HEALTH CONSULTATION

PUBLIC COMMENT RELEASE

Public Health Implications of Inhalation of Manganese in Downriver Soils (Cities of River Rouge and Ecorse) Wayne County, Michigan

EPA FACILITY ID: MID004320479

August 1, 2007

Comment Period End Date: October 1, 2007

Prepared by:

Michigan Department of Community Health
Under A Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material. 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.

The Public Comment Period is an opportunity for the general public to comment on Agency findings or proposed activities for this written consultation. The purposes of the comment period are to 1) provide the public, particularly the community associated with a site, the opportunity to comment on the public health findings, 2) evaluate whether the community health concerns have been adequately addressed, and 3) provide ATSDR with additional information. There will be a time period for written comments, which will run until October 1, 2007. Please address correspondence to the health assessor for this site:

Christina Bush, Toxicologist
Michigan Department of Community Health
Division of Environmental Health
P.O. Box 30195
Lansing, Michigan 48909

Or you may submit your comments via e-mail to bushcr@michigan.gov.

The conclusions and recommendations presented in this health consultation are the result of site-specific analyses and are not to be cited or quoted for other evaluations or health consultations.

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Acronyms and Abbreviations

µg	microgram
µm	micrometer (micron)
ATSDR	Agency for Toxic Substances and Disease Registry
EPA	U.S. Environmental Protection Agency
Ev	emission due to vehicle traffic
Ew	emission due to wind
IE	Integrated Environmental, Inc.
m^3	cubic meter
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MRL	Minimal Risk Level
PEF	Particulate Emission Factor
PM2.5	particulate matter with aerodynamic diameter of 2.5 micrometers or less
PM10	particulate matter with aerodynamic diameter of 10 micrometers or less
ppm	parts per million
PSIC	Particulate Soil Inhalation Criteria
Q/C	air-dispersion factor
RfC	Reference Concentration
RRD	Remediation and Redevelopment Division
TSD	Technical Support Document
TSP	Total Suspended Particulate
U.S. Steel	U.S. Steel Corporation
V	vegetative cover
Weston	Weston Solutions of Michigan, Inc.

Summary

The cities of River Rouge and Ecorse, in Wayne County, Michigan, have been impacted, historically and currently, by airborne manganese deposition to soil. The Michigan Department of Environmental Quality (MDEQ) requested assistance in determining the level of public health threat posed by the inhalation of resuspended manganese-contaminated soil. Some soil samples collected within the cities exceed the MDEQ generic criterion for inhalation of airborne particulate manganese. There are other, on-going sources of manganese to ambient air in this area. Although long-term ambient air monitoring indicates that local air levels of manganese are above health-based comparison values, it is not clear to what extent the soil contamination contributes to the air levels. Also, toxicological studies suggest that Total Suspended Particulate (TSP) manganese inhaled through the nose and absorbed directly to the brain may be a more relevant exposure pathway than particulate matter inhaled into the lungs and absorbed into systemic circulation. Thus, it is also not clear whether TSP should be the appropriate dose metric to evaluate risk or if the current metric (particulate matter less than 10 microns, or PM10) is correct. Therefore, the public health hazard posed by the contaminated soil is indeterminate.

MDEQ should continue monitoring ambient air locally and conduct on-site soil sampling at a nearby steel mill. Exposure to elevated levels of airborne manganese particulates is a public health concern and should be addressed.

Purpose and Health Issues

The purpose of this health consultation is to determine the public health implications of exposure to airborne, manganese-contaminated soil. MDEQ requested assistance from the Michigan Department of Community Health (MDCH) in assessing the risk to people living in an area impacted, historically and currently, by airborne manganese deposition to soil. As yet, no health complaints have been reported to MDCH.

MDCH conducted this health consultation for the federal Agency for Toxic Substances and Disease Registry (ATSDR) under a cooperative agreement. ATSDR conducts public health activities (assessments/consultations, advisories, education) at sites of environmental contamination and concern. ATSDR is primarily an advisory agency. Therefore, its reports usually identify what actions are appropriate to be undertaken by the regulatory agency overseeing the site, other responsible parties, or the research or education divisions of ATSDR. As such, ATSDR recommendations may not encompass all types of federal and state requirements from a regulatory perspective. Thus, the purpose of a health consultation is not to evaluate or confirm regulatory compliance but to determine if any potentially harmful exposures are occurring or may occur in the future.

Background

The "downriver" area of Greater Detroit is south-southwest of the city of Detroit, along the Detroit River. This region has historically supported, and continues to support, heavy industry, including steel mills. In February 2005, the city of River Rouge provided MDEQ with environmental data collected by its consultant, Integrated Environmental,

Inc. (IE), in support of a class-action suit the city had filed against U.S. Steel Corporation (U.S. Steel). The city of Ecorse has also filed suit against U.S. Steel. (These lawsuits stem from a nuisance-dust issue.) The main plant of the U.S. Steel Great Lakes Works facility lies along the Detroit River directly east of the cities of River Rouge and Ecorse (Figure 1). U.S. Steel also has a facility on Zug Island, northeast of the cities across the River Rouge (RTI 2006).

Following review of the IE data, the MDEQ Remediation and Redevelopment Division (RRD) directed its consultant, Weston Solutions of Michigan, Inc. (Weston), to conduct further soil investigation. MDEQ defined the Downriver Soil Study Area as the area including the cities of River Rouge and Ecorse (Figures 2 and 3). The Study Area does *not* include the nearby U.S. Steel Great Lakes Works facility. Both the IE and the Weston data indicated that some soil concentrations of manganese were greater than the MDEQ generic Residential Particulate Soil Inhalation Criterion (PSIC). The results of the IE sampling and the Weston sampling are discussed in the *Environmental Contamination* section of this document. The PSIC criteria for manganese are discussed in Appendix A.

On November 13, 2006, toxicologists from MDCH and MDEQ met with the RRD site manager and Weston to discuss the data collected to-date and future activities. MDCH and MDEQ staff toured the Downriver Soil Study Area following the meeting.

