:

1) The contaminant source (i.e., the reservoir from which contaminants are being released to various media),
2) The environmental fate and transport of contaminants (i.e., how contaminants may dissipate, decay, or move from one medium to another,
3) The exposure point or area (i.e., the location(s) where people may come in physical contact with site contaminants),
4) The exposure route (i.e., the means by which contaminant gets into the body at the exposure point or area), and
5) The potentially exposed population (i.e., a group of people who may come in physical contact with site contaminants).

Exposure pathways can be **complete**, **potential**, or **eliminated**. For a person to be exposed to site contaminants, at least one exposure pathway for those contaminants must be complete. A pathway is **complete** when all five elements in the pathway are present and exposure has occurred, is occurring, or will occur in the future. If one or more of the five elements of a pathway is missing, but could become completed at some point in the future, the pathway is said to be a **potential** pathway. A pathway is eliminated if one or more of the elements are missing and there is no plausible way of it ever being completed, then the pathway has been **eliminated**.

Exposure Assessment Scenarios

After pathways have been evaluated, ATSDR scientists construct a number of plausible exposure scenarios, depicting a range of exposure possibilities, in order to determine whether people in the community have been (or might be) exposed to hazardous materials from the site at levels that are of potential public health concern. To do this, they must take into consideration the various contaminants, the media that have been contaminated, the site-specific and media-specific pathways through which people may be exposed, and the general accessibility to the site. In some cases, it is possible to determine that exposures have occurred or are likely to have occurred in the past. However, a lack of appropriate historical data often makes it difficult to quantify past exposures. If scientists determine that combined exposures from multiple pathways (or individual exposures from a single pathway) are posing a public health hazard, ATSDR makes recommendations for actions that will eliminate or significantly reduce the exposure(s) causing the threat to public health.

Health Effects Data

Even when chemical contaminants come into contact with the lungs, the GI tract, or the skin, adverse health effects may not occur if the contaminant is present in a form that is not readily absorbed into the bloodstream or it does not pass readily through the skin into the bloodstream. Since exposure does not always result in adverse health effects it is important evaluate whether the exposure could pose a hazard to people in the community or to people who visit the site. The factors that influence whether exposure to a contaminant or contaminants could potentially result in adverse health effects include:

- The toxicological properties of the contaminant (i.e., the toxicity or carcinogenicity),
- The manner in which the contaminant enters the body (i.e., the route of exposure),
- How often and how long the exposure occurs (i.e., frequency and duration of exposure),
- How much of the contaminant actually gets into the body (i.e., the delivered dose),
- Once in (or on) the body, how much gets into the bloodstream (i.e., the absorbed dose),
- The number of contaminants involved in the exposure (i.e., the synergistic or combined effects of multiple contaminants), and
- Individual host factors predisposing to susceptibility (i.e., characteristics such as age, sex, body weight, genetic background, health status, nutritional status, and lifestyle factors that may influence how an individual absorbs, distributes, metabolizes, and/or excretes the contaminants).

Thus, as the third step in the health assessment process (often done in conjunction with the pathway analysis and exposure assessment scenarios described above); ATSDR scientists review existing scientific information to evaluate the possible health effects that may result from exposures to site contaminants. This information frequently includes published studies from the medical, toxicologic, and/or epidemiologic literature, ATSDR's Toxicologic Profiles for the contaminants, EPA's online Integrated Risk Information System database, the National Library of Medicine's Hazardous Substance Data Bank, published toxicology textbooks, or other reliable toxicology data sources.

Health Assessment Comparison (HAC) Values

To simplify the health assessment process, ATSDR, EPA, Oak Ridge National Laboratories, and some of the individual states have compiled lists of chemical substances that have been evaluated in a consistent, scientific manner in order to derive toxicant doses (health guidelines) and/or toxicant concentrations (environmental guidelines), exposures to which, are confidently felt to be without significant risk of adverse health effects, even in sensitive sub-populations.

Health Guidelines

Health guidelines are derived from the toxicologic or epidemiologic literature with many uncertainty or safety factors applied to insure that they are amply protective of human health. They are generally derived for specific routes of exposure (e.g., inhalation, oral ingestion, or dermal absorption) and are expressed in terms of dose, with units of mg/kg/day.

