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Subject:

Proposed Approach and Exposure Parameters for the Future Recreational Use Scenario at the RACER Saginaw Malleable Industrial Land Located in Saginaw, Michigan

Introduction

Historical activities have impacted the RACER Saginaw Malleable Industrial Land (SMI) Plant property, the former Green Point Landfill, and the Peninsula property. Previous risk evaluations and recommended institutional and engineering controls have focused on future industrial use of the properties. However, the properties are being considered for redevelopment and use as a passive recreational area.

Based on the potential future land use, the following sections provide a brief overview of the approach that could be used to identify constituents of potential concern (COPCs) for soil, sediment, and surface water at the properties, and the risk evaluation approach and exposure parameters to evaluate the recreational scenario.

In addition, in order to evaluate the recreational use risk assessment; example recreational screening levels were developed for arsenic and vanadium in soil and sediment using the proposed MDEQ residential soil Direct Contact Criteria equations and the proposed exposure parameters. Recreational screening levels for lead in soil were also calculated using the United States Environmental Protection

Agency's (USEPA's) Integrated Exposure Uptake Biokinetic (IEUBK) Model (USEPA 2010) by modifying input values based on the proposed recreational exposure parameters.

Identification of Constituents of Potential Concern

As the first step in the risk evaluation process soil, sediment, and surface water data available for the site will be compared to the Michigan Department of Environmental Quality (MDEQ; 2016) draft proposed non-residential screening levels to identify COPCs to evaluate exposure of future hypothetical recreational users of the properties. Soil and sediment data will be compared to the non-residential soil Direct Contact Criteria, Particulate Soil Inhalation Criteria, and Infinite Source Volatile Soil Inhalation Criteria. Surface water data will be compared to the Groundwater Surface Water Interface Criteria, which consist of the available human health and ecological health screening levels. Constituents with maximum concentrations exceeding their respective criteria will be identified as COPCs for that medium.

Consistent with the proposed MDEQ Part 201 Rule changes, concentration data for the carcinogenic polycyclic aromatic hydrocarbons (PAHs) will be converted to benzo(a)pyrene equivalents using the toxic equivalence factors (TEFs) and summed. The total benzo(a)pyrene equivalents value will be compared to the benzo(a)pyrene criteria.

Risk Evaluation Approach and Proposed Recreational Exposure Parameters

COPCs identified through the screening evaluation will be carried through to the risk evaluation. Anticipated exposure to environmental media include the following:

- Incidental ingestion of and dermal contact with soil, and inhalation of volatiles and particulates emanating from soil.
- Incidental ingestion of and dermal contact with sediments while wading in surface water or playing in sediments.
- Incidental ingestion of and dermal contact with surface water while wading in surface water.

Exposure point concentrations will be calculated as 95 percent (%) upper confidence limits on the mean (95% UCLs) using United States Environmental Protection Agency's (USEPA's) ProUCL software (USEPA 2013), or the maximum detected concentration if a 95% UCL is not able to be calculated or if the 95% UCL is greater than the maximum detected concentration.

Tables 1, 2, and 3 provide proposed recreational use exposure parameters for soil, sediment, and surface water, respectively. Where available and appropriate, the proposed MDEQ (2016) default parameters for residential scenarios were proposed (e.g., body weights, skin surface area, soil ingestion rates). However, scenario-specific exposure parameters are proposed for exposure frequency, fraction ingested from the source (soil and sediment), and skin surface area for sediment and surface water contact, as well as other exposure parameters. The source for each exposure parameter is provided in the tables.

Excess lifetime cancer risks (ELCRs) and noncancer hazard quotients (HQs) will be calculated for each applicable COPC using standard MDEQ and USEPA risk equations, proposed MDEQ toxicity values (MDEQ 2016), and the exposure parameters identified in Tables 1 through 3. If mutagenic COPCs are identified, the appropriate age groups will be evaluated and the age-dependent adjustment factors (ADAFs) will be applied, consistent with the proposed MDEQ Part 201 Rule changes (MDEQ 2016).

ELCRs and HQs will be summed by exposure medium and an overall ELCR and hazard index (sum of the HQs) will be calculated. If the overall ELCR is equal to or below 1×10^{-5} and the overall HI is below 1, then

no additional evaluation is required. If the overall ELCR is above 1×10^{-5} or the overall HI is above 1, additional evaluation will be completed to determine if institutional and/or engineering controls will be required to bring the ELCR and/or HI to below the acceptable levels.

Lead will be evaluated using the USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model (USEPA 2010) and the adult lead model (ALM; USEPA 2003).

Example Constituent Exposure Evaluation

Recreational screening levels for soil and sediment were developed for arsenic and vanadium using the MDEQ residential soil Direct Contact Criteria equations and the proposed exposure parameters, including a fraction ingested term (to account for only being onsite for 2 hours per day). The resulting recreational screening levels for soil and sediment are as follows:

- Soil:
  - Arsenic = 100 mg/kg
  - Vanadium = 48 mg/kg
- Sediment:
  - Arsenic = 74 mg/kg
  - Vanadium = 26 mg/kg

The sediment screening levels are lower due to a higher dermal exposure component since wet sediment adheres to skin at a higher rate than dry soil.