Discussion

Environmental Contamination

From June 2001 through May 2004, IE conducted environmental sampling for the city of River Rouge. IE gathered soil, dust (indoor and outdoor), ponded water (puddles), and ambient air data. IE sampled soils in River Rouge, Ecorse, Delray, southwest Detroit, Plymouth, and Northville (IE 2005). This consultation reviews only the soil data from River Rouge, Ecorse, and the portion of "southwest Detroit" that was within the Downriver Soil Study Area.

In December 2005, Weston conducted soil sampling in the cities of River Rouge and Ecorse. According to Weston's Summary Report of this phase of the investigation, the two consultants had different sampling methodologies. IE reportedly collected samples from medians or near-curb areas from the top 1 inch of soil, targeting bare ground locations (considered more likely to contain elevated levels of metals). IE further biased their sampling by clustering some sample locations in two parks (Figure 2). Conversely, Weston used a statistical sampling approach, which minimized bias (Figure 3), and collected samples without regard to the presence or absence of surface vegetation cover. Weston's sampling depth was 0 to 3 inches (Weston 2006). Because of the differences between the two sampling methodologies, the data cannot be combined for statistical analysis.

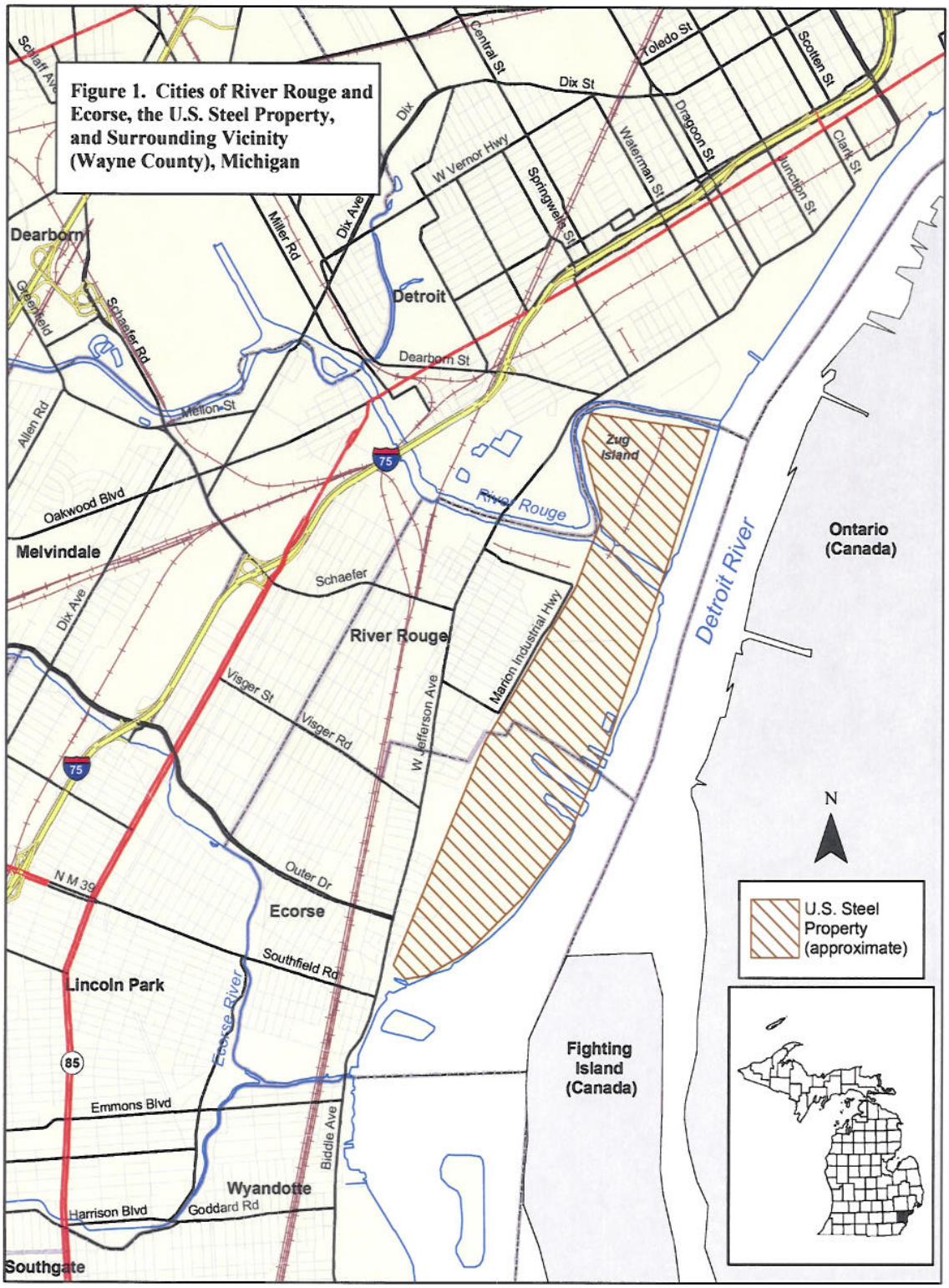
Figure 1. Cities of River Rouge and Ecorse, the U.S. Steel Property, and Surrounding Vicinity (Wayne County), Michigan
Dearborn
Detroit
Melvindale
River Rouge
Ecorse
Lincoln Park
Wyandotte
Southgate
Ontario (Canada)
Fighting Island (Canada)
Detroit River
River Rouge
Zug Island
Dix St
Central St
Toledo St
Scotten St
Clark St
Junction St
Dragoon St
Waterman St
Springwells St
W Vernor Hwy
Dix
Dix Ave
Miller Rd
Greenfield
Schaefer Rd
Dearborn St
Melton St
Allen Rd
Oakwood Blvd
Schaefer
Marion Industrial Hwy
W Jefferson Ave
Visger St
Visger Rd
Outer Dr
N M 39
Southfield Rd
Ecorse River
Biddle Ave
Emmons Blvd
Harrison Blvd
Goddard Rd
75
85
N
U.S. Steel Property (approximate)

