Site-Specific Risk Assessment for Human Health from Hazardous Waste Combustion: Veolia ES Technical Solutions, L.L.C. Sauget, Illinois

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1 Executive Summary

Veolia ES Technical Services, L.L.C. (Veolia) owns and operates three hazardous waste incinerators at its Sauget, Illinois facility (the facility). The incinerators are equipped with air-pollution control devices that include spray dryer absorbers, fabric filters and activated carbon injection systems. The facility operates under a Resource Conservation and Recovery Act (RCRA) permit issued by the Illinois Environmental Protection Agency (IEPA) and a Clean Air Act Title V permit issued by the United States Environmental Protection Agency (EPA). At the request of IEPA and the Illinois Attorney General's Office (IAG), EPA has updated the site-specific risk assessment (SSRA) it completed in 2007, based on potential incinerator emissions from the Veolia facility. EPA incorporated relevant information provided by Veolia into this new SSRA where appropriate. The purpose of this SSRA is to recommend RCRA permit limits, if necessary, that are expected to be protective of human health in the area around the facility.

The Veolia facility's incinerators' emissions are controlled under the Clean Air Act by applying Maximum Achievable Control Technology (MACT) standards in the National Emission Standards for Hazardous Air Pollutants (NESHAP) from Hazardous Waste Combustors (HWC) at 40 C.F.R. Part 63, subpart EEE. For incinerators, the MACT standards are maximum concentrations of certain pollutants in stack gas based on a national evaluation of the emissions limitation achieved by the best performing existing sources. On June 17, 2019, EPA issued the facility a Title V Permit to Operate under the Clean Air Act (June 2019 Title V Permit) that incorporates operating limits established by measuring actual emissions at the facility.

RCRA regulations provide for the evaluation of site-specific considerations relevant to the potential risk from a particular hazardous waste combustion unit. Based on an assessment of site-specific risks, this new SSRA recommends mercury and chromium limits for the Veolia RCRA permit to ensure protectiveness in the area around the facility. See Sections 10.5 (Suggested Limits for Mercury) and 10.6 (Suggested Limits for Chromium). While the results of this SSRA recommend limiting chromium emissions in the RCRA permit to an emission that would not exceed the target risk, future testing of stack-emissions for chromium-speciation could obviate the need for the recommended chromium limit.

This SSRA concludes: 1) the facility's potential mercury emissions should be limited in the RCRA permit to a proposed rate as developed in compliance with RCRA regulatory requirements so that it should not cause a hazard to residents who eat locally-caught fish; and 2) the facility's potential chromium emissions should be limited in the RCRA permit to a proposed rate as developed in compliance with RCRA regulatory requirements so that it should not cause a cancer risk to local residents.

This new SSRA has improved on the 2007 EPA SSRA by, among other things: addressing an evolved understanding of the fate of mercury in the environment, recalculating emission rates, using up-to-date air dispersion modeling, updating meteorological data, using an updated methymercury Henry's Law Constant, modifying the methylmercury bioaccumulation factor value based on a mixture of locally caught fish species, incorporating other sound parameter value inputs and adding a robust uncertainty discussion. EPA also considered the Veolia 2016 and 2017 SSRA submissions and responses to comments on those submissions (Franklin 2016, Franklin 2017, Franklin 2018). These modifications result in the methylmercury hazard index being 59-percent lower than the EPA 2007 SSRA methylmercury hazard index.

For this new SSRA, EPA researched site-specific conditions and used air-dispersion and risk assessment models to focus on the risk drivers. EPA used the AERMOD air-dispersion model as described in the report *"Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois"*(Appendix 1). EPA prepared and conducted the SSRA following the EPA guidance *"Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities"*(HHRAP)(U.S. EPA 2005a).

2 SSRA Methodology, Guidance, Models and Framework

2.1 Conceptual Model

The conceptual model for this SSRA follows potential contaminants through the facility's stack emissions; transport across air media; deposition to soil, watershed and water media; uptake to plants, animal products and fish exposure media; and potential human exposure routes.

The risk assessment methods this report describes are based on well-established human health risk assessment principles and procedures developed for the regulation of environmental contaminants. Applying these guidelines and principles provides a consistent process for evaluating and documenting potential health risks associated with environmental exposures. This report applies a risk assessment process used by federal regulatory agencies that is based on the process described by the National Research Council (NRC 1983), and consists of the following four components:

- Hazard identification: Identify the chemical substances of concern in emissions from the facility and compile, review and evaluate data relevant to the toxic properties of these substances.
- Dose-response evaluation: Evaluate the relationship between dose and response for each chemical of potential concern to derive toxicity values that can be used to estimate the incidence of adverse effects occurring at different exposure levels.
- Exposure assessment: Identify potential exposure pathways and estimate the measurement of chemical exposure (e.g., concentrations for the various environmental media, or doses) for the potential exposure pathways, based upon various exposure assumptions and the characteristics of the population receiving the exposure.
- Risk characterization: Calculate numerical estimates of risk for each substance by each potential route of exposure using the toxicity information and the exposure estimates.

2.2 EPA Air-Dispersion Modeling

EPA conducted air-dispersion and deposition modeling using the AERMOD model. AERMOD is a steady-state plume model that assumes Gaussian distributions in the vertical and horizontal dimensions for stable conditions, and in the horizontal dimension for convective conditions; and a bi-Gaussian probability density function of the vertical velocity for the vertical concentration distribution. EPA determined that AERMOD is an appropriate model to use for point sources with elevated continuous releases of toxic air emissions in rural or urban areas of simple and complex terrain with receptors up to 50 kilometers from the source (U.S. EPA 2005b). EPA's *Revision to the Guidance on Air Quality Models* describes AERMOD as a significant advance over ISCST3, the model used in the 2007 EPA SSRA. Unlike ISCST3, AERMOD includes updated treatments of boundary layer theory, an understanding of turbulence and dispersion, and handling of terrain interactions (U.S. EPA 2003).

EPA performed the air-dispersion modeling with the AERMOD air-dispersion model using five-years of local meteorological data that EPA adjusted for low wind speeds, local surface characteristics, annual precipitation, winter-time snow cover and land use/land cover surrounding the facility. The modeling produced plotfiles of annual average concentrations and deposition fluxes from modeling at unit emission (1 gram per second) for particle, particle bound, vapor and divalent mercury vapor emission partitions. For complete details of the air-dispersion modeling, see *"Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois,"* (Appendix 1).

2.3 EPA Risk Assessment Model

The general model for the risk assessment analysis is contained in the EPA HHRAP (U.S. EPA 2005a). This combustion guidance outlines a comprehensive procedure for calculating estimated environmental media (e.g., air, water, soil, vegetables, fish and meat) concentrations, human intake rates and health risks caused by combustion stack chemical emissions.

The following list summarizes the basic steps in running the risk model for a facility:

1. Identify the chemicals of concern from stack emissions and assign emission rates;
2. Collect facility-specific stack data (e.g., stack height, gas exit velocity, building dimensions) and local meteorological data; use this data as inputs for the AERMOD air dispersion/deposition model;
3. Collect data on local land use (residential locations, agricultural locations, waterbodies) and map this data in reference to facility location;
4. Combine chemical-specific emission rates with the air-dispersion model to calculate chemical-specific air concentrations and deposition rates for multiple receptor points around the facility;
5. Combine air concentrations and deposition rates with fate and transport algorithms to calculate chemical concentrations in environmental media (water, soils, plants, vegetable crops, livestock and fish);
6. Combine human intake rates for environmental media (air, water, soil, plants, vegetable crops, etc.) with estimated chemical concentrations in environmental media to determine chemical doses (i.e., intake per unit time) for each applicable exposure pathway;
7. Combine the chemical doses with chemical-specific toxicity factors (e.g., Cancer Slope Factors, Reference Doses) to calculate a Cancer Risk for potentially carcinogenic

chemicals and a Hazard Index (HI) for potentially toxic chemicals (lead and dioxin are evaluated by alternate dose-response methodologies);
8. Sum the Cancer Risks and Hazard Indices for each chemical across the applicable exposure pathways;
9. Sum the Cancer Risks and Hazard Indices for each chemical to obtain the total Cancer Risks and Hazard Index for all chemicals.

Because evaluating multiple chemicals, multiple exposure pathways, and multiple fate and transport processes presents challenging computations, EPA used a computer software program to run the risk assessment model. For this project, we used the software system called *Industrial Risk Assessment Protocol - Human Health* (IRAP-h View^{TM} v. 5.0.0). Lakes Environmental Software, Waterloo, Ontario, Canada developed this software package (abbreviated "*IRAP*" in this report) (Lakes 2015). They expressly designed IRAP to follow the recommendations, chemical-specific parameters, and fate and transport algorithms the EPA 2005 HHRAP combustion guidance specifies.

EPA does not endorse the use of the IRAP software but recognizes that the developers of IRAP designed the program to follow the recommendations of the 2005 HHRAP combustion guidance.

The major features of the IRAP system are its ability to:

1. Guide the user through the step-by-step process recommended in the 2005 HHRAP guidance;
2. Simultaneously calculate risk values (cancer risks and hazard indices) for multiple chemicals emitted from a single source or from multiple sources at multiple locations;
3. Eliminate the need to perform hand calculations and write multiple interconnected computation spreadsheets;
4. Import air-dispersion plot files containing the output from the AERMOD air-dispersion/deposition model runs;
5. Provide a graphical display of the air modeling receptor grid mode locations;
6. Directly import GIS generated land use/land cover data (e.g., residential, farming, and waterbody locations);
7. Define the perimeter of waterbodies and watersheds using a polygon drawing tool; and
8. Define an area of concern by selecting the receptor grid nodes that represent the highest modeled air-dispersion model values.

All the algorithms used in this risk assessment are presented in complete detail in the 2005 HHRAP guidance and therefore, are not duplicated in this report (U.S. EPA 2005a). Appendices 2 and 3 provide the detailed report tables of the risk model inputs, and Appendix 4 provides the complete modeled project on electronic archive.

2.4 Lead Exposure Effects Model

Exposure from lead emissions presents a special case for human health effects that cannot be characterized in terms of cancer risk or hazard, since EPA and other scientific organizations have not determined an acceptable reference dose (RfD) or reference concentration (RfC) for lead. An effect threshold level has not been established for exposure to lead. In addition, EPA has not derived a Cancer Slope Factor because neurobehavioral effects have been observed in children with blood lead below levels that have caused carcinogenic effects in laboratory animals.

Consequently, EPA has relied on the neurological effects observed in children as the sensitive endpoint for evaluating lead toxicity. This approach to analyzing the potential impact of exposure to lead differs from analysis for other metals. It estimates whether there are potential increases in blood-lead level in a subgroup of the population (i.e., children) expected to have an enhanced sensitivity to lead exposure. One can compare the child-blood lead level with a level associated with protection from adverse developmental neurological effects of lead exposure.

For the SSRA, EPA used the Integrated Exposure Uptake and Biokinetic computer model (the IEUBK model) to evaluate whether potential lead emissions from the facility could have a significant impact on the predicted blood lead level of children assumed to reside in residential neighborhoods near the facility. EPA analyzed the potential lead deposition to soil and potential lead air concentrations from the facility. The *IEUBK Model* combines estimates of lead intake from lead in air, water, soil, dust, diet, and other ingested media, with an absorption model for the uptake of lead from the lung or gastrointestinal tract, and a biokinetic model of lead distribution, and elimination from a child's body, to predict the likely distribution of blood lead for children ages six months through 84 months exposed to lead in these environmental media.

Young children are particularly sensitive to adverse health effects from low-level lead exposures. The usual biomarker of lead exposure is the concentration of lead in the child's blood. Blood lead concentration is useful not only as an indicator of recent lead exposure and historical lead exposure but also as the most widely used index of internal lead body burdens associated with potential adverse health effects. The IEUBK model can be used to predict the probability that children exposed to lead in environmental media will have blood lead concentrations exceeding a health-based level of concern (U.S. EPA 1994a).

EPA developed a computerized version of the IEUBK model that predicts blood lead levels and percentage distributions for children ranging in age from infancy to seven years (U.S. EPA 2001a). The IEUBK model accounts for the major characteristics that influence the uptake and absorption of lead from the environment, including the ability to incorporate default or site-specific values for background levels of lead in air, soil, water, and diet. At present, it is not possible to apply the IEUBK model to predict potential blood lead levels in adults. In general, however, children are more susceptible to lead exposures than adults because of their higher soil ingestion rates, higher absorption from the gut, nutritional variables, and lower body weight.

EPA uses the IEUBK model for evaluating and controlling human exposures to lead under various EPA programs including EPA's review of the 2007 National Ambient Air Quality

Standards (NAAQS) for lead, other hazardous waste combustor SSRAs in Region 5, as well as the 2007 EPA SSRA for this facility. See section 8.4.1 for further discussion.

For this risk assessment, EPA entered environmental concentrations of lead resulting from the facility's potential particulate emissions as inputs into the IEUBK model to predict if child blood lead levels could be significantly affected. The IEUBK model can be used to predict blood lead levels for an individual child or a population of children and was specifically designed to evaluate lead exposure in young children because this age group is known to display enhanced sensitivity to lead exposure. The IEUBK model is a versatile assessment tool that allows the user to make rapid calculations from a complex array of intake, absorption, distribution, and elimination equations by building site-specific and age-dependent exposure scenarios. It allows the user to input different media concentrations and dietary intake rates for lead for the set of consecutive years being modeled (i.e., different concentrations/ingestion rates can be entered for different years to reflect changing site conditions; the model does not allow a temporal resolution finer than a year). The IEUBK computer model then uses the input data to generate a yearly average blood lead level for the population modeled. The IEUBK computer model is comprised of four distinct components that work together in series:

- Exposure component – Determines how much lead enters the child's body over the exposure period. This component combines media-specific (e.g., air, soil, food, water) lead concentrations and age-dependent media intake rates to calculate age- and media-specific lead intake rates.

- Uptake Component – Calculates how much of the lead that enters the body through the exposure routes is actually absorbed into the blood.

- Biokinetic Component – Models the distribution of the lead from the blood to other body tissues and/or elimination from the body.

- Probability Distribution Component – Calculates a probability distribution of blood lead for a hypothetical child or population of children. This component calculates the geometric mean blood lead concentration; and combines that concentration with a prescribed geometric standard deviation value representing inter-individual variability in lead uptake to generate a blood lead distribution that allows the user to estimate the probability (e.g., the estimated proportion) of the target population to exceed a blood lead level of 10 ug/dL.

Lead emissions from the facility could cause an incremental addition of lead to air and soil near the facility. The air-dispersion and risk models calculated estimates of the incremental contribution of lead to ambient air and soil within the study area; and EPA used the IEUBK model to evaluate typical child residents assumed to live in the residential receptor areas within the 20-by-20-kilometer risk assessment study area.

2.5 SSRA Guiding Framework

The Veolia facility's incinerators' emissions are controlled under the Clean Air Act by applying MACT standards in the HWC NESHAP at 40 C.F.R. Part 63 subpart EEE. For hazardous waste incinerators, the MACT standards are maximum concentrations of certain pollutants in stack gas based on a national evaluation of the emissions limitations achieved by the best performing existing sources.

Veolia demonstrated compliance with the HWC NESHAP by showing that combustors' stack concentrations were within the MACT standards during their 2013 Comprehensive Performance Test (CPT). The 2013 CPT also documented maximum stack gas flowrates and waste feedrates. On June 17, 2019, EPA issued to Veolia a Title V Permit to Operate under the Clean Air Act (June 2019 Title V Permit) that incorporates operating limits established during the 2013 CPT, including maximum stack gas flowrates and waste feedrates.[1]

An SSRA evaluates exposure from a specific combustor's emission rates (as opposed to stack concentrations). This SSRA evaluates Veolia's potential emission rates calculated at the MACT standard concentrations. A specific combustor's emission rates derived from the MACT standards are calculated by multiplying the MACT standard concentrations by that specific combustor's stack gas flowrate (see Chapter 5 for the calculated site-specific emission rates used in this SSRA). EPA recognizes that Veolia's actual emission rates are currently limited by the facility's Title V permit to emission rates that are lower than the site-specific emission rates derived from the MACT standards.

Note: In this SSRA, the term "*site-specific emission rates derived from the MACT standards"* is defined as the estimated potential specific combustor's emission rates for Veolia's three incinerators calculated at the Veolia incinerators' measured maximum stack gas flowrates multiplied by the maximum HWC NESHAP Part 63 EEE MACT stack concentrations for certain pollutants.

This new SSRA uses site-specific emission rates derived from the MACT standards to evaluate potential risks at the areas surrounding the Veolia facility from the constituents represented in the MACT standards in the HWC NESHAP at 40 C.F.R. Part 63 subpart EEE (see 70 Fed. Reg. 59401 (October 12, 2005)). The RCRA regulations provide for the evaluation of site-specific considerations relevant to the potential risk from a hazardous waste combustion unit. The RCRA authorized regulations at Illinois Administrative Code § 703.241, Establishing Permit Conditions, and § 703.189, Additional Information Required to Assure Compliance with MACT Standards, provide for determining for a specific area whether additional controls are necessary to ensure adequate protection of human health and the environment under RCRA:

[1] Veolia also conducted a CPT in 2018 after installing activated carbon injection systems on Units 2 and 3. However, the results of that CPT have not been incorporated into the Title V permit at this time so this SSRA relied on data from the 2013 CPT.

If the Agency determines, based on one or more of the factors listed in subsection (a) that compliance with the standards of subpart EEE of 40 CFR 63, incorporated by reference in 35 Ill. Adm. Code 720.111, alone may not adequately protect human health and the environment, the Agency must require the additional information or assessments necessary to determine whether additional controls are necessary to ensure adequate protection of human health and the environment. This includes information necessary to evaluate the potential risk to human health or the environment resulting from both direct and indirect exposure pathways. The Agency may also require a permittee or applicant to provide information necessary to determine whether such an assessment should be required (35 Ill. Adm. Code § 703.189).

In 2010, Veolia appealed IEPA RCRA permit language that included permit conditions based on an SSRA EPA prepared in 2007 (U.S. EPA 2007a). In 2016 and 2017, Veolia sent IEPA draft SSRA documents that lacked information on assumptions and methods used to prepare those documents (see Appendix 5). In January 2019, in an effort to resolve the permit appeal, IEPA and IAG asked EPA for an updated SSRA. While the agencies did not obtain sufficient supporting information on Veolia's SSRA documents, EPA considered them, and incorporated information Veolia provided into this new SSRA where appropriate.

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3 Facility Characterization

3.1 The Facility Area

The facility is a commercial hazardous waste combustion facility in Sauget, Illinois that receives and burns a wide variety of liquid, solid and gaseous wastes. Veolia operates three waste-burning incinerators at the facility (Units 2, 3 and 4). See Figure 3-1 for a map and aerial photo of the area surrounding the facility. Units 2 and 3 are fixed hearth dual chambered incinerators with spray dryer absorbers, fabric filters and activated carbon injection systems for air pollution control (Veolia 2019). Unit 4 is a rotary kiln with a secondary combustion chamber and tempering chamber, spray dryer absorbers, fabric filters and activated carbon injection (Veolia 2014). The activated carbon injection systems at Units 2 and 3 began operating on June 12, 2018 and May 31, 2018, respectively.

The facility is situated in St. Clair County, in southwest Illinois and lies southeast of downtown St. Louis, Missouri, across the Mississippi River, as depicted in Figure 3-1. The facility is surrounded by industrial and commercial properties, rail-line properties and the Mississippi River. The facility is also located near several residential neighborhoods, potential farms and fishable waterbodies.

Four residential neighborhoods lie within the 20-by-20-kilometer grid surrounding the facility EPA used to model air dispersion. Several small, isolated parcels of land that sit within 4 miles (6.4 km) of the facility could possibly be designated for agricultural use. EPA evaluated 17 individual parcels and determined three may be identified as Farmer exposure scenario receptor areas. EPA also assumed two large areas of land (one northeast and one southeast of the facility) were identified as Farmer exposure scenario areas. The near-adjacent Mississippi River and two lakes at Frank Holten State Recreation Area, located 4.13 miles (6.66 km) east of the facility, are fishable waterbodies.

3.2 Residential Receptor Areas

We modeled the potential risk at four neighborhoods near the facility. See Figure 3-2 for residential receptor areas. The following information is from Google Earth Pro and the U.S. Census Bureau (https://factfinder.census.gov). These neighborhoods include residential areas visible on aerial images and named by municipality. These neighborhoods do not include all portions of the town or city such as for industrial or commercial areas. The SSRA used the receptor locations within each neighborhood that had the highest exposures for the risk estimate.

- East St. Louis, Illinois (ESL) is located 0.91 miles (1.47 km) northeast of the facility. It had a 2010 Census population of 27,006 people covering 14.28 square miles (36.99 square km). The racial makeup was 97.6% African-American, 1.9% White Alone, 0.49% Hispanic or Latino and was around 0.01% other. 43.1% of the population was below the poverty level.

- Sauget, Illinois (SVP) is located 1.00 miles (1.60 km) east of the facility. It had a 2010 Census population of 159 people covering 4.61 square miles (11.95 square km). The racial makeup was 5.7% African-American, 93.1% White Alone, 0% Hispanic or Latino and about 0.2% other. 7.6% of the population was below the poverty level.
- Cahokia, Illinois (CHK) is located 0.76 miles (1.22 km) southeast of the facility. It had a 2010 Census population of 15,241 people covering 10.32 square miles (26.72 square km). The racial makeup was 62.2% African-American, 34.3% White Alone, 2.0% Hispanic or Latino and about 1.5% other. 30.9% of the population was below the poverty level.
- St. Louis, Missouri (STL) is located 1.29 miles (2.07 km) west of the facility. It had a 2010 Census population of 319,294 people covering 66 square miles (170square km). The racial makeup was 49.2% African-American, 43.9% White Alone, 3.5% Hispanic or Latino and about 3.4% other. 25% of the population was below the poverty level.