Media-specific HAC values for non-cancer health effects under oral exposure routes are generally based on ATSDR's chronic oral MRLs or EPA's oral reference doses (RfDs). Chronic oral MRLs and RfDs are based on the assumption that there is an identifiable exposure dose (with units of mg/kg/day) for individuals, including sensitive subpopulations (such as pregnant women, infants, children, the elderly, or individuals who are immunosuppressed), that is likely to be without appreciable risk for non-cancer health effects over a specified duration of exposure.

Environmental Guidelines

Environmental guidelines for specific media (e.g., air, soil/sediment, food, drinking water, etc.) are often derived from health guidelines after making certain assumptions about 1) the average quantities of the specific media that a person may assimilate into the body per day (i.e., inhale, eat, absorb through the skin, or drink) and 2) the person's average body weight during the exposure period. Environmental guidelines are expressed as chemical concentrations in a specific medium with units such as micrograms per cubic meter ($\mu g/m^3$), milligrams per kilogram (mg/kg), micrograms per Liter (µg/L), parts per million (ppm), or parts per billion (ppb). If these values are based on ATSDR's oral MRLs, they are known as EMEGs; if they are based on EPA's RfDs, they are called reference dose media evaluation guides.

For airborne contaminants, ATSDR health assessors frequently use ATSDR's inhalation minimal risk levels (inhalation MRLs) or EPA's inhalation reference concentrations (RfCs). Inhalation MRLs and RfCs are all based on the assumption that there is an identifiable exposure concentration in air [with units of $\mu g/m^3$ or parts per billion by volume (ppbv)] for individuals, including sensitive subpopulations (such as pregnant women, infants, children, the elderly, or individuals who are immunosuppressed), that is likely to be without appreciable risk for non-cancer health effects over a specified duration of exposure. Since it is already in the form of a concentration in a particular medium, the inhalation MRL is also called the EMEG for air exposures.

These environmental guidelines are frequently referred to as "screening values" or "comparison values" since the contaminant concentrations measured at a Superfund or other hazardous waste site are frequently "compared" to their respective environmental guidelines in order to screen for those substances that require a more in-depth evaluation. Since comparison values are health-based (i.e., derived so as to be protective of public health) and they are frequently employed in conducting public health assessments, they are frequently referred to as health assessment comparison values or HAC values.

Other HAC value names have been coined by the various EPA Regions or other state or federal agencies including EPA Regional Screening Levels, EPA's health effects assessment summary tables, "dose-response values", California's "reference exposure levels", and Texas Commission on Environmental Quality's "effects screening levels". These values are occasionally used when there are no published MRLs, RfDs, or RfCs for a given contaminant.

HAC values for non-cancer effects (specifically ATSDR's oral and/or inhalation MRLs) may be available for up to three different exposure durations: acute (14 days or less), intermediate (15 to 365 days), or chronic (366 days or more). As yet, EPA calculates RfD or RfC HAC values only for chronic exposure durations.

HACs for Cancer Effects

When a substance has been identified as a carcinogen, the lowest available HAC value usually proves to be the cancer risk evaluation guide (CREG). For oral exposures, the CREG (with units of mg/kg or ppm) is based on EPA's chemical-specific cancer slope factor (also referred to as oral slope factor) and represents the concentration that would result in a daily exposure dose (in mg/kg/day) that would produce a theoretical lifetime cancer risk of 1×10^{-6} (1 additional cancer case in 1 million people exposed over a 70-year lifetime).

For inhalation exposures, the CREG (in $\mu g/m^3$) is based on the EPA's inhalation unit risk (IUR) value and is calculated as CREG = $10^{-6} \div$ IUR. The inhalation CREG represents the ambient air concentration that, if inhaled continuously over a lifetime, would produce a theoretical excess lifetime cancer risk of 1×10^{-6} (1 additional cancer case in 1 million people exposed over a 70-year lifetime).