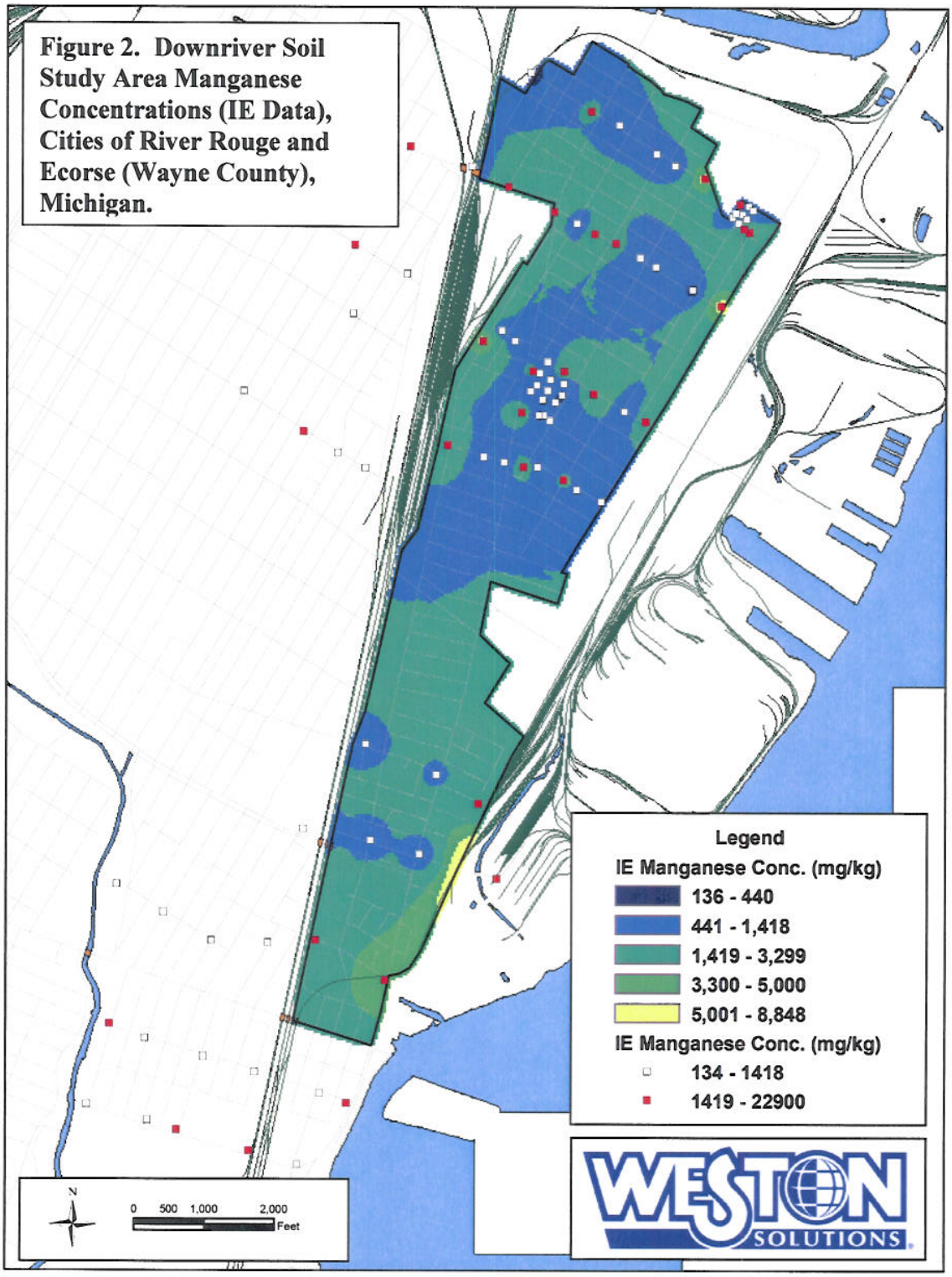
Figure 2. Downriver Soil Study Area Manganese Concentrations (IE Data), Cities of River Rouge and Ecorse (Wayne County), Michigan.
Legend
IE Manganese Conc. (mg/kg)
136 - 440
441 - 1,418
1,419 - 3,299
3,300 - 5,000
5,001 - 8,848
IE Manganese Conc. (mg/kg)
134 - 1418
1419 - 22900
N
0 500 1,000 2,000
Feet
WESTON SOLUTIONS