3.3 Potential Farm Receptor Areas

In considering potential Farmer exposure scenario receptor areas, EPA first reviewed 2011 Land Use/Land Cover (LULC) (USGS 2014) using ArcGIS Desktop 10.6.1 by Esri of Redlands, CA, to screen locations by identifying LULC associated with cultivated crops, hay, or pastureland. Screening such locations closest to the Veolia facility, EPA used Google Earth Pro (GEP) and other available internet resources and databases to evaluate each location as a potential farmstead. Specifically, EPA looked for visual evidence of a Farmer's residence, outbuildings (barns, etc) and livestock.

Table 3-1 summarizes EPA's farmer exposure scenario evaluation of select parcels located within four-miles south and southeast of the facility outlined in Figure 3-3.

Table 3-2 summarizes EPA's farmer exposure scenario evaluation of select parcels in the proximity north of the Veolia facility, noted in figure 3-4.

Table 3-3 summarizes EPA's farmer exposure scenario evaluation of parcel 17 and larger potential farmer areas south, southeast, and northeast of the facility, noted in Figure 3-5.

3.4 Fishable Waterbodies

The nearby fishable waterbodies are the Mississippi River and two lakes at Frank Holten State Recreation Area located 4.13 miles (6.66 km) east of the facility. EPA determined through previous risk screenings that the Mississippi River does not need to be further evaluated because its large volumetric flow does not allow significant accumulation of deposited constituents from this facility. This SSRA evaluated fish-ingestion risk from the two lakes at Frank Holten State Recreation area: Whispering Willow Lake and Grand Marais Lake. Figure 3-1 shows the location of these waterbodies in relation to the Veolia facility. Figure 3-6 shows these waterbodies and delineated watersheds.

According to the Illinois State Park website (www.stateparks.com), Frank Holten State Recreational Area (4500 Pocket Road, East St. Louis, Illinois, 62205) is located within sight of

St. Louis Gateway Arch. Frank Holten State Recreation Area sits in an urban area almost entirely surrounded by East St. Louis. The 1,080-acre park features an 18-hole golf course and facilities for other outdoor recreational activities, including day-use fishing, hunting, swimming, boating, picnicking, and camping. The park, originally called Grand Marais when established in 1964, was renamed after Frank Holten in 1967.

In addition to the lakes and facilities, the park features a diversity of plant and animal life. Shade and decorative trees include Scotch pine, maple, oak, poplar, sycamore, gingko, tulip, red bud, sweet gum, and wild cherry. Water lily, lilac, arrowhead, bridal wreath, honeysuckle bush, and mock orange are some of the blossoming flowers and bushes. Wildlife species found at the park include rabbit, squirrel, raccoon, fox, groundhog, muskrat, and mink.

Frank Holten contains two lakes - Whispering Willow Lake and Grand Marais Lake - with a combined water surface of 208 acres and five miles of shoreline. Whispering Willow Lake was rehabilitated in 1983 and stocked with largemouth bass, bluegill, and channel catfish. The park allows both boat and bank fishing, requiring boat anglers to use trolling motors or motors no larger than 10 horsepower. Daily creel and length advisory limits are in effect for some sport species.

During the public comment period for the 2003 proposed RCRA permit renewal, the public raised concerns that the original risk screening report did not consider the fact that significant resident fishing occurs at the nearby Frank Holten State Park. Commenters pointed out that some local residents use these lakes as a source of food (U.S. EPA 2004). In response, all revised SSRAs have evaluated fishing and fish consumption at these lakes.

Table 3-1 Farmer Scenario Evaluation - Parcels 1-11		
No.	Evaluation	Y/N
1	This rectangular area is identified as pasture/hay in the LULC dataset. Inspection using GEP showed no residential structures. Further investigation showed the parcel is actually the Sauget Area 2 Superfund Site; a remediation site where several landfills and surface impoundments were cleaned up (https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0500047). The grass visible in the pictures appears to be the vegetative cover of the landfills and grounds of the remediation area. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
2	This triangular area indicated in the LULC dataset as pasture/hay contains no residential structures. GEP *Street View* shows this parcel to be contained within the fence line of a large industrial complex (Center Ethanol Company L.L.C. as indicated on https://iaspub.epa.gov/enviro/fii_query_detail.disp_program_facility?p_registry_id=110033218426). No other indication of possible farming was evident. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
3	A small parcel at the corner of a crossroads identified as cultivated crops by LULC. GEP imagery, both aerial and *street view* show the land is overgrown with vegetation and appears completely uncultivated in any planned fashion. The imagery showed no structures reasonably associated with agriculture or residential occupation. Part of the overall property appeared to comprise a trucking company. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
4	This small area indicated in LULC as cultivated crops appears to now have developed into light industrial purposes. A field directly north of this parcel does appear to have been cultivated for row crops at times, however, new roads have been built through the field indicating further development. No farm related residential or outbuilding structures are visible on the property or found adjacent to the field. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
5	This area comprises several fields that aerial imagery shows cultivated for grasses – maybe hay. They may also be fields of grass mown for appearance and cover. Nearby residences included small homes, garages, and some small storage buildings, however, no farm equipment, barns or livestock could be seen in GEP *street view*. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
6	These fields identified by LULC as both cultivated crops and pasture/hay surround the Saint Louis Downtown Airport. A job posting on the internet clearly states the airports intent to grow crops on-site (https://www.metrostlouis.org/nextstop/wanted-farmer-for-st-louis-downtown-airport/). A review of aerial imagery did not reveal any farm building and residential farm structures adjacent to any of these fields. While the land may be used for crops, no evidence of livestock or a farmer living on-site could be found. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
7	A large field of corn is evident in aerial and street imagery. This property was the former Parks College of Engineering, Aviation and Technology in Cahokia. The college moved to St. Louis in 1997. While the field is cultivated, no adjacent farmer's residence or farm structures could be identified. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N

8	This parcel appears to be within the fence line of an industrial tank farm. LULC identifies the land use as cultivated crops, however, it is not clear if this is just grass grown for cover or for hay. No other evidence of the farmer scenario is visibly present. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
9	This large parcel comprises very large fields that appear contiguous and adjacent to a farmstead on Plum Street in Cahokia. The fields appear to be consistent with the LULC designation as cropland. A close inspection of the immediate vicinity of the farmstead shows evidence of livestock, including various small fenced pens. A structure in one of the pens appears like a small livestock shelter. Since the parcel appears to include a residence collocated with traditional farm buildings (barns, etc.) and evidence of possible livestock, EPA considered Parcel 9 a potential Farmer exposure scenario receptor in this SSRA and was given the receptor ID Potential Farm 1 (PF1).	Y
10	These fields are identified as cropland in the LULC database. This is consistent with visual evidence from aerial imagery. However, GEP aerial imagery and street views do not show structures consistent with the farmer scenario, such as a farmer's residence with outbuildings (barns, etc.), equipment, or livestock enclosures. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
11	The fields in this parcel appear to be consistent with the LULC designations as cropland. One adjacent property on Sonny Lane appears consistent with a farmstead, with a residence and several outbuildings. While EPA found no evidence of structures associated with livestock on any of the imagery, EPA considered Parcel 11 as a potential Farmer exposure scenario receptor in this SSRA and labeled the receptor ID Potential Farm 2 (PF2).	Y

Table 3-2 Farmer Scenario Evaluation - Parcels 12-16		
No.	Evaluation	Y/N
12	This small triangle-shaped area is identified by LULC data as hay and pastureland. A review of aerial imagery revealed only groundcover type grass on open land surrounding utility installations. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
13	This parcel is a collection of smaller plots that are identified as hay/pasture or cultivated crops in LULC data. Aerial imagery reveals these are just grass covered open land surrounding various businesses or overgrown vacant lots. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
14	This area comprises open land surrounding what was once a railroad yard. The vegetation is a mix of mown grasses and overgrown areas. There is no visual evidence of agricultural activity or any buildings or structures associated with farming. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
15	Several noncontiguous fields are identified as cultivated land by LULC near the towns of Venice and Brooklyn, Illinois. A review of GEP aerial imagery and *street view* showed that these fields may be cultivated as crops or as mown grass cover. No farmstead could be identified adjacent to any of these locations. Therefore, this parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N
16	The LULC dataset indicates a combination of both cultivated cropland and hay/pasture on this parcel. A review of aerial imagery going back to 1988 shows almost continuous earthmoving activity consistent with solid waste disposal activities. None of the visible activities from either aerial imagery or *street view* are consistent with agriculture. This parcel does not appear consistent with the Farmer exposure scenario and was not included as such in the SSRA.	N

Table 3-3 Farmer Scenario Evaluation - Parcel 17 and Undifferentiated Farmer Areas		
No.	Evaluation	Y/N
17	The LULC dataset indicates a combination of both cultivated cropland and hay/pasture within this parcel located east of the facility and close to the Frank Holten State Recreation Area. A review of aerial imagery and street views in GEP show evidence of active farming as well as the presence of livestock. Since the parcel also appears to include a residence collocated with traditional farm buildings (barns, etc.) Parcel 17 is considered as a potential Farmer exposure scenario receptor in this SSRA and was given the receptor ID Potential Farm 3 (PF3).	Y
18, 19	Numerous other potential farm receptors may be present within the receptor grid based on LULC data to the south and southeast of the facility and to the northeast of the facility. These areas of potential farmer receptors are further away from the facility, greater than five-kilometers south and southeast, and greater than seven-kilometers northeast. These entire areas were added to the SSRA project without regard to the actual location of individual farms or utilizing further evaluation with aerial imagery or *street view* technology as a screening step to see if any location within those zones exceed risk and hazard targets. These potential farmer receptor areas were given the receptor IDs FSE (farms south and east) and FNE (farms northeast).	Y

Title:
Figure 3-1. Site Location Map.
Veolia ES Technical Solutions, L.L.C., Sauget, Illinois

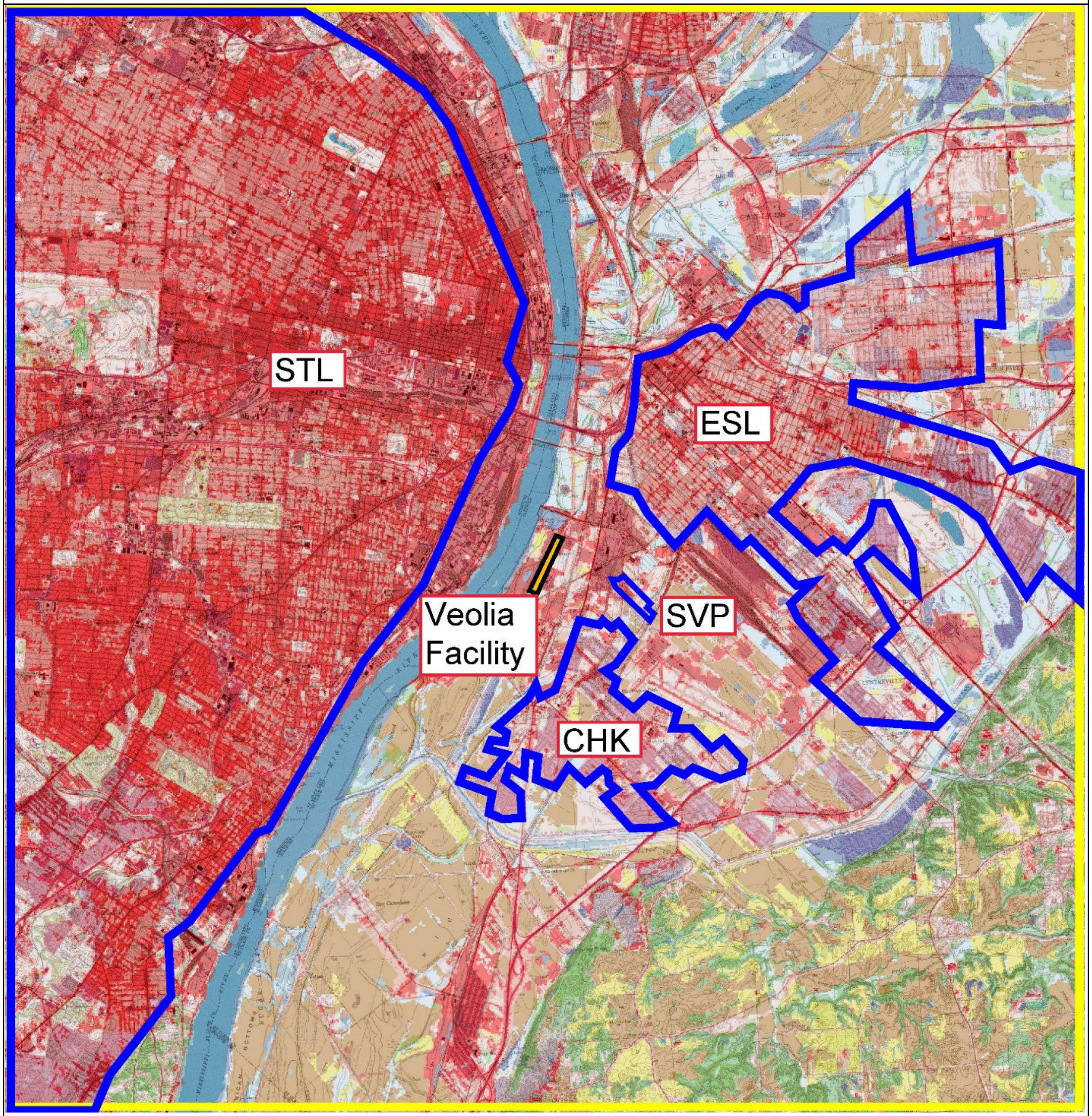
Source:
Google Earth 2018

Scale: (approximate) kilometers

0 1 2 4

Title:

Figure 3-2. Residential Receptor Areas.
Veolia ES Technical Solutions, L.L.C., Sauget, Illinois

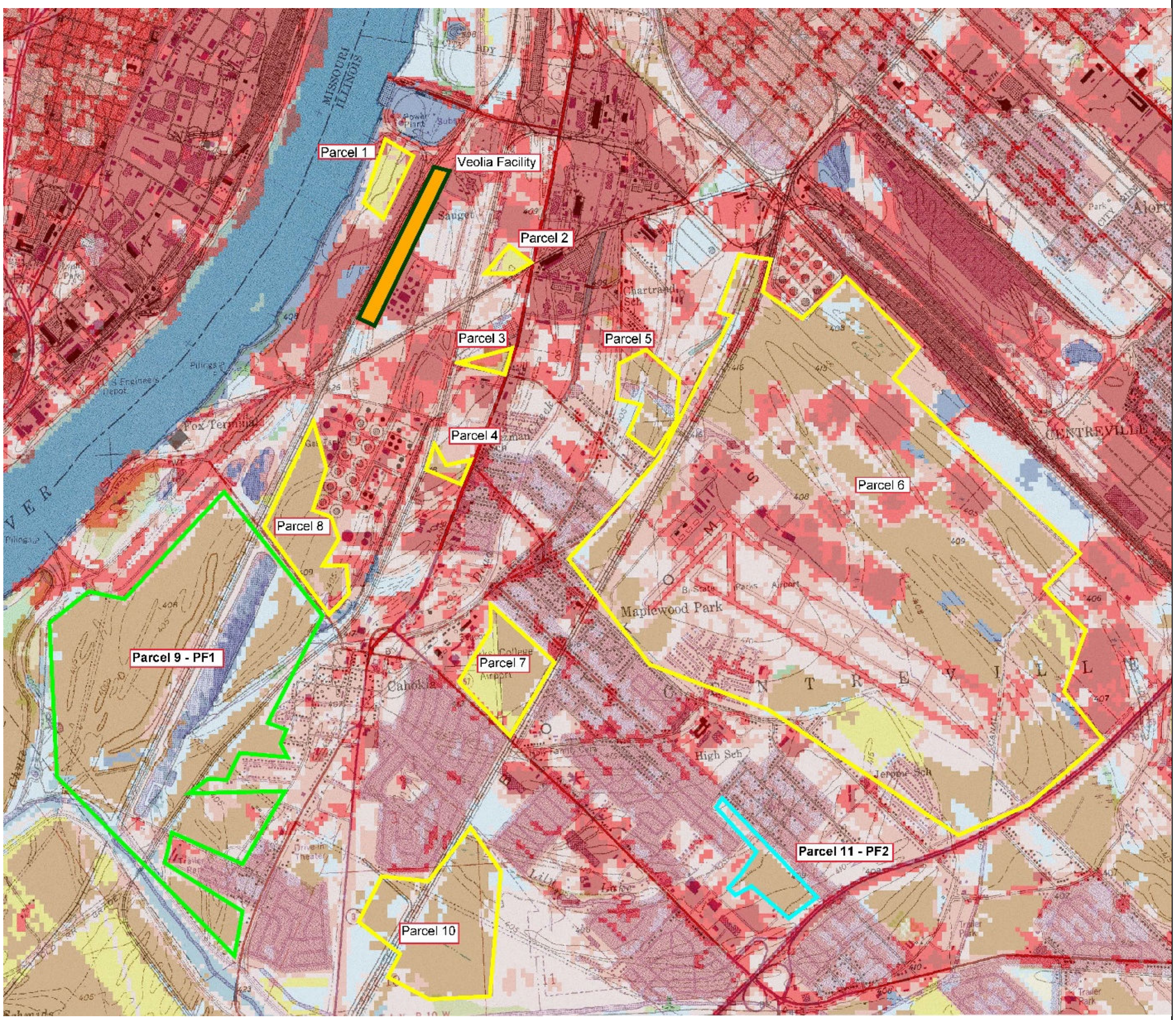


Source:
USGS 2014, *NLCD 2011 Land Cover (2011 Edition)*

Scale: (approximate) kilometers

Title:

Figure 3-3. Potential Farm Receptor Locations – Within 4 Miles South and Southeast of the Facility
Veolia ES Technical Solutions, L.L.C., Sauget, Illinois



Legend

- Veolia Facility
- Pasture/Hay
- Cropland
- Non-Farm Parcels
- Potential Farm 1 - PF1
- Potential Farm 2 - PF2

Source:
USGS 2014, *NLCD 2011 Land Cover (2011 Edition)*

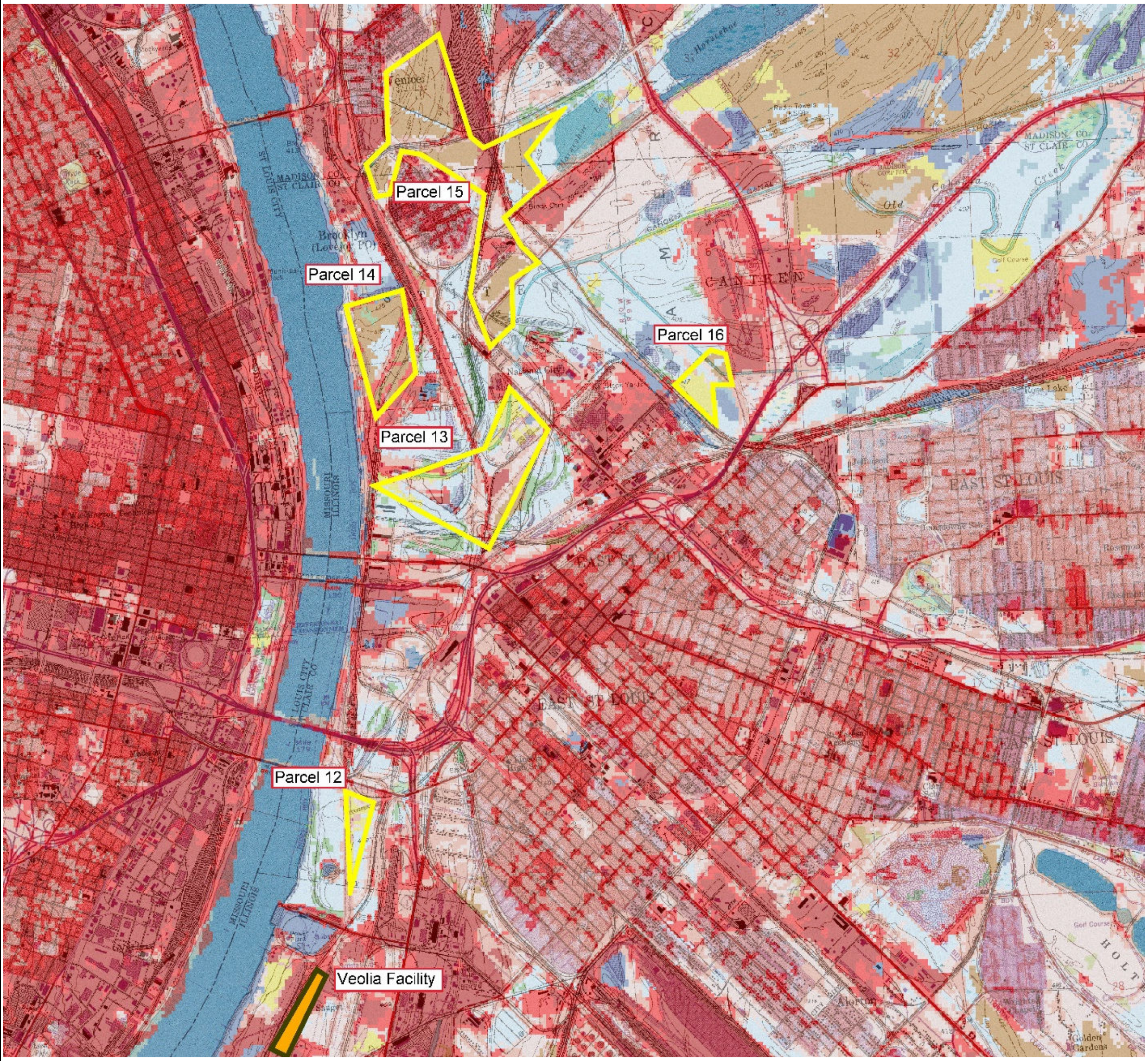
Scale: (approximate)

kilometers

0 1/2 1 2

Title:

