Health Consultation

CHROMASCO REUSE CONSIDERATIONS

MEMPHIS, SHELBY COUNTY, TENNESSEE

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
The Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This publication concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

The Tennessee Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry
Atlanta, Georgia 30333

Background and Statement of Issues

A plan to construct and operate a Class III landfill at 3328 Fite Road in Memphis, Shelby County, Tennessee, was presented to the Tennessee Department of Environment and Conservation (TDEC). The location proposed for the Class III landfill includes the Chromium Mining and Smelting Corporation (Chromasco) site. After state Superfund remediation, the Chromasco site was closed. TDEC approved a cleanup to reduce risks posed by heavy metals (LEF 2004a) to an acceptable level for industrial uses. Some heavy metals remain in soils at the inactive property. The plan to convert this de-listed state Superfund site to a non-hazardous Class III landfill stirred comments within the local community, potential business neighbors, and public officials. To assist in the evaluation of the landfill plan, TDEC's Division of Solid Waste Management (SWM) and Division of Superfund (DSF) asked Environmental Epidemiology (EEP) of the Tennessee Department of Health (TDH) Communicable and Environmental Disease Services (CEDS), "Would adverse health risks result from the proposed change in land use?" As a landfill is only one possible reuse option, TDEC also requested that EEP provide health-based discussion on what would be acceptable future reuses of the Chromasco property.

In June 2004, Environmental Epidemiology, under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), published the *Health Consultation: Chromasco Mining and Smelting Corporation*. This public health document concluded that the inactive Chromasco site posed no apparent public health hazard. The conclusion was formulated because no pathway existed for people to become exposed to the heavy metals. Pathways considered included inhalation, ingestion, and dermal contact of dust particles, and consumption of and contact with groundwater. The consultation concluded that heavy metals might become a health problem if site conditions changed or if land use alterations were proposed. Therefore, this second document was prepared to investigate environmental public health concerns about converting the Chromasco site to a new land use, including the proposed Class III landfill.

From 1952 to 1980, Chromium Mining and Smelting Corporation produced alloys of ferrochrome, ferrosilicon, and ferromanganese. Chromasco used coke, gravel, chrome ore, and manganese ore as principal raw materials. Although furnace operations ceased in 1980, from 1981 to 1983, the plant operated as a ferrochrome slag concentrator. Due to the presence of heavy metals at the property, the Chromasco site later became a state Superfund site. After remedial investigation and cleanup action in November 2001, the site was de-listed. Dilapidated buildings (Figure 1), chromium-contaminated slag, and other materials were allowed to remain on site. A deed restriction on subsurface activities near an old process landfill prevented heavy metals from being unearthed and spread (SWM 2004). Soil samples analyzed post-excavation as part of the remediation process showed high levels of trivalent chromium(III), hexavalent chromium(VI), arsenic, and manganese (WRS 2001). Lead, selenium, and other metals were also reported during the remedial investigation of the Chromasco site. Leaching of these metals into the shallow groundwater was also documented.

The Chromasco site is approximately 6 miles north of Memphis. The 8 nearby businesses, which employ 711 employees, are mostly light industrial and industrial (BLF 2004). The Memphis Motor Sports Park, with approximately 500,000 spectators annually, borders the Chromasco property to the north. The closest residential areas are about 1.5 miles from the site.

Two Shelby County Schools, Lucy Elementary School and Woodstock Middle School, are approximately 2 and 1.5 linear miles away from the site, respectively. Figure 2 shows two perimeter circles that illustrate areas within 1 and 2 miles of 3328 Fite Road address.

A compilation of letters of concern, signatures opposing the landfill, and a collection of articles about other chromium-impacted areas were recruited, collected, and organized by a local business. This spiral bound set of documents was presented to the Commissioners of Shelby County and to other interested parties on the behalf of the concerned stakeholders (BLF 2004). One document referenced as part of the opposition was a letter from the Memphis-Shelby County Health Department (MSCHD 2004) to TDEC, expressing concern about hexavalent chromium(VI) and lead dust in ambient air. MSCHD requested that any approved landfill operation be required to monitor the levels of these chemicals in the air to insure that safety standards are met and that citizens are not put at risk. The landfill applicant later agreed to amend the application regarding ambient air monitoring.

Dr. Ruth Chen of TDEC SWM wrote a memorandum responding to the MSCHD letter. In the memorandum (SWM 2004), she agrees with the MSCHD that an air monitoring plan for hexavalent chromium(VI) and lead is called for if a landfill were to be constructed and operated on the de-listed Superfund site. SWM has requirements, such as use of a synthetic liner and leachate collection system, when disposing of hexavalent chromium(VI). The plan for the Class III/IV landfill requests that the site be permitted to accept Type III/IV wastes without proper disposal of the hexavalent chromium(VI). Type III/IV wastes can include farming wastes, landscaping and land clearing wastes, demolition/construction waste, and shredded automobile tires. Dr. Chen's memo suggests that chromium-contaminated waste water could be created when the landfill operators spray water to suppress dust and she states that no plan for this waste water was presented. In addition, Dr. Chen recommended that site workers and inspectors wear personal protective equipment during the construction of the landfill to mitigate inhalation of metal particles.