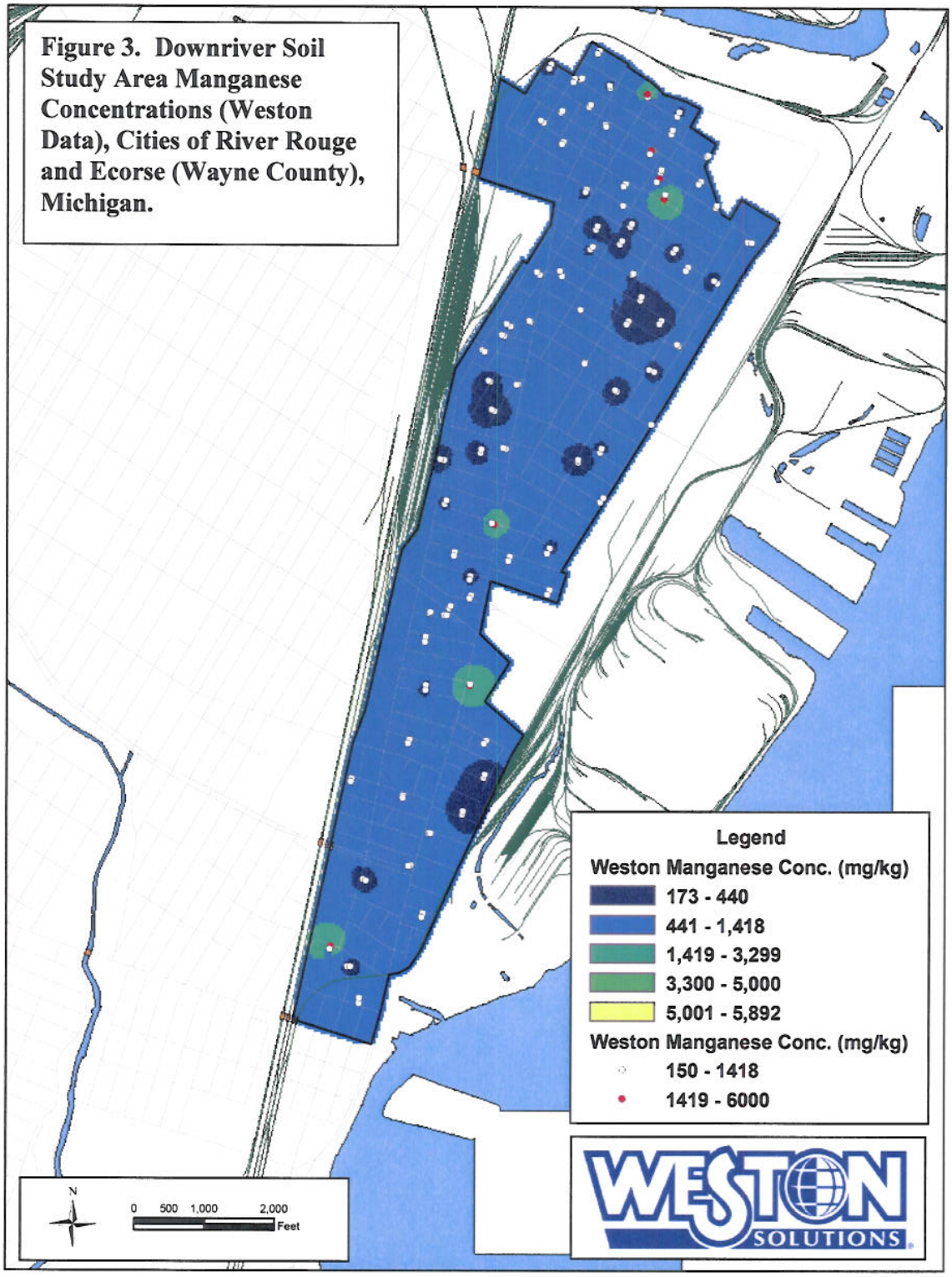
Figure 3. Downriver Soil Study Area Manganese Concentrations (Weston Data), Cities of River Rouge and Ecorse (Wayne County), Michigan.
Legend
Weston Manganese Conc. (mg/kg)
173 - 440
441 - 1,418
1,419 - 3,299
3,300 - 5,000
5,001 - 5,892
Weston Manganese Conc. (mg/kg)
150 - 1418
1419 - 6000
N
0 500 1,000 2,000
Feet
WESTON SOLUTIONS

MDEQ determines the generic PSIC value for a source assuming a one-half acre source size. For large source area sizes, a modifier is applied to the generic value to obtain a screening value. Appendix A contains further discussion regarding modifiers and other PSIC considerations. The Downriver Soil Study Area covers about 700 acres. Although most soil sampling locations were in residential areas, some were taken from industrial properties. Table 1 shows the manganese soil concentrations in the Downriver Soil Study Area, the comparison to the residential and industrial generic (for one-half acre) PSIC, and the comparison to the residential and industrial screening-value PSIC.

The exposure route of concern at this site is inhalation of airborne manganese, regardless of source. Therefore, MDCH asked the MDEQ Air Quality Division for local ambient air monitoring data for manganese particulates. MDEQ maintains an air monitoring station in the city of River Rouge. The station has been at its current location since 1971, however air data for metals have been collected only since 1994. Table 2 shows the average (annualized) ambient air concentrations for manganese, reported as Total Suspended Particulates (TSP), at the River Rouge station for the years 1994 through 2005.

The table also compares reported concentrations to the U.S. Environmental Protection Agency (EPA) Reference Concentration (RfC) and the ATSDR chronic Minimal Risk Level (MRL) for manganese. The RfC and the chronic MRL represent long-term exposure concentrations below which adverse human health effects should not be expected. (More discussion regarding these comparison values and the health effects of excessive exposure to manganese is in the *Toxicological Evaluation* section of this document.) Note that the comparison values are based on "PM10" (particulate matter less than 10 microns in aerodynamic diameter) and not TSP. The EPA Office of Air Quality Planning and Standards recommends the use of PM10 for risk assessment (EPA 2002). However, only about 25 national air monitoring sites report PM10 metals whereas about 73 sites report TSP to EPA's Air Quality System database (EPA 2006). MDEQ historically has collected TSP metals at most of its air monitoring stations, although PM10 and PM2.5 (particulate matter less than 2.5 microns in aerodynamic diameter) metals are collected at some sites. The River Rouge air monitoring location does not report PM10 or PM2.5 (MDEQ 2005).

The U.S. Steel Great Lakes Works is an operating facility. Thus, it cannot be readily determined from the air monitoring data what proportion of the manganese TSP concentration is soil-derived versus stack- or fugitive-emission-derived. However, the data in Table 2 indicate that airborne manganese particulates in the city of River Rouge have consistently exceeded comparison values set by regulatory and public health agencies. Exceeding a screening or comparison value does not necessarily mean that negative health effects are guaranteed. Further evaluation of exposure pathways and exposed populations is necessary.

Table 1. Manganese soil concentrations in the Downriver Soil Study Area (cities of River Rouge and Ecorse), Wayne County, Michigan, and comparison to generic and screening-value criteria. (Concentrations in parts per million [ppm]. Data collected June 2001 through December 2005.)