Figure 3-4. Potential Farm Receptor Locations – In Proximity to and North of the Facility
Veolia ES Technical Solutions, L.L.C., Sauget, Illinois



Legend

- Veolia Facility
- Pasture/Hay
- Cropland
- Non-Farm Parcels

Source:
USGS 2014, *NLCD 2011 Land Cover (2011 Edition)*

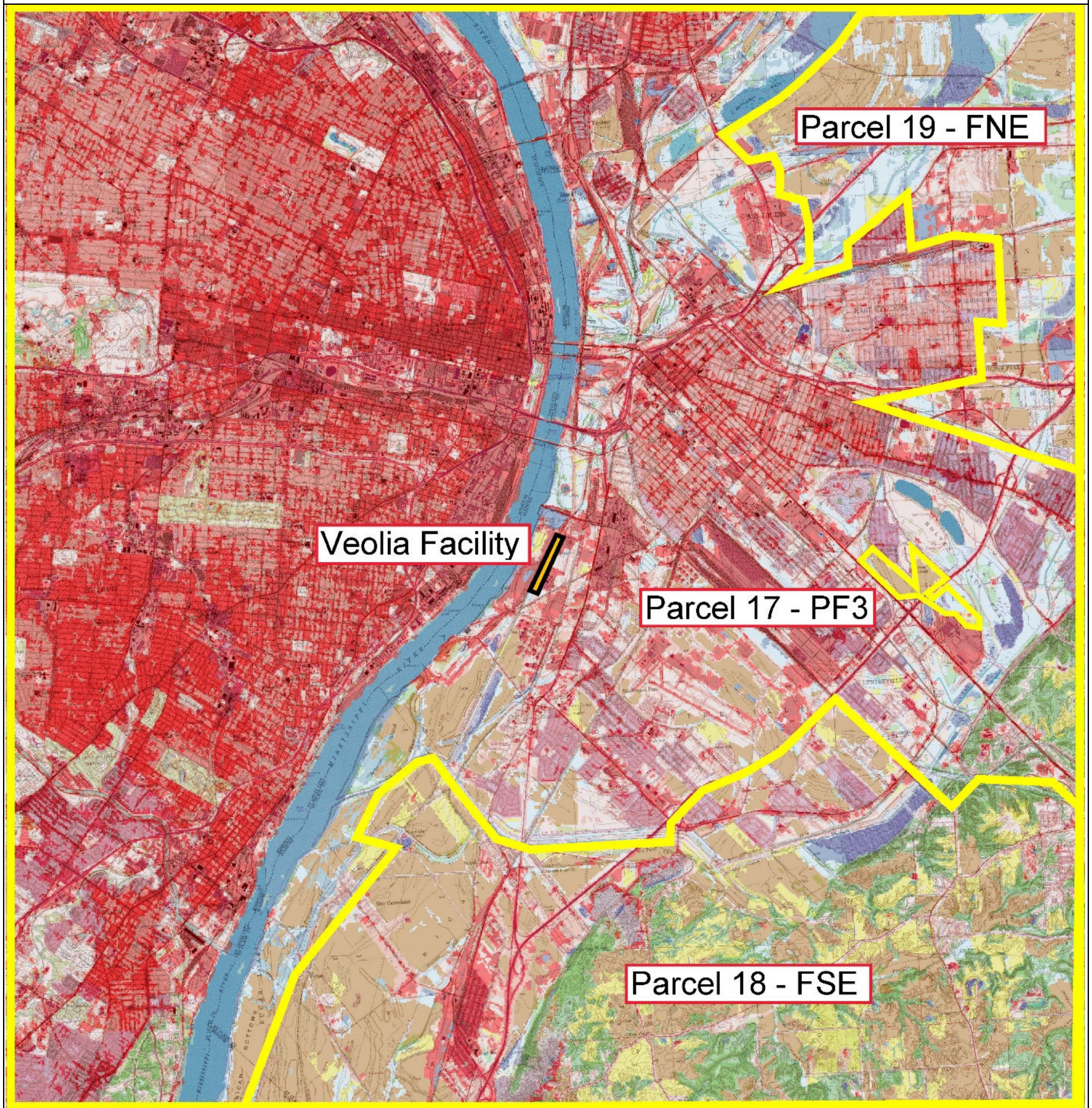
Scale: (approximate)

kilometers

0 1/2 1 2

Title:

Figure 3-5. Potential Farm Receptor Locations – Greater than 3 Miles from the Facility
Veolia ES Technical Solutions, L.L.C., Sauget, Illinois



Legend

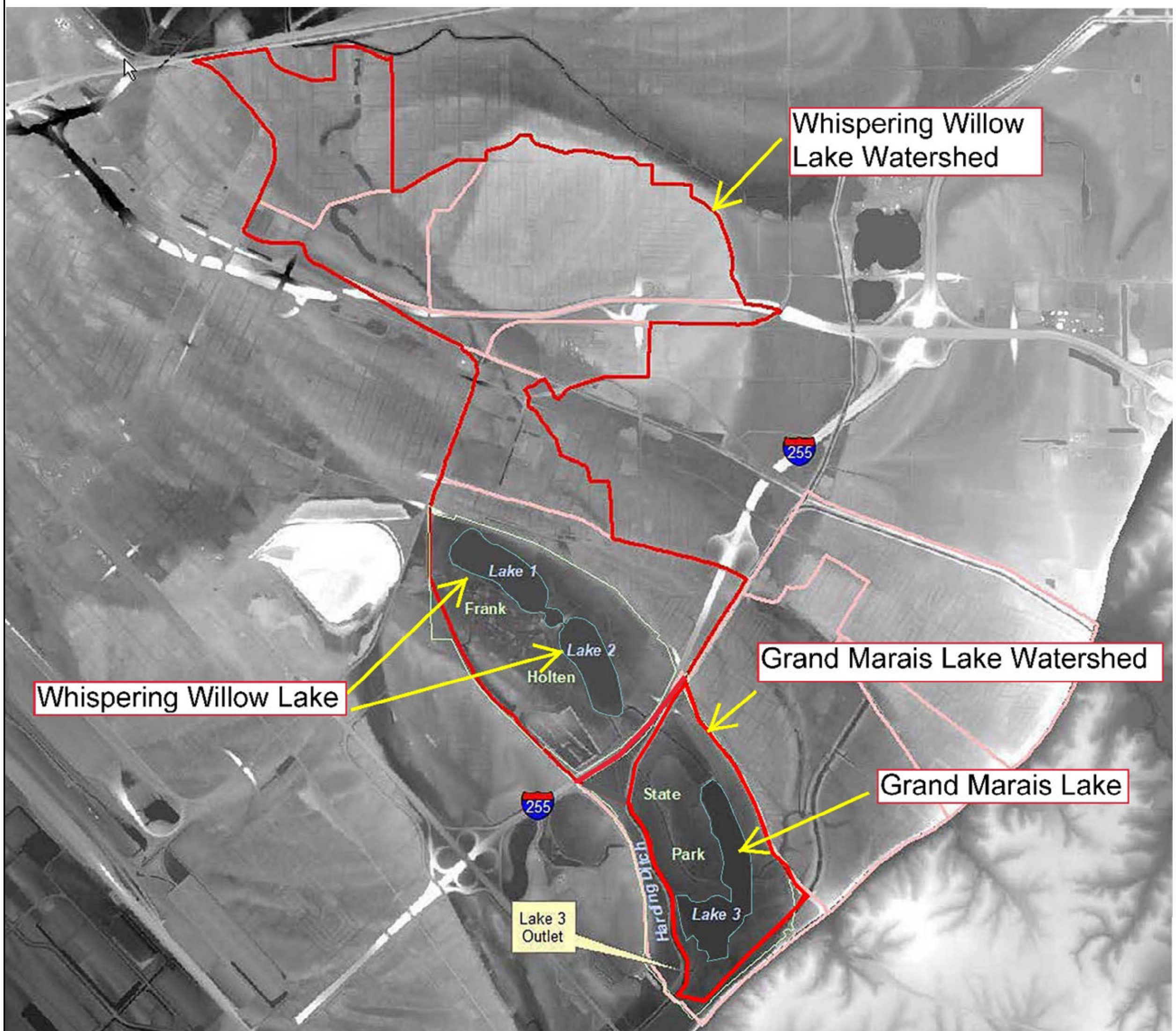
- Veolia Facility
- Pasture/Hay
- Cropland

Source:
USGS 2014, *NLCD 2011 Land Cover (2011 Edition)*

Scale: (approximate) kilometers

Title:

Figure 3-6. Watersheds for Whispering Willow Lake and Grand Marais Lake.
Veolia ES Technical Solutions, L.L.C., Sauget, Illinois



Source:
Army Corps of Engineers through U.S. EPA (U.S. EPA 2019a)

Scale: (approximate) kilometers

0 1/2 1 2

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4 Constituents of Potential Concern (COPCs)

As noted earlier, this SSRA ascertains protective emission rates for certain constituents. It updates a 2007 EPA SSRA that specifically targeted constituents of potential concern (COPCs) addressed in the HWC NESHAP. This NESHAP governs hazardous waste burning incinerators, cement kilns, lightweight aggregate kilns, industrial/commercial/institutional boilers and process heaters, and hydrochloric acid production furnaces and regulates emissions of numerous hazardous air pollutants. These include: dioxins/furans, other toxic organics (through surrogates), mercury, other toxic metals (both directly and through a surrogate), hydrogen chloride and chlorine gas.

Hazardous waste combustion is subject to both Clean Air Act and RCRA requirements. Section 112(d) of the Clean Air Act requires EPA to promulgate emission standards that require the maximum degree of reduction that can be achieved for the source. RCRA requires EPA to promulgate regulations establishing standards necessary to protect human health and the environment. When EPA promulgated the HWC NESHAP under Clean Air Act Section 112(d), 42 U.S.C. § 7412, in 2005, it also promulgated regulations under RCRA Sections 3004(a) and (q) and 3005(c), 42 U.S.C. § 6924(a) and (q) and 6925(c), that authorize the addition of conditions to ensure protection of human health and the environment based on site-specific risks at those sources. *See* 70 Fed. Reg. 59402, 59506 (Oct.12, 2005).

The HWC NESHAP applies MACT standards, which are technology-based standards. Further, that NESHAP applied surrogate standards for certain pollutants, rather than pollutant-specific emission standards. As discussed in the preamble to the NESHAP, EPA assumed that metal emissions for metals not enumerated with emission standards in the rule would be adequately controlled by compliance with the particulate matter (PM) emission standard within the MACT. See 70 Fed. Reg. 59402, 59459 (Oct.12, 2005). EPA also implied that toxic organics not enumerated with emission standards in the MACT (every organic except dioxins and furans) would be adequately controlled by compliance with a destruction/removal efficiency standard (DRE) combined with continuous compliance with either a total hydrocarbon standard or carbon monoxide standard. *See id* at 59463.

While the HWC NESHAP MACT standards are technology-based, EPA conducted a national risk assessment to ensure the protectiveness of the technology standards. EPA's July 2000 HWC NESHAP Final Rule Fact Sheet discusses its determination that sources complying with the MACT standards generally are not anticipated to pose an unacceptable risk to human health and the environment under RCRA:

> *Since the MACT standards are technology-based, we performed a national risk assessment to determine if they satisfied the RCRA mandate to protect human health and the environment. This national assessment was a multimedia, multipathway analysis addressing both human health and ecological risk. The assessment was predicated on the assumption that sources whose emissions are currently above the MACT standards will reduce their emissions to MACT levels and that sources whose emissions currently are below the standards will maintain their emissions at current levels. Based on this*

national assessment, we determined that sources complying with the MACT standards generally are not anticipated to pose an unacceptable risk to human health and the environment under RCRA. Thus, we concluded that the technology-based MACT standards met the protectiveness requirement of RCRA sections 3004(a) and (q). Although comprehensive, the national risk assessment did contain several uncertainties and limitations. As a result, we could not conclude that the MACT standards would be protective of human health and the environment in all cases, i.e., that it would never be necessary to include additional permit conditions in a specific facility's permit pursuant to the omnibus provision of § 3005(c)(3). For example, the national risk assessment did not include an evaluation of the potential risk posed by nondioxin products of incomplete combustion. In addition, the uncertainties associated with the mercury portion of the assessment were significant and limited the use of the analysis for drawing quantitative conclusions regarding the risk associated with the mercury MACT standard. Finally, the national risk assessment utilized generalized assumptions which may not be reflective of unique, site-specific considerations. Thus, in some cases an SSRA may be necessary to confirm whether operation of a particular hazardous waste combustor in accordance with the MACT standards will be protective of human health and the environment under RCRA (U.S. EPA 2000a, p.2).

EPA conducted this SSRA to assist the State to determine whether additional State RCRA permit conditions are necessary to ensure protection of human health and the environment.

In this SSRA, EPA assessed the impact of the following HWC NESHAP Constituents:

- arsenic
- beryllium
- cadmium
- chromium
- lead
- mercury
- dioxins/furans (modeled as a single value based on the relative toxicity of individual dioxin and furan congeners to 2,3,7,8-tetrachloro-dibenzo-dioxin, known as toxicity equivalence - TEQ)

This SSRA demonstrates that provided the facility complies with the June 2019 Title V Permit feedrate limits, actual emission rates for these constituents (demonstrated at the 2013 CPT) should be protective.

5 Emission Rates

EPA calculated the site-specific emission rates derived from the MACT standards used in this SSRA as described in the *Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois* report in Appendix 1. The MACT standards that apply to incinerators were promulgated as stack concentrations and not as emission rates. An SSRA, however, evaluates exposures from a source's emission rates. To calculate the facility's site-specific emission rates derived from the MACT standards, we must determine the stack gas flowrate and combine it with the MACT standard concentrations.

EPA used the stack gas flowrates demonstrated during the 2013 CPT to calculate site-specific emission rates derived from the MACT standards[2]. These stack gas flowrates came from the 2013 CPT report *Table Summaries of Isokinetic Sampling, 3-3, 3-4, and 3-5* (Veolia 2014). The Veola 2013 CPT report presents 12 maximum stack gas flowrates for each of the three units. EPA used an average of these 12 measured maximum flowrates for each unit during the CPT to calculate the facility's site-specific emission rates derived from the MACT standards.

EPA notes Veolia has operated at increased stack gas flowrates at each of its units in the past. An increased stack gas flowrate in combination with the constant MACT standard concentrations would result in increased site-specific emission rates derived from the MACT standards which would result in increased potential exposure and risk. This is because an increased stack gas flowrate could allow for increased future feedrates of MACT constituents that in combination achieve the same stack concentration. In other words, a stack with an increased flowrate held to the same pollutant concentration as a stack with a decreased flowrate will have an increased pollutant emission rate which is directly proportional to expected risk.

Any limits this SSRA recommends for the State RCRA permit should be protective of human health by adding restrictions beyond compliance with 40 C.F.R. part 63, subpart EEE, for this facility, based on site-specific factors, that narrow the potential to increase emission rates in the future. Please note the SSRA demonstrates the measured emission rates for these constituents at the June 2019 Title V Permit feedrates (demonstrated at the 2013 CPT) should be protective at the stack gas flowrates noted. Table 5-1 summarizes the maximum stack gas flowrates used to calculate the site-specific emission rates derived from the MACT standards used in this SSRA.

Emission rates for mercury and chromium were further modified from the site-specific emission rates derived from the MACT standards to account for metals speciation. In accordance with HHRAP, EPA estimated 50-percent of the chromium emission to be hexavalent chromium and 50-percent trivalent (identified in the SSRA as the COPC chromium) (U.S. EPA 2005a). EPA also divided site-specific emission rates derived from the MACT standards for mercury into divalent and elemental mercury. Divalent mercury, also known as oxidized, is modeled as the COPC mercuric chloride and includes divalent vapor and particle bound mercury fractions. Elemental mercury is only modeled as a vapor. EPA based site-specific emission rates derived from the

[2] ibid., [p. 2-6]

MACT standards for these fractions on mercury speciation as described in the *Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois* report in Appendix 1.

Tables 5-2 through 5-7 summarize site-specific emission rates derived from the MACT standards and average 2013 CPT emission rates for metals, and Table 5-8 describes site-specific emission rates derived from the MACT standards and average 2013 CPT emission rates for dioxins and furans.

Table 5-1 Maximum Stack Gas Flowrate

Unit	Dry Standard Cubic Feet per Minute (dscfm)	Dry Standard Cubic Meters per Second (dscms)
2	5,235	2.47
3	5,459	2.58
4	16,471	7.77

5.1 Metals

Table 5-2 Total Mercury Emission Rates

Unit	2013 CPT Stack Flowrate (dscms)	MACT Standard Mercury Concentration (ug/dscm)	Site-Specific Mercury Emission Rate Derived from the MACT Standard (ug/s)	Site-Specific Mercury Emission Rate Derived from the MACT Standard (g/s)	Average 2013 CPT Mercury Emission Rate (g/s)
2	2.47	130	321	3.21E-4	1.87E-4
3	2.58	130	335	3.35E-4	8.51E-5
4	7.77	130	1,010	1.01E-3	4.95E-5

Table 5-3 Site-Specific Speciated Mercury Emission Rate Derived from the MACT Standard

Unit	Site-Specific Mercury Emission Rate Derived from the MACT Standard (g/s)	Divalent Mercury Emission Rate (divalent vapor and particle bound) (g/s)	Modeled	Elemental Mercury Emission Rate (g/s)	Modeled
			Divalent Mercury Emission Rate with Loss to Global Cycle (g/s)		Elemental Mercury Emission Rate with Loss to Global Cycle (g/s)
2	3.21E-4	2.80E-4	1.94E-4	4.11E-5	4.11E-7
3	3.35E-4	3.05E-4	2.07E-4	2.97E-5	2.97E-7
4	1.01E-3	9.81E-4	6.65E-4	2.97E-5	2.97E-7

Table 5-4 Speciated Mercury Emission Rates at the 2013 CPT Emission Rate					
			Modeled		Modeled
Unit	Average 2013 CPT Mercury Emission Rate (g/s)	Divalent Mercury Emission Rate (divalent vapor and particle bound) (g/s)	Divalent Mercury Emission Rate with Loss to Global Cycle (g/s)	Elemental Mercury Emission Rate (g/s)	Elemental Mercury Emission Rate with Loss to Global Cycle (g/s)
2	1.87E-4	1.63E-4	1.11E-4	2.39E-5	2.39E-7
3	8.51E-5	7.86E-5	5.27E-5	7.55E-6	7.55E-8
4	4.95E-5	4.81E-5	3.26E-5	1.45E-6	1.45E-8

Table 5-5 Semi Volatile Metals (SVM) – Cadmium and Lead – Emission Rates					
Unit	2013 CPT Stack Flowrate (dscms)	MACT Standard SVM Concentration (ug/dscm)	SVM Emission Rate Derived from the MACT Standard (ug/s)	SVM Emission Rate Derived from the MACT Standard (g/s)	Average 2013 CPT SVM Emission Rate (g/s)
2	2.47	230	568	5.68E-4	1.77E-6
3	2.58	230	593	5.93E-4	2.70E-5
4	7.77	230	1,790	1.79E-3	3.87E-5

Table 5-6 Low Volatile Metals (LVM) – Arsenic, Beryllium, and Chromium – Emission Rates					
Unit	2013 CPT Stack Flowrate (dscms)	MACT Standard LVM Concentration (ug/dscm)	LVM Emission Rate Derived from the MACT Standard (ug/s)	LVM Emission Rate Derived from the MACT Standard (g/s)	Average 2013 CPT LVM Emission Rate (g/s)
2	2.47	92	227	2.27E-4	4.76E-6
3	2.58	92	237	2.37E-4	1.69E-5
4	7.77	92	715	7.15E-4	4.76E-5

Table 5-7 Speciated Chromium Emission Rates Derived from the MACT Standard and 2013 CPT Emission Rates				
Unit	Chromium Emission Rate as Hexavalent Chromium Derived from the MACT Standard (g/s)	Chromium Emission Rate as Trivalent Chromium Derived from the MACT Standard (g/s)	Average 2013 CPT Chromium Emission Rate as Hexavalent Chromium (g/s)	Average 2013 CPT Chromium Emission Rate as Chromium (as trivalent) (g/s)
2	1.14E-4	1.14E-4	2.38E-6	2.38E-6
3	1.19E-4	1.19E-4	8.45E-6	8.45E-6
4	3.58E-4	3.58E-4	2.38E-5	2.38E-5

5.2 Dioxins/Furans

Table 5-8 Dioxin/Furan Emission Rates					
Unit	2013 CPT Stack Flowrate (dscms)	MACT Standard Dioxin Concentration (ng TEQ/dscm)	Dioxin Emission Rate Derived from the MACT Standard (ng TEQ/s)	Dioxin Emission Rate Derived from the MACT Standard (g TEQ/s)	Average 2013 CPT Dioxin Emission Rate (g TEQ/s)
2	2.47	0.2	0.494	4.94E-10	1.77E-11
3	2.58	0.2	0.515	5.15E-10	2.12E-12
4	7.77	0.4	3.109	3.11E-9	6.55E-10

6 Exposure Scenarios

EPA followed the HHRAP guidance recommendations in determining the evaluated exposure scenarios (U.S. EPA 2005a). The exposure scenarios EPA assessed are resident adult, resident child, fisher adult, fisher child, farmer adult and farmer child. The HHRAP protocol recommends using the default values for exposure scenario exposure duration. EPA used the following default values: 30 years for Adult Resident and Adult Fisher, 40 years for Adult Farmer, and 6 years for Child Resident, Child Fisher and Child Farmer.