The plan to operate the Class III landfill joins two properties, the 92-acre Chromasco site and an adjacent 32-acre undeveloped parcel; 81 of these 124 total acres will be used as a landfill. The onsite process landfill will not be disturbed as per the deed restriction. Waste would be put on top of the onsite process landfill, with no excavation. Elsewhere on the property, three other lifts would be excavated for landfilling, and the landfill would accept all allowable Type III wastes. The plan specifies how the landfill will be operated and later closed upon completion of its disposal operations. A projected life span of 66 years was calculated for the landfill; therefore, it would close in 2070. Additional details on construction, operation, and environmental impact of the landfill are planned for discussion with TDEC if the landfill application is approved (EnSafe 2004).

Discussion

Introduction to Chemical Exposure

To determine whether persons are, have been, or are likely to be exposed to chemicals, Environmental Epidemiology of the Tennessee Department of Health evaluates mechanisms that could lead to human exposure. An exposure pathway contains five parts:

1. a source of contamination,
2. contaminant transport through an environmental medium,
3. a point of exposure,
4. a route of human exposure, and
5. a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements are, have been, or will be present at the site. The pathway is considered either a potential or an incomplete exposure pathway if there is no evidence that at least one of the five elements listed is, has been, or will be present at the site, or if there is a lower probability of exposure.

When a chemical is released from an area such as an industrial plant or from a container such as a drum, it enters the environment. A chemical release does not, however, always lead to human exposure. Persons can be exposed to a chemical when contact is made by breathing, eating, drinking, or otherwise touching the chemical.

Furthermore, physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect public health is also controlled by a number of other factors, including:

- the amount of the chemical that a person is exposed to (dose)
- the length of time that a person is exposed to the chemical (duration)
- the number of times a person is exposed to the chemical (frequency)
- the person's age and health status
- the person's diet and nutritional habits.

Environmental Sampling

Soil

The Chromium Mining and Smelting Corporation property has had environmental samples collected and analyzed in the preparation of several reports. Table 1 below shows the range of chromium, arsenic, and manganese measured in on-site soil. See Figure 3 for a map of the Chromasco site.

Table 1: Concentration ranges of metals (ppm or mg/kg) measured in soils and sediments post-excavation remedial action, Chromium Mining and Smelting Corporation (Chromasco) site (WRS 2001 and EnSafe 2003).

Location	*Chromium(VI) (Cr^{6+})*	*Chromium (total) (Cr)*	*Arsenic (As)*	*Manganese (Mn)*
WRS 2001	<0.19 – 0.84	280 – 3,900	3.0 – 29.0	270 – 74,000
EnSafe 2003	<1.0 – 221.88	8.28 – 3,697.16		
ATSDR RMEG[1]	200 child 2,000 adult	-	20 child 200 adult	3,000 child 40,000 adult
EPA Region 9 industrial soil PRG[2]	64	450	1.6	19,000

[1] = ATSDR soil Reference Dose Media Evaluation Guide
[2] = EPA Region 9 industrial soil Preliminary Remediation Goal

For many chemicals, EPA Region 9 has established preliminary remedial goals (PRGs), which are tools for evaluating and cleaning up contaminated sites (EPA9 2002). PRGs are risk-based calculations designed as screening levels and are one method often used to set worker health protective criteria when job site and land use alterations are being considered. Table 1 shows EPA Region 9 industrial soil PRGs. Furthermore, ATSDR has established reference dose media evaluation guides (RMEGs), that can also be used as a screening tool. Table 1 shows the ATSDR RMEG values (ATSDR 2004). For each of the chemicals analyzed, hexavalent chromium(VI), total chromium, arsenic, and/or manganese, the ATSDR RMEG or EPA Region 9 PRG was exceeded.

The Chromasco site is not suitable for residential reuse, and should only be considered for industrial reuse. The property appears suitable for consideration as a brownfields site. An operational health and safety plan to protect future site workers is appropriate. The potential for exposure to heavy metals will increase if frequent excavation is part of a land reuse proposal.

Most often when people are exposed to chemicals in soils, it occurs from exposure to surface soil. Surface soils can easily contact the skin, become breathable dust, or become incidentally ingested during hand-to-mouth activities. The EnSafe (2003) data was examined to investigate the potential for heavy metals in surface soil to cause adverse health effects. Table 2 lists chromium concentrations in surface soils. Seven of the eight surface soil samples (88%) collected by EnSafe measured total chromium concentrations above the 450 parts per million (ppm) or milligrams per kilogram (mg/kg) Region 9 PRG. The hexavalent chromium(VI) levels in surface soil were all below the Region 9 PRG and the ATSDR RMEG. Note an additional PRG value of 38.00 mg/kg is presented in Table 2. This guide is based on the leaching potential of chromium from soil into groundwater which matches with the Toxicity Characteristic Leaching Potential (TCLP) that defines whether a waste is classified as hazardous waste or special waste. Based on the EnSafe 2003 data, chromium in soils classifies as special waste.

The landfill proposal includes a health and safety plan for site workers. The proposal states that the greatest risk is posed by hexavalent chromium(VI). Unfortunately, the data set provided in the plan does not list other chemicals of concern. Therefore, we consider it is prudent to refer back to the Final Remediation Summary (WRS 2001), and we expect that the landfill health and safety plan should consider all chemicals of concern known to exist at Chromasco. In regards to other possible land use alterations, we suggest that any new industries planning to locate on the site consider all known and suspected metal contaminants in the soil when preparing their site worker safety plans. Furthermore, in cases in which there will be general public access to the new industry, non-site worker health and safety should be protected.