Data source	**No. samples**	**Concentration Range**	**Generic PSIC for 1/2-acre (No. exceedances)**		**Screening Value PSIC for 1,000 acres (No. exceedances)**	
			Residential	*Industrial*[2]	*Residential*	*Industrial*[2]
IE	99	134 – 22,900	3,300 (13)	1,500 (31)	1,155 (41)	525 (73)
Weston	181[1]	150 – 6,000	3,300 (3)	1,500 (7)	1,155 (15)	525 (77)

References: MDEQ 2004, IE 2005, Weston 2006

Acronyms/Abbreviations:

IE Integrated Environmental, Inc.
PSIC Particulate Soil Inhalation Criterion
Weston Weston Solutions of Michigan, Inc.

Notes:

1. Weston "No. samples" includes duplicates. If both a sample and its duplicate exceeded the criterion, MDCH only counted it as one exceedance.
2. Industrial PSIC typically are more restrictive than Residential PSIC. See Appendix A for further discussion.

Table 2. Average annual ambient air concentrations of manganese, as Total Suspended Particulates, in River Rouge, Michigan, from 1994 to 2005, and comparison to federal regulatory or screening values. (Concentrations reported in micrograms per cubic meter [$\mu g/m^3$]. Bolded years exceeded at least one comparison value.)

Year	No. measurements	Average concentration	RfC[A] (Exceeded?)	Chronic MRL[A] (Exceeded?)
1994	30	0.07	0.05 (yes)	0.04 (yes)
1995	30	0.05	0.05 (no)	0.04 (yes)
1996	29	0.06	0.05 (yes)	0.04 (yes)
1997	28	0.05	0.05 (no)	0.04 (yes)
1998	20	0.08	0.05 (yes)	0.04 (yes)
1999	29	0.06	0.05 (yes)	0.04 (yes)
2000	27	0.06	0.05 (yes)	0.04 (yes)
2001	48	0.07	0.05 (yes)	0.04 (yes)
2002	54	0.07	0.05 (yes)	0.04 (yes)
2003	55	0.10	0.05 (yes)	0.04 (yes)
2004	56	0.07	0.05 (yes)	0.04 (yes)
2005	61	0.07	0.05 (yes)	0.04 (yes)

Reference: MDEQ, unpublished data, 2006; EPA 1993; ATSDR 2000

Acronyms/Abbreviations:

MRL Minimal Risk Level
RfC Reference Concentration

Note:

A. RfC and MRL values are based on PM10 (particulate matter less than 10 microns in aerodynamic diameter).

Exposure Pathways Analysis

To determine whether persons are, have been, or are likely to be exposed to contaminants, MDCH evaluates the environmental and human components that could lead to human exposure. An exposure pathway contains five elements:

- a source of contamination
- contaminant transport through an environmental medium
- a point of exposure
- a route of human exposure
- a receptor population

An exposure pathway is considered complete if there is evidence, or a high probability, that all five of these elements are, have been, or will be present at a site. It is considered either a potential or an incomplete pathway if there is no evidence that at least one of the elements above are, have been, or will be present, or that there is a lower probability of exposure. The exposure pathway elements for manganese particulates in ambient air in the cities of River Rouge and Ecorse are shown in Table 3.

Table 3. Exposure pathways analysis for manganese particulates in ambient air in and around the cities of River Rouge and Ecorse, Michigan.

Source	Environmental Transport and Media	Chemicals of Interest	Exposure Point	Exposure Route	Exposed Population	Time Frame	Status
Emissions from steel mills, other industries	Contaminated soil (from historic emissions)	Manganese	Ambient air	Inhalation, ingestion	People living, working or visiting in the area within the plume from the stack emissions	Past	Complete
						Present	Complete
						Future	Potential
	Stack emissions	Manganese	Ambient air	Inhalation, ingestion	People living, working or visiting in the area within the plume from the stack emissions	Past	Complete
						Present	Complete
						Future	Potential
Fill material	Contaminated soil	Manganese	Ambient air	Inhalation, ingestion	People living, working, or visiting in areas on or near fill material	Past	Complete
						Present	Complete
						Future	Potential
NOTE: THE PRESENCE OF A COMPLETE EXPOSURE PATHWAY IN THIS TABLE DOES NOT IMPLY THAT AN EXPOSURE WOULD BE SUBSTANTIVE OR THAT AN ADVERSE HEALTH EFFECT WOULD OCCUR.							

Former and current steel mills and other metal works facilities in and around the cities of River Rouge and Ecorse likely contributed to the elevated manganese in area soils. For example, MDCH conducted a health consultation for the former Mill Street Plant in Ecorse, which is a former steel mill being redeveloped for residential and commercial use (ATSDR 2005). The Mill Street Plant site had high manganese levels in on-site soils. (Off-site soils were not evaluated). Due to the presence of manganese-contaminated soil, River Rouge and Ecorse residents will likely continue to be exposed to elevated levels of manganese in airborne soils in the foreseeable future.

U.S. Steel is an operating facility with known stack emissions. Other area industries that may be affecting manganese levels in ambient air include the facilities within the Rouge Manufacturing Complex, which is west of the Downriver Soil Study Area. River Rouge and Ecorse residents will likely continue to be exposed to elevated levels of manganese in ambient air from stack emissions in the foreseeable future.

Much of the development along the Detroit River is built on fill material (S. Hoin, MDEQ-RRD, personal communication, 2007). Fill material, which is usually slag (waste) from various industries, often contains elevated concentrations of metals. It is possible that some of the manganese contamination of the soil in the River Rouge and Ecorse areas is due to the soil actually being fill and not native material. Area residents will likely continue to be exposed to elevated levels of manganese in airborne fill material in the foreseeable future.

Although the exposure route of concern at this site is inhalation, ingestion of airborne particulates often occurs following inhalation. Smaller particulates will usually deposit in the lungs and alveoli whereas larger particles may adhere to the trachea and throat lining. The mucosa moves the deposited material upward toward the mouth. When a person coughs, the particles are expelled from the respiratory tract and may be spit out or swallowed. A person may also experience oral exposure via incidental ingestion of contaminated soil. However, ingestion of manganese, as discussed in the *Toxicological Evaluation* section below, is of less public health concern than inhalation of the metal and is not considered an exposure pathway of concern in the Downriver Soil Study Area.

