HEALTH CONSULTATION

GLOBE BUILDING BROWNFIELD REDEVELOPMENT ASSESSMENT

CITY OF DETROIT , WAYNE COUNTY, MICHIGAN

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Prepared by

Michigan Department of Community Health
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry

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Abbreviations and Acronyms

ACM	Asbestos containing material
AST	Above ground storage tanks
ATSDR	Agency for Toxic Substances and Disease Registry
COPC	Chemicals of potential concern`
GSI	Groundwater/surface water interface protection criteria
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
NESHAP	National Emissions Standards for Hazardous Air Pollutants
PCBs	Polychlorinated biphenyls
ppb	parts per billion
ppm	parts per million
SVOC	Semivolatile organic compound
VOC	Volatile organic compound
UST	Underground storage tank

Foreword

The federal Agency for Toxic Substances and Disease Registry (ATSDR) and the Michigan Department of Community Health (MDCH) have a cooperative agreement for conducting assessments and consultations regarding potential health hazards at chemical contamination sites within the State of Michigan. The Michigan Department of Environmental Quality (MDEQ), Superfund Section, has asked MDCH to evaluate the health risks associated with several properties including Brownfield Projects throughout Michigan.

The U.S. Environmental Protection Agency defines Brownfields as "abandoned, idled, or under-used" industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. Local governmental entities have asked the MDEQ to conduct environmental assessments of the Brownfield properties in their jurisdiction. The MDEQ has consulted with the MDCH concerning public health aspects of these assessments.

The MDCH health consultation for a Brownfield property includes consideration of the following fundamental questions:

- Are there any imminent or urgent threats to public health associated with the property?
- Does the proposed future use of the property pose any long-term public health hazard?
- What specific actions, if any, are necessary to make the property safe for future use?
- Is there enough information available to answer these questions, and if not, what additional information is needed?

The conclusions and recommendations provided in an MDCH health consultation pertain only to human health hazards identified for the property under review given the intended future land use. An MDCH health consultation may not be used to demonstrate compliance with the requirements of the Michigan Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, or the administrative rules promulgated there under.

Summary

The Michigan Department of Environmental Quality (MDEQ) asked the Department of Community Health (MDCH) to conduct a health consultation for the Globe building property, Detroit, Michigan. The property is a former metal works, machine shop and industrial warehouse. The environmental contamination currently poses no apparent public health hazard, due to the short duration of potential exposures. For the future the property represents an indeterminate public health hazard primarily due to the need for more data on subsurface soils, data on surrounding properties contributing contamination to the Globe property, and information about how the property will be redeveloped. If the property is redeveloped using "due care", as described in MDEQ regulations (section 20107a of Part 201), and potential human exposures are addressed, then the property will not pose a public health hazard.

Purpose and Health Issues

The purpose of this public health consultation is to evaluate the health risks associated with the Globe Building Brownfield located at 1801 East Atwater Street, Detroit, Michigan, hereafter referred to as the Globe property (Figure 1). Current and future exposure scenarios were considered in this consultation. Due to lack of data, past exposures were not be evaluated. The future use of the property has not been determined, thus MDCH evaluated exposure scenarios that protect for all potential future uses including using the property for residential purposes. These scenarios included exposures to current trespassers, future employees during redevelopment and future users of the property. The questions listed in the Foreword section of this document will also be addressed. MDCH will communicate the findings of this health consultation to the Michigan Department of Environmental Quality (MDEQ), Wayne County Health Department and officials of the city of Detroit.

Background

The Globe property is a rectangular shaped property (55,602 square feet) with greater than 80 percent of the property covered by a three-story building (Binkley and Bartz 1999) (Figure 2). The property is currently not in use and considered abandoned. The Globe property is one of 107 parcels within a 67-acre area owned by the city of Detroit. Thus, several city blocks of similarly abandoned properties surround the Globe property. Residential property is not in the immediate vicinity. These parcels have been used for industrial, not residential purposes. In 1999, these 107 parcels were grouped together by Detroit and named the *Waterfront Reclamation and Casino Development Project* (WRCDP). The original plan to develop the land for a casino has been abandoned, however, the city is still planning to redevelop this property. The type of redevelopment had not been determined at the time of this report, however, the objective of the WRCDP was to bring more residents to this waterfront area.

Between 1884 and 1950, the Globe property was the location for various metal works and machine shops. The Globe property was used in combination with an adjoining property (1901 East Atwater Street) for these activities. In 1950, the Globe property had been used as a warehouse and continued to be used in this fashion through 1991. The property

has been abandoned since 1999. During the use of the Globe property, four 20,000-gallon underground storage tanks (UST) were installed. Three of those tanks were used for gasoline while a fourth was used to hold fuel oil. A record exists of two of those tanks being removed in 1990, however, no record of removal exists for the other two tanks. In addition, a 200-gallon above ground storage tank (AST) was located within the building. The adjoining property (1901 East Atwater Street), which was used in combination with the Globe property, was reported to have 10 USTs that range in volumes of 2,500 to 20,000 gallons and were used to hold petroleum products (MDEQ 1999). Three 300-gallon steel ASTs were also located on this property. During a previous environmental evaluation, chemical analyses of liquid from fill/vent pipes from both properties were shown to have a similar set of semi-volatile organic compounds (MDEQ 1999). No occurrence of leaks has been documented from these tanks.

On April 13, 2004, MDEQ staff conducted an initial property audit and reconnaissance of the Globe property. MDEQ identified various solid wastes such as tires and common household and office debris. Soils located around and throughout the building and wood floors in the building were stained, likely with petroleum type products (MDEQ 2004).

On April 27, 2004, two staff persons from MDCH accompanied MDEQ staff to the site to conduct environmental sampling. Soil samples were collected from the property and analyzed for a set of chemicals listed in MDEQ Generic Cleanup Criteria (MDEQ 2003). During that visit, MDCH staff observed signs (i.e., bed and household type materials) that a person(s) had been inhabiting the property. It was not possible to determine if the occupation was recent, nor was it possible to obtain a description of the person(s).

Discussion

Environmental Contamination

Chemical Contamination

The soil sampling results discussed in this consultation were taken from the available investigations of the property, and are not adjusted for limitations or bias in the sampling program. Brownfield sampling is conducted in a manner that seeks to test matrices (soil, groundwater, debris, etc.) that are likely to have contamination based on appearance and location of the sample. This type of sampling design is useful in identifying chemicals of potential concern (COPC), but does not sufficiently determine the spatial extent of contamination.

Soil sample locations were primarily along the north western and north eastern property boundaries (Figure 2). MDEQ collected seven surficial (0-12 inches) and eight boring (0-8 feet or 0-12 feet) soil samples from the Globe property around the outside of the building (Figure 2). For the boring samples, MDEQ staff selected a 12 to 18 inch section of the soil core that was likely to contain contamination. Samples were analyzed by the State of Michigan's analytical laboratory. Appropriate quality control procedures were conducted with the collection and analysis of the samples. The samples were analyzed for a total of 188 chemicals that included volatile organic compounds (VOCs), semivolatile

organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and a set of elements including heavy metals.

MDEQ attempted to collect groundwater samples from the property, however, the amount of water encountered was insufficient for chemical analyses. Groundwater exposure pathways will not be evaluated in this consultation.

The number of soil samples was sufficient to identify COPC, however, not sufficient to make comparisons between sampling locations. The surficial soil results will be used to evaluate exposure pathways associated with the top 12 inches of soil. The top 12 inches of soil are not ideal for estimating potential exposure to surficial soils, because people are more likely to be exposed only to the top couple of inches of soil. Thus, the 0-12 inch soil samples may under or over estimate the chemical concentration depending on the vertical location of the contamination. The soil boring results will be used to evaluate exposure pathways associated with soils below the top 12 inches.

MDCH compared results from soil analyses to values that are protective of human health in residential situations for acute (1 to 14 days), intermediate (15 to 364 days) and chronic (365 days and longer) exposures. MDCH chose the residential evaluation scenario because residential comparison values are the most protective of human health. Furthermore, the future use of the Globe property has not been determined, and complying with a residential evaluation would make the property, from a human health perspective, available for any type of development.

Whereas, soils with chemical concentrations below comparison values can be assumed to pose minimal risk to an exposed person, it is not appropriate to assume that soil samples exceeding these comparison values would automatically cause adverse health effects. Comparison values represent concentrations that are far below levels that are likely to result in adverse health effects. When chemicals are found to exceed comparison values, further evaluations of the data are necessary.