The potential receptor area is the entire 20-by-20-kilometer air-dispersion grid. EPA selected this area as described in HHRAP Chapter 4: "*most significant deposition occurs within a 10 km radius*" (U.S. EPA, 2005a). EPA modeled nine receptor areas, including the four neighborhoods near the facility discussed in Section 3.2, for the exposure scenarios of Resident Adult, Resident Child, Fisher Adult and Fisher Child; and five areas (Parcels 9, 11, 17, 18 and 19 from Section 3.3) for the Farmer Adult and Farmer Child exposure scenarios. The IRAP computer program calculates and generates the maximum exposed individual locations for each exposure receptor area.

The exposure pathways for the Adult Resident and Child Resident scenarios are:

- Inhalation of vapors and particles,
- Incidental ingestion of soil,
- Ingestion of drinking water from surface water sources,
- Ingestion of homegrown produce,
- Infant ingestion of dioxin in breast milk.

The exposure pathways for the Adult Fisher and Child Fisher scenarios include the above pathways plus:

- Ingestion of locally-caught fish.

In this SSRA, EPA used the routes of exposure for the Adult Fisher and Child Fisher scenarios as the pathways for the Adult Resident and Child Resident scenarios plus the ingestion of locally-caught fish. The fish consumption rate should closely represent the SSRA's scenario identification of focus – namely, residents who fish locally and eat some of the fish they catch. While this group may include some people that consume a lot of local fish, it also includes people who eat few local fish. EPA considered that the identified scenarios for Adult and Child Fishers are people who fish locally and consume some of the fish they catch.

The exposure pathways for the Adult Farmer and Child Farmer scenarios include the above Resident pathways plus:

- Ingestion of homegrown beef,
- Ingestion of milk from homegrown cows,
- Ingestion of homegrown poultry,
- Ingestion of eggs from homegrown chickens,
- Ingestion of homegrown pork.

The HHRAP contains a complete description of the exposure scenarios as well as the methodology for fate and transport of contaminants, and risk assessment (U.S. EPA 2005a). For the lead exposure scenario, the *Integrated Exposure Uptake and Biokinetic (IEUBK) Model* combines estimates of lead intake from lead in air, water, soil, dust, diet, and other ingested media, with an absorption model for the uptake of lead from the lung or gastrointestinal tract, and a biokinetic model of lead distribution and elimination from a child's body, to predict the likely distribution of blood lead for children of ages six months through 84 months exposed to lead in these environmental media.

7 Site-Specific Input Parameter Values

The detailed report tables of the model inputs are in Appendix 2, and the complete modeled project is provided in electronic format in Appendix 4. The following tables present important site-specific input parameter values, modeling options, and their sources.

Table 7-1 General Site-Specific Parameter Values

Parameter	Value	Source
Time Period for Deposition (yrs)	30	U.S. EPA 2005a
Average Annual Precipitation (cm/yr)	102.7	*Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois* (Appendix 1)
Average Annual Surface Runoff (cm/yr)	12.5	U.S. EPA 2005a
USLE Rainfall (Erosivity) Factor (yr^{-1})	210	U.S. EPA 2005a and Wischmeier et al 1978
USLE Cover Management Factor (yr-1)	0.1	U.S. EPA 2005a
Average Annual Irrigation (cm/yr)	12.5	U.S. EPA 2005a
Average Annual Evapotranspiration (cm/yr)	62.5	Baes et al 1984
Wind Speed (m/s)	4.05	*Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois* (Appendix 1)

Table 7-2 Whispering Willow Lake Site-Specific Parameter Values

Parameter	Value	Source
Waterbody Type	Lake	www.dnr.illinois.gov, Google Earth Pro
Waterbody Area (m^2)	429,561.33	IRAP Calculated from Aerial Overlay
Waterbody Grid Node Selection	Average	Selected based on representativeness
Depth of Water Column (m)	2.0	IDNR (www.ifishillinois.com)
Average Volumetric Flow Rate (m^3/yr)	859,122.66	Calculated Assume Retention Time 1 year
Watershed Area (m^2)	8,991,280.87	IRAP Calculated from Aerial Overlay
Percent Impervious to Runoff	5	Estimated from Aerial Overlay
Watershed Grid Node Selection	Average	Selected based on representativeness

Table 7-3 Grand Marais Lake Site-Specific Parameter Values

Parameter	Value	Source
Waterbody Type	Lake	www.dnr.illinois.gov, Google Earth Pro
Waterbody Area (m^2)	317,421.35	IRAP Calculated from Aerial Overlay
Waterbody Grid Node Selection	Average	Selected based on representativeness
Depth of Water Column (m)	2.0	IDNR (www.ifishillinois.com)
Ave. Volumetric Flow Rate (m^3/yr)	622,241.96	Calculated Assume Retention Time 1 year
Watershed Area (m^2)	1,321,679.02	IRAP Calculated from Aerial Overlay
Percent Impervious to Runoff	5	Estimated from Aerial Overlay
Watershed Grid Node Selection	Average	Selected based on representativeness

Table 7-4 Air-Dispersion Modeling Site-Specific Parameter Sources	
Parameter	Source
Stack Location	Google Earth Pro
Stack Height	Franklin 2017
Stack Diameter	Franklin 2017
Stack Gas Exit Velocity	Veolia 2016a, 2016b, 2016c
Stack Gas Temperature	Veolia 2014
Stack Base Elevations and Terrain Data for Study Area	AERMAP
Surface and Upper Air Hourly and Climatic Data from 2011-2015	NOAA ftp://ftp.ncdc.noaa.gov/pub/data/noaa/ http://esrl.noaa.gov/raobs/ https://www.ncdc.noaa.gov/qclcd/QCLCD https://www.weather.gov/media/lsx/climate/stl/precip/precip_stl_ranked_annual_amounts.pdf ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin
Local Land Use/Land Cover Data for Wind Profile and Deposition	USGS 2000, 2014
Location and Dimensions of Facility Building, Tanks, and Structures for Building Downwash Evaluation	IEPA 2017b
Site-specific Test Data for Particle Size Distribution	Onyx 2005

EPA details the air-modeling parameters values in the *Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois* report (Appendix 1).

Table 7-5 shows the site-specific parameter values for the lead exposure modeling.

Table 7-5 IEUBK Site-Specific Parameter Values		
Parameter	Value	Source
Ambient Lead Air Concentration	0.027ug/m^3	Granite City Ambient Air Monitoring 7-Year Average (U.S. EPA 2019b)
Drinking Water Lead Concentration	2.0 mg/L	Water Quality Report (Illinois American Water 2018)

8 Uncertainty

8.1 Overview of Uncertainty

EPA based this SSRA on a combination of site-specific data, default parameters (some typical and others conservatively protective), and sophisticated models meant to characterize potential risk to given receptors under several assumptions. Despite that comprehensive approach, some uncertainty remains in the assessment.
EPA consulted a variety of publications for guidance on evaluating uncertainty including:

- U.S EPA *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, (Part A),* Sections: 6.8 (exposure uncertainty); 8.4 (risk characterization uncertainty); 8.5 (comparisons to other studies); and 8.6 (summarizing and presenting results) (U.S. EPA, 1989).

- U.S. EPA *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities,* Chapter 8 (Interpreting Uncertainty for Human Health Risk Assessment) and Chapter 9 (Completing the Risk Assessment Report and Follow-On Activities), (U.S. EPA 2005a).

- U.S. EPA *Exposure Factors Handbook: 2011 Edition*, Chapter 2 (Variability and Uncertainty), (U.S. EPA 2011).

This section describes potential sources of uncertainty and what they mean in the context of the SSRA results.

8.2 Uncertainty versus Variability

Uncertainty describes the lack of knowledge about models, parameters, constants, data, and beliefs (U.S. EPA 2009a). Changes to the risk evaluation for some input parameters or conditions might stem from an expected variability rather than from a lack of knowledge about a parameter. As an example, one can gather data on the amount of home-grown produce residents and farmers in the surrounding community eat. A single number may be selected for evaluation, such as a mean value or an upper limit, though the numbers could differ considerably. While these different inputs could change the risk estimate, this is due not to uncertainty, but to evidence of natural variability. Some people eat no home-grown produce, some eat less than average, and some eat more. All these receptors are plausible for the exposure scenario.

8.3 Types of Variability

Spatial Variability relates to impacts on the SSRA due to location. The current or future location of a school, neighborhood, or retirement community could impact the risk analysis. In drinking water scenarios, the location of residents using groundwater versus supplied water could present a significant variability for the SSRA. In this assessment, EPA used actual locations for the facility's emissions sources, the fishable waterbodies, and the measured terrain data for dispersion modeling. The dispersion modeling used five years of observed meteorological data from a local airport to model the emissions dispersion. In delineating receptor locations, EPA confirmed there are four residential neighborhoods and identified several potential farm locations near the Veolia facility. People who fish at the selected fishable waterbodies may reside in any of the nearby residential neighborhoods within the 20-by-20-kilometer receptor grid area. Different land-use types have different types of land cover (urban parking lots, forests or farm fields, for example) that can alter fate-and-transport parameter estimates. EPA incorporated actual land-use classifications for the community surrounding the Veolia facility into this SSRA where possible for air-dispersion modeling and receptor selection. EPA based deposition rates and dispersion coefficients on actual land-use patterns surrounding the facility.

Temporal Variability refers to variations over time. Differences in short-term exposure could stem from variations in personal activities such as those performed on weekdays or weekends. Other impacts could be seasonal wherein biological activity changes with temperature. EPA incorporated some of these variations into the model, such as seasonal variations in vegetative cover (see *Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois* - Appendix 1).

Intra-Individual Variability refers to fluctuations in an individual's physiologic or behavioral characteristics. These are changes that may occur day-to-day or over a lifetime in a specific individual; such as body weight, ingestion rates, physical activity or proximity to source. Some of these types of variability are discussed in the Exposure Factors Handbook, which includes tables with percentiles by age groups or other populations (U.S. EPA 1997a). As the 2005 HHRAP recommends, this SSRA used single values for intra-individual variable parameters, generally set at the mean or median. In choosing the mean or median to represent the population, the actual parameter values for a given individual could be more or less, and his/her exposure and risk could be greater or less based on this variability. Intra-individual variations could also be related to spatial and temporal variability.

Inter-Individual Variability refers to variability across individuals such as characteristics (such as age, sex, or race), behavior (such as activity patterns or ingestion rates), and susceptibilities (such as life stage or genetic predisposition). Inter-individual variations could also be related to spatial and temporal variability. One expression of inter-individual variability in this SSRA is the choice of receptors evaluated. Some receptors EPA chose were intended not to statistically represent the entire population but to focus on individuals who have specific behaviors that affects their potential exposure.

Examples of these include farmers who consume home grown produce and residents who fish locally and eat some of their catch. This SSRA also evaluates adults and children separately.

8.4 Potential Areas of Uncertainty in the Veolia SSRA

8.4.1 Model Uncertainty

EPA selected the air-dispersion and deposition model, and the indirect exposure models because they provide the information needed to conduct indirect assessments. EPA considers them the state-of-the-science (U.S. EPA 2005a) (U.S. EPA 2005b).

The type of risk assessment EPA performed for the facility is referred to as a deterministic risk assessment. The risk characterization is meant to evaluate potential risk to a particular receptor under specific conditions. This approach assists in evaluating permit limits for environmental releases if the receptor and conditions are both reasonable and conservative.

A more sophisticated approach to modeling that includes collection of data distributions for many important input parameters followed by thousands of computer simulations is referred to as a probabilistic risk assessment or Monte-Carlo simulation. This approach can provide a more quantitatively descriptive estimate of uncertainty. However, such a highly quantitative uncertainty analysis is beyond the typical resources of the Agency (U.S. EPA 1989). The 2005 HHRAP Guidance presents the deterministic risk assessment approach to achieve a reasonably conservative permit limit that protects human health (U.S. EPA 2005a).

AERMOD Air-Dispersion Model: As discussed in Section 2.2 above, EPA conducted the air-dispersion and deposition modeling using the AERMOD model.

Although there may be some uncertainty with models, such as AERMOD, and actual concentrations and estimated deposition could be higher or lower, studies of model accuracy show that "*models are more reliable for estimating longer time-averaged concentrations*", as compared to short time-averaged concentrations (70 Fed. Reg. 68246 (November 9, 2005)). The annual averages EPA chose for this SSRA are the more reliable longer time-averaged concentrations. EPA also stated that "*the models are reasonably reliable in estimating the magnitude of highest concentrations*" (70 Fed. Reg. 68246 (November 9, 2005)). Furthermore, model evaluation studies showed a notable improvement in accuracy over the dispersion model, ISCST3, which EPA used in its previous SSRAs (U.S. EPA 2005b).

EPA selected a 20-by-20-kilometer grid centered on the facility to model air dispersion for this SSRA. HHRAP recommends this configuration. As described in Chapter 4: "*experience has shown us that most significant deposition occurs within a 10 km radius*"

(U.S. EPA 2005a, p.4-3). EPA determined that this configuration is appropriate in this situation.

HHRAP Risk Assessment Model: In 2005, the EPA Office of Solid Waste (OSW) finalized an approach for conducting multi-pathway, site-specific human health risk assessments on RCRA hazardous waste combustors. The approach, also known as the Human Health Risk Assessment Protocol ("*HHRAP*" or "*protocol*") can be used where the permitting authority determines such risk assessments are necessary. The HHRAP replaces an earlier Peer Review Draft published in July 1998.

The HHRAP brings together information from other risk assessment guidance and method documents prepared by EPA and state environmental agencies. It also contains the latest advancements in risk assessment science and builds on the experience EPA has gained through conducting and reviewing combustion risk assessments.

The fate and transport, and exposure models recommended in HHRAP may also present some uncertainty. The component models selected, reviewed and improved by peer-review and public comment directly address the purpose of this SSRA. The purpose of the 2005 HHRAP Guidance is specifically to evaluate potential risk from emissions of hazardous waste combustors, as in this case. The 2005 HHRAP Guidance describes the uncertainties associated with the component models (U.S. EPA 2005a).

While some uncertainty associated with models remains, EPA is confident using HHRAP and assesses overall model uncertainty with the risk model as low to medium.

IEUBK Computer Model: As discussed above, EPA relied upon the well-characterized neurological effects observed in children as the sensitive endpoint for evaluating lead toxicity. To apply a protective reference exposure level for lead in children, EPA aimed to limit exposure to lead levels in soil and air such that a typical (or hypothetical) child or group of similarly exposed children would have no more than a five percent probability of exceeding a 10 micrograms per deciliter (ug/dL) blood lead level. EPA based this 10 ug/dL blood lead level on analyses conducted by the Centers for Disease Control and Prevention (CDC) and EPA that associate blood lead levels above 10 ug/dL with neurological health effects in children. That level also falls below a blood lead level that would trigger medical intervention (U.S. EPA 1994b, U.S. EPA 1998a). EPA normally employs this strategy as part of determining a soil preliminary remediation goal (PRG) for lead at hazardous waste sites (e.g., Superfund, RCRA, Brownfields). It can also be used to determine an allowable limit for long-term air emission and deposition of lead onto soil in the vicinity of a lead-emitting combustion unit or other lead-emitting sources.

The IEUBK computer model for lead was originally developed by EPA and collaborators from academia (Kneip et al. 1983, U.S. EPA 1990a). The IEUBK computer model integrates several characteristics that reflect the complex exposure pattern and physiological handling of lead by the body.

The IEUBK computer model uses standard age-weighted exposure parameters for consumption or intake rates of food, drinking water, soil, dust, and inhalation of air. It combines those parameters with the available site-specific information on the concentrations of lead in these media in order to estimate exposure for the child. The model inserts default values whenever site-specific information is not used. The default values (e.g., dietary lead concentrations, consumption values) are typical of a child's environment and were derived from research and published information on lead levels in environmental media and child-specific consumption and intake rates for children in the United States.

EPA made the following key model assumptions when it ran the IEUBK computer model: that well-characterized neurological effects in residential children are appropriate for evaluating lead toxicity to all receptors; and that the age-weighted parameters for consumption or intake rates (of food, drinking water, soil, dust, and inhalation of air) for those children are representative of the child-resident receptors in the SSRA study area.

The IEUBK model has been validated at several sites where lead exposure data and human blood lead levels are available. The EPA Science Advisory Board has reviewed the IEUBK computer model and found it sound and valid for evaluating and controlling human exposures to lead under EPA programs (U.S. EPA 1992). A 2007 EPA Full-Scale Human Exposure and Health Risk Assessment evaluated three lead models, including the IEUBK. Performance evaluations included replicating national-scale child blood lead levels and blood lead levels for an urban child cohort. That 2007 assessment selected the IEUBK model, whose estimates came closer to the observed values, as the primary blood lead model for the risk assessment used to inform the EPA's review of the National Ambient Air Quality Standards (NAAQS) for lead. (U.S. EPA 2007b).

Although some uncertainty remains with using models (such as IEUBK), and actual blood lead concentrations could be higher or lower, EPA has high confidence in the IEUBK model and uses it for most site-specific risk assessments as well as the basis for major regulations such as the 2008 National Ambient Air Quality Standards for Lead (U.S. EPA 2008a).

8.4.2 Source Parameters Uncertainty

Facility Physical Parameters: These parameters include the physical stack locations, which EPA took from the internet-based geographic information system (GIS) Google Earth Pro (Appendix 1). These values are considered site-specific and high certainty.

Another facility physical parameter uncertainty is the potential for existing accumulation of COPCs emitted from the facility and deposited in the study area during the past 30 years of operations. This issue is further discussed in section 8.5.1,

This SSRA does not address risk from COPCs from other industrial sources in the vicinity of the facility. This selection presents medium uncertainty and would bias the results low. That uncertainty is partially offset, however, by setting the target hazard index at 0.25 instead of 1.0 (see section 9.1 Cancer and Hazard Target Levels.)

Waterbodies, Watersheds and Parameter Values Selection: This SSRA evaluated fish-ingestion risk from the two lakes at Frank Holten State Recreation Area: Whispering Willow Lake and Grand Marais Lake. While EPA and Veolia evaluated these lakes in earlier SSRA documents (U.S. EPA 2004, U.S. EPA 2007a, Franklin 2016, Franklin 2017), the earlier SSRA evaluations considered these lakes as one waterbody called Frank Holten Lake. This new SSRA accurately differentiates the two lakes as two separate waterbodies. EPA also determined through previous risk screenings that the Mississippi River does not need to be further evaluated because its large volumetric flow does not allow significant accumulation of deposited constituents from this facility; and did not evaluate the waterbody called Dead Creek because it found no evidence that waterbody was used for fishing.

EPA derived the lakes' watersheds based on subarea drainage delineations that relate to the upstream watershed of the lakes taken from digitized versions of Army Corps of Engineers (ACOE) publications from the 1960s and having a drainage exit point that coincides with the outlet of Grand Marais Lake in Frank Holten State Recreation Area. The 1960's delineations had been digitized into a GIS layer, which the St. Louis ACOE District provided to EPA Region 5. EPA merged the ACOE subarea delineations upstream of Interstate 255 to use as the upper watershed boundary - exactly as drawn by ACOE. EPA modified the lower waterbody boundary downstream of this Interstate 255 from the ACOE delineations to follow the encapsulating levee system surrounding Grand Marais Lake. Figure 3-6 displays the overall watershed for the lakes in red, overlaying the pink Corps' subarea drainage delineations (U.S. EPA 2019a).

EPA collected the waterbody and watershed input parameter values for the Whispering Willow Lake and Grand Marais Lake from Illinois State sources (IDNR 2019a, U.S. EPA 2019a) and previous SSRAs (U.S EPA 2004, U.S. EPA 2007a, Franklin 2016, Franklin 2017). The waterbody and watershed parameter values were similar to historical SSRAs and associated references except for the average annual volumetric flowrate through waterbody values. The inverse of this parameter is waterbody retention time. Retention time values for the two lakes varied from 0.2 to 1.7 years. EPA evaluated the methylmercury hazard results using these two values and determined that the methylmercury hazard results were not sensitive over this range. EPA calculated the average annual volumetric flowrate for each waterbody using a mid-point retention time of 1 year. The selection of these waterbodies, watersheds and parameter values for risk evaluation presents low uncertainty.

Table 8-1 Methylmercury HI versus Waterbody Retention Time (RT)

	RT = 0.2 years	RT = 1.0 years	RT = 1.7 years
Whispering Willow Lake HI	0.92	0.92	0.92
Grand Marais Lake HI	0.94	0.93	0.92

COPC Selection Uncertainty: This SSRA evaluated risk from potential stack emissions of MACT metals and dioxins and furans (expressed as 2,3,7,8-tetrachloro-dibenzo-dioxin TEQ).

As stated in the executive summary, the purpose of this SSRA is to determine certain constituent emission rates that are expected to be protective of human health in the area around the facility and recommend the RCRA permit ensures this protectiveness. This effort is an update to an earlier 2007 EPA SSRA that specifically targeted COPCs enumerated within the hazardous waste combustor NESHAP. This SSRA, as well as the ones that preceded it, is considered a screening risk assessment in that emission COPCs were limited to those "*U.S. EPA believes to have a likelihood of exceeding accepted levels of cancer risk or chronic toxicity . . .*" and EPA "*focused specifically on the potential health impacts of chemicals . . . related to emission limits established by the Hazardous Waste Combustion - Maximum Achievable Control Technology Rule*" (U.S. EPA 2007a, p.1).