A recreational soil screening level was also calculated for lead using the USEPA's IEUBK Model for childhood exposures and the ALM for adult exposures. The default soil ingestion rates in the IUEBK model were adjusted to account for 100 days of exposure (versus 365 days for the default). The calculated recreational screening level for lead in soil are as follows:

- Childhood exposures = 673 mg/kg
- Adult exposures = 1,700 mg/kg

The calculated recreational soil screening levels for arsenic, vanadium, and lead are at higher concentrations than the current and proposed MDEQ non-residential soil Direct Contact criteria, which are 37/52 mg/kg, 5,500/33 mg/kg, and 900/330 mg/kg, respectively, except for the current vanadium criteria. It should be noted that the example calculations did not include constituents that are carcinogenic through a mutagenic mode of action or have noncarcinogenic developmental endpoints. Additional evaluation is ongoing to determine if the non-residential soil Direct Contact Criteria are also lower than calculated recreational screening levels for constituents with these endpoints.

Conclusions

Based on the example recreational soil screening level calculations, screening the available data using the non-residential soil criteria will likely conservatively identify COPCs to evaluate exposure of potential future recreational users of the properties. Additional data evaluation or a risk evaluation will be completed for the COPCs identified to determine if planned exposure controls (e.g., engineering or institutional controls) will be adequate to limit potential exposures that could result in risks above the MDEQ target risk levels, or if additional exposure controls will be required.

References

MDEQ. 2016. 2015-094 EQ. Remediation and Redevelopment Division. Environmental Contamination Response Activity. Cleanup Criteria Requirements for Response Activity. Office of Regulatory Reinvention. Proposed rule revisions dated April 27, 2016. Available online at: http://w3.lara.state.mi.us/orr/Rules.aspx?type=dept&id=EQ.

USEPA. 2003. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. EPA-540-R-03-001. January.

USEPA. 2010. Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows® Version (IEUBKwin v1.1 build 11). Available at http://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals#users. February.

USEPA. 2013. ProUCL Version 5.0.00 Technical Guide, Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September.

Table 1
Summary of Proposed Surface Soil Exposure Parameters for a Recreational Scenaio
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Parameter Symbol	Parameter Definition	Units	Proposed Value		Reference (Notes)
			Adult	Child	
Soil Ingestion					
IR-S	Ingestion Rate - Soil	mg/day	89	179	MDEQ 2016
AE_o	Oral Absoption Efficiency	unitless	Chemical-specific	Chemical-specific	MDEQ 2016
FI	Fraction Ingested from source	unitless	0.125	0.125	PJ (1)
EF	Exposure Frequency	days/years	100	100	PJ (2)
ED	Exposure Duration	years	26	6	MDEQ 2016 (3)
BW	Body Weight	kg	80	15	MDEQ 2016, USEPA 2014
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-Cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989
Soil Dermal Contact					
AF	Soil to Skin Adherence Factor	mg/cm²	0.07	0.3	MDEQ 2016
AE_d	Dermal Absorption Efficiency	unitless	Chemical-specific	Chemical-specific	MDEQ 2016
SA	Skin Surface Area Available for Contact	cm^2/day	6,000	2,400	MDEQ 2016
EF	Exposure Frequency	days/years	100	100	PJ (2)
ED	Exposure Duration	years	26	6	MDEQ 2016
BW	Body Weight	kg	80	15	MDEQ 2016, USEPA 2014
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-Cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989
Soil Inhalation					
EF	Exposure Frequency	days/year	100	100	PJ (2)
ED	Exposure Duration	years	26	6	MDEQ 2016
ET	Exposure Time	hours/day	2	2	PJ (1)
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-Cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989

Notes
(1) Represents 2 hours per day spent at the site.
(2) Assumes exposure occurs 5 days per week, 5 months (approximately 20 weeks) per year.
(3) MDEQ (2016) defualt residential expousre duration of 32 years (6 years as child, 26 years as adult) used.
(4) Assumes that dermal contact with soil is expected to occur on the head, hands, forearms, and lower legs of an adult and the head, hands, forearms, lower legs and feet of a child. Values are rounded to two significant figures.

References

MDEQ 2016 MDEQ. 2016. 2015-094 EQ. Remediation and Redevelopment Division. Environmental Contamination Response Activity. Cleanup Criteria Requirements for Response Activity. Office of Regulatory Reinvention. Proposed rule revisions dated April 27, 2016. Available online at: http://w3.lara.state.mi.us/orr/Rules.aspx?type=dept&id=EQ.

USEPA 1989 Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.

USEPA 2014 Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6.