Table 2. Chromium measurements of composite soil samples near the surface (EnSafe 2003). (Figure 4 shows the geographic distribution of the boring locations.)

Boring Location	Sample ID	Depth Interval (ft bgs)	Sample Date	Analytical Results		
				TCLP Cr (mg/L)	Total Cr (mg/kg)	Cr^{6+} (mg/kg)
B-112	JCLSB11202	0-2	4/08/03	0.517	693.622	6.610
B-127	JCLSB12702	0-2	4/08/03	BQL	3,316.946	14.030
B-103	JCLSB10302	2	3/27/03	0.316	1,464.586	18.820
B-152	JCLSB15202	1-2	3/27/03	BQL	611.168	38.590
B-132	JCLSB13202	0-2	4/01/03	0.598	1,101.136	14.130
B-101	JCLSB10101	0-1	4/02/03	0.159	1,325.735	12.840
B-136	JCLSB13603	1-3	4/03/03	BQL	32.603	<1.0
B-151	JCLSB15102	1-2.5	4/04/03	BQL	3,697.165	2.920

Notes:
ATSDR soil RMEG = 200 mg/kg children and 2,000 mg/kg adult
EPA Region 9 Soil Screening Level for chromium (total) = 450 mg/kg
EPA Region 9 Soil Screening Level for chromium (VI) = 64 mg/kg
EPA Region 9 Soil Screening Level for chromium (total & VI) leaching potential = 38.00 mg/kg
TCLP = Toxicity Characteristic Leaching Potential;
>5 milligrams per liter (mg/L) defines hazardous waste;
therefore, the Cr is classified as "special waste"
ft bgs = Measurement in Feet Below Ground Surface
BQL = Below Quantitation Level

The EnSafe (2003) data for soil at a depth of six feet or more were examined to investigate the potential for deeper soils and buried process materials to cause adverse human health effects. Table 3 lists the chromium concentrations in composite soil samples from a depth of 6 feet or greater. In two of the five samples (40%), the concentration of total chromium exceeded the ATSDR RMEG and EPA Region 9 soil PRG. No soil samples from depths below 6 feet exceeded the hexavalent chromium(VI) soil PRG or the leaching potential PRG.

The Class III landfill plan calls for utilizing on-site soil for the bi-weekly covering of new landfill materials. A telephone conversation with EnSafe clarified that to reduce the potential for fugitive dust, the landfill would not reuse surface soils that have higher concentrations of heavy metals as the final cover. The landfill will, however, use this on-site soil as a bi-weekly cover material until a lift is filled. EnSafe and the potential landfill owner considered the soil below the buried process materials, which is below a depth or approximately 5 feet, to still be native, uncontaminated soil. They rationalized that the soil would be suitable for use as cover material. On the basis of the data shown in Table 3, chromium contamination exists at depths below six feet and would likely be unearthed during this type of action.

Incorporating the metal-contaminated soils into a Class III/IV landfill is not appropriate. Although the TCLP sample measurements do not define site soils as hazardous wastes, the soils are special waste. Therefore, if Chromasco site alterations include excavation of contaminated soils, these soils should only be disposed of in a proper and legal manner.

Table 3. Chromium measurements of composite soil samples 6 feet depth below ground surface or greater (EnSafe 2003) at the Chromasco site. (Figure 4 shows the geographic distribution of the boring locations.)

Boring Location	Sample ID	Depth Interval (ft bgs)	Sample Date	Analytical Results		
				TCLP Cr (mg/L)	Total Cr (mg/kg)	Cr^{6+} (mg/kg)
B-117	JCLSB11708	6-8	3/26/03	BQL	12.784	<1.0
B-147	JCLSB14707	6-7	3/26/03	BQL	2,153.057	23.190
B-122	JCLSB12208	6-8	3/31/03	BQL	16.261	<1.0
B-146	JCLSB14608	6-8	4/07/03	0.122	159.293	2.330
B-124	JCLSB12407	6-7	3/31/03	0.111	610.459	1.660

Notes:
ATSDR soil RMEG = 200 mg/kg children and 2,000 mg/kg adult
EPA Region 9 Soil Screening Level for chromium (total) = 450 mg/kg
EPA Region 9 Soil Screening Level for chromium (VI) = 64 mg/kg
EPA Region 9 Soil Screening Level for chromium (total & VI) leaching potential = 38.00 mg/kg
TCLP = Toxicity Characteristic Leaching Potential;
>5 mg/L defines hazardous waste; therefore, the Cr is "special waste"
ft bgs = Measurement in Feet Below Ground Surface
BQL = Below Quantitation Level

Groundwater

Groundwater monitoring data show that arsenic, total chromium, and lead are present in shallow groundwater at levels above the drinking water maximum contaminant levels (MCL). Analytical results of four monitoring wells at depths 20 feet or shallower are presented in Table 4 (EnSafe 2003). If groundwater were to be directly consumed as drinking water, then arsenic, total chromium, and lead would be contaminants of concern. According to a well survey performed by the Memphis-Shelby County Health Department (2004), no one within a 1-mile radius should be pumping groundwater for drinking water. The contaminated shallow groundwater, however, is not likely to be the aquifer that drinking water would be drawn from. Deeper groundwater is available for drinking water wells. Even so, no local groundwater wells are used for human consumption. All known local wells are all annually sampled and permitted for industrial use only. It is unknown whether the shallow aquifer is connected to deeper groundwater that supplies drinking water for other areas. Whether the groundwater re-emerges in wet weather conveyances, streams, or surface waters off-site is also unknown. If the shallow groundwater re-emerges off-site, direct measurement will be necessary to determine whether the heavy metals are problematic.