The HWC NESHAP addresses control of metals by establishing standards for several enumerated toxic metals and relying on compliance with the PM standard to control other metals that may be present in the emissions. This is an appropriate consideration in establishing a technology-based standard for metals of low volatility expected to be primarily present in particle form or bound to particulates. As a practical matter, control of these metals would be accomplished by controlling PM emissions. Nevertheless, there may be emissions of non-MACT metals within the limits of the PM control standard that this SSRA does not evaluate. As a permitted commercial hazardous waste incinerator, the facility is expected to burn a wide variety of hazardous waste that could contain many different metals. Selecting COPC metals for this SSRA presents a low uncertainty; and not evaluating other metals presents a moderate uncertainty.

The MACT rule also addresses control of toxic organic compounds by establishing standards for dioxins and furans and relying on compliance with a destruction/removal efficiency standard (DRE) combined with continuous compliance with either a total hydrocarbon standard or carbon monoxide standard for other organics. As a practical matter, control of these organics would be accomplished by ensuring the best combustion conditions, as evidenced by these surrogate emission standards. Nevertheless, there may be emissions of non-enumerated organic compounds within the limits of the DRE control standard this SSRA does not evaluate. As a permitted commercial hazardous waste incinerator, Veolia is expected to burn a wide variety of hazardous wastes that could contain many different organics. Additional organics could form in the exhaust gas as products of incomplete combustion (PICs). This SSRA did not evaluate unburned organics and PICs occurring within the limits of the DRE, total hydrocarbon or carbon monoxide standard. Selecting COPC organics for this SSRA presents a moderate uncertainty due to those organics omitted from the analysis.

The decision to limit the emitted constituents of concern thus presents a moderate uncertainty that could bias the risk estimate low.

COPC Emission Rates: EPA evaluated risk from COPC emissions assumed to occur continuously at the site-specific emission rates derived from the MACT standards. This is appropriate for setting a maximum permit value and is not meant to estimate average or day-to-day risk from the facility's stack emissions. Estimating COPC emission rates based on MACT standards presents a low uncertainty provided the facility does not or cannot appreciably increase the maximum stack gas flowrate or COPC feed rates. If the calculated site-specific emission rates derived from the MACT standards represent the upper limit of the facility's system, then these emission rates are estimated with high confidence.

There is also uncertainty associated with assumptions EPA made about metals speciation of mercury and chromium. EPA derived mercury speciation from actual stack test data. The method EPA used (adapted Method 29) can overestimate the fraction of divalent mercury, however. Assumptions about loss of mercury to the global cycle are made using universal factors. Given these limitations, we assess the uncertainty to be medium, with the accuracy of stack tests potentially offset by the method and loss assumptions. Updated stack testing using methods specific for mercury speciation (Ontario-Hydro method) could reduce uncertainty associated with mercury speciation.

This SSRA addresses chromium speciation by making generic assumptions taken from the HHRAP, in the absence of stack testing for chromium speciation. As such, EPA believes the assumptions about chromium speciation present a high uncertainty. The actual fraction of hexavalent chromium (the species that significantly adds to risk) could be higher or lower, although the default value from HHRAP is meant to be conservative. Site-specific stack testing would reduce chromium speciation uncertainty.

8.4.3 COPC Chemical and Physical Properties Uncertainty

HHRAP provides physical and chemical properties for constituents of potential concern. These include molecular weight, solubility, melting temperature, vapor pressure, Henry's Law constant, diffusivity in air and water, fraction of airborne COPC in vapor phase, octanol/water partitioning coefficient, bed sediment-sediment pore water partition coefficient, soil organic carbon-water partition coefficient, soil-water partition coefficient, suspended sediment-surface water partition coefficient and COPC soil loss constant due to biotic and abiotic degradation.

Some of these parameters, such as the molecular weight or melting point of a particular chemical, present little uncertainty. Others may show some variability, usually influenced by the test conditions and the presence of other constituents. In preparing HHRAP and its companion database of physical and chemical properties, EPA employed a strategy designed to select the most appropriate and justifiable value. This strategy prioritized measured values from recent and accessible peer-reviewed studies. EPA conducted further research on the parameters to identify study observations affecting their usability in the HHRAP scenarios. The parameters had to be verifiable with source citations. When the best-source study presented multiple values in the best-source study, EPA selected the source-recommended value. Where the source did not recommend a particular value, EPA chose the study value closest to the average of all study values.

This SSRA used alternate parameter values instead of the default values the HHRAP recommends for the Henry's Law Constant and Diffusivity in Air for divalent mercury vapor (U.S. EPA 2016a). EPA performed sensitivity comparisons that determined the alternative parameter values are expected to change the risk results appreciably lower. These parameter value changes are part of the differences in this SSRA and the 2007 EPA SSRA.

There is a medium degree of uncertainty associated with both the default parameters and the alternate values mentioned. EPA minimized this uncertainty significantly by prioritizing the best measured data values over estimates. Appendix A to HHRAP cites sources for the default parameters and also provides a brief discussion on the default values used in this SSRA, and, in some instances, the relative uncertainties associated with these values (U.S. EPA 2005a).

8.4.4 COPC Toxicity Values Uncertainty

In the HHRAP, EPA obtained toxicity reference values from a variety of sources while following its preferred hierarchy for data sources. This approach uses toxicity reference values from EPA Integrated Risk Information System (IRIS) (http://www.epa.gov/iris/index.html) to the greatest extent possible because the toxicity assessments within IRIS have achieved full intra-agency consensus and are regularly updated and available on-line. Since 1996, IRIS values have undergone external peer review and Agency consensus review. Both the EPA Superfund and RCRA programs use the human health toxicity values contained in IRIS (U.S. EPA 2005a).

For contaminants lacking current IRIS assessments, the toxicity reference data hierarchy requires that toxicity benchmark values be obtained from one of the following data sources by order of preference: Provisional Peer-Reviewed Toxicity Values (PPRTVs) or other peer reviewed values. These include: California Environmental Protection Agency (CalEPA) (http://oehha.ca.gov/) chronic Reference Exposure Levels (RELs) and Unit Risk Estimate (UREs), U.S. Agency for Toxic Substances and Disease Registry (ATSDR) (http://www.atsdr.cdc.gov/) chronic Minimum Risk Levels (MRLs), Health Effects Assessment Summary Tables (HEAST) (U.S. EPA. 1997b), and older health effects assessment documents not incorporated into HEAST - EPA Office of Research and Development (ORD)-National Center for Environmental Assessment (EPA-NCEA).

IRIS: EPA-verified Reference Doses and Reference Concentrations (RfD and RfC) found in IRIS are accompanied by a statement of the confidence that the evaluators have in the value itself, the critical study, and the overall data base. Oral Cancer Slope Factors (CSFo) or Inhalation Unit-Risk Concentrations (URF) include a weight-of-evidence classification indicating likelihood that the agent is a human carcinogen based on the completeness of the evidence that the agent causes cancer in animals or humans. EPA uses these designations as one basis for discussing uncertainty.

IRIS designations of low confidence could suggest a high uncertainty and imply that the toxicity value might change if additional chronic toxicity data become available. High confidence could imply low uncertainty, an indication that a value is less likely to change as more data become available, because there is consistency among the toxic responses observed in different species, sexes, study designs, or in dose-response relationships. A lower uncertainty about toxicity values gives a decision-maker more confidence in the SSRA results. Often, high confidence is associated with values based on human data for the exposure route of concern. (U.S. EPA 1989).

Toxicity Reference data from EPA (IRIS, HEAST, etc.) use a different system to discuss confidence in carcinogenic potency factors. These weight-of-evidence factors have been modified over the years. The description below lists the classifications U.S.EPA used in this SSRA in order of descending degree of confidence using terms common to the various classification systems:

- Group A – Known Human Carcinogen: The reference data include sufficient evidence of human carcinogenicity usually strengthened with corroborating data from animal studies. The highest confidence in carcinogenicity.
- Group B1 – Probable or Likely Human Carcinogen: Reference data includes limited information from human epidemiology. The second highest confidence in carcinogenicity.
- Group B2 – Probable or Likely Human Carcinogen: Reference data includes sufficient data from animal studies, but no adequate data from human epidemiological studies. The third highest confidence in carcinogenicity.

PPRTV: PPRTVs are developed for use in the Superfund program when toxicity values are not available in IRIS. PPRTVs toxicity value assessments are subject to both internal and external peer review, but do not require the multi-program consensus review provided for IRIS values. This SSRA did not use toxicity data from PPRTV.

CalEPA: Toxicity reference values obtained from California EPA Office of Environmental Health Hazard are not necessarily accompanied by statements of confidence. This SSRA used CalEPA reference dose concentrations (RfC) for arsenic inhalation and a cadmium oral cancer slope factor. The SSRA based the arsenic value on a 2008 CalEPA update to the RfC that replaced a 2000 value that originally appeared in the 2005 HHRAP. The new value includes human toxicity data and presents much lower uncertainty factors (30 versus 1000). We believe this new arsenic value is provides greater confidence and presents low uncertainty in this SSRA (CalEPA 2008). The CSF for cadmium, however, is one of several calculated toxicity benchmark values this report discusses below.

ATSDR: ATSDR refers to the RfDs and RfCs derived as Minimum Risk Levels (MRLs). They are based on the no-observed-adverse-effect level (NOAEL) uncertainty factor approach. These values fall below levels that might cause adverse health effects in the people most sensitive to such chemical-induced effects. MRLs contain some uncertainty because of the lack of precise toxicological information about people who might be most sensitive (e.g., infants, elderly, nutritionally or immunologically compromised) to the effects of hazardous substances. ATSDR uses a conservative (i.e., protective) approach to address this uncertainty, consistent with the public health principle of prevention. This SSRA uses ATSDR's RfC for cadmium. The combined uncertainty factor applied to this value was relatively low (value of 9). The evaluation included human exposure and toxicity data (ATSDR 2012).

HEAST: This SSRA took the oral cancer slope factor (CSF_O) for dioxin from EPA Health Effects Summary Tables (U.S. EPA 1997b). This older source of toxicity reference data is a tertiary source of toxicity information and its evaluation and studies can be less comprehensive than those used from sources that are continually updated with additional studies (such as IRIS, CalEPA, and ATSDR). The studies that support this dioxin value classified dioxin as a Group B.2 – Probable Human Carcinogen based on animal studies. The cancer potency of dioxin is currently under review under the IRIS protocols, including additional information on human exposure that could change the classification to human carcinogen. The HEAST value for dioxin this SSRA uses should thus be considered to have medium uncertainty.

Route–To–Route Extrapolation (Calculated Toxicity Benchmark Values): EPA calculated or converted some toxicity reference values so that it could evaluate a different route of exposure before using them in this SSRA. For instance, if the oral RfD (mg/kg/day) was available and the inhalation RfC (mg/m^3) was not; EPA calculated the RfC by dividing the RfD by an average human inhalation rate of 20 m^3/day and multiplying by the average human body weight of 70 kg. This conversion is based on a route-to-route extrapolation, which assumes that the toxicity of the given chemical is equivalent over all routes of exposure. Route-to-route extrapolation of oral dose-response or inhalation information is done to avoid omitting potentially important pathways of exposure. In some cases where the affected organ lies far from the point of entry (such as the liver which is downstream from the stomach (ingestion) and the lungs (inhalation)), route-to-route extrapolation is appropriate. However, assumptions and uncertainties involved when using toxicity benchmarks calculated based on route-to-route extrapolation should limit their use to screening-level or priority type risk assessments. Uncertainty for calculations based on route-to-route extrapolations is medium to high.

Summary of Toxicity Uncertainty: Table 8-2 summarizes the values used in this SSRA and their relative confidence. Actual COPC toxicity may be higher or lower.

The only COPC in this SSRA to significantly exceed its target risk management level is mercury (via methylmercury ingestion from locally-caught fish). The toxicity reference data from IRIS (as shown in the table below) for ingestion of methylmercury is of high quality based on multiple human epidemiological studies with corroborative animal studies. The selection of the IRIS toxicity reference data values for ingestion of methylmercury presents low uncertainty.

This SSRA estimated emissions of hexavalent chromium to contribute cancer risk at values similar to the target cancer risk for this project. The confidence in toxicity reference values for cancer potency through inhalation is high for hexavalent chromium. The selection of hexavalent chromium toxicity reference values presents low uncertainty.

Table 8-2 Toxicity Reference Data Source and Relative Confidence								
	Noncancer Oral Reference Dose (RfD_O)		Noncancer Inhalation Reference Concentration (RfC)		Oral Cancer Slope Factor (CSF_O)		Inhalation Cancer Unit Risk Concentration (URF_i)	
COPC CAS#	Source	Confidence	Source	Confidence	Source	Confidence	Source	Confidence
Arsenic 7440-38-2	IRIS	medium	CalEPA	reasonably high	IRIS	Group A – Known Human Carcinogen with some uncertainties in dose response	IRIS	Group A – Known Human Carcinogen with large study and measured observations
Beryllium 7440-41-7	IRIS	low to medium	IRIS	medium			IRIS	Group B1 – Probable (Likely) Human Carcinogen with some uncertainty in study exposure levels and duration but with corroborating animal studies
Cadmium 7440-43-9	IRIS	high	ATSDR	medium	CalEPA	*rtr	IRIS	Group B1 – Probable (Likely) Human Carcinogen with large study and measured observations with corroborating animal studies
Chromium (Hexavalent) 18540-29-9	IRIS	low	IRIS	low to medium			IRIS	Group A – Known Human Carcinogen with large study and measured observations
Chromium (as Trivalent) 7440-47-3 (16065-83-1)	IRIS	low						
Dioxin/Furans (As 2,3,7,8-TCDD) 1746-01-6	IRIS	high	IRIS	*rtr	HEAST	Group B.2 Probable (Likely) Human Carcinogen Based on Animal Studies		
Mercury (Elemental) 7439-97-6	IRIS	*rtr	IRIS	medium				
Mercury (Divalent – as Mercuric Chloride) 7487-94-7	IRIS	high	IRIS	*rtr				
Methylmercury 22967-92-6	IRIS	high	IRIS	*rtr				

Note: Methylmercury and hexavalent chromium are the only constituents significantly exceeding the target risk or hazard levels.

*rtr Route-to-route extrapolation (calculated toxicity reference data). See narrative above.

8.4.5 Risk Receptor Parameters Uncertainty

Receptor Scenario and Pathway Selection: This SSRA evaluated risks posed to nearby Resident Adults and Children), Fisher Adults and Children (residents who fish at local waterbodies that eat some of their catch), and Farmer Adults and Children. There are established residential neighborhoods near the facility and scattered throughout the study area. There are fishable waterbodies near the facility at Frank Holton State Recreation Area. There are potential agricultural land use areas that may contain livestock. EPA included the farmer scenarios in this assessment with medium confidence because current farms may continue to operate and there is future potential of farming land use. EPA researched but did not find any information that indicated these types of land use would change significantly in the future.

Veolia's 2016 SSRA submission suggested that residents who are also fishers should be assigned residential exposures only on the shores of the lakes at Frank Holten State Recreation Area. EPA rejected this receptor limitation because any resident in the community, regardless of location, could travel to and fish at Frank Holten State Recreation Area. Moreover, a resident living closer to the emission source may have a higher exposure when home (via inhalation, consumption of home-grown produce, etc) than someone assumed to live on the lake while still catching fish to consume at the lakes.

For the lead exposure scenario, EPA used the *Integrated Exposure Uptake and Biokinetic (IEUBK) Model* discussed in Sections 2.4 and 8.4.1. As noted in the 2004 and 2007 EPA SSRAs, public comments on the draft permit renewal expressed concern that: a) the current background level of lead in soil is already elevated because of past and current industrial activity in and around Sauget, and b) future emissions of lead from the facility would add to a background of lead that may be unacceptable.

Risk Model Site and Scenario Default Parameter Values: EPA considered using site-specific parameter values for parameters that drive the risk results to provide a more representative estimate of site-specific risk, as recommended in HHRAP section 5.8 (U.S. EPA 2005a). Section 1.3 of HHRAP recommends focusing resources on areas that are considered "*risk drivers*" and not spending resources collecting site-specific information that may not affect the final results of the assessment (U.S. EPA 2005a).

Unless EPA found site-specific information, this SSRA used the HHRAP default parameter values for most of the site and scenario parameters. We specifically investigated site-specific parameters related to the methylmercury hazard through fish ingestion. The HHRAP protocol, its appendices and the companion database detail default parameter values and their uncertainty (U.S. EPA 2005a). The uncertainties associated with using these values are reasonable and well documented in the EPA guidance.

One important default receptor parameter is the fish consumption rate. Actual differences in the fish consumption rate value may stem not necessarily from uncertainty but from expected variability. The comprehensive USDA food survey, upon which the default fish consumption rates (fisher adult and fisher child) in HHRAP are based, shows that some fishers do ingest locally-caught fish at rates both greater than and less than the default value chosen. The value may vary based on behavior patterns both within an individual's lifespan (intra-individual variability) and from one individual to another (inter-individual variability). The impact of this variability on the SSRA is further discussed in section 8.5 below.

Risk Model Site-specific Parameter Values: Section 1.3 of HHRAP recommends using existing and site-specific information throughout the SSRA process when available or reasonably obtainable to evaluate actual regulated operations for any particular combustor (U.S. EPA 2005a).

The general site-specific parameters and the waterbody and watershed parameters for Whispering Willow and Grand Marais Lakes are described in section 7.0. These values present low uncertainty.

Site and Scenario Default Parameter Values for the IEUBK Computer Model: The IEUBK computer model for evaluating lead exposure includes a number of input parameter values that may be user-specified or default. The model comprises three major components: exposure, uptake, and biokinetic. Evaluating the few adjustable parameters that correspond to the uptake and biokinetic components of the model fell outside the scope of this SSRA. The remaining adjustable parameters concern the exposure component, which can be further divided into exposure to air, diet, drinking water, dust and soil.

The air inhalation element includes an outdoor air-concentration along with estimates of the time spent outdoors, indoor air concentration default values estimated from the outdoor concentration, and a respiration ventilation rate. For this SSRA, EPA did not find site-specific data for any of these except the outdoor air concentration. The IEUBK computer model derives default indoor air-concentration from studies of homes near lead point sources.

This assessment predicts a minor increase in soil-lead concentration compared to background soil-lead estimates. Therefore, this SSRA also expects the corresponding estimated increases in dietary lead intake from bioaccumulation of lead emitted from the facility to be minor in comparison to contributions from background sources. We used the default dietary lead intake values from the model.

The dust and soil component include a variety of possible input and default parameters. The 2004 and 2007 EPA SSRAs used a house-dust value of 250 mg/kg from a Rochester NY study as a surrogate value. EPA does not have site-specific data that would allow alternative calculations of indoor dust-lead concentrations at the facility. This assessment used a default parameter that estimates the indoor dust concentration (from all sources) from the outdoor soil-lead concentration. The estimated lead dust concentration from 400 mg/kg lead soil is 290 mg/kg, which is higher than the surrogate value.

EPA estimates the default parameters the IEUBK computer model uses to have medium to low uncertainty for the application to the incremental increase in soil-lead estimated from the facility. The use of default parameter values presents a medium uncertainty, while overall the use of the IEUBK computer model presents high confidence based on model performance evaluations.

Site-Specific IEUBK Parameter Values:

EPA did not use measured ambient air lead concentrations in this SSRA, but instead used a recent measured ambient air lead concentration from a nearby area with known lead sources. EPA and IEPA previously monitored ambient air lead concentrations in East St. Louis at monitoring station #171630010, located approximately 1.5 miles from the facility at 13th St. and Tudor Street through 2010. The 2010 Illinois Annual Air Quality Report shows a lead concentration maximum three-month mean of 0.03 ug/m^3 (IEPA 2011). The Agencies discontinued ambient air lead monitoring in 2011, after a demonstration under 40 C.F.R. § 58.14(c) (IEPA 2010). That demonstration suggests rolling three-month average concentrations of lead in East St. Louis stayed below 0.15 ug/m3 between 2005 and 2010.

Because the Agencies have not monitored lead ambient air in East St. Louis since 2010, this SSRA evaluated lead ambient air concentrations measured at the nearest lead monitoring station located in Granite City, Illinois, which is seven miles north of the facility. Granite City is one of only four sites in the State of Illinois which continue to monitor for lead ambient air concentrations. In the IEUBK lead model, EPA used a lead ambient air concentration of 0.027 ug/m^3. This value represents the daily average for the last seven-years from the Granite City monitoring site (U.S. EPA 2019b). The long-term daily average is appropriate since it is the most recent data available nearby and the lead emission deposition from the facility would be long term also. This value is also similar to the maximum three-month mean last reported for East St. Louis in 2010. EPA estimates this value to be of low uncertainty as it is a recent, local, and measured value.

EPA investigated lead concentrations in drinking water for the area around the facility. The Safe Drinking Water Act requires analysis of drinking water for large public water supply utilities. The constant water-lead concentration for this SSRA is site-specific at 2.0 mg/L reported by the water supplier for the East St. Louis water supply district (Illinois American Water 2018). This is the 90th percentile of the 2018 lead results collected at household taps. EPA estimates this concentration to present a low uncertainty as it is recent, local, and determined by sampling and analysis.