Imputed or Derived HAC Values

The science of environmental health and toxicology is still developing, and sometimes, scientific information on the health effects of a particular substance of concern is not available. In these cases, ATSDR scientists will occasionally look to a structurally similar compound, for which health effects data are available, and assume that similar health effects can reasonably be anticipated on the basis of their similar structures and properties. Occasionally, some of the contaminants of concern may have been evaluated for one exposure route (e.g., the oral route) but not for another route of concern (e.g., the inhalation route) at a particular NPL site or other location with potential air emissions. In these cases ATSDR scientists may do what is called a route-to-route extrapolation and calculate the inhalation RfD, which represents the air concentration (in $\mu g/m^3$) that would deliver the same dose (in mg/kg/day) to an individual as the published oral RfD for the substance. This calculation involves making certain assumptions about the individual's inhalation daily volume (in cubic meters per day), which represents the total volume of air inhaled in an average day, the individual's body weight (in kg), a similarity in the oral and inhalation absorption fraction, and – once the contaminant has been absorbed into the bloodstream – that it behaves similarly whether it came through the GI tract or the lungs. Because of all the assumptions, route-to-route extrapolations are employed only when there are no available HAC values for one of the likely routes of exposure at the site.

Use of HAC Values

When assessing the potential public health significance of the environmental sampling data collected at a contaminated site, the first step is to identify the various plausible site-specific pathways and routes of exposure based on the media that is contaminated (e.g., dust, soil, sediment, sludge, ambient air, groundwater, drinking water, food product, etc.). Once this is done, maximum values for measured contaminant concentrations are generally compared to the most conservative (i.e., lowest) published HAC value for each contaminant. If the maximum contaminant concentration is below the screening HAC value, then the contaminant is eliminated from further consideration, but if the maximum concentration exceeds the screening HAC, the contaminant is identified as requiring additional evaluation. However, since the screening HAC value is almost always based on a chronic exposure duration (or even a lifetime exposure duration, in the case of comparisons with CREG values) and the maximum contaminant concentration represents a single point in time (which would translate to an acute duration exposure), one cannot conclude that a single exceedance (or even several exceedances) of a HAC value constitutes evidence of a public health hazard. That conclusion can be reached only after it has been determined that peak concentrations are exceeding acute-exposure-duration HAC values, intermediate-term average concentrations are exceeding intermediate-exposure-duration HAC values, or long-term average concentrations are exceeding chronic-exposure-duration HAC values.

Community Health Concerns

If nearby residents are concerned about specific diseases in the community, or if ATSDR determines that harmful exposures are likely to have occurred in the past, health outcome data may be evaluated to see if illnesses are occurring at rates higher than expected and whether they plausibly could be associated with the hazardous chemicals released from the site. Health outcome data may include cancer incidence rates, cancer mortality rates, birth defect prevalence rates, or other information from state and local databases or health care providers. The results of health outcome data evaluations may be used to address community health concerns. However, since various disease incidence, mortality, and/or prevalence rates can (and do) fluctuate randomly over space and time, care must be taken not to attribute causality to a real or theoretical exposure possibility when rates are slightly higher than expected (any more than one would attribute a protective effect to an environmental exposure if disease rates were lower than expected).

ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the public comments that related to the public health assessment document are addressed in the final version of the report.

Conclusions
The public health assessment document presents conclusions about the nature and severity of the public health threat posed by the site. Conclusions take into consideration the environmental sampling data that have been collected, the available toxicologic data regarding the contaminants identified, the environmental media that are affected, and the potential pathways of exposure for the public. If health outcome data have been evaluated, conclusions are also presented regarding these data evaluations.

Recommendations
If the conclusions indicate that the site represents a public health hazard, the ATSDR will make recommendations to the state or federal environmental agencies regarding steps that can be taken to stop or reduce the exposures to the public. These steps are presented in the public health action plan for the site. However, if the public health threat is urgent, the ATSDR can issue a public health advisory, warning people of the danger. ATSDR can also recommend health education activities or initiate studies of health effects, full-scale epidemiology studies, exposure investigations, disease registries, disease surveillance studies, or research studies on specific hazardous substances.