Table 4. Measurements of heavy metals in shallow groundwater from four sampling locations at Chromasco, Memphis, Shelby County, TN, collected on Sept. 6, 2002. Wells were in the upper 20 feet of ground. All values are listed in µg/L or ppb (EnSafe 2003). (Figure 4 shows the geographic distribution of the monitoring wells.)

Parameter	Sample ID				drinking water MCL	EPA R9 PRG tap water
	SB0101	SB0301	SB0701	SB0801		
Arsenic, total	**18**	10.6	5.42	**16.7**	*10*	*0.045*
Barium, total	286	234	210	328	*2,000*	*2,600*
Cadmium, total	ND	ND	ND	ND	*5*	*18*
Chromium, total	**144**	62.5	**7,580**	**123**	*100*	*NA*
Chromium, 6+	ND	ND	**7,610**	ND	*NA*	*110*
Lead, total	**23.5**	**14.7**	ND	**27.4**	*15*[1]	*NA*
Mercury, total	ND	ND	ND	ND	*2*	*4*
Selenium, total	3.58 J	2.45 J	ND	5.22	*50*	*180*
Silver, total	ND	ND	ND	ND	*NA*	*180*

Notes: ND = Not detected; J = estimated value

*[1] = 15 µg/L is the action level for lead; **bold** = exceeds screening level*

The plan to construct and operate a Class III landfill at the former Chromasco Superfund site acknowledges that chromium pollution exists in the groundwater and needs to be mitigated. The plan includes the use of an ion exchange system to remove the contamination. The plan also includes five monitoring wells in deeper groundwater to ensure that inorganic constituents are not leaching off-site. These monitoring wells will be used to identify the extent of the contaminant plume and determine if is moving underground beyond the boundaries of the Chromasco property. Given the levels of heavy metals in the on-site soils, we are uncertain whether or not the proposed mitigation system can effectively remediate the heavy metals problem that has been documented at the site. The likelihood that the shallow aquifer can be pumped dry is questionable. Deeper groundwater may spring up when the pressure from the shallow aquifer is reduced.

Because three of the planned landfill cells, or lifts, will be excavated to below grade, the shallow water table may be reached. If waste materials are buried in groundwater, there could be side effects, such as migration, especially within an unlined landfill. If the heavy metals are mixed with wastes, such as farming wastes rich in organics, in groudwater, then physical and chemical changes are possible. Chromasco soils have large amounts of trivalent chromium(III). If the pH and redox potential changes because of conditions within the landfill, then the formation of hexavalent chromium(VI) is possible. The conditions necessary for this formation to happen include the presence of oxygen, manganese dioxide, and low oxidizable organic substances, (ATSDR 2000). To supplement to the original plan, the landfill applicant considered a leachability study that uses treatment with biological or chemical methods to reduce the soluable chromium(VI) to insoluble chromium(III) (EnSafe 2004), thus reducing the potential risk of chromium(VI) migration.

Additional needs as mentioned in Dr. Chen's memo (SWM 2004), for remediation of water may arise from waste water created after soils are sprayed to minimize dust. Whether this spraying to minimize dust will be a significant new waste stream is difficult to surmise. However, this possibility should be accounted for when considering any land use alteration at Chromasco.

The landfill plan suggests that placing landfill materials on top of the existing metal processing wastes will reduce the opportunity for leaching because of the increased cover. Additionally, the construction of berms, use of sloped landfill sides, and placement of erosion controls are planned to minimize rainwater intrusion into the existing process landfill. These engineering methods may be feasible ways to minimize the potential for the heavy metals to migrate off-site.

Another engineering technology that can reduce the opportunity for leaching is a landfill liner and leachate collection system. Although this technology would require excavation, the placing of a liner under each cell would effectively remove future groundwater problems if the Chromasco site were to be converted to a Class III/IV landfill.

The groundwater monitoring program proposed in the landfill plan uses five perimeter monitoring wells on the property, three down gradient and two up gradient. To ensure that leachate is not entering the groundwater and migrating off-site, the plan proposes to meet criteria based on MCLs for drinking water inorganic constituents. Where there is no MCL, background levels are proposed as the guidance value. The background levels are to be created from the first year's monitoring data. It may be possible to establish a background/guidance level that is elevated from past events which fails to be protective. Therefore, it is not appropriate to collect such background data on the site itself, since the on-site groundwater is within a zone of influence from the heavy metals contamination.

Rainwater can percolate through soils and enter groundwater. Land alterations or reuse scenarios should consider stormwater discharge issues. This forethought can minimize the potential leaching of metals from contaminated soils.

Air / Dust

Concerns about fugitive dust that would be released during excavation or from large-wheeled machinery operating on the property were mentioned by all stakeholders considering reuse options for Chromasco. The use of large-wheeled machinery inherent in construction and operation of a landfill is greater, in both extent and duration, than is that of non-excavating industrial uses. The landfill plan includes on-site air monitoring during construction (EnSafe 2003). The landfill applicant agreed to conduct off-site air monitoring for hexavalent chromium(VI) and lead before and during construction (EnSafe 2004). TDEC SWM anticipated air monitoring for arsenic, chromium, hexavalent chromium, and manganese. Of these heavy metals, chromium has the most severe health effects because breathing hexavalent chromium(VI) over a long period is thought to increase the risk of some types of cancer.