EPA researched background soil-lead values for use in the IEUBK computer model. The 2004 and 2007 EPA SSRAs describe background lead soil concentrations and remediation projects that removed contaminated soil from around abandoned industrial facilities and residences in East St. Louis, Illinois. EPA ran the IEUBK computer model at a range of potential background soil-lead concentrations including 100, 200, 300, and 400 mg/kg. Since we do not have verifiable background soil-lead data, EPA believes these background soil estimates present a medium uncertainty.

The site-specific parameters EPA used in the IEUBK computer model have low uncertainty with respect to applying them to the incremental increase in soil-lead estimated from the facility. While the background soil concentration presents a high uncertainty, the overall uncertainty of using these site-specific parameter values is offset by EPA's overall high confidence in the IEUBK computer model based on its past performance evaluations and by the minor incremental impact EPA estimated for the facility. Actual lead concentrations in air, water, diet, soil and dust may be higher or lower at any residence.

8.5 Potential Sensitive Parameters in the SSRA

8.5.1 Total Averaging Time Period over Which Deposition Has Occurred Uncertainty

The assumption regarding the source's estimated duration of emissions and deposition (tD) presents an uncertainty. Although this SSRA used a value of 30 years, the guidance suggests that the industrial activity in some cases may continue for 60 to 100 years. This continuation of operation and emissions is estimated to further increase the concentration of COPCs in soils in the watersheds and other receptor locations in the study area. The facility has been operating a commercial chemical waste incinerator in Sauget, Illinois for 47 years (since 1972) (U.S. EPA 1987). Using the 60-year value would result in a 45% greater HI (1.42) than the 30-year period and using the 100-year value would result in a 207% greater HI (2.01) than the 30-year period. It is reasonable to assume the combustion activity may continue for at least 30 years into the future. By assuming a duration of emissions and deposition of only 30 years, EPA's risk estimate may present high uncertainty and be biased low.

8.5.2 Bioaccumulation Factor for Methylmercury in Fish Uncertainty

BAF Values Used in this SSRA and Supporting Data

EPA researched and did not find site-specific bioaccumulation factor (BAF) values for the waterbodies it evaluated in this SSRA. HHRAP recommends a methylmercury BAF of 6.8E+06 L/kg for trophic-level 4 fish (BAF4), which is the BAF4 used in the EPA 1997 Mercury Study Report to Congress (MSRC) for trophic-level 4 fish (U.S. EPA 1997c). These BAFs are based on directly-measured BAF4s for freely-dissolved methylmercury in several lakes throughout North America.

Overall, EPA has used a wide range of BAFs to estimate the fate and transport of methylmercury in fish. EPA selected the BAF4 of 1.6E+06 L/kg in the Utility Steam Report to Congress. EPA used BAF4 values of 1.6E+06 L/kg and 6.8E+06 L/kg in the risk assessment it conducted for the HWC NESHAP (U.S. EPA 1998b).

Additionally, in 2001, EPA prepared draft national methylmercury BAFs lower than those used in HHRAP (U.S. EPA 2001b). A 2010 EPA Guidance recommends a BAF4 of 2.7E+06 L/kg and a trophic-level 3 BAF (BAF3) of 6.8E+05 L/kg (U.S. EPA 2010). We note the Draft National BAF was not finalized when EPA issued the 2010 implementing guidance and did not incorporate peer-review comments (U.S. EPA 2013). In fact, the 2010 implementing guidance for the 2001 FINAL Ambient Water Quality Criterion (AWQC) indicates that states and tribes should use the Draft National BAF only as a last resort due to the significant uncertainties associated with it. Peer review comments indicated the draft national BAF's application of the combined river and lake BAF across ecosystems was inappropriate. EPA issued the 2005 HHRAP after it issued the 2001 water quality criterion and retained the default BAF4 (from MSRC) as the more appropriate value.

EPA incorporated the MSRC data into the 2001 guidance which was expanded to include additional lake-or lentic-data (where freely-dissolved methylmercury was estimated from either total water column methylmercury or total water column mercury) and data from the lotic environment (streams and rivers). In 2001, EPA prepared the draft national methylmercury BAF as a combination of observed and converted BAFs from both lentic and lotic environments. The reasoning was that "*at this time lotic BAFs cannot be distinguished from lentic BAFs, though the data suggests slightly reduced methylmercury accumulation may occur in higher trophic-level organisms in lotic/wetland environments*" (U.S. EPA 2001b, p.A-17).

In Figure 8-1 at the end of this section (referring to Figure A-3 of Appendix A to the 2001 Guidance), the lotic (riverine) methylmercury BAF4s overlap those of the lentic (lake) BAF4s (U.S. EPA 2001b). It is important to note that while the lotic BAF4s occur over an extremely wide range (two orders of magnitude, perhaps due to the wide variety of stream conditions such as fast-flowing, slow-moving, etc.), the lentic BAF4s minimally overlap the extreme upper range of lotic observations and are much less variable (ranging within less than one order of magnitude). Thus, it may not be appropriate to mix lentic and lotic BAF4s when evaluating lakes.

As part of other risk assessments, EPA considered using several United States Geological Survey (USGS) studies for setting methylmercury BAFs (Krabbenhoft, et al 1999, USGS 2001). To assess updated BAFs using the additional USGS data, EPA evaluated the BAF3s and BAF4s for lakes and rivers separately for the USGS fish and water sample data referenced from locations within the lower 48 states. EPA considered limiting this approach to USGS data from midwestern basins; but none of the fish sampled in the midwestern basins were collected from lakes. Also, no trophic-level 3 fish were collected from the midwestern basins.

Using information about trophic levels from Table 6, Appendix I in the 1995 Great Lakes Water Quality Guidance, we separated fish species that are expected to be classified as trophic-level 3 from trophic-level 4 (U.S. EPA 1995). These included: bluegill sunfish, mixed sunfish, mountain whitefish, carp, spotted bass less than 200mm in length, channel- and flathead-catfish less than 450mm in length, and crappie. EPA combined these calculated BAFs with those reported in the MSRC (U.S. EPA 1997c) and the additional "*converted*" values reported in the 2001 Ambient Water Quality Criteria (U.S. EPA 2001b) into an "*Aggregated Lower 48*" BAF by waterbody type (see Table 8-3).

Table 8-3 Comparison of Methylmercury BAFs

Water Body	Aggregated Lower 48 (all data)	MSRC (direct measurements only)	2001 AWQC (including direct and converted and MSRC values)	USGS 2-Midwestern Basins	USGS All Basins in the Lower 48 States
Trophic 4 Methylmercury BAF					
Lakes	**6.3E6**	6.8E6	5.7E6	NA -no lakes sampled	6.7E6
Rivers	3.4E6	2.5E6	1.2E6	2.7E6	3.6E6
Trophic 3 Methylmercury BAF					
Lakes	**1.3E6**	1.6E6	1.3E6	NA - no lakes sampled	NA - no lakes sampled
Rivers	7.6E5	NA - no rivers reported	4.3E5	NA - no T3 reported	1.3E6

These various derivations of BAF4 values for lake waterbodies are all consistent. The different estimates of BAF3 values are also similar by waterbody type. Since reported BAFs for lake waterbodies are typically higher than for river waterbodies for both trophic-level 3 and trophic-level 4 fish and this SSRA independently addresses risk from fish consumed from specific and known waterbodies, it is appropriate to consider BAFs specific to waterbody type.

For this SSRA, EPA combined BAF3s and BAF4s (25% and 75% respectively) for the purposes of locally-caught fish consumption because channel catfish, which the Illinois Department of Natural Resources (IDNR) stocks at the Frank Holten State Recreation Area, can be harvested at any length, including as smaller trophic-level 3 fish. IDNR also stocks bluegill, which are trophic-level 3 fish. EPA applied this factor by weighting the BAF used in the IRAP-H-view model. Accordingly, the methylmercury BAF for lakes EPA used in the model is 5.0E06.

Other BAFs and Trophic Level Rationale Considered

Veolia's 2016 SSRA submission considers choosing fish of trophic-level 4 too conservative for the Lakes at Frank Holten State Recreation Area and proposes using a combination BAF that represents fish of trophic-levels 3 and 4 (Franklin 2016). It presented several factors; but lacked supporting citations. (For example, only one reference to State biologists provided a name or cited the conversation referenced.) EPA agrees that a mix of trophic-level 3 and 4 should be factored into the BAF for the Frank Holten State Recreation Area lakes, however. The value EPA calculated above is appropriate because the underlying BAFs are derived from many more samples (with the USGS studies added in).

Veolia's 2017 SSRA submission presented the same factors but concluded that trophic-level 4 fish should be eliminated from the SSRA without any additional rationale. It did not provide additional references or citations for that conclusion (Franklin 2017). It also referenced "*site observations*" to conclude that most of the catch for local fisherman is bluegill and catfish and that these are not trophic-level 4 fish.

EPA considered Veolia's submissions but believes there is a substantial likelihood that fishers catch and eat trophic-level 4 fish in the lakes at Frank Holten State Park based on the following information. Both largemouth bass and channel catfish are stocked by the state (IDNR 2019b). Largemouth bass of legal harvest length, 14 inches, and channel catfish greater than 13.8- to 17.7-inches in length are both trophic-level 4 (U.S. EPA 1995, 2002, 2003b). The state average length of caught channel catfish is 18 inches in length (IDNR 2019c). If these fish are stocked, grown to legal (largemouth bass) or average (channel catfish) length, they will be trophic-level 4 when caught and consumed.

EPA also considered the statement in Veolia's 2016 SSRA submission: *"Coldwater fish species such as bass account for the trophic level 4 fish found even sporadically in these lakes. Fishing at Frank Holten is almost exclusively from the shore. These types of fish are not typically caught from the shallower, warmer waters near the shoreline"* (Franklin 2016, p.52). EPA could not find any references nor corroborate that statement to these claims. However, fishing by boat is promoted and Frank Holten State Recreation Area provides boat ramps (IDNR 2019a). Furthermore, the State specifically identifies the trophic-level 4 species EPA evaluated for BAFs (largemouth bass and channel catfish) as species likely to be caught from shoreline fishing (bank fishing) at Frank Holten State Recreation Area (IDNR 2019d).

EPA also considered the quote from Veolia's 2016 SSRA submission:

> "*The stocked game fish ". . .are culled out fairly quickly. They do not survive the summers in these lakes.*" *"(sic). . . 75 to 80 percent are caught. You may have some mortality on some, but most of them are harvested. These statements from the IDNR fishing reports indicate that these game fish do not survive long enough in the lakes to be affected by long-term exposure of pollutants or to propagate*" (Franklin 2016, p.52).

The following information EPA reviewed contradict these statements. EPA contacted several current and former Illinois State fish biologists who assert that most fish taken are typically native to the waterbody and not from stocked populations. They also say that even if stocked fish (largemouth bass in particular) were caught and kept, legal-sized fishes would have spent the vast majority of their life cycle in the stocked waterbody. Largemouth bass are stocked as 3-month old small fingerlings (4-inches in length) and must typically live to 3- to 4-years of age to reach legal size. The State fish biologists also indicate that large-mouth bass that develop to legally catchable size have spent their entire trophic-4 phase of their life in the stocked waterbody preying on other fish (Parkos 2018 and Diana 2018). For these reasons, largemouth bass and channel catfish would not be culled immediately after stocking as the fingerling fish are not large enough to catch and keep.

Conclusions about BAFs and Trophic-Levels

After reviewing information from fisheries biologists and the State of Illinois' website on fishing in Frank Holten State Recreation Area that indicates the potential for local fishers to catch and consume trophic-level 4 fish, EPA decided to continue to include trophic level 4 fish in this SSRA. The efforts by the State of Illinois to actively stock and promote fishing of such species in Frank Holten State Recreation Area and the legal size of caught and kept fish supports this scenario. It remains appropriate to include the risk to local fishers from consumption of locally caught fish of trophic-level 4.

EPA combined lake-BAF3 and lake-BAF4 values (25% and 75% respectively) for the purposes of locally-caught fish consumption resulting in a methylmercury lake-BAF of 5.0E06. That BAF is considered of medium uncertainty since it is based on an aggregation of data, not site-specific to these lakes.

Figure 8- 1.

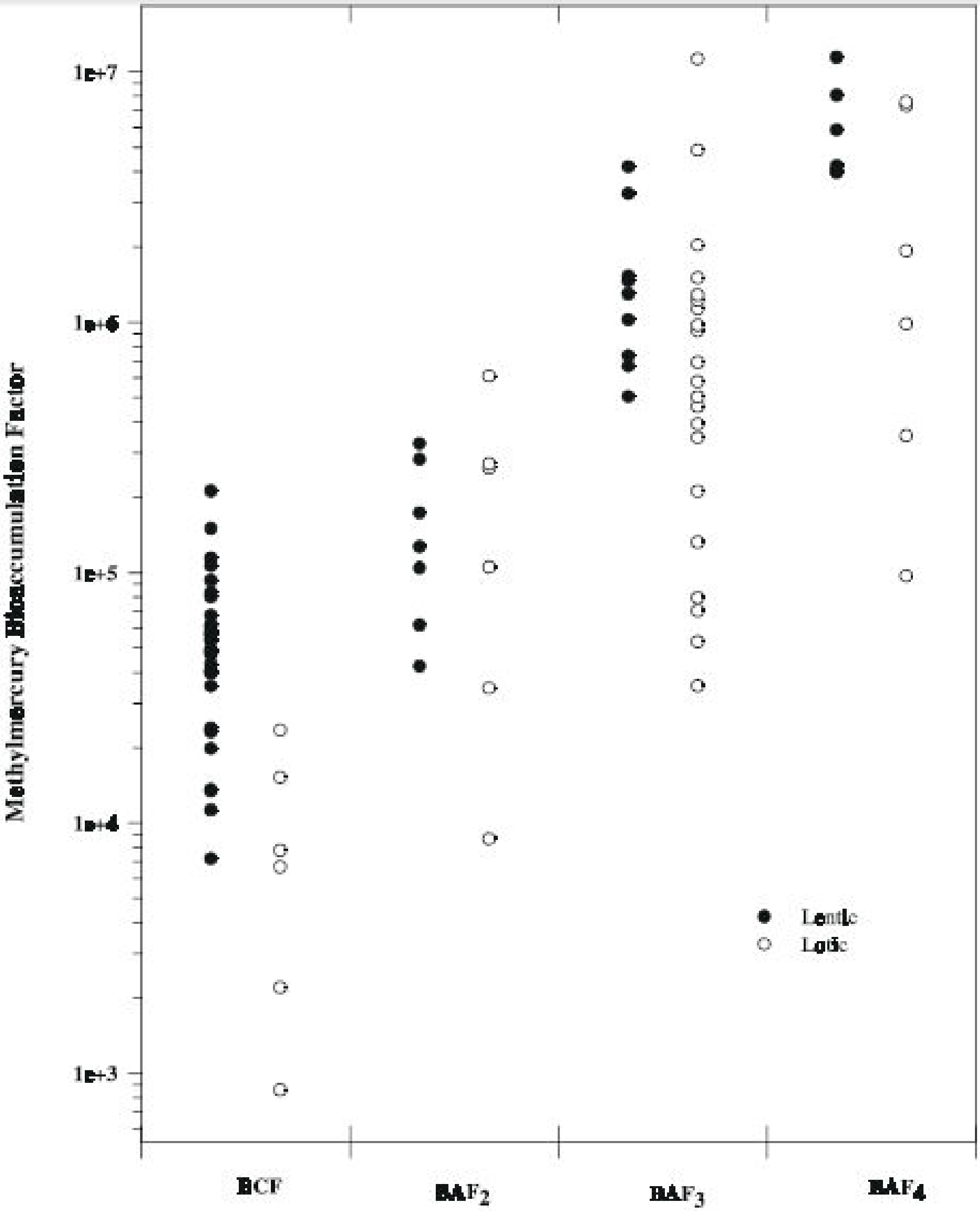


Figure A-3. Comparison of lentic and lotic methylmercury BAFs. Data includes both direct field-measured BAFs and converted field-measured BAFs.

8.5.3 Fish Consumption Rate Uncertainty

EPA used the fish consumption rate the HHRAP recommends since it exactly matches the identification of the exposure scenario of people who fish locally and eat some of their catch. The 2016 and 2017 SSRA submissions recommended alternate fish consumption rates based on fish ingestion by the general population, which includes many people who eat no fish, locally caught or otherwise (Franklin 2016 and Franklin 2017). This does not match the exposure scenario indicated in HHRAP for consideration. EPA guidance recommends considering sensitive populations, such as residential fishers who consume some of their catch, when evaluating site-specific scenarios as opposed to broader evaluations where parameters derived from general population studies may be used (U.S. EPA 2001b and 2015). EPA also considered alternate approaches for fish consumption rates that U.S.EPA's Office of Water recommends as a hierarchy of options. The optimal approach based on this hierarchy is a fish consumption study of a similar geographical area (southern Indiana) that has fish consumption rates comparable to the value the HHRAP recommended and this SSRA used.

Scenario Identification – Local Fishers Who Eat Some of Their Catch

In this SSRA, the routes of exposure for the Adult Fisher and Child Fisher scenarios are the pathways used for the residential scenarios plus the ingestion of locally-caught fish. The fish consumption rate should closely represent the risk assessment's scenario identification of focus – namely, people who catch fish locally and eat some of the fish they catch. While this group may include some people that consume a lot of local fish, it also includes people who eat very little local fish. EPA considered that the identified scenarios for Adult and Child Fishers are people who fish locally and consume some of the fish they catch.

The HHRAP default rates are derived from consumption rates from EPA 1997 Exposure Factors Handbook. The rates in the Exposure Factors Handbook are based on the 1987-1988 USDA National Food Consumption Survey (NFCS) (USDA 1994) (U.S. EPA 1997a). The HHRAP states that these default consumption rates may be used to assess exposure to contaminants in foods grown, raised, or caught at a specific site (U.S. EPA 2005a). EPA 1997 and 2011 editions of Exposure Factors Handbook use the same 1987-88 USDA NFCS data to show fish consumption rates for people who fish locally and eat some of the fish they catch (U.S. EPA 1997a) (U.S. EPA 2011). The 2011 edition of Exposure Factors Handbook has the same consumer only intake rates of home caught fish as the 1997 edition. Therefore, EPA continues to rely on the HHRAP recommended default fish consumption rate from the USDA NFCS for risk assessments.

EPA used the Nationwide Food Consumption Survey (NFCS) data to generate intake rates for home produced foods. The survey used a statistical sampling technique designed to ensure that all seasons, geographic regions of the 48 conterminous states in the U.S., and socioeconomic and demographic groups were represented (USDA 1994). The sample size for the 1987-88 survey was approximately 4,300 households. Although the intake rates are based on a 7-day survey and might not measure long-term consumption behavior, efforts were made to account for seasonal, geographic, socioeconomic and demographic variability. Even though the household-level response rate for the survey was low (38%), the survey's relatively robust sample size of the defined exposure scenarios lends reliability and representativeness to the results.

EPA also considered potential uncertainty associated with seasonal availability of lakes for fishing and use of fish consumption advisory guidelines. The default fisher scenarios consider fish caught and frozen for later consumption. EPA assumes potential seasonal availability would not reduce fish consumption rates because the USDA survey included locally-caught fish stored for later consumption.

The default consumption rates are derived from data that represents the mean (average) amount of home-caught fish eaten per day by people who fish in a local waterbody and eat at least some of the fish they catch. The fish consumption rate in the HHRAP most closely represents the risk assessment's scenario identification of focus – namely, people who catch fish locally and eat some of the fish they catch. While this group may include some people that consume a lot of local fish, it also includes people who eat few local fish. The fish consumption rate from the USDA survey is a mean value from surveys of this population, not an upper or lower bounding. It is not reflective of only subsistence-type fishers. EPA chose to use the mean-value consumption rates rather than upper-limit (higher) values for the identified exposure scenarios (Fisher Adult and Fisher Child). These consumption rates convert to 87.5 grams per day for an Adult Fisher and 13.2 grams per day for a Child Fisher.

The HHRAP recommended default fish consumption rates are not intended to specifically represent subsistence fishers or other high-end consumers of home-caught fish, as explained in the HHRAP Guidance and the USDA Survey. In some instances, EPA has performed risk assessments using subsistence fisher scenarios. Subsistence fishers may be defined as "*fishers who rely on noncommercially caught fish and shellfish as a major source of protein in their diets*" (U.S. EPA 2000b, p.1-6). However, the HHRAP fish consumption default values are derived from consumer only intake of home-caught fish scenarios.

Since the 1930s, USDA has conducted seven household food consumption surveys on a national scale. The NFCS 1987-88 is the only survey to study locally-caught and consumed food. The locally-caught and consumed fish study (Consumer Only Intake of Home Caught Fish) had 220 households and 239 individuals respond. Respondents also gave information on home food production and preservation.

Fish Consumption Rates for Other Scenarios Based on EPA's Ambient Water Quality Criteria

The Human Health Ambient Water Quality Criteria 2015 Update states:

> *Therefore, EPA suggests a four preference hierarchy for states and authorized tribes that encourages use of the best local, state, or regional data available to*

derive fish consumption rates. EPA recommends that states and authorized tribes consider developing criteria to protect highly exposed population groups and use local or regional data in place of a default value as more representative of their target population group(s). The preferred hierarchy is: (1) use of local data; (2) use of data reflecting similar geography/population groups; (3) use of data from national surveys; and (4) use of EPA's default consumption rates. (U.S. EPA 2015, p.2)

EPA researched and did not find local fish consumption studies in the vicinity of the facility. However, EPA reviewed two Indiana fish consumption rate studies that include data reflecting similar geography/population groups. Southern Illinois and southern Indiana have similar geography and demographics. We believe those studies have compelling components that support considering them for inclusion in this SSRA. Both studies were conducted to survey fresh-water caught fish consumption rates in Indiana.