Appendix C: Figures

Figure 1. Site Location and Facility Layout [5]

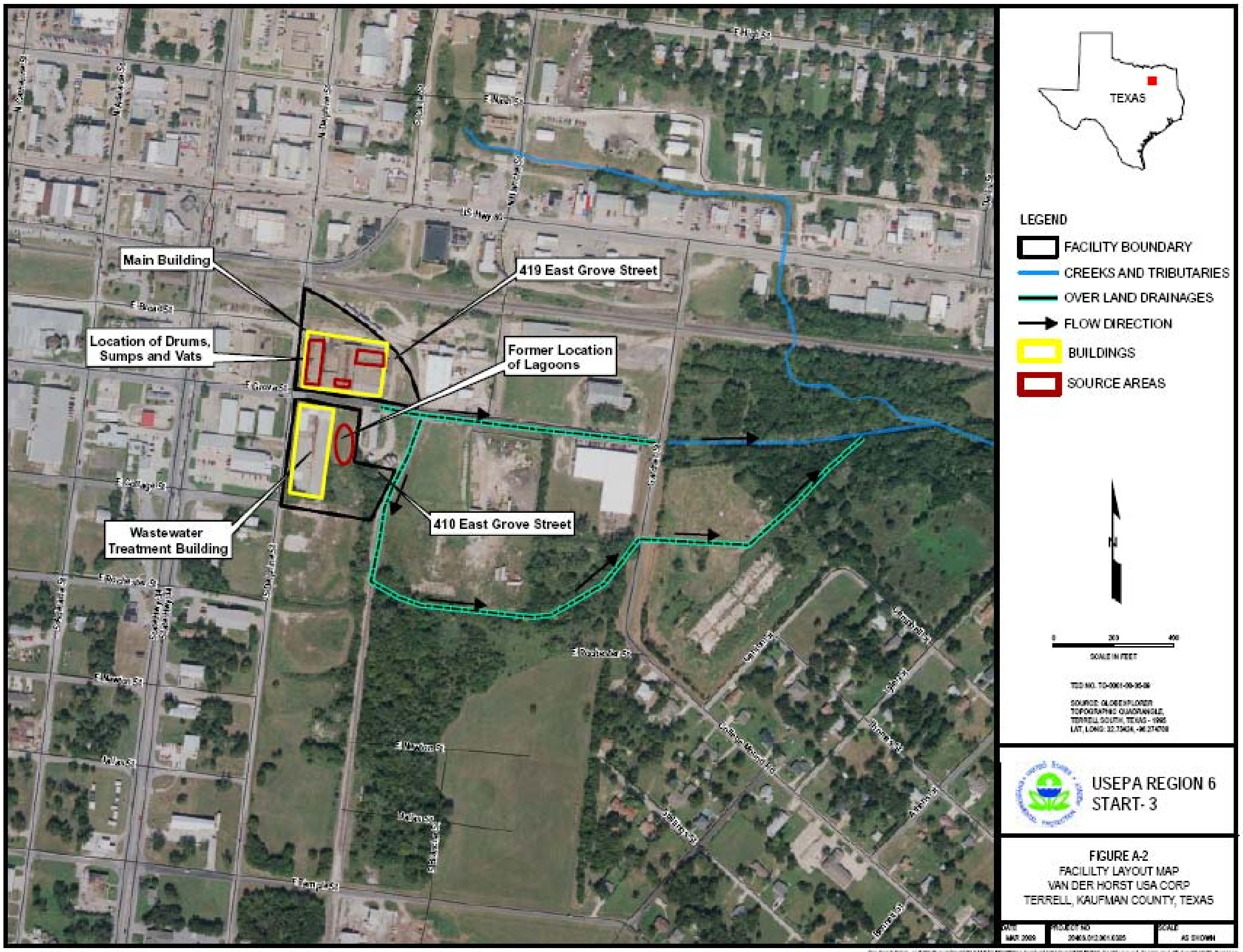
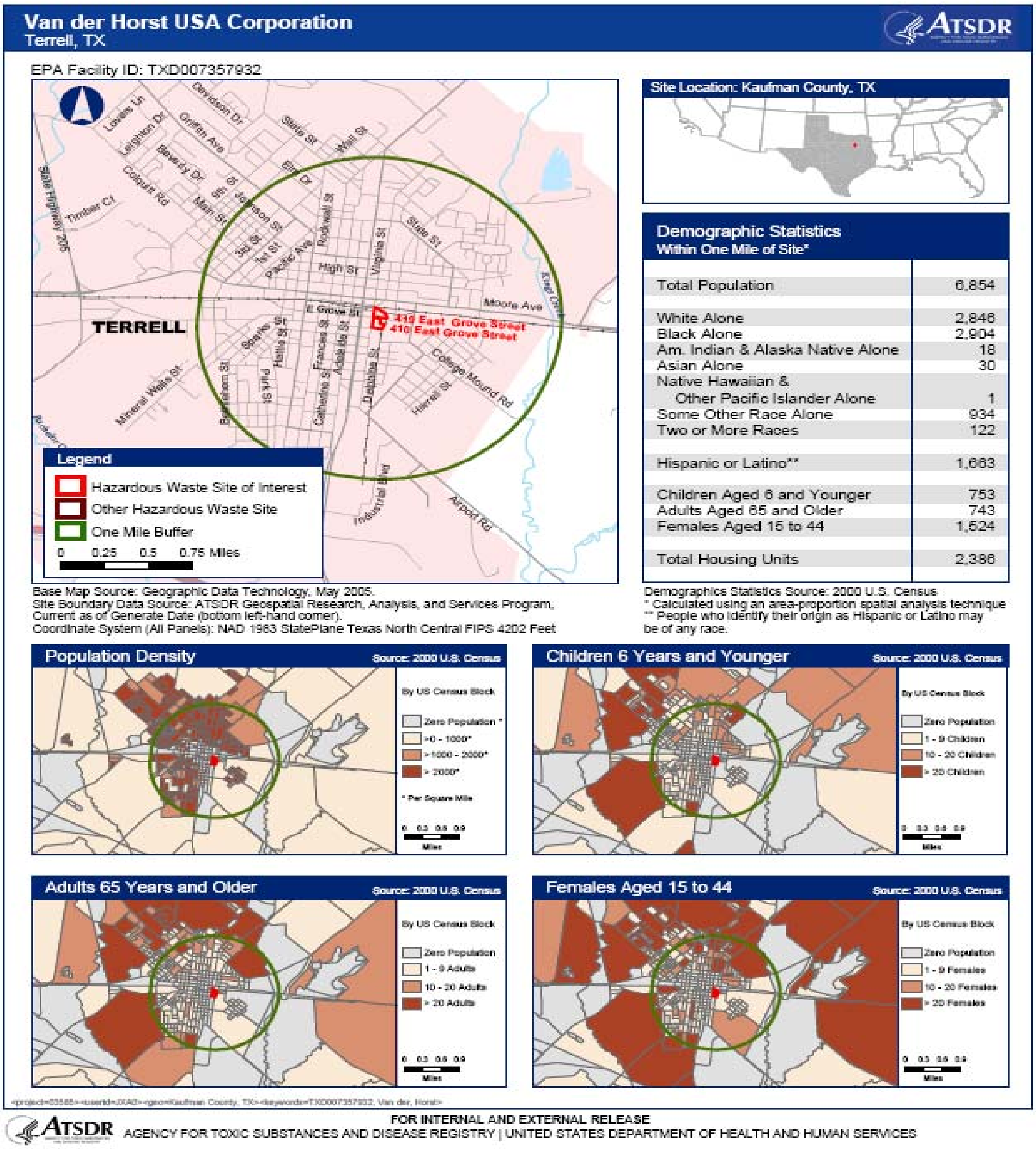