Definitions
cm²/day - square centimeter per day
kg - kilogram
mg/cm² - milligram per square centimeter
mg/day - milligram per day
MDEQ - Michigan Department of Environmental Quality
PJ - professional judgment
USEPA - United States Environmental Protection Agency

Table 2
Summary of Proposed Sediment Exposure Parameters for a Recreational Scenaio
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Parameter Symbol	Parameter Definition	Units	Proposed Value		Reference (Notes)
			Adult	Child	
Sediment Ingestion					
IR-Sed	Ingestion Rate - Sediment	mg/day	20	50	USEPA 2011 (1)
AE_o	Oral Absoption Efficiency	unitless	Chemical-specific	Chemical-specific	MDEQ 2016
FI	Fraction Ingested from source	unitless	0.125	0.125	PJ (2)
EF	Exposure Frequency	days/years	100	100	PJ (3)
ED	Exposure Duration	years	26	6	MDEQ 2016 (4)
BW	Body Weight	kg	80	15	MDEQ 2016, USEPA 2014
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-Cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989
Sediment Dermal Contact					
AF	Sediment to Skin Adherence Factor	mg/cm²	0.3	0.3	USEPA 2004 (5)
AE_d	Dermal Absorption Efficiency	unitless	Chemical-specific	Chemical-specific	MDEQ 2016
SA	Skin Surface Area Available for Contact	cm²/day	6,100	1,700	USEPA 2011 (6)
EF	Exposure Frequency	days/years	100	100	PJ (3)
ED	Exposure Duration	years	26	6	MDEQ 2016 (4)
BW	Body Weight	kg	80	15	MDEQ 2016, USEPA 2014
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-Cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989

Notes

(1) Sediment ingestion rates are the central tendency value for soil for <1 to 6 year olds and adults from Table 5-1 of USEPA 2011.
(2) Represents 2 hours per day spent at the site.
(3) Assumes exposure occurs 5 days per week, 5 months (approximately 20 weeks) per year. Exposure frequency may be overly conservative, as it is not likely that a recreational user would be exposed to sediment at the same frequency as soil.
(4) MDEQ defualt residential expousre duration of 32 years (6 years as child, 26 years as adult) used.
(5) AF for sediment based on mean AF for reed gatherers as presented in Table C-2 of USEPA 2004.
(6) Assumes hands, forearms, feet and lower legs are exposed during wading. Value is rounded to two significan figures.

References

MDEQ 2016 MDEQ. 2016. 2015-094 EQ. Remediation and Redevelopment Division. Environmental Contamination Response Activity. Cleanup Criteria Requirements for Response Activity. Office of Regulatory Reinvention. Proposed rule revisions dated April 27, 2016. Available online at: http://w3.lara.state.mi.us/orr/Rules.aspx?type=dept&id=EQ.

USEPA 1989 Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.

USEPA 2004 Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. EPA/540/R99/005, OSWER 9285.7-02EP, PB99-963312. July.

USEPA 2011 Exposure Factors Handbook 2011 Edition (Final). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F.

USEPA 2014 Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6.

Definitions

cm²/day - square centimeter per day
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mg/cm² - milligram per square centimeter
mg/day - milligram per day
MDEQ - Michigan Department of Environmental Quality
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Table 3
Summary of Proposed Surface Water Exposure Parameters for a Recreational Scenaio
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Parameter Symbol	Parameter Definition	Units	Proposed Value		Reference (Notes)
			Adult	Child	
Surface Water Ingestion					
IR-W	Ingestion Rate of Water	liters/hour	0.0037	0.0037	USEPA 2011 (1)
EF	Exposure Frequency	days/year	100	100	PJ (2)
ED	Exposure Duration	years	26	6	MDEQ 2016 (3)
ET	Exposure Time	hours	2	2	PJ (4)
BW	Body Weight	kg	80	15	MDEQ 2016, USEPA 2014
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-Cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989
Surface Water Dermal Contact					
EV	Event frequency	events/day	1	1	USEPA 2004
SA	Skin Surface Area Available for Contact	cm^2	6,100	1,700	USEPA 2011 (5)
EF	Exposure Frequency	days/years	100	100	PJ (1)
ED	Exposure Duration	years	26	6	MDEQ 2016 (3)
ET	Exposure Time	hours	2	2	PJ (4)
BW	Body Weight	kg	80	15	MDEQ 2016, USEPA 2014
AT-C	Averaging Time (Cancer)	days	28,470	28,470	MDEQ 2016
AT-N	Averaging Time (Non-cancer)	days	9,490	2,190	MDEQ 2016, USEPA 1989

Notes
(1) Mean hourly surface water ingestion rate for wading/splashing.
(2) Assumes wading takes place 5 days per month, 5 months (approximately 20 weeks) per year.
(3) MDEQ (2016) defualt residential expousre duration of 32 years (6 years as child, 26 years as adult) used.
(4) Represents 2 hours per day spent at the site.
(5) Assumes hands, forearms, feet and lower legs are exposed during wading. Value is rounded to two significan figures.

References

MDEQ 2016 MDEQ. 2016. 2015-094 EQ. Remediation and Redevelopment Division. Environmental Contamination Response Activity. Cleanup Criteria Requirements for Response Activity. Office of Regulatory Reinvention. Proposed rule revisions dated April 27, 2016. Available online at: http://w3.lara.state.mi.us/orr/Rules.aspx?type=dept&id=EQ.

USEPA 1989 Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.

USEPA 2004 Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. EPA/540/R99/005, OSWER 9285.7-02EP, PB99-963312. July.

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USEPA 2014 Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6.

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