MDCH used the following screening process of the soil chemical analyses to select chemicals for further evaluation (Appendix A, Tables A1 and A2) in this consultation:

1. MDCH compared the maximum soil concentrations to the human health based MDEQ Generic Soil Cleanup Criteria (i.e., comparison values) for residential, commercial, and industrial land uses (MDEQ 2003). For each category of land use (residential, commercial, industrial), MDEQ has derived soil comparison values that protect against different types of exposure pathway. The exposure pathways applicable to this consultation were defined as follows:

   Group A. Direct Contact Comparison Values: Soil concentrations that are protective against adverse health effects following long-term ingestion of contaminated soils, inhalation of contaminated particles, and dermal exposure to contaminated soils.

   Group B. Ambient Indoor and Outdoor Air Protection Comparison Values: Soil concentrations which are not expected to yield ambient air

concentrations that would cause adverse human health effects through inhalation of chemical vapors from either outdoor or indoor environments.

2. In addition to MDEQ comparison values, MDCH compared the maximum soil concentration of each chemical detected to existing ATSDR acute, intermediate, and chronic environmental soil concentration guidelines for both cancer and non-cancer endpoints (ATSDR 2004). The "Group A" exposure pathway, defined above, applies to the ATSDR soil comparison values.

The COPC that exceeded comparison values and are further evaluated in this consultation are presented in Table 1 and 2 and Appendix Table A3. The degree to which chemicals in Table 1 and 2 exceeded comparison values was evaluated by dividing the maximum soil concentration of each chemical by its lowest (most restrictive) comparison value within each exposure pathway (Appendix Table A4).

Table 1. COPCs found in surficial soil samples (0 to 12 inches).

Chemical Name	State BL[a] ppm	Measured Range ppm	N[b]	No. of Detects[c]	No. Above Lowest CV[d]
Benzo[a]pyrene	NA	ND - 15	7	4	4
Dibenz[a,h]anthracene	NA	ND - 2.7	7	2	1
PCBs - Aroclor1260	NA	0.11 - 16	7	7	6
Aluminum	6,900	3,500 - 6,500	7	7	4
Arsenic	5.8	4.6 - 12	7	7	7
Cadmium	1.2	ND - 29	7	4	1
Chromium	18	16 - 330	7	7	2
Cobalt	6.8	5.3 - 150	7	7	1
Copper	32	51 - 690	7	7	6
Cyanide	0.39	ND - 1.3	7	6	1
Iron	12,000	8,200 -190,000	7	7	1
Lead	21	33 - 610	7	7	2
Vanadium	NA	15 - 32	7	7	7

[a] BL: State of Michigan background soil estimate.
[b] N: number of chemical analyses conducted for the chemical.
[c] No. of detects: number of the analyses in which the chemical was detected.
[d] No. above lowest CV: Number of analyses that exceed the lowest comparison value for the chemical.
NA: not available.
ND: non-detection, which means that the analysis was below the detection level of the chemistry equipment.

Table 2. COPCs found in soil boring samples (0 to 12 feet).

Chemical Name	State BL[a] ppm	Measured Range ppm	N[b]	No. of Detects[c]	No. Above Lowest CV[d]
Acenaphthene	NA	ND - 1,200	9	5	1
Benz[a]anthracene	NA	ND - 430	9	6	2
Benzene	NA	ND -16	8	1	1
Benzo[a]pyrene	NA	ND - 220	9	5	5
Benzo[b]fluoranthene	NA	ND - 300	9	6	2
Carbazole	NA	ND - 890	9	3	1
Fluorene	NA	ND - 1,600	9	5	1
Fluoroanthene	NA	ND - 1,900	9	6	1
Indeno(1,2,3-c,d)pyrene	NA	ND - 77	9	3	1
2-Methylnaphthalene	NA	ND - 1,400	17	3	3
Naphthalene	NA	ND - 5,100	17	5	3
Phenanthrene	NA	ND - 4,000	9	6	3
Toluene	NA	ND - 53	8	1	1
Vinylchloride	NA	ND - 1.0	8	2	1
Aluminum	6,900	2,000 - 10,000	8	8	7
Arsenic	5.8	3 - 9	8	8	8
Copper	32	10 - 100	8	8	1
Cyanide	0.39	ND - 1.4	8	2	1
Vanadium	NA	5.7 - 24	8	8	7

[a] BL: State of Michigan background soil estimate.

[b] N: number of chemical analyses conducted for the chemical.

[c] No. of detects: number of the analyses in which the chemical was detected.

[d] No. above lowest CV: Number of analyses that exceed the lowest comparison value for the chemical.

NA: not available.

ND: non-detection, which means that the analysis was below the detection level of the chemistry equipment.

Physical Contamination

Asbestos testing was conducted on materials found within the building (Table 3). National Emissions Standards for Hazardous Air Pollutants (NESHAP) guidelines will be required by MDEQ during reconstruction or demolition of the Globe building (MDEQ 2004). Asbestos is to be properly remediated, thus limiting the potential for excess human exposures.

Table 3 Asbestos results for the Globe building.

No.	Type of Material	Location	Amount	Result
1	Pipe wrap	NE Wall in building	~150 linear ft	15% Amosite
2	Ceiling Tile	NE bay in building	~12,000 sq. ft	< 1%
3	Floor Tile	NE bay in building	~7,600 sq. ft	2% Chrysotile
4	Pipe Wrap	SW bay in building	~50 linear ft	15% Amosite
5	Air Cell Wrap	On boiler in NE bay	~100 sq. ft	25% Chrysotile

During property reconnaissance and environmental sampling, MDEQ and MDCH documented that the building was open with broken windows and various debris scattered throughout the building.

Human Exposure Pathways

MDCH evaluated past, present, and future human exposure pathways. An exposure pathway contains five elements: (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 property. More simply stated, an exposure pathway is considered complete when it is highly likely people are being exposed to the COPC. It is considered a *potential* exposure pathway if at least one of the elements is missing but could be found present at some point. An *incomplete* pathway exists if at least one element is missing and will never be present.

Plausible exposure pathways to COPC for this property involve incidental soil ingestion and inhalation, dermal contact with contaminated soil, and inhalation of chemical vapors (Table 4). MDCH believes that present exposure pathways are limited to individuals who temporarily visit the property, but are not likely to spend substantial amounts of time on the property. MDCH therefore concludes that the duration of exposure (i.e., the amount of time an individual may be exposed) is the limiting factor making the present potential for chronic or intermediate exposures low.

Exposure from local drinking water will not likely occur at this property. Regional groundwater will not be directly consumed by the public. The Globe property and surrounding properties would use Detroit's public water system. Offsite movement of quantities of chemicals from the Globe property into surface water that might result in excessive contamination of the public water supply (i.e., Detroit River) is also unlikely, given that MDEQ was unable to find sufficient amounts of shallow groundwater for sampling.

Table 4 Exposure pathways for the Globe property.

Source	Chemical Transport	COPCs	Exposure Point	Exposure Route	Potentially Exposed Population	Time	Status
Former Industrial Activities at the Globe Property	Surficial Soils (Top 12 in)	Table 2	Incidental contact with soils during outdoor activities	Group A: Dermal and Incidental Ingestion	Squatters and trespassers, construction and utility workers, employees and customers, gardeners	Past	Potential
						Present	Potential
						Future	Potential
Former Industrial Activities at the Globe Property	Soil Borings (0 to 12 ft)	Table 2	Incidental contact with soils during outdoor activities	Group A: Dermal and Incidental Ingestion	Construction and utility workers	Past	Potential
						Present	Potential
						Future	Potential
Former Industrial Activities at the Globe Property	Surficial Soils (Top 12 in)	Table 2	Outdoor air	Group B: Inhalation of volatile chemicals	Squatters and trespassers, construction and utility workers, employees and customers, gardeners, neighbors	Past	Incomplete
						Present	Incomplete
						Future	Incomplete
Former Industrial Activities at the Globe Property	Soil Borings (0 to 12 ft)	Table 2	Outdoor air	Group B: Inhalation of volatile chemicals	Squatters and trespassers, construction and utility workers, employees and customers, gardeners, neighbors	Past	Potential
						Present	Potential
						Future	Potential
Former Industrial Activities at the Globe Property	Soil Borings (0 to 12 ft)	Table 2	Indoor air in any building built below the surface (basements)	Group B: Inhalation of volatile chemicals	Future employees and customers that would frequent basement area on the property	Past	Incomplete
						Present	Incomplete
						Future	Potential
						Present	Potential
						Future	Potential

Toxicological Evaluation

Organic Chemicals

Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
BTEX measurements did not exceed comparison values in the surficial sediments suggesting that gasoline contamination was not significant issue at the surface. BTEX was detected in soil boring sample SB2, benzene and toluene exceeded residential comparison values in that sample. Benzene exceeded the ATSDR cancer comparison value by 5,300 times. Benzene also exceeded the MDEQ comparison value protecting against vapor intrusion by 10 fold. Benzene further exceeded MDEQ commercial and industrial comparison values for vapor intrusion into indoor air. The toluene detection in soil boring SB2 exceeded, by 1.3 times, the ATSDR comparison value protecting children that exhibit hand to mouth behavior (i.e., pica behavior) on a regular basis for more than 14 days. This was the only detection of toluene in the soil boring samples. The data were insufficient to determine if these chemicals are widely dispersed in the soils deeper than 12 inches. MDCH considers BTEX as COPCs at this property.