Dermal exposure to airborne manganese particulates is not a health concern and was omitted from the exposure pathway analysis in Table 3.

Toxicological Evaluation

Manganese

Manganese is a naturally occurring metal as well as an essential trace element. It is used in the manufacture of various types of steel, in the production of batteries, dietary supplements, and some pesticides and fertilizers. Many foods contain manganese, especially nuts, legumes, grains, and tea. Insufficient dietary manganese can lead to slowed blood clotting, skin problems, changes in hair color, and alterations in metabolism (ATSDR 2000).

Humans exert an efficient homeostatic control over ingested manganese in the body. The body absorbs and uses what is nutritionally necessary and excretes the remainder. Thus, ingested manganese has rarely been associated with toxicity (EPA 1996). Individuals who cannot efficiently excrete excess metals from their bodies, such as persons with liver disorders, may be more at risk to potential toxicity. Patients receiving total parenteral nutrition (elemental liquid-form nutrition delivered intravenously because the person cannot or should not obtain his nutritional needs via the gastrointestinal tract) may receive too much manganese and experience the less severe symptoms described below (ATSDR 2000).

Manganese miners or steel workers exposed to high levels of manganese dust in air may develop mental and emotional disturbances. Their body movements may become slow and clumsy. These symptoms, when associated with manganese exposure, describe a disease called "manganism." Less severe symptoms of excessive manganese exposure include difficulty in the following motor skills: holding one's hand steady, performing fast hand movements, and maintaining balance when tested. Exposed males may

experience sexual dysfunction. Inhalation of manganese-containing dust may cause respiratory problems (ATSDR 2000).

The EPA RfC and the ATSDR chronic MRL for manganese are both derived from data gathered in a study of neurological effects seen in workers exposed to manganese in a dry alkaline battery factory. The RfC and MRL are derived from an "integrated respirable dust" (PM10) concentration and not from a TSP concentration (EPA 1993, ATSDR 2000). Smaller inhaled particulates usually deposit in the lungs and alveoli, where they can be absorbed into the bloodstream and distributed via the circulatory system. Most inhaled particles larger than 5 μm deposit in the upper airways (nose and trachea) or large lower airways (bronchioles) of the respiratory system (Bascom et al. 1996). More recent toxicological data on the absorption of inhaled manganese suggests that manganese inhaled through the nose may deposit directly to the brain via the olfactory bulb, which is responsible for the sense of smell (ATSDR 2000, Dorman et al. 2002, Elder et al. 2006). It is not clear if the neurotoxic effects seen in humans are due to absorption via the olfactory bulb, via deposition to the alveoli, or a combination of two. It may not be appropriate to compare TSP concentrations from ambient air monitoring data to the RfC or MRL when evaluating public health implications. TSP would likely overestimate the risk but can be used as an initial screen of the data (EPA 2006). MDEQ has requested that EPA evaluate the new toxicological data and determine the appropriate dose metric: TSP or PM10 (MDEQ 2007a).

Children's 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 found 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. Fetal development involves the formation of the body's organs. Injury during key periods of prenatal 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 to toxicants in soil, water, or air than adults can.

Children do not appear to be any more or less sensitive than adults to the toxic effects of manganese, whether exposure is via ingestion or inhalation. Daily oral intake of small amounts of manganese is needed for growth and good health in children (ATSDR 2000). Because there are unknowns regarding the route of absorption and the appropriate dose metric, it is not clear whether the long-term exposure to airborne manganese that has occurred in the cities of River Rouge and Ecorse could cause negative health effects in children living in that area.

Community Health Concerns

MDCH is not aware of any health concerns voiced by the community or local governmental officials other than generalized concerns listed in the Class Action Complaint filed by the city of River Rouge against U.S. Steel. The city did not allege public health complaints. Rather, the suit lists potential health effects (similar to the *Toxicological Evaluation* section of this consultation) and nuisance dust events (Charfoos and Christenson 2004).

Conclusions

The public health hazard posed by the inhalation of manganese-contaminated soil in the cities of River Rouge and Ecorse is indeterminate. (Appendix B describes ATSDR's public health hazard categories.) It is evident that ambient air has contained elevated levels of manganese as TSP for some years. However, it is not clear to what extent airborne soil has contributed to the TSP. Also, it is not clear whether TSP or PM10 should be the appropriate dose metric to evaluate risk.

Further local investigation is needed to determine the contribution made by soils to airborne manganese in the Downriver Soil Study Area. Investigative efforts should be expanded to include nearby, ongoing sources of manganese emissions, such as the U.S. Steel Great Lakes Works facility east of the cities of River Rouge and Ecorse, since these sources likely are impacting ambient air.

Recommendations

1. Continue ambient air monitoring at the River Rouge location, adding the collection of PM10 metals.
2. Determine the increment that each source of airborne manganese contributes to ambient air levels in the Downriver Soil Study Area. This may involve comparing the "fingerprint" (manganese and other metal species present) of soil samples with that from particulates collected via air monitoring.
3. Develop site-specific PSIC (residential and industrial) for manganese for the Downriver Soil Study Area, substituting site-specific data for generic assumptions, as appropriate.
4. Reduce exposure to elevated levels of airborne manganese particulates in the cities of River Rouge and Ecorse.

Public Health Action Plan

1. MDEQ Air Quality Division will continue monitoring for manganese (as TSP), as well as arsenic, cadmium, nickel, and carbonyls, at the River Rouge air monitoring location. PM10 monitoring will be added as MDEQ funds and priorities allow.
2. MDEQ RRD, or its consultant, will collect ambient air samples at several locations and use the data to determine what proportions of manganese are stack-derived, soil-derived, or derived from another source. (Weston has written a workplan for this investigation.)

3. MDEQ RRD, or its consultant, will gather on-site data from major sources in the Downriver Soil Study Area (such as the U.S. Steel property) and use local meteorological data to develop a site-specific PSIC. (Weston has written a workplan for this investigation.)
4. MDEQ will oversee efforts to reduce emissions (from stacks, soil, or other points) to ambient air made by industrial sources of manganese TSP to the Downriver Soil Study Area.