The US EPA *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (2001) was used to determine if chromium in fugitive dust was a health problem. For most metals listed in the guidance, generic soil screening levels were derived from incidental ingestion pathways because those are the pathways of exposure with the most risk. Chromium is unique in that the inhalation pathway presents the greatest risk. Total chromium is often reported as a summation of the amount of trivalent chromium(III) and hexavalent chromium(VI). Hexavalent chromium(VI) is the most toxic form of chromium and is associated through the inhalation pathway with an increased risk of lung cancer in workers through the inhalation pathway (ATSDR 2000). There is a tendency is look closely at the hexavalent concentrations and overlook the trivalent concentrations. Typically, the total chromium mixture favors the less reactive trivalent chromium(III) in a 6:1 ratio to hexavalent chromium(VI). The EPA guidance assumes this 6:1 ratio in describing the risk from chromium in soil. A soil screening level of 510 mg/kg (ppm) for total chromium and hexavalent chromium (VI) was calculated for the commercial/industrial fugitive dust scenario, outdoor worker receptor; the health guideline was based on the inhalation risk posed by hexavalent chromium(VI).

The concentration of total chromium in soils at many sample locations at Chromasco is above 510 mg/kg and may pose a fugitive dust inhalation risk to outdoor workers on-site. This increased risk would only be for workers exposed on a daily basis over a period of many years. Acute exposure to fugitive dust should not result in adverse health effects.

Lead

Because lead was mentioned in Dr. Chen's memorandum and in the request for air sampling by the Memphis-Shelby County Health Department, EEP considered lead data in this consultation. Lead concentrations were investigated during the preparation of the Preliminary Remediation Goals Report in 1999 (ATC). Table 5 below lists the maximum concentration of lead prior to remedial action as detailed in the report.

Table 5: Maximum concentration of lead prior to remedial action, Chromium Mining and Smelting Corporation (Chromasco) site (ATC 1999).

Soil	Sediment	Surface Water	Shallow Ground Water
536 mg/kg	106 mg/kg	260 µg/L [1]	31 µg/L

Note: [1] lead was detected in only 1 of 11 samples

Lead in soil and sediment is below the EPA Region 9 PRG for lead (750 ppm or mg/kg) for industrial exposures (2002). The shallow groundwater at the Chromasco site is not a source of drinking water. At this time, lead is not a chemical of concern. If site reuse dictates, then lead presence should be considered in a groundwater monitoring program for inorganic constituents.

Toxicology

Chemicals with concentrations that exceed a health screening guide are often referred to as chemicals of concern. At the Chromasco site, concentrations of arsenic, total chromium, hexavalent chromium(VI), and manganese exceeded at least one screening value. Of these chemicals of concern, evidence indicates that exposure to hexavalent chromium(VI) and arsenic increases the risk of developing certain cancers.

Arsenic

A naturally occurring element, arsenic is widely distributed in the Earth's crust. Elemental arsenic sometimes occurs naturally. More often, arsenic is found with other elements forming inorganic compounds. Arsenic can change chemical form, but is never destroyed. Inorganic arsenic occurs naturally in minerals and ores of copper and lead. Most of these arsenic compounds are white or colorless powders. Most are reported to have no smell or taste. Thus, people likely cannot tell if there is arsenic in the air (or dust) they are breathing. Breathing high levels of inorganic arsenic may cause a sore throat and irritated lungs (ATSDR 2000).

Until recently, most of the arsenic used in the United States was to make lumber resistant to rotting and decay (i.e. "pressure-treated" wood). Some arsenic is used in agriculture as a pesticide and some as an alloy in making automobile batteries.

Sufficient evidence exists from studying human populations to label arsenic through the inhalation pathway a carcinogen. People who breathed high levels of arsenic were, over time, more likely to develop lung cancer.

Chromium

A naturally occurring element, chromium is found in rocks, animals, plants, soil, and volcanic dust and gases. Chromium can be found in different forms in the environment. The three most common forms of chromium are elemental chromium(0), trivalent chromium(III), and hexavalent chromium(VI). The metal chromium(0) does not occur naturally and is therefore uncommon. Chromium(III) is an essential nutrient that helps the human body use sugar, protein, and fat. Hexavalent chromium(VI) is produced by industrial processes (ATSDR 2000).

Chromium compounds have no known odor or taste. Elemental chromium(0) is a grey solid metal with a high melting point. It is used in making steel and other metal alloys. The naturally occurring mineral chromite in the chromium(III) form is used as lining in high-temperature industrial furnaces, in other chemical compounds, and in metal alloys. Chromium(III) and chromium(VI) are used to make chrome metal plating. In addition, chromium(III) and chromium(VI) are used in the manufacture of dyes and pigments, in the tanning of leather, and in the use of wood preserving products (ATSDR 2000).

Inhalation of chromium(0) and trivalent chromium(III) are not currently believed to cause a serious health risk to humans. Inhalation of hexavalent chromium(VI), however, is known to be carcinogenic to humans. A link between chromium(VI) and lung cancer has been consistently demonstrated in scientific studies (ATSDR 2000).