Exposure to the BTEX chemicals can produce neurological impairments, and exposures to benzene can additionally cause blood related diseases (ATSDR 2001a). EPA has classified benzene as a "known" human carcinogen under the 1986 Risk Assessment Guidelines (IRIS 2001). Ethylbenzene is possibly carcinogenic to humans based on a recent assessment by IARC (2000). Toluene and xylenes have not been classifiable as to human carcinogens.

Polycyclic Aromatic Hydrocarbons (PAHs)
Numerous PAHs at elevated concentrations were detected at the Globe property, primarily in the non-surficial soils. The PAHs found to exceed comparison values at this site were acenaphthene, benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, carbazole, dibenz[a,h]anthracene, fluorene, fluoroanthene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene.

Four surficial benzo[a]pyrene measurements exceeded the ATSDR cancer based comparison value by 14 to 150 times at sample locations SS1, SS3, SS5, and SS6. Benzo[a]pyrene further exceeded MDEQ commercial and industrial comparison values for direct contact to soils. There is credible evidence to suggest that benzo[a]pyrene is a widely dispersed contaminant in the surficial soils of this property.

In soil boring samples, maximum concentrations of acenaphthene, benz[a]anthracene, benzo[b]fluoranthene, carbazole, fluorene, fluoroanthene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene exceeded various group "A" related comparison values by 1.2 to 22 times. The concentrations that exceeded comparison values were at locations SB1A and SB2. Benzo[a]pyrene measurements exceeded ATSDR cancer comparison values (Group "A") in five locations (SB1A, SB1, SB4, SB5, SB7) by 4.2 to 2,200 times. Benzo[a]pyrene further exceeded MDEQ commercial and industrial comparison values for direct contact to soils. Group "B" (vapor inhalation)

comparison values were exceeded by naphthalene and phenanthrene in soil boring samples SB1A and SB2. The data were insufficient to determine if these chemicals are widely dispersed in the soils deeper than 12 inches. MDCH considers PAHs as COPCs at this property.

PAHs can be found in petroleum products such as crude oil, coal, coal tar pitch, creosote, and roofing tar. PAHs are a group of chemicals that can be formed during the incomplete burning of coal, oil, gas, and wood. There are more than 100 different PAHs and they typically occur as complex mixtures in the environment. Several of the PAHs, including benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, have caused tumors in laboratory animals when exposed through inhalation, consumption, or skin contact (ATSDR 1995). Studies of people have shown that inhalation and skin contact for long periods to mixtures of PAHs can result in cancer (ATSDR 1995). Skin contact with PAHs may also cause irritation and sensitization to sunlight (ATSDR 1995).

Polychlorinated Biphenyls (PCBs)
PCBs (Aroclor 1260) were detected in all seven surficial soil samples, but none of the soil boring samples. Six of the seven surficial soil samples exceeded ATSDR's cancer comparison value. PCB measurements exceeded the comparison value by 1.4 to 40 times. PCBs further exceeded MDEQ commercial and industrial comparison values for direct contact to soils. There is credible evidence to suggest that PCBs are a widely dispersed contaminant in the surficial soils of this property. MDCH considers PCBs as COPC at this property.

Health effects that have been associated with exposure to PCBs in humans and/or animals include liver, thyroid, dermal, ocular, immunological, and neurodevelopmental changes (ATSDR 2000d). In addition, reduced birth weight, reproductive toxicity, and cancer have also been observed (ATSDR 2000d).

Vinyl Chloride
Vinyl chloride was detected in soil boring samples SB3 and SB6, with the SB6 value being twice the ATSDR cancer comparison value. The SB6 concentration also exceeded the MDEQ vapor intrusion comparison values by 3.7 times. The data were insufficient to determine if these chemicals are widely dispersed in the soils deeper than 12 inches. MDCH considers vinyl chloride a COPC at this property.

Vinyl chloride has been identified as a human carcinogen (EPA 1994, IARC 1987). Inhalation of vinyl chloride is the most studied route of exposure and has been the exposure route to which most adverse effects have been attributed (ATSDR 1997a). Vinyl chloride has been linked to cancers of the liver and central nervous system in humans (ATSDR 1997a). Vinyl chloride has also been found to adversely affect the human nervous, immune, and cardiovascular systems (ATSDR 1997a).

Inorganic Chemicals

Aluminum
Aluminum was detected in all surficial and boring soil samples, however the concentrations are typical of soil aluminum concentrations throughout the State of Michigan. MDEQ reports a statewide background level of aluminum in soil of 6,900 parts-per-million (ppm) (MDEQ 2003). All samples at this site were within 2 fold of this background concentration. Four surficial and seven boring samples exceeded the ATSDR comparison value protecting children that exhibit hand to mouth behavior (i.e., pica behavior) on a regular basis for more than 14 days. These samples exceeded the comparison value by 1.03 to 2.5 times. However, given that the location of the property is not in close proximity to residential housing, children are not expected to frequent the Globe property and thus would not likely be exposed. Given that children will not likely be exposed at this property, MDCH does not consider aluminum to be a COPC at this property.

Arsenic
Arsenic was detected in all surficial and boring soil samples. All surficial and boring soil samples exceeded the ATSDR cancer comparison value by 6 to 24 times. MDEQ reports a statewide background level of arsenic in soil of 5.8 ppm (MDEQ 2003). All samples at this site were within two fold of this background concentration. There is credible evidence to suggest that arsenic is a widely dispersed element in the surficial and subsurface soils of this property and that the measurements were similar to the state background soil concentration. MDCH does not consider arsenic to be a likely COPC at this property.

Cadmium
Cadmium was detected in four (SS3, SS4, SS5, SS6) of the seven surficial soil samples and none of the soil boring samples. One of the surficial soil samples (SS6) exceeded, by 2.9 times, the ATSDR comparison value that protects children and adults. MDEQ reports a statewide background level of cadmium in soil of 1.2 ppm (MDEQ 2003). Three of the detections at this site were within approximately three fold of this background concentration, with sample SS6 being 24 times higher than background. Cadmium may be a widely dispersed element in the surficial soils of this property with some highly elevated concentrations over background, however further analyses would be necessary to confirm these initial results. MDCH finds cadmium to be a COPC at this property.

Once cadmium has entered the human body, it can take 30 years for the body to remove half of that original amount (ATSDR 1990). Long-term, low dose exposures can result in kidney dysfunction and pain felt in bones (ATSDR 1990).

Chromium
Total chromium was tested for in the soils, but the specific types of chromium (+3 vs +6) were not determined. The type of chromium is important in determining the potential risk. Chromium with a plus six charge is far more toxic to people than chromium with a plus three charge. Total chromium was detected in all the surficial and boring soil

samples, however, the highest concentrations were in the surficial soils at the same location (SS3, SS4, SS5, SS6) where cadmium was detected. Two surficial soil samples (SS5 and SS4) exceeded, by 1.3 and 1.7 times, respectively, an ATSDR comparison value that protects children and adults from chromium with a +6 charge. None of the soil boring samples exceeded comparison values. MDEQ reports a statewide background soil concentration of total chromium in soil of 18 ppm (MDEQ 2003). Most surficial soil samples were above the statewide background level. There is credible evidence to suggest that chromium is a widely dispersed element in the surficial and subsurface soils of this property, and that surficial soil samples are likely elevated over expected background soil concentration. MDCH considers chromium to be a COPC at this property.