Figure 2. Site Location and Demographic Statistics.



Appendix D: Exposure Dose Calculations

In this PHA, DSHS evaluated one scenario in order to determine if there is a risk of adverse health effects when a person is exposed to chromium-contaminated sediment from Frazier Creek, Kings Creek, or the drainage ditch located between the site and Frazier Creek.

The exposure dose is calculated using the following equation:

$$\text{Dose} = \frac{\text{Concentration} \times \text{Intake Rate} \times \text{Exposure Frequency} \times \text{Conversion Factor}}{\text{Body Weight}}$$

The values used in estimating the exposure doses are shown below:

Variable	**Value**	**Source of Value**
Total Chromium Geometric Mean Concentration Frazier Kings Drainage Ditch	 78.5 mg/kg 48.7 mg/kg 544 mg/kg	Geometric mean for sediment sample concentration from each location
Chromium concentrations found in on-site groundwater monitoring well (MW) samples MW-2 total chromium MW-4 total chromium MW-4 hexavalent chromium	 0.029 mg/L 0.399 mg/L 0.2 mg/L	The concentration of chromium detected in two on-site groundwater monitoring well samples
Preschool-Aged (1-6 years) Child Soil Intake Rate	200 mg/day	The average amount of soil a preschool-aged child will ingest on a daily basis
Preschool-Aged (1-6 years) Child Water Intake Rate	1 L/day	The average amount of water a preschool-aged child will ingest on a daily basis
Preschool-Aged Child Body Weight	16 kg	Standard default, median body weight of a preschool-aged child (1-6 years)
Elementary-Aged Child (7-11 years) Soil Intake Rate	200 mg/day	The average amount of soil an elementary-aged child will ingest on a daily basis
Elementary-Aged Child (7-11 years) Water Intake Rate	1 L/day	The average amount of water an elementary-aged child will ingest on a daily basis
Elementary-Aged Child Body Weight	30 kg	Standard default, median body weight of an elementary-aged child (7-11 years)
Adolescent (12-17 years) Soil Intake Rate	100 mg/day	The average amount of soil an adolescent will ingest on a daily basis
Adolescent (12-17 years) Water Intake Rate	2 L/day	The average amount of water an adolescent will ingest on a daily basis
Adolescent Body Weight	50 kg	Standard default, median body weight of an adolescent (12-17 years)
Adult Soil Intake Rate	100 mg/day	The average amount of soil an adult will ingest on a daily basis
Adult Water Intake Rate	2 L/day	The average amount of water an adult will ingest on a daily basis
Adult Body Weight	70 kg	Standard default, median body weight of an adult.
Exposure Frequency	7 days per week for 1 year	Professional judgment used to demonstrate a “worst case scenario”
Exposure Frequency	5 days per week for 1 year	Professional judgment used to demonstrate a work schedule
Conversion Factor	10^{-6} kg/mg	Conversion for sediment units

mg/kg = milligram per kilogram
MW = monitoring well
mg/L = milligram per Liter
mg/day = milligrams per day
L/day = Liter per day
kg = kilograms
kg/mg = kilograms per milligrams

Using standard exposure assumptions (body weights of 16 kg for preschool-aged children, 30 kg for elementary-aged children, 50 kg for an adolescent, and 70 kg for an adult and ingestion rates of 200 mg soil/day for preschool and elementary-aged children, and 100 mg/day for adolescents and adults, and the geometric mean concentration of total chromium measured at each of the locations; Frazier Creek 78.5 mg/kg Kings Creek 48.7 mg/kg and the drainage ditch 544 mg/kg, we calculated the exposure doses for a preschool and elementary child, and an adolescent and adult exposed to the total chromium geometric mean concentration of chromium in the collected sediment samples 5 days per week for 30 years.

Example:

Preschool-Aged Child exposed to the total chromium geometric mean concentration in samples collected from Frazier Creek, exposed 5 days per week for 30 years (chronic exposure).

$$\text{Exposure Frequency} = \frac{(\text{Frequency of Exposure (days/year)} \times \text{Exposure Duration (years)})}{(\text{Averaging Time (Exposure Duration} \times 365\ \text{days/year}))}$$

$$\text{Exposure Frequency} = \frac{\left(\left(5\ \text{days/week} \times \frac{50\ \text{weeks}}{1\ \text{year}}\right) \times 30\ \text{years}\right)}{(30\ \text{years} \times 365\ \text{days/year})}$$