If any citizen has additional information or health concerns regarding this public health consultation, please contact the MDCH Division of Environmental and Occupational Epidemiology at 1-800-648-6942. ATSDR and MDCH remain available for further consultation on this site.

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. ATSDR, Division of Health Assessment and Consultation. Guidance on Including Child Health Issues in Division of Health Assessment and Consultation Documents. July 2, 1998.

Agency for Toxic Substances and Disease Registry (ATSDR). Health consultation concerning the Mill Street Plant Brownfield Redevelopment Assessment. Atlanta: U.S. Department of Health and Human Services; 2005 March 2.

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for manganese. Atlanta: US Department of Health and Human Services; 2000 Sept. http://www.atsdr.cdc.gov/toxprofiles/tp151.html

Bascom, R., P. A. Bromberg, D. A Costa, R. Devlin, D. W. Dockery, M. W. Frampton, W. Lambert, J. M. Samet, F. E. Speizer, and M. Utell. 1996. Health effects of outdoor air pollution. Am. J. Respir. Crit. Care Med. 153:3-50.

Charfoos and Christenson, P.C. 11/30/2004. City of River Rouge vs. United States Steel Corporation. U.S. District Court, Eastern District of Michigan, Southern Division. http://www.c2lawfirm.com/FINAL_CITY_COMPLAINT.doc

Dorman, D. C., K. A. Brenneman, A. M. McElveen, S. E. Lynch, K. C. Roberts, and B. A. Wong. 2002. Olfactory transport: a direct route of delivery of inhaled manganese phosphate to the rat brain. J. Toxicol. Environ. Health A. 65(20):1493-1511.

Elder, A., R. Gelein, V. Silva, T. Feikert, L. Opanashuk, J. Carter, R. Potter, A. Maynard, Y. Ito, J. Finkelstein, and G. Oberdöster. 2006. Translocation of inhaled ultrafine manganese oxide particles to the central nervous system. Environ Health Perspect 114:1172-1178.

Integrated Environmental, Inc. (IE). Compilation of environmental data pertaining to the Draft Initial Renewable Operating Permit for United States Steel Great Lakes Works (SRN: A7809), Ecorse, Wayne County. Livonia (MI): Integrated Environmental, Inc., prepared on behalf of the City of River Rouge, Wayne County, Michigan; received by Michigan Department of Environmental Quality 2005 Feb. IE Project No. 123002.

Michigan Department of Environmental Quality (MDEQ). Detroit Air Toxics Initiative risk assessment report. Lansing (MI): MDEQ Air Quality Division; 2005 Nov. http://www.michigan.gov/documents/DATI_-_COMPLETE_FINAL_REPORT_11-9-05_142053_7.pdf

Michigan Department of Environmental Quality (MDEQ). Letter to U.S. Environmental Protection Agency from MDEQ Air Quality Division Air Toxics Unit concerning Docket ID No. EPA-HQ-ORD-2006-0950. Lansing, Michigan. January 19, 2007 (2007a).

Michigan Department of Environmental Quality (MDEQ). Remediation and Redevelopment Division Operational Memorandum No. 1 Part 201 Cleanup Criteria and Part 213 Risk-Based Screening Levels; 2004 December 10. http://www.michigan.gov/deq/0,1607,7-135-3311_4109_9846_30022-101581--,00.html.

Michigan Department of Environmental Quality (MDEQ). Part 201 Generic Soil Inhalation Criteria for Ambient Air: Technical Support Document – Draft Document. Lansing (MI): MDEQ Remediation and Redevelopment Division; 2007 February (2007b).

RTI International (RTI). Evaluation of PM2.5 emissions and controls at two Michigan steel mills and a coke oven battery. Research Triangle Park (NC): RTI International; 2006 Feb. Work assignment 4-12 under EPA Contract No. 68-D-01-073.

U.S. Environmental Protection Agency (EPA). Integrated Risk Information System – Manganese (CASRN 7439-96-5): Reference Concentration for Chronic Inhalation Exposure (RfC). Last revised 12/1/1993. http://www.epa.gov/iris/subst/0373.htm#refinhal

U.S. Environmental Protection Agency (EPA). Integrated Risk Information System – Manganese (CASRN 7439-96-5): Reference Dose for Chronic Oral Exposure (RfD). Last revised 5/1/1996. http://www.epa.gov/iris/subst/0373.htm#reforal

U.S. Environmental Protection Agency (EPA). Quality assurance guidance document – model quality assurance project plan for the national air toxics trends stations. Research Triangle Park (NC): EPA Office of Air Quality Planning and Standards; 2002 Dec. Report No.: EPA454/R-02-007. http://www.epa.gov/ttnamti1/airtoxqa.html

U.S. Environmental Protection Agency (EPA). Responses to peer review comments on general issues for all indicators (concerning Air chapter of 2007 Report on Environment). oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=455822

Weston Solutions of Michigan, Inc. (Weston). Phase II Summary Report (draft), Downriver Soil Assessment Project, Cities of River Rouge and Ecorse, Wayne County, Michigan. Detroit: Weston Solutions of Michigan, Inc; 2006 July. W. O. No. 20083.064.001.

Certification

This **Public Health Implications of Inhalation of Manganese in Downriver Soils (Cities of River Rouge and Ecorse) 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. Editorial review was completed by the cooperative agreement partner.

Technical Project Officer, Cooperative Agreement Program Evaluation Branch (CAPEB), Division of Health Assessment and Consultation (DHAC), ATSDR

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

Team Leader, CAPEB, DHAC, ATSDR

Appendix A. Particulate Soil Inhalation Criteria: Considerations for the Downriver Soil Study Area

The MDEQ Particulate Soil Inhalation Criteria (PSIC) address the emission and dispersion of contaminated soil particulates into the ambient air. The generic PSIC identify concentrations of hazardous substances in soil that, upon becoming airborne particulates, are not expected to impact ambient air at levels that may cause adverse human health effects. The criteria are intended to be protective of chronic human health effects and may not be protective of other endpoints such as acute human health effects, odors, physicals hazards, nuisance dust conditions, or ecological impacts (MDEQ 2007b).