Manganese

A naturally occurring substance found in many types of rock, manganese most often is found as part of inorganic compounds. Rocks with high levels of manganese compounds are mined and used to produce manganese metal, which can then be mixed with iron to make certain types of steel. Some manganese compounds are used in batteries, ceramics, pesticides, and fertilizers. The form of manganese can be changed, but it never breaks down (ATSDR 2000).

Manganese is an essential trace element and is necessary for good health, but too much manganese may cause serious illness. Inhaling high levels of manganese over many years can lead to an illness called, manganism. Symptoms include weakness, stiff muscles, and trembling hands. There is no supporting information that manganese, through any exposure pathway, increases the risk of cancer.

Additional Comments

Reuse plans for the Chromasco site should be carefully considered before land alterations are made. The old process landfill has an institutional control in the form of a deed restriction that allows no subsurface activity. Maintaining this restriction is still appropriate as the closed on-site landfill was recorded to have high concentrations of heavy metals.

A non-hazardous materials landfill is being proposed on a site where hazardous materials and special wastes have been documented in soils and groundwater. As a matter of prudent health policy, Environmental Epidemiology cannot encourage that any site closed because of environmental pollution be reopened without corrective action. Future exposures cannot be ruled out given the Class III/IV landfill plan.

With heavy metals above ATSDR RMEGs and EPA Region 9 PRGs present in soils, the future reuses of the Chromasco site should be limited to industrial activities. Because total chromium concentration in soils exceeds EPA Superfund guidance for outdoor workers from inhalation of fugitive particulates, site workers may require respiratory protection if subsurface excavation activities are planned. Reuse that does not require frequent excavation is preferable. Land use alterations that would encapsulate the heavy metals or cause minimal disturbance to the site are encouraged. Options such as concrete or asphalt paving, vegetative cover, no general public access, or in-situ remediation can create barriers between people and the remaining on-site heavy metals.

Child Health Considerations

TDH recognizes that in communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposures to hazardous substances. Children have lower body weights than do adults. Because children drink a larger volume of water per mass of body weight than do adults, a child’s lower body weight and higher intake rate results in a greater dose of heavy metals per unit of body weight. Additionally, if toxic exposure levels are high enough during critical growth stages, then the developing body systems of children can sustain permanent damage. Finally, we recognize that children are dependent on adults for access to housing and medical care and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children’s health.

No environmental public health hazards unique to children were discovered during this investigation. No health hazards were identified for children attending Lucy Elementary School or Woodstock Middle School. Any proposed reuse plan should be considerate of children and ensure their health and physical safety.

Conclusions

1. Several heavy metal contaminants – arsenic, chromium, manganese, and lead - have been identified as chemicals of concern at the Chromium Mining and Smelting Corporation (Chromasco) site in Memphis, Shelby County, Tennessee.

2. The concentrations of arsenic, hexavalent chromium(VI), and manganese in soils exceed ATSDR RMEGs. The concentrations of arsenic, total chromium, hexavalent chromium(VI), and manganese in soils exceed EPA Region 9 PRGs. Therefore, without extensive remediation, only industrial reuse of the Chromasco site is appropriate. Chromasco is a potential brownfields site.

3. If land use changes or if alterations at the Chromasco site frequently generate fugitive dust, then a future health hazard could exist for site workers chronically exposed to chromium inhaled in fugitive dust.

4. No apparent public health hazard exists for visitors, inspectors, or short-term site workers from limited-duration inhalation exposure to chromium in fugitive dust.

5. No apparent public health hazard exists from ingestion of groundwater as drinking water. Although groundwater samples are above the drinking water MCL for arsenic, total chromium, and lead no complete exposure pathway was observed.

6. Dilapidated buildings are a physical hazard.

Recommendations

1. Reuses of the Chromasco site in such ways that will not generate fugitive dust on a regular basis are encouraged. Any reuse that creates new barriers between people and potential exposure to the metals-contaminated soil is encouraged. Furthermore, any reuse that removes the heavy metals by in-situ remediation or by proper off-site disposal is strongly encouraged.

2. Reuse that includes subsurface activity should honor the request of the MSCHD and perform perimeter air sampling for chemicals of concern to ensure the health of the public.

3. Maintain the deed restriction that prevents subsurface activity near the old process landfill.

4. Special or hazardous wastes unearthed during a reuse scenario should be properly and legally disposed.

5. Reuse of the Chromasco site should include removal of the dilapidated buildings.

6. Reuse should consider routing storm water drainage to minimize the potential for leaching heavy metals into surface water or groundwater.

7. Reuse should include vegetative cover on all soil areas.

Public Health Action Plan

1. Environmental Epidemiology (EEP) will provide this public health document to the appropriate environmental regulatory agencies.

2. EEP will send the document to the Memphis-Shelby County Health Department to inform local health officials of the results of this investigation. In addition, copies of the document will be provided to stakeholders including the landfill permit applicant, nearby businesses, Shelby County Schools, environmental consultants, and interested citizens.

3. If additional assistance is required by any agency, EEP is available to provide follow up to this environmental public health investigation.