The first study (Sheaffer et al 1999) surveyed Indiana sport fishers by mailing questionnaires to licensed Indiana sport anglers. The report states that respondents indicated their consumption patterns during a three-month recall, as well as fishing rates, species of fish consumed, awareness of advisory warnings, and associated behaviors related to deciding whether or not and how to eat sport caught fish. The second study (Williams et al 2000) performed an in-person, walk-up, on-site survey of Indiana anglers to assess fish consumption rates and relations to minority and low-income status and awareness of fish consumption advisories. Both studies differentiated results by state, geographical location, and potential and active locally-caught fish consumption.

The mail-in survey identified the average rate for active adult consumers in the southern part of the state to be 23.4 g/d, and the 90th percentile consumption rate to be 49.1 g/d (5.01 g/d and 10.5 g/d for the child fisher). The walk-up survey identified the average rate for active adult consumers in the southern part of the state to be 23.3 g/d, and the 90th percentile consumption rate to be 90.7 g/d (4.99 g/d and 19.4 g/d for the child fisher). EPA recommends using a value similar to the walk-up survey results since this study includes all fishers, not just licensed sport anglers. The 90th percentile fish consumption rate from the walk-up survey, 90.7 g/d, is similar to the mean value from the HHRAP-recommended fish consumption survey that matches our selected scenario: 87.5 g/d.

Other Fish Consumption Rates Considered

Veolia's 2016 submission suggested using fish consumption rates taken from more recent national surveys of fish consumption as well as comparing such values to current Illinois fish consumption advisories. EPA considered these fish consumption rates, but determined they are not appropriate for this project. Fish consumption rates derived from surveys of the general population (known as a "*per capita*" study) include respondents who eat no fish and those who may eat fish but not locally caught fish. Those respondents do not match our exposure scenario. Veolia's 2016 submission suggested using the 75^{th} percentile (Franklin 2016) and their 2017 submission suggested using the

50th percentile (Franklin 2017) for fish consumption rates from general population surveys. Both indicated these values were based on the Ambient Water Quality Criteria Guidance. Fish consumption advisories for impacted waters are not useful for fish consumption rates since EPA's guidance on fish advisories states that the programmatic goal is unrestricted consumption.

The fish consumption rates referenced as based on the Ambient Water Quality Guidance derive from national surveys and nationwide defaults, which are not preferred when local data from similar populations is available. The 2016 submission indicated that EPA's Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010), Final Report, EPA-820-R-14-002, EPA Office of Water, April 2014, recommended using a 50th percentile user to characterize recreational fishers and using a 90th percentile user is indicative of a subsistence fisher. EPA reviewed that document, its available appendices, and subsequent communications with Veolia but could not obtain the information the 2016 submission referenced. The EPA 2014 guidance does not assign percentiles to categories such as sport, recreational, or subsistence fishers. The citations provided did not support the fish consumption rates from the Veolia 2016 and 2017 SSRA submissions.

EPA evaluated the impact of fish advisories and the goal of restoring waterbodies. The 1996 Fish Advisory Guidance aims for waterbodies that do not need advisories:

> *[t]he ultimate goal of a fish contamination reduction program is to return waterbodies to a condition in which fish are no longer contaminated at a level that will pose unacceptable risks to human health. . . . The overall goal of many agencies is to have waterbodies and fish that are sufficiently contaminant-free that advisories are no longer necessary* (U.S. EPA 1996, p.1-9).

That goal counsels against limiting the fish consumption rate for the SSRA by fish consumption advisories for impacted waters since it aims for waterbodies that allow for fish consumption with no restrictions. The advisory fish consumption rate for unrestricted consumption is based on a model that 70-kg adult fishers are consuming 8 ounces of fish on 225 days each year over 70 years (140 g/d) (Great Lakes Task Force 1993). Moreover, fish consumption advisories are voluntary and may not reflect actual consumption rates. EPA disagrees that fish consumption rates should be changed to match fish advisory guidelines for impacted waters.

Fish Consumption Rate Values Conclusion:

Local studies from neighboring Indiana surveyed similar residential-fisher exposure scenarios and geographic locations to those in this SSRA. Thus, fish consumption rates derived from the Indiana studies represent the highest preference among the available alternative approaches recommended by the Ambient Water Quality Criteria Guidance. None of the other suggested fish consumption rates match the stated HHRAP scenario identification of a resident who fishes locally and eats some of their catch. Fish consumption rates based on national "*per capita*" studies and other default values are of least preference. The fish consumption rates recommended in the Veolia 2016 and 2017 submissions are not supported by the references cited. Table 8-4 summarizes fish consumption rates and their corresponding protected populations based on various survey respondent group values.

Table 8-4 Estimated Protected Populations by Fish Consumption Rate

Fish Consumption Rate (g/d)	Estimated Protected Population	Reference
49	90% of Active Consuming Fishers (Licensed Only)	Indiana Mail-in Survey (Sheaffer et al 1999)
87.5	90% of Active Consumers of Locally Caught Fish	1998 National Study used in HHRAP (USDA 1994, U.S. EPA 1997a, U.S. EPA 2005a)
91	90% of Active Consuming Fishers (Including Unlicensed)	Indiana Walk-up Survey (Williams et al 2000)
140	All Fishers – Including Sensitive Subpopulations Such as Women of Child-bearing age, Pregnant Women, Children, and Subsistence Fishers	Fish Advisory Guidance for Unrestricted Consumption (Great Lakes Task Force 1993)

The fish consumption values this SSRA uses presents a medium uncertainty; and the actual fish consumption rates may be higher or lower. In conclusion, based on the information discussed above, using the HHRAP default fish consumption rate in this SSRA is appropriate and presents a medium uncertainty.

To further illustrate a comparison of the suggested Fish Consumption Rates, Table 8-5 converts the fish consumption rates into the number of caught-fish consumed over time for each consumption rate. This SSRA uses a fish consumption rate that corresponds with the consumption of approximately one minimum legal-sized largemouth bass or one average-sized channel catfish per week. Local fish consumption studies from a geographically similar area show similar catch and consumption rates for the 90th percentile of surveyed fishers. The 2017 Veolia SSRA submission suggests that local fishers are protected by assuming they consume one fish caught every seven to nine months. That fish consumption rate assumption is not borne out by the Indiana survey and is less protective than assuming consumption of one fish per week as recommended by the HHRAP. EPA chose that HHRAP fish consumption rate for this SSRA because it is more realistic based on the information available and increases the protectiveness of the risk assessment.

Table 8-5 Comparison of Time Period Between Each Fish Caught for Consumption for Various Fish Consumption Rates								
	Veolia 2017[a]		HHRAP Default[b]		90% of S. Indiana Fishers (all)[c]		90% of S. Indiana fishers (licensed only)[d]	
	Largemouth Bass	Channel Catfish	Largemouth Bass	Channel Catfish	Largemouth Bass	Channel Catfish	Largemouth Bass	Channel Catfish
Minimum Catch Size Length (inches)[e]	14	None (ave.18[f])	14	None (ave. 18[f])	14	None (ave. 18[f])	14	None (ave. 18[f])
Daily Harvest Limit[e]	6	6	6	6	6	6	6	6
Fish Weight (lbs)[g]	1.42	1.76	1.42	1.76	1.42	1.76	1.42	1.76
Fish Weight (grams)	644	798	644	798	644	798	644	798
Fish Serving Size (ounces)	8	8	8	8	8	8	8	8
Fish Serving Size (grams)	227	227	227	227	227	227	227	227
Loss to Preparation (%)[h]	30	30	30	30	30	30	30	30
Loss to Cooking (%)[h]	11	11	11	11	11	11	11	11
Fish Consumption Rate (g/day)	1.89	1.89	87	87	90	90	49	49
Fish Consumed per Day	0.005	0.004	0.22	0.17	0.22	0.18	0.12	0.10
Fish Consumed per Week	0.03	0.03	1.52	1.22	1.57	1.27	0.85	0.69
Fish Consumed per Month	0.14	0.12	6.6	5.3	6.8	5.5	3.7	3.0
Fish Consumed per Year	1.7	1.4	78.9	63.7	81.6	65.9	44.4	35.9
Time Period Between Each Fish Caught for Consumption (days)	212	263	5	6	4	6	8	10

a Franklin 2017
b U.S. EPA 2005a
c Williams et al 2000
d Sheaffer et al 1999
e IDNR 2018
f IDNR 2019c
g Schneider et al 2000
h U.S. EPA 2005a

8.5.4 Mercury Methylation Rate Uncertainty

The MSRC reported methylation values of mercury in deep water lakes vary from 4.6% up to 15% (U.S EPA 1997c). EPA used the default methylation rate of 15% recommended in HHRAP. Actual mercury methylation rates in the waterbodies this SSRA evaluated may be lower than the default value. EPA researched and did not find any site-specific mercury methylation data for these waterbodies. The mercury methylation rate value EPA used in this SSRA presents a medium uncertainty and the actual value could be less. The default value used in this SSRA is conservative and protective.

8.5.5 Fraction of Fish Contaminated Uncertainty

Fraction of Fish Contaminated Used in this SSRA

In this SSRA, EPA used the HHRAP default value of 100% for fraction of contaminated fish (U.S. EPA 2005a). Chapter 6 of HHRAP states:

> *The percentage of food consumed by an individual which is home-grown will affect exposure, because HHRAP assumes that only the portion of an individual's dietary intake which is home-grown is impacted by facility emissions. We recommend assuming that all food produced at the exposure location - i.e. the farm for the farming scenarios, and the home garden for the residential and fishing scenarios - is impacted by facility emissions. Only that portion of the diet produced at home (and therefore exposed to facility emissions) is of consequence in the SSRA. As detailed in Section 6.2.2.2, the consumption rates we recommend represent only the home-produced portion of the diet. Therefore, by using consumption rates specific to home produced foods, we consider it reasonable to assume that 100% of those home-produced foods are contaminated* (U.S. EPA 2005a, p.6-13).

The uncertainty in this parameter may be more accurately described as variability as opposed to uncertainty. Spatial variability results in different estimates of mercury in fish tissue depending upon the location of the fishable waterbodies. Furthermore, the exact behaviors of fishers that affect how much fish is consumed from the study area and from which particular waterbody are both intra- and inter-individual variabilities.

Although some fishers might not get all their fish from the Grand Marais Lake, this SSRA estimates the other local waterbody (Whispering Willow Lake) to have fish similarly contaminated with methylmercury. Therefore, it is reasonable to assume 100% of locally-caught fish may be contaminated. The fraction of fish contaminated value this SSRA uses presents a medium uncertainty and the actual percentage of fish contaminated maybe lower or contain less-contaminated fish.

Other Values of Fraction of Fish Contaminated Considered

Veolia's submissions have suggested that the stocking of trout and catfish supports reducing the percentage of contaminated food consumed from 100% to 75%. EPA considered this suggestion and responds the locally-caught fish consumption rate is tied directly to the fish in local waterbodies (such as the lakes at Frank Holten State Recreation Area) and EPA determined all fish in the study-area waterbodies modeled may be impacted by emitted COPCs. Illinois Fish biologists (former and current) indicate that stocked fish species considered in this SSRA (largemouth bass and channel catfish) are stocked as small fingerlings of approximately 3 months of age (Parkos 2018 and Diana 2018). These fish biologists also indicated that such stocked fingerlings must live 3-4 years to grow to the legal size. With at least 92% of the fish lifetime (and 100% of the time the target species fish is piscivorous) spent growing and living in the lakes at Frank Holten State Recreation Area, the stocked fish have virtually the same exposure to contaminant impacts as the native fish.

Furthermore, fish study workplans Veolia prepared in an earlier effort to measure site-specific BAFs described significant time between the stocking events and the catching of stocked fish. The facility's February 29, 2012 response to an IEPA comment about the impact of fish stocking on the ability to collect fish for a site-specific bioaccumulation factor (BAF) study agreed that legally harvestable largemouth bass *"will have spent at least 80 percent of their life in the Frank Holten Lakes."* It concluded that a target size of 16- to 20-inches in length would *"not allow for collecting recently stocked fish"* (Veolia 2012, p.7). The information EPA reviewed does not support reducing the percentage contaminated from 100% to 75% based on the impacts of fish stocking.

Veolia has also suggested that connections to the Mississippi River mitigate risk from the facility because fish caught from the lakes at Frank Holten State Recreation Area could have come from other locations. Veolia's 2017 SSRA submission provided an undated quote from Dan Stephenson of IDNR finding:

> *…the lakes at Frank Holten are connected via ditches to the Mississippi River allowing a constant exchange of multiple species between lake and river. This is not a static system. There could be a claim that the fish tested originally came from the river and pick up the methylmercury elsewhere.* (Franklin 2017, p.56).

EPA considered this information. The ditch connecting the lakes to the Mississippi River is the man-made Harding Ditch which drains an area upstream of the lakes before passing through park property and connecting to the Mississippi River 9.5-miles downstream. It drains Grand Marais Lake (a.k.a. Frank Holten Lake Number 3); but at one time passed through Grand Marais Lake and overflowed into the lower section of Whispering Willow Lake (a.k.a. Frank Holten Lake Number 2). From 1977 through the early 1980s, Harding Ditch was moved to bypass the lakes. The Harding Ditch-bypass and a control structure at the outlet from Grand Marais Lake to the Harding Ditch make "*dry weather flows and* *all but major storm event flows pass around the southern edge of Lake 3 and away from the other lakes. During very large storm events, the Ditch could overflow into the Lake system through the Lake 3 control structure*" (Raman and Bogner 1994). This information indicates there is no ditch that connects Whispering Willow Lake with the Mississippi River; and the ditch that connects to Grand Marias Lake only connects through the far downstream tip of the lake and is only expected to be connected during major storm events.

Moreover, the ditch connection does not change the potential for mercury emissions to deposit into the lakes and bioaccumulate in fish caught and consumed by local fishers. In assessing the potential uncertainty from fish migration, we consulted guidance on collecting fish samples for the purpose of determining site-specific BAFs. To measure BAFs, a study must ensure that the fish collected correspond with water and sediment concentrations of methylmercury from the same location. In other words, the fish must be from the same environmental setting. We made the same general assumption for this SSRA: that the fish caught and consumed are from and exposed to methylmercury within the Frank Holten State Recreation Area.

EPA guidance on developing site-specific BAFs (U.S. EPA 2009b) addresses the uncertainty presented by connections with other waterbodies by targeting fish for collection that have lived primarily within a home-range (or foraging-range) estimated to be much smaller than the size of the subject waterbody. This minimizes the potential for collecting fish from outside the waterbody. In Section 3.3.2 of the guidance, EPA recommends incorporating home-range estimates into sampling design. It states that *"[o]rganisms with smaller home ranges will be more representative of the study site than those with larger home ranges which extend beyond the study site*" U.S EPA 2009b, p.3-34). Based on the guidance, the home-range estimate for largemouth bass of legal size (14 inches) is five acres and the home-range estimate for Illinois state average channel catfish (18 inches) is seven acres. These are both significantly smaller than the size of either lake in the SSRA, roughly 100 acres each. The uncertainty from potential fish migration via the ditch is low because the home-range areas of largemouth bass and channel catfish are much smaller than the size of either Whispering Willow Lake or Grand Marais Lake. On this basis, EPA does not believe the fraction of fish contaminated needs to be adjusted down from 100% to account for fish that may have migrated from the Mississippi River through a single connection to one of the lakes that occurs during extreme storm events.

Fraction of Fish Contaminated Conclusion:

The information EPA reviewed does not support reducing the fraction of fish contaminated from 100% based on impacts of fish stocking or a connection to the Mississippi River. As discussed above, EPA has not reduced the fraction of fish contaminated on the basis that fish are stocked or may have migrated from the Mississippi River through a single connection to one of the lakes that is said to occur during extreme storm events.

This SSRA modeled Frank Holten Lakes exclusively for a number of reasons, which include: public comments that Frank Holten Lakes is the major or only significant waterbody used by local fishers who eat their catch; Frank Holten Lakes are the only significant fishable waterbodies in the air model zone; Frank Holten Lakes were selected exclusively so that potential fish ingestion intake of methylmercury would not be underestimated for a local fisher. The assumption of 100% fraction of fish contaminated presents a medium uncertainty as there are no site-specific studies available and the actual value may be lower.

9 Risk Characterization and Results

9.1 Cancer and Hazard Target Levels

In the 1994 EPA *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities*, DRAFT, EPA recommends acceptable cancer risk and hazard index target levels that EPA Region 5 generally implements in risk management decisions concerning RCRA permits. To ensure protection of human health from toxic constituents, the total incremental risk from the high-end individual exposure to carcinogenic constituents should not exceed 1 in 100,000 (or 1E-05). EPA Region 5 also generally limits the cancer risk from each constituent to not exceed 1 in 1,000,000 (or 1E-06).

In addition, risk assessments for hazardous waste combustors have also typically calculated a cumulative hazard index as the sum of the hazard indices from all constituents in each exposure scenario. This result is compared to the index value 0.25. If a cumulative hazard index is above 0.25, the analysis may segregate the hazard indices by summing COPC-specific hazards according to toxicological similarity (same target organs or systems) and comparing these values to 0.25 (U.S. EPA 2005a).

To apply a protective reference exposure level for lead in children, EPA aimed to limit exposure to lead levels in soil and air such that a typical (or hypothetical) child or group of similarly exposed children would have no more than a five percent probability of exceeding a 10 micrograms per deciliter (ug/dL) blood lead level.

This SSRA uses these combined criteria (for cancer risk and hazard index) as indicators of whether human health is adequately protected, based on historical health risk benchmarks typically recommended by the EPA (U.S. EPA 1994c).

9.2 Risk and Hazard Results

The following tables show the highest cancer risk and hazard index by exposure scenarios. None of the receptor scenarios have a cancer risk higher than the target risk of 1E-05. The HI for Fisher Adult and Fisher Child are both over the acceptable HI of 0.25. The cancer risk for hexavalent chromium is above the target risk of 1.0E-06 for an individual constituent. Appendix 3 provides detailed report tables of the risk results, and Appendix 4 provides the complete modeled project on electronic format.

Table 9-1 Maximum Individual Receptor Total Risk and Hazard from Three Units and All COPCs				
	Whispering Willow Lake		Grand Marais Lake	
Receptor Scenario	Total Cancer Risk	Total Hazard Index	Total Cancer Risk	Total Hazard Index
Resident Adult	2.00E-06	0.0383	2.00E-06	0.0383
Resident Child	4.05E-07	0.0403	4.05E-07	0.0423
Farmer Adult	1.39E-06	0.0216	1.39E-06	0.0216
Farmer Child	2.40E-07	0.0259	2.40E-07	0.0259
Fisher Adult	2.02E-06	**0.958**	2.02E-06	**0.968**
Fisher Child	4.06E-07	**0.688**	4.07E-07	**0.695**

Table 9-2 Maximum Total Cancer Risks by COPC for Resident Adult				
COPC	Unit 2	Unit 3	Unit 4	All Units
Arsenic	4.95E-08	5.08E-08	9.05E-08	1.67E-07
Beryllium	2.67E-08	2.74E-08	5.83E-08	8.95E-08
Cadmium	5.12E-08	5.25E-08	9.32E-08	1.72E-07
Chromium, hexavalent	4.69E-07	4.82E-07	8.46E-07	**1.57E-06**
Lead[a]	3.58E-10	3.67E-10	6.62E-10	1.22E-09
TetraCDD, 2,3,7,8-	5.12E-10	5.26E-10	1.96E-09	2.64E-09

a This SSRA also evaluated lead exposure to children as summarized in Section 9.3 below.

The exposure scenarios that have the highest hazard indices are those where methylmercury fish consumption drives the majority of the hazard. The Resident Child scenario has the highest hazard indices for COPCs, other than methylmercury. The following table shows the highest COPC hazard indices and target organs for the Farmer Child scenario. There is no individual COPC that has a hazard index above the target value of 0.25. There is no summed target organ or system effect that has a hazard index above the target value of 0.25.

Table 9-3 Child Farmer Highest Individual Receptor Hazard from Three Units		
COPC	Hazard Index	Target Organ/System
Arsenic	5.89E-03	Cardiovascular, Developmental, Nervous System, Skin
Beryllium	4.36E-03	Gastrointestinal, Lung
Cadmium	2.19E-02	Kidney
Chromium	1.68E-04	(No Effect)
Chromium, hexavalent	5.46E-03	Respiratory Tract
Lead[a]	2.95E-04	Nervous System
Mercuric Chloride	1.86E-03	Immune System
Methylmercury	3.17E-04	Nervous System
TetraCDD 2,3,7,8-	1.68E-04	Developmental
Total	4.03E-02	

a This SSRA also evaluated lead exposure to children as summarized in Section 9.3 below.

The following table shows the hazard index for Fisher Adult and Fisher Child scenarios modeled at each of the two waterbodies. Both waterbodies produce hazard indices greater than the target hazard of 0.25. At both waterbodies, the Fisher Adult scenario hazard exceeds the Fisher Child scenario hazard. The Grand Marais Lake has the highest hazard index. The uncertainty section of this report (Section 8) discusses the impact of the hazard index from the other waterbodies (Section 8).

Table 9-4 Total Hazard from Three Units and All COPCs

	Whispering Willow Lake	Grand Marais Lake
Fisher Adult	**0.95**	**0.96**
Fisher Child	**0.68**	**0.69**

The following table shows the hazard index contribution by COPC. The methylmercury hazard index is the most significant and is the only hazard that exceeds the target value of 0.25.