The charge on the chromium molecule makes a large difference in its toxicity. Chromium with a +3 charge is an essential dietary element that plays a role in maintaining normal metabolism of glucose, fat, and cholesterol (ATSDR 2000c). Contact with chromium with a +6 charge has been found to cause severe dermatitis, respiratory irritation, and increased risk of lung cancer (ATSDR 2000c). Chromium leaves the body within days to several weeks of an exposure (ATSDR 2000c).

Cobalt
Cobalt was detected in all the surficial soil samples and in seven of eight soil boring samples, however, only the surficial soil sample at location SS5 exceeded, by 7.5 times, the ATSDR comparison value protecting children that exhibit hand to mouth behavior (i.e., pica behavior) on a regular basis for more than 14 days. None of the soil boring samples exceeded comparison values. MDEQ reports a statewide background level of cobalt in soil of 6.8 ppm (MDEQ 2003). There is credible evidence to suggest that cobalt is a widely dispersed element in the surficial and subsurface soils of this property, and with the exception of sample SS5, all cobalt concentrations were similar to the statewide background concentration. MDCH does not consider cobalt to be a COPC at this property.

Copper
Copper was detected in all surficial and boring soil samples. Six surficial samples (SS2-SS7) exceeded (1.2 to 11.5 times) the ATSDR comparison value protecting children that exhibit hand to mouth behavior (i.e., pica behavior) on a regular basis for more than 14 days. One soil boring sample (SB1) exceed this same comparison value by 1.7 times. MDEQ reports a statewide background level of copper in soil of 32 ppm (MDEQ 2003). There is credible evidence to suggest that copper is a widely dispersed element in the surficial and subsurface soils of this property, and that the surficial soils likely contain elevated levels of copper. MDCH considers copper to be a COPC at this property. Long-term exposure to copper dust can irritate the inner lining of the nose, lungs, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea (ATSDR 2002).

Cyanide
Cyanide was detected in six of seven surficial soil samples and two of eight boring soil samples. One surficial samples (SS4) exceeded by 1.3 times the ATSDR comparison

value protecting children and adults from long-term exposures. One soil boring sample (SB2) exceed this same comparison value by 1.4 times. MDEQ reports a statewide background level of cyanide in soil of 0.39 ppm (MDEQ 2003). The Globe property concentrations were within three fold of the background concentration. There is credible evidence to suggest that cyanide is a widely dispersed element in the surficial soils of this property, and the concentrations are relatively similar to the statewide background soil concentration. MDCH does not consider cyanide to be a COPC at this property.

Iron

Iron, a commonly occurring element in soil, was detected in all soil samples. One surficial soil sample (SS4) exceeded the MDEQ residential direct contact comparison value by 1.2 times. The MDEQ reported the state background soil concentration of iron was 12,000 ppm (MDEQ 2003). The maximum surficial iron concentration exceeded this background level by 16 times and the maximum soil boring sample exceeded this background value by 3.7 times. There is credible evidence to suggest that iron is a widely dispersed element in the surficial and subsurface soils of this property, and that some surficial soils contain elevated levels of iron. MDCH does not consider iron to be a COPC at this property.

Lead

Lead was detected in all seven of the surficial soil samples (Range: 33 to 610 ppm). Two samples exceed the MDEQ residential direct soil contact comparison value (400 ppm) by 1.1 and 1. 5 times. No soil boring samples exceed any comparison values, however, lead was detected in all the samples. MDEQ reports a statewide background level of lead in soil of 21 ppm (MDEQ 2003), however, the Detroit Free Press (http://www.freep.com/lead/) reported higher lead soil levels in the city of Detroit. The Detroit Free Press contracted with Howard Mielke, PhD, who is a professor of environmental toxicology at Xavier University of Louisiana in New Orleans to test the soil in the city of Detroit for lead. A total of 59 soil samples were collected from the city of Detroit and analyzed for total lead. Of the 59 soil samples, 10 samples were greater than the MDEQ residential direct soil contact comparison value. The average concentration in the city of Detroit was 285 ppm (Range: 13 to 1,347 ppm). Thus, the lead concentrations in soil at the Globe property were similar to lead levels found on many other properties within the city of Detroit. Given that children are not likely to be exposed at this property, MDCH does not consider lead to be a COPC at this property.

Vanadium

Similar concentrations of vanadium were found in all surficial and boring soil samples. Most (14 of 15) of the samples exceeded the ATSDR comparison value protecting children that exhibit hand to mouth behavior (i.e., pica behavior) on a regular basis for more than 14 days. MDEQ does not report a background default value for vanadium (MDEQ 2003), however, the pattern of similar surface and subsurface concentrations is suggestive that these levels may be at background levels and are not site related. There is credible evidence to suggest that vanadium is a widely dispersed element in the surficial and subsurface soils of this property, and that the concentrations may be at the statewide

background soil concentration. MDCH does not consider vanadium to be a COPC at this property

Physical Hazards

The chain-link fence was not preventing entry onto the property because a recently used bed, clothing, and personal items were found in the Globe building. Broken glass and other sharp items existed on the property. If redevelopment of the property occurs, asbestos remediation is to be conducted according to NESHAP guidelines; however, anyone inhabiting the property currently could be exposed to asbestos.

ATSDR Child Health Considerations

Children may be at greater risk than adults from exposure to hazardous substances at sites of environmental contamination. Children engage in activities such as playing outdoors and hand-to-mouth behaviors that could increase their intake of hazardous substances. They are shorter than most adults, and therefore breathe dust, soil, and vapors closer to the ground. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures are high enough during critical growth stages. Even before birth, children are forming the body organs they need to last a lifetime. Injury during key periods of growth and development could lead to malformation of organs (teratogenesis), disruption of function, and premature death. Exposure of the mother could lead to exposure of the fetus, via the placenta, or affect the fetus because of injury or illness sustained by the mother (ATSDR 1998). The obvious implication for environmental health is that children can experience substantially greater exposures than adults to toxicants that are present in soil, water, or air.

MDCH considered the possibility of exposure to children at the Globe property both in the present and future. MDCH has used comparison values to evaluate the chemical soil concentrations that are protective of children's health. Currently, the property is abandoned and has a fence marking the edge of the property. Future exposures to children can be prevented if "due care", as described in MDEQ regulations (section 20107a of Part 201), is taken to prevent human contact with the surface and subsurface soils.

Conclusions

For present exposure pathways, MDCH concludes that the Globe property presents *no apparent public health hazard* due to the short duration of potential exposures. MDCH does not find soil concentrations to represent an acute (<14 day exposures) exposure problem.

For future exposure pathways, MDCH concludes that the property represents an *indeterminate public health hazard* for four reasons. (1) The final use of this property has not been decided, and land use will influence the exposure pathways. (2) Soil sampling methodology was not designed to properly characterize the extent of the contamination, especially the soils below 12 inches. (3) Two 20,000-gallon underground storage tanks (USTs) have not been accounted for on this property. (4) Surrounding properties may be

contributing contaminants to the vapor inhalation pathway, however, insufficient data exists to evaluate these industrial properties

MDCH would consider the on-site hazards to be eliminated if the owners of the property exhibit "due care", as described in MDEQ regulations (section 20107a of Part 201), and take actions that prevent the potential human exposures listed in Table 4. MDCH believes that testing soil and groundwater from the surrounding 67 areas of industrial land would allow for human health risk evaluations to be conducted. Such evaluations could determine if these surrounding properties pose any human health hazards.

Recommendations

1. Remove ACM according the NESHAP guidelines.
2. Determine if the two unaccounted for 20,000-gallon underground storage tanks are still buried on the property.
3. Take actions that will prevent exposure form occurring during or after redevelopment, as discussed in MDEQ "Due Care" regulations (section 20107a of Part 201).
4. Conduct additional site characterization including soil and groundwater chemistry analyses on the 67-acres surrounding the Globe property.

Public Health Action Plan

1. Property owners/developers should remove ACM according the NESHAP guidelines.
2. Property owners/developers should determine if the two unaccounted for 20,000-gallon underground storage tanks are still buried on the property.
3. Property owners/developers should take due care, as described in MDEQ regulations (section 20107a of Part 201), during redevelopment of the Globe property.
4. Property owners/developers should conduct additional site characterization and chemical analyses, in consultation with MDEQ, on the 67 acres surrounding the Globe property prior to redevelopment of the 67 acres.
5. MDCH will remain available to answer questions and for further consultation regarding the Globe property.