An MDEQ-RRD work group currently is revising the ambient air Technical Support Document (TSD) to include issues regarding application of the PSIC and the derivation of site-specific criteria. The work group includes toxicologists and other staff from RRD, the Air Quality Division, and the Waste and Hazardous Materials Division. MDEQ has indicated that the revised document is nearing completion and adoption and that the draft TSD may be cited (D. Stemm, MDEQ-RRD, personal communication, 2007).

To calculate the PSIC for non-cancer-causing chemicals, such as manganese, MDEQ assumes that the contaminated soil is the only source of the chemical (versus fugitive or stack emissions, or other sources). The agency also considers exposure frequency and duration, the MDEQ air screening level for the chemical of interest, and the Particulate Emission Factor (PEF). The PEF relates the concentration of a particulate contaminant in ambient air to the corresponding concentration of contaminant in soil, accounting for its emission and subsequent dispersion. The PEF is affected by several parameters: an **air-dispersion factor, emission due to vehicle traffic, emission due to wind**, and the **vegetative cover** on the source area (MDEQ 2007b).

The default values for the **air-dispersion factor (Q/C)** and **emission due to vehicle traffic (Ev)** are calculated assuming a half-acre source area size. MDEQ air modelers have determined appropriate modifiers for source area sizes different from one-half acre. Larger source areas result in a modifier less than 1, whereas smaller source areas result in a modifier greater than 1. For large sites under investigation, risk assessors first apply the 1,000-acre modifier (0.35) to the generic one-half acre PSIC value in the Part 201 criteria tables to obtain a screening value. (Note that a screening value is *not* a clean-up value.) Areas with soil concentrations exceeding the screening value are identified as source areas. Individual source area sizes are summed to yield a total source area size. The modifier closest to this sum is then applied to the generic (half-acre) PSIC, resulting in the applicable PSIC. The applicable PSIC is compared only to those soil concentrations that exceeded the screening value. Those areas exceeding the applicable PSIC are targeted for remedial action consideration (MDEQ 2007b).

The source area may include both on-site (such as an industrial site) and off-site (areas to which emissions deposited, such as residential neighborhoods) soils. MDEQ-RRD requires the evaluation of potential off-site migration of contamination and risk to off-property receptors. Contamination emitted from all source areas likely will commingle in

ambient air and may result in a greater concentration than that from a single source area. Source areas must be adequately characterized to determine if the variability in the data indicate considering the individual source areas separately (MDEQ 2007b).

As discussed in this health consultation, the Downriver Soil Study Area is approximately 700 acres. However, if soils on the U.S. Steel Great Lakes Works property are also considered, since they may be impacting local ambient air as well, the total acreage under investigation could exceed 1,500 acres. (The main plant area for U.S. Steel, in the city of Ecorse, is 682 acres. This does not include the hot strip mill facility, in the city of River Rouge, nor the facilities on Zug Island [RTI 2006].) A modifier calculated for a 1,500-acre potential source area could result in a screening value below expected background concentrations. If this occurs, then the screening value would default to the background value.

Ev assumes that the vehicles in question are passenger automobiles. For the generic PSIC, MDEQ assumes more vehicle traffic (50 versus 10 round trips per day) over longer (45 versus 20 meters), unpaved driveways at industrial sites. (This is why the Industrial PSIC is more restrictive, or lower, than the Residential PSIC.) At facilities where trucks and other heavy equipment are expected to be present, further facility-specific evaluation is necessary to derive an industrial/commercial Ev (MDEQ 2007b). If the U.S. Steel Great Lakes Works property were included in the site assessment for the Downriver Soil Study Area, it would be necessary to derive a site-specific industrial Ev.

Emission due to wind (Ew) and **vegetative cover (V)** are considered together when determining the PEF. The default Ew uses meteorological data from three sites that MDEQ uses routinely for air modeling and considers representative of wind conditions in Michigan. For site-specific calculations, wind data can be taken from the nearest airport with meteorological equipment or can be gathered locally. Unless the percent vegetative cover is known, the central tendency of 50 percent is used (MDEQ 1998).

MDEQ guidance regarding the compliance with the PSIC states that ambient air monitoring may be used to determine that contaminant concentrations in facility soils will not result in unacceptable inhalation exposures at Part 201 facilities (MDEQ 1998). U.S. Steel is still operating. It may be difficult to determine compliance unless the contribution each manganese source (stack emissions, fugitive emissions, and contaminated soil) to ambient air levels can be determined.

Appendix B. ATSDR Public Health Hazard Categories

Depending on the specific properties of the contaminant(s), the exposure situations, and the health status of individuals, a public health hazard may occur. Sites are classified using one of the following public health hazard categories:

Urgent Public Health Hazard
This category applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects. These sites require quick intervention to stop people from being exposed. ATSDR will expedite the release of a health advisory that includes strong recommendations to immediately stop or reduce exposure to correct or lessen the health risks posed by the site.

Public Health Hazard
This category applies to sites that have certain physical hazards or evidence of chronic (long-term, more than 1 year), site-related exposure to hazardous substances that could result in adverse health effects. ATSDR will make recommendations to stop or reduce exposure in a timely manner to correct or lessen the health risks posed by the site.

Indeterminate Public Health Hazard
This category applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard. ATSDR will make recommendations to identify the data or information needed to adequately assess the public health risks posed by this site.

No Apparent Public Health Hazard
This category applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects. ATSDR may recommend any of the following public health actions for sites in this category:

- cease or further reduce exposure (as a preventive measure)
- community health/stress education
- health professional education
- community health investigation.

No Public Health Hazard
This category applies to sites where no exposure to site-related hazardous substances exists. ATSDR may recommend community health education for sites in this category.

For more information, consult Chapter 9 and Appendix H in the 2005 ATSDR Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/HAC/PHAManual/index.html).