Exposure Frequency = 0.68

$$\text{Exposure Dose} = \frac{(\text{Contaminant Concentration} \times \text{Ingestion Rate} \times \text{Exposure Frequency} \times \text{Conversion Factor})}{(\text{Body Weight})}$$

$$\text{Exposure Dose} = \frac{\left(78.5\ \frac{\text{mg chromium}}{\text{kg sediment}} \times 200\ \frac{\text{mg sediment}}{\text{day}} \times 0.68 \times \frac{10^{-6}\text{kg}}{\text{mg sediment}}\right)}{(16\ \text{kg body weight})}$$

Exposure Dose = 0.006 mg/kg/day

Using standard exposure assumptions (body weights of 16 kg for preschool-aged children, 30 kg for elementary-aged children, 50 kg for an adolescent, and 70 kg for an adult and ingestion rates of 200 mg soil/day for preschool and elementary-aged children, and 100 mg/day for adolescents and adults, and the geometric mean concentration of total chromium measured at each of the locations; Frazier Creek 78.5 mg/kg Kings Creek 48.7 mg/kg and the drainage ditch 544 mg/kg, we calculated the exposure doses for a preschool and elementary child, and an adolescent and adult exposed to the total chromium geometric mean concentration of chromium in the collected sediment samples 5 days per week for 1 year.

Example:

Preschool-Aged Child exposed to the total chromium geometric mean concentration in samples collected from Frazier Creek, exposed 5 days per week for 1 year (intermediate exposure).

$$\text{Exposure Frequency} = \frac{(\text{Frequency of Exposure (days/year)} \times \text{Exposure Duration (years)})}{(\text{Averaging Time (Exposure Duration} \times 365\text{ days/year}))}$$

$$\text{Exposure Frequency} = \frac{\left(5\text{ days/week} \times \frac{52\text{ weeks}}{1\text{ year}}\right) \times 1\text{ year}}{(1\text{ year} \times 365\text{ days/year})}$$

Exposure Frequency = 0.71

$$\text{Exposure Dose} = \frac{(\text{Contaminant Concentration} \times \text{Ingestion Rate} \times \text{Exposure Frequency} \times \text{Conversion Factor})}{(\text{Body Weight})}$$

$$\text{Dose} = \frac{78.5\ \frac{\text{mg chromium}}{\text{kg sediment}} \times 200\ \frac{\text{mg sediment}}{\text{day}} \times 0.71\ \frac{10^{-6}\text{kg}}{\text{mg sediment}}}{(16\text{ kg body weight})}$$

Dose = 0.006 mg/kg/day

Using standard exposure assumptions (body weights of 16 kg for preschool-aged children, 30 kg for elementary-aged children, 50 kg for an adolescent, and 70 kg for an adult and water ingestion rates of 1L/day for preschool and elementary-aged children, and 2L/day for adolescents and adults), and chromium concentrations detected in groundwater monitoring well samples (0.029 mg/L, 0.399 mg/L and 0.2 mg/L); we calculated the exposure doses for a preschool and elementary child, and an adolescent and adult exposed to the concentrations found in groundwater wells on-site, exposed 7 days per week for 1 year.

Example:

Preschool-Aged Child exposed to the total chromium concentration detected in a on-site monitoring well sample, exposed 7 days per week for 1 year (intermediate exposure).

$$\text{Exposure Frequency} = \frac{\left(7\ \text{days/week} \times \frac{52\ \text{weeks}}{1\ \text{year}}\right) \times 1\ \text{year}}{(1\ \text{year} \times 365\ \text{days/year})}$$

Exposure Frequency = 1

$$\text{Exposure Dose} = \frac{(\text{Contaminant Concentration} \times \text{Ingestion Rate} \times \text{Exposure Frequency} \times \text{Conversion Factor})}{(\text{Body Weight})}$$

$$\text{Dose} = \frac{0.029\ \frac{\text{mg chromium}}{\text{Liter water}} \times 1\ \frac{\text{Liter water}}{\text{day}} \times 1)}{16\ \text{kg body weight}}$$

Dose = 0.002 mg/kg/day