If any resident has additional information or health concerns regarding this health consultation, please contact the Michigan Department of Community Health, Environmental and Occupational Epidemiology Division, at 1-800-648-6942.

FIGURES

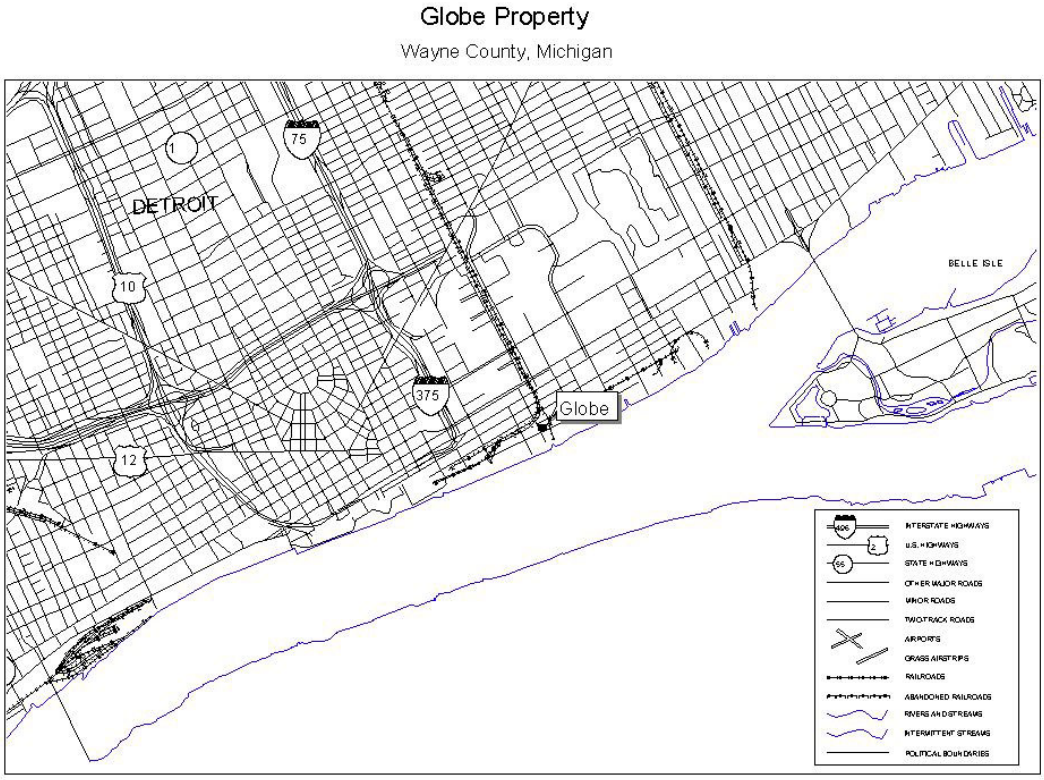

Figure 1 Location of the Globe property within the City of Detroit.

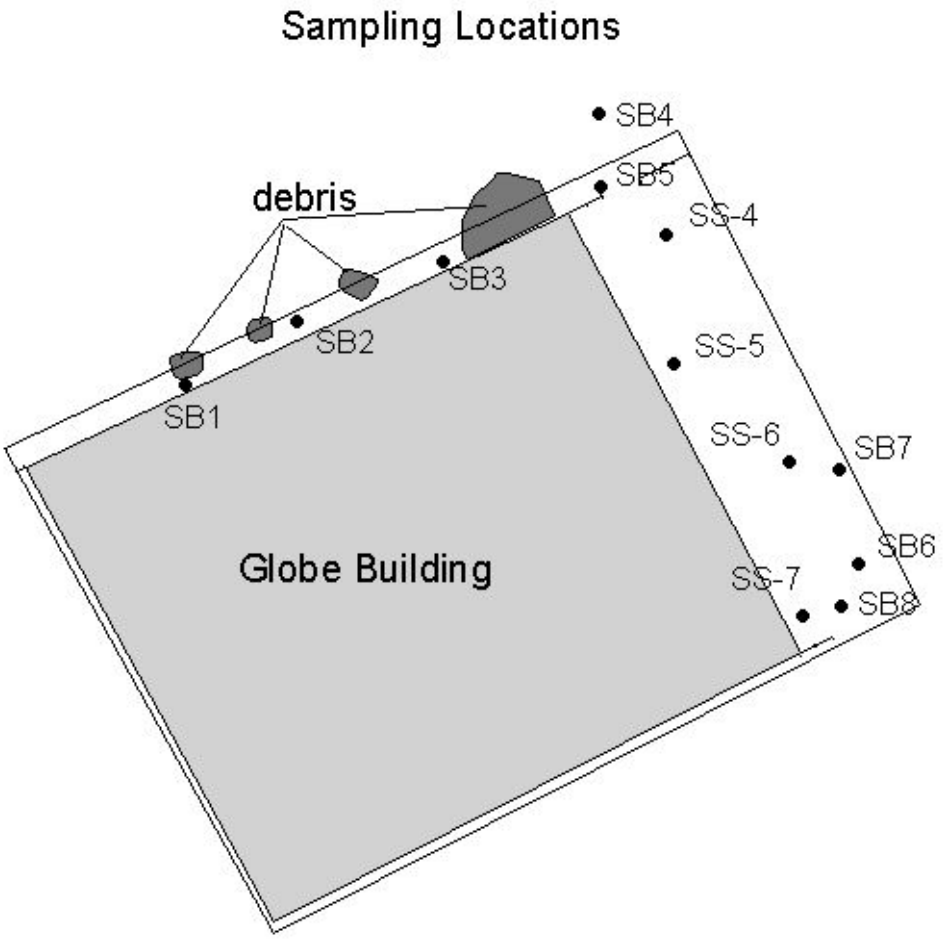

Figure 2 Locations of the soil boring (SB) and surficial soil (SS) samples on the Globe property in relation to the Globe building.

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Certification

This Globe Building Brownfield Redevelopment Assessment Health Consultation was prepared by the Michigan Department of Community Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was conducted by the cooperative agreement partner.

Technical Project Officer, Cooperative Agreement Team, Superfund and Program Assessment Branch, Division of Health Assessment and Consultation, ATSDR

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

Team Leader, Cooperative Agreement Team, SPAB, DHAC, ATSDR

Appendix A: Soil Concentrations of chemicals and associated comparison values for those samples in which a chemical concentration exceeded a comparison value.

Table A1. Surface soil concentrations for organic and inorganic chemicals that were found to exceed a comparison value.

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Surface ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
Organic Chemicals											
AA29421	SS3	50-32-8	Benzo[a]pyrene	**15**		0.1			2		
AA29424	SS6	50-32-8	Benzo[a]pyrene	**2.6**		0.1			2		
AA29423	SS5	50-32-8	Benzo[a]pyrene	**2.0**		0.1			2		
AA29419	SS1	50-32-8	Benzo[a]pyrene	**1.4**		0.1			2		
AA29420	SS2	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29422	SS4	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29425	SS7	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29421	SS3	53-70-3	Dibenz[a,h]anthracene	**2.7**					2		
AA29424	SS6	53-70-3	Dibenz[a,h]anthracene	0.29					2		
AA29419	SS1	53-70-3	Dibenz[a,h]anthracene	0					2		
AA29420	SS2	53-70-3	Dibenz[a,h]anthracene	0					2		
AA29422	SS4	53-70-3	Dibenz[a,h]anthracene	0					2		
AA29423	SS5	53-70-3	Dibenz[a,h]anthracene	0					2		
AA29425	SS7	53-70-3	Dibenz[a,h]anthracene	0					2		
AA29423	SS5	11096-82-5	PCBs - Aroclor1260	**16**		0.4			1.2		
AA29424	SS6	11096-82-5	PCBs - Aroclor1260	**2.4**		0.4			1.2		
AA29422	SS4	11096-82-5	PCBs - Aroclor1260	**1.9**		0.4			1.2		
AA29421	SS3	11096-82-5	PCBs - Aroclor1260	**0.66**		0.4			1.2		
AA29419	SS1	11096-82-5	PCBs - Aroclor1260	**0.65**		0.4			1.2		
AA29420	SS2	11096-82-5	PCBs - Aroclor1260	**0.56**		0.4			1.2		
AA29425	SS7	11096-82-5	PCBs - Aroclor1260	0.11		0.4			1.2		
Inorganic Chemicals											
AA29425	SS7	7429-90-5	Aluminum	**6500**				4000			
AA29422	SS4	7429-90-5	Aluminum	**6100**				4000			
AA29421	SS3	7429-90-5	Aluminum	**4400**				4000			
AA29419	SS1	7429-90-5	Aluminum	**4100**				4000			