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Figure 1. Photo of one abandoned building at Chromasco site Date: April 16, 2004
Memphis, Shelby County, TN Photo Credit: David Borowski, TDH

Figure 2. Map of 3328 Fite Rd with 1 and 2 mile distances indicated Date: June 15, 2004
Memphis, Shelby County, TN Map Credits: www.mapquest.com

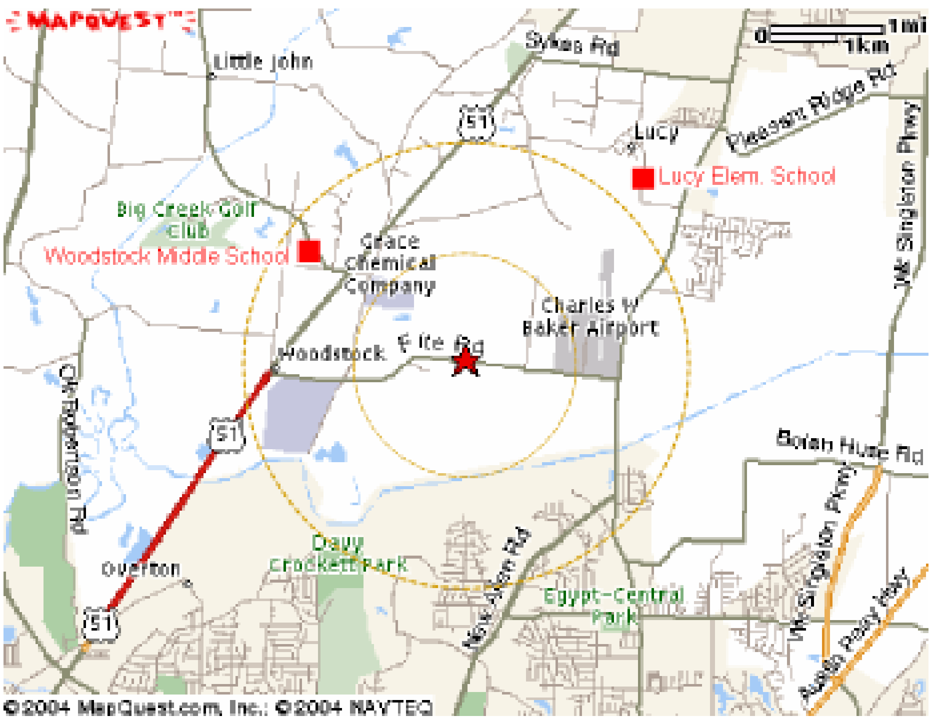


Figure 3. Chromasco site map
Memphis, Shelby County, TN

Date: 2001
Reference: WRS 2001

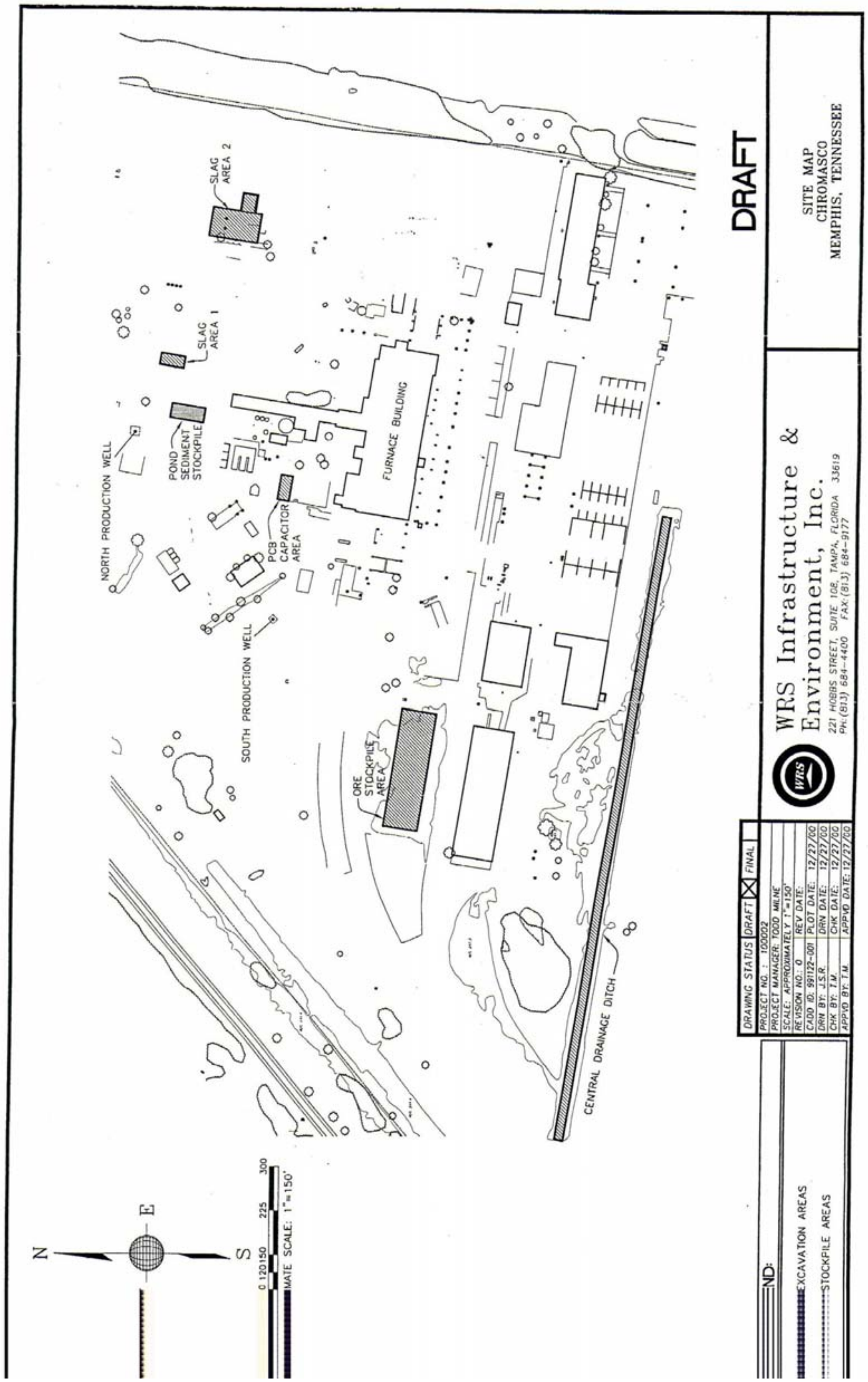
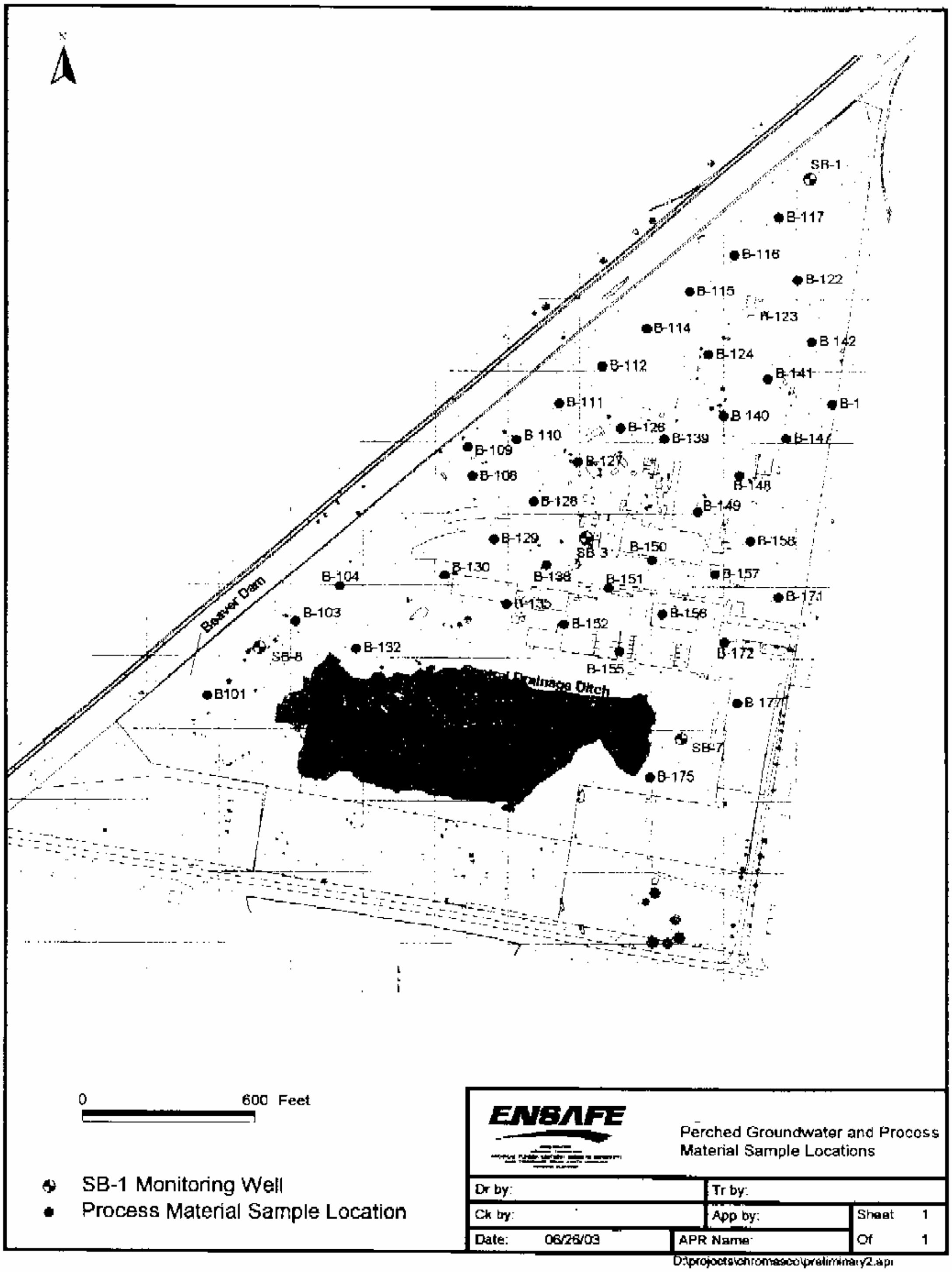


Figure 4. Map of environmental sampling sites at Chromasco Memphis, Shelby County, TN

Date: April 16, 2003
Reference: EnSafe 2003



Certification

This Health Consultation: Chromasco Reuse Considerations, Memphis, Shelby County, Tennessee, was prepared by Environmental Epidemiology of the Tennessee Department of Health under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun.

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

___________Roberta Erlwein_________________
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