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Surface ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29420	SS2	7429-90-5	Aluminum	3800				4000			
AA29423	SS5	7429-90-5	Aluminum	3800				4000			
AA29424	SS6	7429-90-5	Aluminum	3500				4000			
AA29422	SS4	7440-38-2	Arsenic	**12**		0.5			7.6		
AA29423	SS5	7440-38-2	Arsenic	**7.4**		0.5			7.6		
AA29424	SS6	7440-38-2	Arsenic	**6.3**		0.5			7.6		
AA29421	SS3	7440-38-2	Arsenic	**6.2**		0.5			7.6		
AA29420	SS2	7440-38-2	Arsenic	**5.1**		0.5			7.6		
AA29419	SS1	7440-38-2	Arsenic	**4.6**		0.5			7.6		
AA29425	SS7	7440-38-2	Arsenic	**4.6**		0.5			7.6		
AA29423	SS5	7440-43-9	Cadmium	**29**	10						
AA29422	SS4	7440-43-9	Cadmium	3.7	10						
AA29424	SS6	7440-43-9	Cadmium	3.5	10						
AA29421	SS3	7440-43-9	Cadmium	2.2	10						
AA29419	SS1	7440-43-9	Cadmium	0	10						
AA29420	SS2	7440-43-9	Cadmium	0	10						
AA29425	SS7	7440-43-9	Cadmium	0	10						
AA29422	SS4	7440-47-3	Chromium	**330**			200				
AA29423	SS5	7440-47-3	Chromium	**260**			200				
AA29421	SS3	7440-47-3	Chromium	130			200				
AA29424	SS6	7440-47-3	Chromium	120			200				
AA29420	SS2	7440-47-3	Chromium	64			200				
AA29419	SS1	7440-47-3	Chromium	38			200				
AA29425	SS7	7440-47-3	Chromium	16			200				
AA29423	SS5	7440-48-4	Cobalt	**150**				20			
AA29422	SS4	7440-48-4	Cobalt	17				20			
AA29424	SS6	7440-48-4	Cobalt	14				20			
AA29425	SS7	7440-48-4	Cobalt	8.7				20			
AA29421	SS3	7440-48-4	Cobalt	7.8				20			
AA29420	SS2	7440-48-4	Cobalt	6.6				20			

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Surface ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29419	SS1	7440-48-4	Cobalt	5.3				20			
AA29422	SS4	7440-50-8	Copper	**690**				60			
AA29423	SS5	7440-50-8	Copper	**640**				60			
AA29424	SS6	7440-50-8	Copper	**220**				60			
AA29421	SS3	7440-50-8	Copper	**160**				60			
AA29420	SS2	7440-50-8	Copper	**130**				60			
AA29425	SS7	7440-50-8	Copper	**71**				60			
AA29419	SS1	7440-50-8	Copper	51				60			
AA29422	SS4	57-12-5	Cyanide	**1.3**			1				
AA29424	SS6	57-12-5	Cyanide	1			1				
AA29423	SS5	57-12-5	Cyanide	0.8			1				
AA29420	SS2	57-12-5	Cyanide	0.5			1				
AA29421	SS3	57-12-5	Cyanide	0.5			1				
AA29419	SS1	57-12-5	Cyanide	0.4			1				
AA29425	SS7	57-12-5	Cyanide	0			1				
AA29422	SS4	7439-89-6	Iron	**190000**					160000		
AA29423	SS5	7439-89-6	Iron	100000					160000		
AA29424	SS6	7439-89-6	Iron	78000					160000		
AA29421	SS3	7439-89-6	Iron	51000					160000		
AA29420	SS2	7439-89-6	Iron	45000					160000		
AA29419	SS1	7439-89-6	Iron	18000					160000		
AA29425	SS7	7439-89-6	Iron	8200					160000		
AA29423	SS5	7439-92-1	Lead	**610**					400		
AA29424	SS6	7439-92-1	Lead	**450**					400		
AA29421	SS3	7439-92-1	Lead	370					400		
AA29420	SS2	7439-92-1	Lead	310					400		
AA29422	SS4	7439-92-1	Lead	280					400		
AA29419	SS1	7439-92-1	Lead	52					400		
AA29425	SS7	7439-92-1	Lead	33					400		

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Surface ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29422	SS4	7440-62-2	Vanadium	**32**				6			
AA29423	SS5	7440-62-2	Vanadium	**23**				6			
AA29421	SS3	7440-62-2	Vanadium	**19**				6			
AA29420	SS2	7440-62-2	Vanadium	**18**				6			
AA29424	SS6	7440-62-2	Vanadium	**18**				6			
AA29419	SS1	7440-62-2	Vanadium	**16**				6			
AA29425	SS7	7440-62-2	Vanadium	**15**				6			

[a] $EMEG_{cc}$ refers to the ATSDR environmental media evaluation guides for chronic exposures to children.
[b] CREG ATSDR's cancer risk evaluation guides based on a risk of 1 increased cancer per 1,000,000 exposed individuals.
[c] RMEG reference media evaluation guides based on U.S. EPA reference doses.
[d] $EMEG_{ipc}$ refers the ATSDR environmental media evaluation guides for intermediate exposures for pica children.
[e] DC refers to the MDEQ residential and commercial I direct contact soil criteria to protect human health.
[f] GSI refers to the MDEQ groundwater-surface water protection criteria established to protect drinking water sources used by people.
[g] Air-VI refers to the MDEQ indoor air protection criteria that is to protect buildings from vapor intrusion from contaminated soils.
[h] Air-Out refers to the MDEQ outdoor ambient air protection criteria to protect human health.

Table A2. Soil boring concentrations for organic and inorganic chemicals found to exceed applicable comparison values.

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
Organic Chemicals											
AA29436	SB1A	83-32-9	Acenaphthene	**1200**				1000			
AA29427	SB2	83-32-9	Acenaphthene	390				1000			
AA29426	SB1	83-32-9	Acenaphthene	1.2				1000			
AA29430	SB5	83-32-9	Acenaphthene	0.25				1000			
AA29432	SB7	83-32-9	Acenaphthene	0.22				1000			
AA29428	SB3	83-32-9	Acenaphthene	0				1000			
AA29429	SB4	83-32-9	Acenaphthene	0				1000			
AA29431	SB6	83-32-9	Acenaphthene	0				1000			
AA29433	SB8	83-32-9	Acenaphthene	0				1000			
AA29436	SB1A	56-55-3	Benz[a]anthracene	**430**					20		
AA29427	SB2	56-55-3	Benz[a]anthracene	**150**					20		
AA29426	SB1	56-55-3	Benz[a]anthracene	4.2					20		
AA29430	SB5	56-55-3	Benz[a]anthracene	0.82					20		
AA29432	SB7	56-55-3	Benz[a]anthracene	0.52					20		
AA29429	SB4	56-55-3	Benz[a]anthracene	0.30					20		
AA29428	SB3	56-55-3	Benz[a]anthracene	0					20		
AA29431	SB6	56-55-3	Benz[a]anthracene	0					20		
AA29433	SB8	56-55-3	Benz[a]anthracene	0					20		
AA29427	SB2	71-43-2	Benzene	**16**		0.003				1.6	
AA29426	SB1	71-43-2	Benzene	0		0.003				1.6	
AA29428	SB3	71-43-2	Benzene	0		0.003				1.6	
AA29429	SB4	71-43-2	Benzene	0		0.003				1.6	

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29430	SB5	71-43-2	Benzene	0		0.003				1.6	
AA29431	SB6	71-43-2	Benzene	0		0.003				1.6	
AA29432	SB7	71-43-2	Benzene	0		0.003				1.6	
AA29433	SB8	71-43-2	Benzene	0		0.003				1.6	
AA29436	SB1A	50-32-8	Benzo[a]pyrene	**220**		0.1			2		
AA29426	SB1	50-32-8	Benzo[a]pyrene	**3.8**		0.1			2		
AA29430	SB5	50-32-8	Benzo[a]pyrene	**0.74**		0.1			2		
AA29429	SB4	50-32-8	Benzo[a]pyrene	**0.42**		0.1			2		
AA29432	SB7	50-32-8	Benzo[a]pyrene	**0.42**		0.1			2		
AA29427	SB2	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29428	SB3	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29431	SB6	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29433	SB8	50-32-8	Benzo[a]pyrene	0		0.1			2		
AA29436	SB1A	205-99-2	Benzo[b]fluoranthene	**300**					20		
AA29427	SB2	205-99-2	Benzo[b]fluoranthene	**100**					20		
AA29426	SB1	205-99-2	Benzo[b]fluoranthene	3.5					20		
AA29430	SB5	205-99-2	Benzo[b]fluoranthene	0.84					20		
AA29432	SB7	205-99-2	Benzo[b]fluoranthene	0.50					20		
AA29429	SB4	205-99-2	Benzo[b]fluoranthene	0.44					20		
AA29428	SB3	205-99-2	Benzo[b]fluoranthene	0					20		
AA29431	SB6	205-99-2	Benzo[b]fluoranthene	0					20		
AA29433	SB8	205-99-2	Benzo[b]fluoranthene	0					20		
AA29436	SB1A	86-74-8	Carbazole	**890**					530		
AA29427	SB2	86-74-8	Carbazole	150					530		
AA29426	SB1	86-74-8	Carbazole	0.66					530		
AA29428	SB3	86-74-8	Carbazole	0					530		
AA29429	SB4	86-74-8	Carbazole	0					530		
AA29430	SB5	86-74-8	Carbazole	0					530		

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29431	SB6	86-74-8	Carbazole	0					530		
AA29432	SB7	86-74-8	Carbazole	0					530		
AA29433	SB8	86-74-8	Carbazole	0					530		
AA29436	SB1A	86-73-7	Fluorene	**1600**				800			
AA29427	SB2	86-73-7	Fluorene	490				800			
AA29426	SB1	86-73-7	Fluorene	0.95				800			
AA29432	SB7	86-73-7	Fluorene	0.27				800			
AA29430	SB5	86-73-7	Fluorene	0.21				800			
AA29428	SB3	86-73-7	Fluorene	0				800			
AA29429	SB4	86-73-7	Fluorene	0				800			
AA29431	SB6	86-73-7	Fluorene	0				800			
AA29433	SB8	86-73-7	Fluorene	0				800			
AA29436	SB1A	206-44-0	Fluoroanthene	**1900**				800			
AA29427	SB2	206-44-0	Fluoroanthene	580				800			
AA29426	SB1	206-44-0	Fluoroanthene	12				800			
AA29430	SB5	206-44-0	Fluoroanthene	2.1				800			
AA29432	SB7	206-44-0	Fluoroanthene	1.2				800			
AA29429	SB4	206-44-0	Fluoroanthene	0.58				800			
AA29428	SB3	206-44-0	Fluoroanthene	0				800			
AA29431	SB6	206-44-0	Fluoroanthene	0				800			
AA29433	SB8	206-44-0	Fluoroanthene	0				800			
AA29436	SB1A	193-39-5	Indeno(1,2,3-c,d)pyrene	**77**					20		
AA29430	SB5	193-39-5	Indeno(1,2,3-c,d)pyrene	0.43					20		
AA29429	SB4	193-39-5	Indeno(1,2,3-c,d)pyrene	0.28					20		
AA29426	SB1	193-39-5	Indeno(1,2,3-c,d)pyrene	0					20		
AA29427	SB2	193-39-5	Indeno(1,2,3-c,d)pyrene	0					20		
AA29428	SB3	193-39-5	Indeno(1,2,3-c,d)pyrene	0					20		
AA29431	SB6	193-39-5	Indeno(1,2,3-c,d)pyrene	0					20		

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29432	SB7	193-39-5	Indeno(1,2,3-c,d)pyrene	0					20		
AA29433	SB8	193-39-5	Indeno(1,2,3-c,d)pyrene	0					20		
AA29436	SB1A	91-57-6	2-Methylnaphthalene	**1400**			200				
AA29427	SB2	91-57-6	2-Methylnaphthalene	**1000**			200				
AA29427	SB2	91-57-6	2-Methylnaphthalene	**410**			200				
AA29426	SB1	91-57-6	2-Methylnaphthalene	0			200				
AA29426	SB1	91-57-6	2-Methylnaphthalene	0			200				
AA29428	SB3	91-57-6	2-Methylnaphthalene	0			200				
AA29428	SB3	91-57-6	2-Methylnaphthalene	0			200				
AA29429	SB4	91-57-6	2-Methylnaphthalene	0			200				
AA29429	SB4	91-57-6	2-Methylnaphthalene	0			200				
AA29430	SB5	91-57-6	2-Methylnaphthalene	0			200				
AA29430	SB5	91-57-6	2-Methylnaphthalene	0			200				
AA29431	SB6	91-57-6	2-Methylnaphthalene	0			200				
AA29431	SB6	91-57-6	2-Methylnaphthalene	0			200				
AA29432	SB7	91-57-6	2-Methylnaphthalene	0			200				
AA29432	SB7	91-57-6	2-Methylnaphthalene	0			200				
AA29433	SB8	91-57-6	2-Methylnaphthalene	0			200				
AA29433	SB8	91-57-6	2-Methylnaphthalene	0			200				
AA29427	SB2	91-20-3	Naphthalene	**5100**			1000	1000		250	300
AA29436	SB1A	91-20-3	Naphthalene	**4200**			1000	1000		250	300
AA29427	SB2	91-20-3	Naphthalene	**1800**			1000	1000		250	300
AA29426	SB1	91-20-3	Naphthalene	0.42			1000	1000		250	300
AA29432	SB7	91-20-3	Naphthalene	0.18			1000	1000		250	300
AA29426	SB1	91-20-3	Naphthalene	0			1000	1000		250	300
AA29428	SB3	91-20-3	Naphthalene	0			1000	1000		250	300
AA29428	SB3	91-20-3	Naphthalene	0			1000	1000		250	300
AA29429	SB4	91-20-3	Naphthalene	0			1000	1000		250	300

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29429	SB4	91-20-3	Naphthalene	0			1000	1000		250	300
AA29430	SB5	91-20-3	Naphthalene	0			1000	1000		250	300
AA29430	SB5	91-20-3	Naphthalene	0			1000	1000		250	300
AA29431	SB6	91-20-3	Naphthalene	0			1000	1000		250	300
AA29431	SB6	91-20-3	Naphthalene	0			1000	1000		250	300
AA29432	SB7	91-20-3	Naphthalene	0			1000	1000		250	300
AA29433	SB8	91-20-3	Naphthalene	0			1000	1000		250	300
AA29433	SB8	91-20-3	Naphthalene	0			1000	1000		250	300
AA29436	SB1A	85-01-8	Phenanthrene	**4000**					1600	2800	160
AA29427	SB2	85-01-8	Phenanthrene	**1300**					1600	2800	160
AA29426	SB1	85-01-8	Phenanthrene	**11**					1600	2800	160
AA29430	SB5	85-01-8	Phenanthrene	1.6					1600	2800	160
AA29432	SB7	85-01-8	Phenanthrene	1.1					1600	2800	160
AA29429	SB4	85-01-8	Phenanthrene	0.39					1600	2800	160
AA29428	SB3	85-01-8	Phenanthrene	0					1600	2800	160
AA29431	SB6	85-01-8	Phenanthrene	0					1600	2800	160
AA29433	SB8	85-01-8	Phenanthrene	0					1600	2800	160
AA29427	SB2	108-88-3	Toluene	**53**				40			
AA29426	SB1	108-88-3	Toluene	0				40			
AA29428	SB3	108-88-3	Toluene	0				40			
AA29429	SB4	108-88-3	Toluene	0				40			
AA29430	SB5	108-88-3	Toluene	0				40			
AA29431	SB6	108-88-3	Toluene	0				40			
AA29432	SB7	108-88-3	Toluene	0				40			
AA29433	SB8	108-88-3	Toluene	0				40			
AA29431	SB6	75-01-4	Vinylchloride	**1.0**	1.0	0.5				0.27	
AA29428	SB3	75-01-4	Vinylchloride	0.17	1.0	0.5				0.27	
AA29426	SB1	75-01-4	Vinylchloride	0	1.0	0.5				0.27	

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29427	SB2	75-01-4	Vinylchloride	0	1.0	0.5				0.27	
AA29429	SB4	75-01-4	Vinylchloride	0	1.0	0.5				0.27	
AA29430	SB5	75-01-4	Vinylchloride	0	1.0	0.5				0.27	
AA29432	SB7	75-01-4	Vinylchloride	0	1.0	0.5				0.27	
AA29433	SB8	75-01-4	Vinylchloride	0	1.0	0.5				0.27	
Inorganic Chemicals											
AA29428	SB3	7429-90-5	Aluminum	**10000**				4000			
AA29426	SB1	7429-90-5	Aluminum	**9100**				4000			
AA29433	SB8	7429-90-5	Aluminum	**9100**				4000			
AA29430	SB5	7429-90-5	Aluminum	**9000**				4000			
AA29429	SB4	7429-90-5	Aluminum	**6600**				4000			
AA29432	SB7	7429-90-5	Aluminum	**5900**				4000			
AA29431	SB6	7429-90-5	Aluminum	**5400**				4000			
AA29427	SB2	7429-90-5	Aluminum	2000				4000			
AA29426	SB1	7440-38-2	Arsenic	**9**		0.5			7.6		
AA29433	SB8	7440-38-2	Arsenic	**5.5**		0.5			7.6		
AA29427	SB2	7440-38-2	Arsenic	**4.3**		0.5			7.6		
AA29430	SB5	7440-38-2	Arsenic	**4.3**		0.5			7.6		
AA29428	SB3	7440-38-2	Arsenic	**4.1**		0.5			7.6		
AA29431	SB6	7440-38-2	Arsenic	**3.8**		0.5			7.6		
AA29432	SB7	7440-38-2	Arsenic	**3.4**		0.5			7.6		
AA29429	SB4	7440-38-2	Arsenic	**3**		0.5			7.6		
AA29426	SB1	7440-50-8	Copper	**100**				60			
AA29432	SB7	7440-50-8	Copper	36				60			
AA29430	SB5	7440-50-8	Copper	28				60			
AA29433	SB8	7440-50-8	Copper	25				60			
AA29428	SB3	7440-50-8	Copper	23				60			

Sample Number	Sample Location	CAS Number	Chemical Name	Result Soil Boring ppm	ATSDR EMEGcc[a] ppm	ATSDR CREG[b] ppm	ATSDR RMEG[c] ppm	ATSDR EMEGipc[d] ppm	MDEQ DC[e] ppm	MDEQ Air-VI[f] ppm	MDEQ Air-Out[g] ppm
AA29429	SB4	7440-50-8	Copper	20				60			
AA29427	SB2	7440-50-8	Copper	18				60			
AA29431	SB6	7440-50-8	Copper	10				60			
AA29427	SB2	57-12-5	Cyanide	**1.4**			1				
AA29432	SB7	57-12-5	Cyanide	0.3			1				
AA29426	SB1	57-12-5	Cyanide	0			1				
AA29428	SB3	57-12-5	Cyanide	0			1				
AA29429	SB4	57-12-5	Cyanide	0			1				
AA29430	SB5	57-12-5	Cyanide	0			1				
AA29431	SB6	57-12-5	Cyanide	0			1				
AA29433	SB8	57-12-5	Cyanide	0			1				
AA29428	SB3	7440-62-2	Vanadium	**24**				6			
AA29432	SB7	7440-62-2	Vanadium	**24**				6			
AA29426	SB1	7440-62-2	Vanadium	**23**				6			
AA29433	SB8	7440-62-2	Vanadium	**23**				6			
AA29430	SB5	7440-62-2	Vanadium	**22**				6			
AA29429	SB4	7440-62-2	Vanadium	**21**				6			
AA29431	SB6	7440-62-2	Vanadium	**15**				6			
AA29427	SB2	7440-62-2	Vanadium	5.7				6			

[a] $EMEG_{cc}$ refers to the ATSDR environmental media evaluation guides for chronic exposures to children.
[b] CREG ATSDR's cancer risk evaluation guides based on a risk of 1 increased cancer per 1,000,000 exposed individuals.
[c] RMEG reference media evaluation guides based on U.S. EPA reference doses.
[d] $EMEG_{ipc}$ refers the ATSDR environmental media evaluation guides for intermediate exposures for pica children.
[e] DC refers to the MDEQ residential and commercial I direct contact soil criteria to protect human health.
[f] GSI refers to the MDEQ groundwater-surface water protection criteria established to protect drinking water sources used by people.
[g] Air-VI refers to the MDEQ indoor air protection criteria that is to protect buildings from vapor intrusion from contaminated soils.
[h] Air-Out refers to the MDEQ outdoor ambient air protection criteria to protect human health.

Table A3. Summary of the chemicals found in surficial and boring soil samples that exceed ATSDR and MDEQ residential comparison values that have been grouped by exposure route. [a]

Chemical Name	Number of Analyses	Number of Detections	Number of Analyses Exceeding a Comparison Value	
			A	B
Surficial Soil (0 to 12 in)				
Organic Chemicals				
Benzo[a]pyrene[b]	7	4	4	0
Dibenz[a,h]anthracene	7	2	1	0
PCBs - Aroclor1260[b]	7	7	6	0
Inorganic Chemicals				
Aluminum	7	7	4	0
Arsenic	7	7	7	0
Cadmium	7	4	1	0
Chromium	7	7	2	0
Cobalt	7	7	1	0
Copper	7	7	6	0
Cyanide	7	6	2	0
Iron	7	7	1	0
Lead[b]	7	7	2	0
Magnesium	7	7	7	0
Vanadium	7	7	7	0
Soil Boring (0 to 12 feet)				
Organic Chemicals				
Acenaphthene	9	5	1	0
Benz[a]anthracene[b]	9	6	2	0
Benzene[c]	8	1	1	1
Benzo[a]pyrene[b]	9	5	5	0
Benzo[b]fluoranthene[b]	9	6	2	0
Carbazole	9	3	3	0
Fluorene	9	5	1	0
Fluoroanthene	9	6	1	0
Indeno(1,2,3-c,d)pyrene	9	3	1	0
2-Methylnaphthalene	17	3	3	0
Naphthalene[c]	17	5	3	3
Phenanthrene	9	6	1	2
Toluene	8	1	1	0
Vinylchloride	8	2	1	1
Inorganic Chemicals				
Aluminum	8	8	7	0
Arsenic	8	8	8	0

Chemical Name	Number of Analyses	Number of Detections	Number of Analyses Exceeding a Comparison Value	
			A	B
Copper	8	8	1	0
Cyanide	8	2	1	0
Magnesium	8	8	7	0
Vanadium	8	8	7	0

[a] A: Comparison values that relate to exposure routes that address ingestion, inhalation of small particles and/or dermal contact and are protective of children and adults.

B: Comparison values that relate to exposure routes that address volatile chemicals and the inhalation pathway.

[b] Chemicals that also exceed MDEQ industrial and/or commercial use comparison values for direct contact pathways.

[c] Chemicals that also exceed MDEQ industrial and/or commercial use comparison values for vapor inhalation/vapor intrusion pathways.

Table A4. Amount (i.e., number of times) the maximum chemical concentration exceeded the lowest comparison value grouped by exposure route.*

Chemical Name	Number of times the maximum concentrations exceeded the lowest comparison value by exposure route group	
	A	B
Surficial Soil (0 to 12 inches)		
Organic Chemicals		
Benzo[a]pyrene	150	
Dibenz[a,h]anthracene	1.4	
PCBs - Aroclor1260	40	
Inorganic Chemicals		
Aluminum	1.6	
Arsenic	24	
Cadmium	2.9	
Chromium	1.7	
Cobalt	7.5	
Copper	11.5	
Cyanide	1.3	
Iron	1.2	
Lead	1.5	
Magnesium	3.7	
Vanadium	5.3	
Soil Boring (0 to 12 feet)		
Organic Chemicals		
Acenaphthene	1.2	
Benz[a]anthracene	22	
Benzene	5300	10
Benzo[a]pyrene	2200	
Benzo[b]fluoranthene	15	
Carbazole	1.7	
Fluorene	2.0	
Fluoroanthene	2.4	
Indeno(1,2,3-c,d)pyrene	3.9	
2-Methylnaphthalene	7.0	
Naphthalene	5.1	20
Phenanthrene	2.5	25
Toluene	1.3	

Vinylchloride	2.0	3.7
Inorganic Chemicals		
Aluminum	2.5	
Arsenic	18	
Copper	1.7	
Cyanide	1.4	
Magnesium	4.4	
Vanadium	4.0	

* A: Exposure routes that address ingestion, inhalation of small particles and/or dermal contact and are protective of children and adults.
B: Exposure routes that address volatile chemicals and the inhalation pathway.