Table 9-5 Adult Fisher Hazard by COPC from All Three Units at Grand Marais Lake

COPC	Hazard Index
Arsenic	5.83E-03
Beryllium	4.36E-03
Cadmium	2.19E-02
Chromium	3.81E-09
Chromium, hexavalent	5.46E-03
Lead	2.08E-04
Mercuric Chloride	4.61E-04
Mercury	3.10E-07
Methylmercury	**0.93**
TetraCDD 2,3,7,8-	4.50E-04
Total	**0.97**

The following table shows the contribution of hazard from methylmercury by Unit.

Table 9-6 Adult Fisher Hazard from Methylmercury at Grand Marais Lake

	Unit 2	Unit 3	Unit 4	All Units
Adult Fisher	0.21	0.23	0.49	**0.93**

9.3 Lead Exposure Results

EPA evaluated the potential health impact of exposure to emissions of the metal lead under a different approach than other metals. EPA used the IEUBK computer model to estimate whether there are potential increases in blood-lead level in a subgroup of the population (i.e., children) expected to have an enhanced sensitivity to lead exposure. EPA assessed the potential additional lead concentration to soil and additional lead ambient air concentration from the facility.

Table 9-7 Air-Dispersion and Risk Models Results

Estimated Additional Average Soil Lead Concentration (mg/kg)	3.0E-06
Estimated Additional Maximum Soil Lead Concentration (mg/kg)	3.0E-06
Estimated Additional Lead Ambient Air Concentration (ug/m^3)	2.3E-04

The child-blood lead level can be compared with a level known to be associated with protection from adverse developmental neurological effects of lead exposure.

Table 9-8 IEUBK Computer Model Results

	Without Veolia Emissions		With Veolia Emissions	
Potential Background Soil Lead (mg/kg)	Predicted Geometric Mean Blood Lead Level (ug/dL)	Predicted Percent of Children Above 10 ug/dL	Predicted Geometric Mean Blood Lead Level (ug/dL)	Predicted Percent of Children Above 10 ug/dL
100	1.583	0.004	1.583	0.004
200	2.519	0.167	2.519	0.168
300	3.413	1.109	3.413	1.110
400	4.270	**3.510**	4.270	**3.511**
Predicted Preliminary Remediation Goal (PRG) Pb = 441 mg/kg (soil concentration corresponding to a IEUBK-prediction of no more than 5% of children estimated to have blood lead greater than 10 ug/dL)				

9.4 Evaluation of Dioxin in Breast Milk for Noncancer Hazards

Infant exposure to PCDDs, PCDFs, and dioxin-like PCBs via the ingestion of their mother's breast milk is evaluated as an additional exposure pathway, separately from the recommended exposure scenarios. EPA recommends comparing PCDD and PCDF oral exposure estimates to national average background exposure levels. The HHRAP recommends comparing to the national average background for the infant of 93 picograms per kilogram per day (pg/kg-day) of 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD) TEQ (U.S. EPA 2005a). In this SSRA, the highest modeled average daily dose (ADD) of dioxin (as 2,3,7,8-TCDD) is 1.0510E-02 pg/kg-day from the Farmer adult scenario. This result is almost four-orders of magnitude below the national average background exposure level cited in HHRAP.

10 Conclusions

10.1 Human Health Effects Risk Conclusions

This SSRA concludes: 1) the facility's potential mercury emissions should be limited in the RCRA permit to a proposed rate as developed in compliance with RCRA regulatory requirements so that it should not cause a hazard to residents who eat locally-caught fish; and 2) the facility's potential chromium emissions should be limited in the RCRA permit to a proposed rate as developed in compliance with RCRA regulatory requirements so that it should not cause a cancer risk to local residents. This SSRA also concludes potential emissions of the other MACT constituents evaluated (arsenic, beryllium, cadmium, trivalent chromium, lead and dioxin) do not pose unacceptable risks or hazards.

It is important to note that all the measured emission rates at the current Title V Permit feedrates (demonstrated at the 2013 CPT) are within the protective emission rates demonstrated in this risk assessment, therefore, compliance with the current feedrate operating limits included in the Title V permit would likely result in acceptable risks.

EPA recommends limiting the mercury emissions in the RCRA permit to a proposed emission rate that does not exceed the target hazard risk. EPA also recommends limiting the chromium emissions in the RCRA permit to an emission rate that would not exceed the target cancer risk. The chromium risk is based on an assumed 50-percent hexavalent-speciation chromium emission that could be modified with future testing of stack-emissions chromium speciation.

Cancer Risk: Except for chromium, the estimated excess cancer risks from carcinogenic metals and dioxin emitted at site-specific emission rates derived from the MACT standards are each less than the target individual COPC cancer risk of 1.0E-6. The aggregate cancer risk from all metals emitted at site-specific emission rates derived from the MACT standards is estimated to be less than the 1.0E-5 target aggregate risk. We conclude that chromium emissions should be limited to protect human health and the environment.

Noncancer (Hazard) Effects: Site-specific emission rates derived from the MACT standards calculated for all COPCs evaluated for noncancer (hazard) effects, except for mercury, resulted in estimated hazard indices for individual COPCs that fell well below the target hazard limit of 0.25. We conclude that mercury emissions should be limited to protect human health and the environment.

Lead Exposure Effects: This SSRA estimates that there will be minimal predictable amount of lead deposition to soil from the facility. The air-dispersion and risk models predict that after 30-years of operation, the maximum increase in soil-lead concentration is 3.0E-06 mg/kg. At an elevated soil-lead background concentration (400 mg/kg), the predicted increase of children with blood-lead levels above 10ug/dL with estimated lead deposition from the facility is 0.001 percent compared to without the facility's contribution. In comparison to a range of background soil lead concentrations and ambient air and drinking water concentrations, the corresponding additional increase in predicted child blood-lead levels from the Veolia facility appears to be minimal. EPA notes that current scientific literature on lead toxicology and epidemiology provides evidence that adverse health effects are associated with blood lead levels less than 10 ug/L (U.S. EPA 2016b). While this SSRA estimates the incremental increase of lead concentrations from this facility to be minimal, higher background concentrations or contributions from other sources may increase lead-exposure concentrations and health effects.

Dioxin in Breast Milk for Noncancer Hazards: In this SSRA, the estimated exposures to infants from breast milk due to the facility's emissions during the exposure duration of concern are low compared to background exposures and are not expected to cause an increase in noncancer effects.

10.2 Overall Confidence in Conclusion

EPA considered the relative strengths and uncertainties associated with this SSRA in evaluating the need for permit feedrates. Confidence is generally considered inversely proportional to uncertainty. Effect sensitivity is the estimated relative ability of a change in the component to impact the results of the risk assessment. Table 10-1 provides a summary.

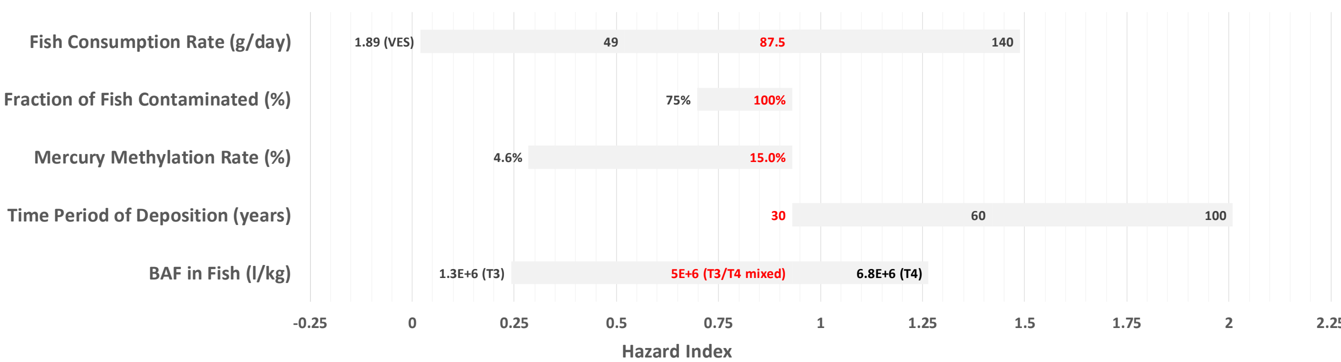
Table 10-1 Relative Confidence and Sensitivity of Major Model Components				
Component	Relative Confidence	Rationale	Effect	Effect Sensitivity
Model (see 8.4.1)	High	Models are peer-reviewed and include a significant amount of site-specific input. Evaluations of model accuracy are favorable.	Underestimate or Overestimate	Low
Source Parameters (see 8.4.2)	High	Based on known site-specific values.	Underestimate or Overestimate	Low
COPC Selection (see 8.4.2)	High	Based on collected data.	Underestimate to the extent that unidentified compounds emitted	Low
COPC Physical and Chemical Parameters (see 8.4.3)	High	Selection procedure designed to minimize uncertainty and select the most appropriate value.	Underestimate or Overestimate	Medium
COPC Toxicity Reference Data (see 8.4.4)	High	Data for these COPCs of high quality.	Underestimate or Overestimate	Low
Risk Receptors (see 8.4.5)	High	Presence of evaluated receptors undisputed. Behavior patterns are estimated.	Underestimate or Overestimate	Medium
Combustion/Deposition Duration (see 8.5.1)	Medium	Time period could be much longer than assumed.	Underestimate	Medium
BAF (see 8.5.2)	Medium	Value used is a mean based on limited studies. Adjusted for species of fish caught.	Underestimate or Overestimate	Medium
Fish Consumption Rate (see 8.5.3)	Medium	Based on comprehensive study, however, site-specific information not available	Underestimate or Overestimate	High
Mercury Methylation Rate (see 8.5.4)	Medium	No site-specific data available and maximum value from literature used.	Overestimate	Medium
Fraction of Fish Contaminated (see 8.5.5)	Medium	No site-specific data available and maximum possible value used.	Overestimate	Medium

While there is some uncertainty in modeling the environment and behavior patterns of receptors, the degree of uncertainty within this SSRA is appropriate, acceptable and protective of human health. We have medium to high confidence in the elements of this SSRA. As discussed, some parameter value estimates could be higher or lower and the SSRA results may be sensitive to some parameter values.

10.3 Degree of Conservatism

EPA evaluated the following parameters to which the SSRA was particularly sensitive. Figure 10-1 below discusses and summarizes the parameters, the range of their possible values, and their estimated impact on this SSRA.

Figure 10-1. Methylmercury Hazard Index at MACT Standard Emissions as a Function of Sensitive Parameter Range



The figure above shows fish consumption rates for locally-caught and consumed fish for the 90th percentile of licensed fishers in southern Indiana (49 g/day), and the mean of all local fishers from a national survey (87.5 g/day) (Sheaffer et al 1999 and U.S. EPA 2005a). The figure also includes the fish consumption rate suggested by the 2017 Veolia SSRA submission at approximately one fish per year (1.89 g/day) and the rate used by the State of Illinois that corresponds to unrestricted consumption for purposes of evaluating consumption advisories (140 g/day) (Franklin 2017 and Great Lakes Task Force 1993). As recommended in the HHRAP guidance, EPA used the mean value from the national survey of local fishers who consume some of their catch for this SSRA. While this value is skewed to the right of the median in that study, much higher consumption rates were reported for some fishers. The value EPA used is also nearly identical to that of the 90th percentile of southern Indiana fishers including both licensed and unlicensed fishers (91 g/day) (Williams et al 2000). Using the mean value in this case represents a plausible scenario very similar to a study conducted in a nearby, similar-geographical area, and is neutral in effect such that actual consumption rates could be higher or lower.

As recommended in the HHRAP Guidance, EPA projected the fraction of fish contaminated to be 100%. That is the percentage of locally-caught and consumed fish that is contaminated. This is a conservative value and means that local residents who fish are assumed to catch their locally-caught fish from impacted waterbodies within the study area. EPA researched but did not find any site-specific information for this value. However, the deposition patterns show that most, if not all, waterbodies within the study area will carry some impact from COPCs emitted from the facility. This estimate is conservative and possibly overestimates risk.

As recommended in the HHRAP guidance, EPA also used the high-value methylation rate from literature to estimate conversion of mercury into methylmercury, as recommended in the HHRAP guidance (U.S. EPA 2005a). While this value could be lower, the lowest value in the literature referenced in HHRAP, 4.6%, still results in a risk estimate exceeding target limits. The maximum value, used here, is an observed value for some lakes and is considered plausible for our lake scenarios. This value is conservative and possibly overestimates risk.

This SSRA set the time period of combustion and deposition at 30 years, which is likely to be an underestimate. Recommended values for long-lived facilities where the operations of concern may continue for many years result in higher estimates of risk. This facility has been incinerating chemical wastes for 47 years. EPA believes that the plausible non-default values (operational time periods longer than 30 years) for this parameter will increase the estimated risk.

The methylmercury bioaccumulation factor for fish this SSRA uses is taken from a collection of studies on BAFs measured in lake environments for both trophic-level 3 fish (such as bluegill) and trophic-level 4 fish (such as largemouth bass and channel catfish) (Krabbenhoft et al 1999, U.S. EPA 1997c, U.S. EPA 2001b, U.S. EPA 2005a, and USGS 2001). The values shown on the figure above include the mean lake BAF for trophic level 3 fish, a value corresponding to a 25/75% mix of trophic 3 and 4 mean lake BAFs, and the mean of lake BAFs for trophic-level 4. The methylmercury BAF value used in this SSRA is neither an underestimate or overestimate for a lake environment and is appropriate for this SSRA.

This SSRA does not employ an excessive degree of conservatism in arriving at the conclusions herein. The inputs provide a reasonable level of confidence and were obtained in a manner that prioritizes site-specific, measured, available, and peer-reviewed data. The sensitive parameters above include of mix of parameters that may underestimate or overestimate the impact of COPC emissions or are taken from a mean or median value, neither high nor low. The degree of conservatism is appropriate for setting a permit limit meant to protect human health and the environment under current and future scenarios.

10.4 Potential Further Research of Sensitive Site-Specific Parameter Values

Section 8.5 of this report identifies and describes potential sensitive parameters in this SSRA. For these parameters, except the BAF, we used the HHRAP recommended default values since we did not find acceptable site-specific values. EPA altered the values for the BAF to reflect the fish species expected to be present, caught and consumed. Values for fish consumption rates from a study of local fishers in a geographically similar area were nearly identical to the fish consumption rate used in the assessment. The following risk-driver parameters may be studied to determine more appropriate site-specific values: methylmercury bioaccumulation factors, fish consumption rates and mercury methylation rate. While pursuing site-specific values for these parameters is beyond the scope and resources of this SSRA, future site-specific studies could reduce the uncertainty of these sensitive parameters. Site-specific values may be determined by: 1) investigating other reliable studies that apply to the defined identified exposure scenarios; 2) performing quality-controlled scientific measurements of environmental media; or 3) using scientifically defensible models with site-specific information. Any use of site-specific parameter values should satisfy the criterion recommended in HHRAP Section 5.8. (U.S. EPA 2005a).

To determine site-specific methylmercury BAF values, EPA 2010 *Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion* recommends either obtaining field-collected samples of tissue from aquatic organisms that people eat and water from the waterbody of concern or using a scientifically defensible bioaccumulation model that explicitly incorporates organism-, water-chemistry-, and waterbody/watershed-specific factors (U.S. EPA 2010).

A field-measured site-specific BAF is the most direct and most relevant measure of bioaccumulation. EPA's 2009 guidance describes an approach to determining a site-specific BAF (U.S. EPA 2009b). Strengths associated with using a site-specific BAF approach include simplicity, widespread applicability (i.e., site-specific BAFs can be derived for any waterbody, fish species, and the like), and the incorporation of the net effects of biotic and abiotic factors that affect bioaccumulation within the measurements used to derive the BAF. Limitations to this site-specific BAF approach relate primarily to its cost and empirical nature.

Bioaccumulation models for mercury vary with the technical foundation on which they are based (empirically or mechanistically based), spatial scale of application (specific to waterbodies, watersheds or regions, and species of fish), and level of detail in which they represent critical bioaccumulation processes (simple, mid-level, or highly detailed representations). The literature provides many examples of such models (e.g., USGS 2001; Kamman et al. 2004; Sorensen et al. 1990).

Mechanistic bioaccumulation models are mathematical representations of the natural processes that influence methylmercury bioaccumulation. The process of methylation itself is incompletely understood, and general models for reliably predicting rates of methylation do not exist, although EPA's WASP model might be useful in some environments. Three examples of mechanistic bioaccumulation models are the Dynamic Mercury Cycling Model, or D-MCM (EPRI 2002); the Bioaccumulation and Aquatic System Simulator, or BASS (Barber 2002): and the Quantitative Environmental Analysis Food Chain model, or QEAFDCHN (QEA 2000). Another model, SERAFM, is a steady-state, process-based mercury cycling model designed specifically to assist a risk assessor or researcher in estimating mercury concentrations in the water column, sediment, and fish tissue for a given waterbody for a specified watershed (U.S. EPA 2008b).

A site-specific mercury methylation rate may also be determined by performing field-measured site-specific measurements of the waterbody and sediment media or by using scientifically defensible models, if available.

Site-specific fish consumption rates may be determined from finding new or existing fish consumption studies performed in the general geographical area that specifically match the identified exposure scenario of people who fish locally and eat some of the fish they catch, or by performing a suitable and robust survey of the identified exposure scenario local population.

10.5 Suggested Limits for Mercury

This SSRA concludes the site-specific emission rates derived from the MACT standards should not cause noncancer negative health (hazard) effects for evaluated constituents other than mercury. The following expression can be used to ensure compliance with the mercury target hazard index recommendations herein:

$$\sum_{i=2}^{4} (Emission\ Rate_i)\ (Specific\ Hazard_i)\ \leq\ 0.25$$

Where:

i = units 2, 3, and 4

Emission $Rate_i$ = mercury emission rate for Unit i (grams per second – g/s)

Specific $Hazard_i$ = hazard index per g/s mercury emission rate for Unit i

Unit 2 Specific Hazard = 0.21 HI ÷ 3.21E-04 g/s = 6.54E+02 HI per g/s

Unit 3 Specific Hazard = 0.23 HI ÷ 3.35E-04 g/s = 6.87E+02 HI per g/s

Unit 4 Specific Hazard = 0.49 HI ÷ 1.01E-03 g/s = 4.85E+02 HI per g/s

Using this expression, mercury hazard indices are summed across incinerators.

Potential mercury site-specific emission rates derived from the MACT standards from the facility could cause unacceptable hazard risks due to fish consumption from locally-caught fish. The hazard result from ingesting locally-caught fish at nearby waterbodies is estimated to exceed 3.8-times the acceptable target hazard. For persistent, bioaccumulative toxics, such as mercury, there could be even higher risks from longer periods of a facility's operation. EPA recommends a restrictive emission rate for mercury to address this potential risk and protect human health and the environment.

Due to the long-term (chronic) nature of exposure to mercury emissions via methylation, bioaccumulation, and fish ingestion, compliance with mercury limitations from this

SSRA can alternatively be demonstrated on an annual basis. With this approach, annual mercury emitted from all three incinerators running simultaneously should be limited to approximately 25 pounds per year based on the incinerator with the highest hazard per emission (Unit 2).

10.6 Suggested Limits for Chromium

With the exception of chromium, this SSRA does not estimate site-specific emission rates derived from the MACT standards to cause excess cancer risk to the community. The following expression can be used to ensure compliance with the chromium target cancer risk recommendations herein:

$$\sum_{i=2}^{4} (Emission\ Rate_i)\ (Unit\ Risk_i)\ \leq\ 1.00E-06$$

Where:

i = incinerator 2, 3, and 4

Emission $Rate_i$ = chromium emission rate, incinerator i (grams per second - g/s)

Unit $Risk_i$ = cancer risk per g/s chromium emission rate for incinerator i

Incinerator 2 Unit Risk = 4.69E-07 CR ÷ 2.27E-04 g/s = 2.07E-03 CR per g/s

Incinerator 3 Unit Risk = 4.82E-07 CR ÷ 2.37E-04 g/s = 2.03E-03 CR per g/s

Incinerator 4 Unit Risk = 8.46E-07 CR ÷ 7.15E-04 g/s = 1.18E-03 CR per g/s

Using this expression, chromium cancer risks are summed across incinerators.

Potential chromium site-specific emission rates derived from the MACT standards from the facility have the potential to cause unacceptable cancer risks due to the inhalation pathway. The excess cancer risk result from inhalation of chromium (primarily as the hexavalent fraction) is estimated to be greater than 1.6-times the acceptable target cancer risk for individual COPCs. EPA recommends a restrictive emission rate for chromium to address this potential risk and protect human health and the environment. However, this chromium limit is based on a 50-percent hexavalent speciation that could be modified with adequate stack-emissions chromium-speciation testing.

10.7 Comparison to Other Emission Standards or Feedrate Limits

10.7.1 Mercury

The following table compares the overall mercury emissions and HI to previous SSRAs and Veolia's CPT results.

Table 10-2 Overall Mercury Emissions and Hazard Index for EPA SSRAs and CPTs

Emission Rate Basis	Unit 2 (g/s)	Unit 3 (g/s)	Unit 4 (g/s)	Total Annual Emission Rate (pounds)	Estimated Mercury HI
2007 EPA SSRA Calculated Site-specific Emission Rates Derived from the MACT Standards[a]	2.34E-04	2.29E-04	6.39E-04	76	2.24
2007 EPA SSRA Recommended Emission Rates[a] Based on Highest Specific Hazard (Unit 3)	1.15E-04 (Facility Total)			8	0.25
2008 CPT Report[b] (Measured Emissions)	1.01E-04	1.06E-04	1.52E-04	25	0.21
2013 CPT Report[c] (Measured Emissions)	1.87E-04	8.51E-05	4.94E-05	22	0.20
2019 EPA SSRA Calculated Site-specific Emission Rates Derived from the MACT Standards	3.21E-04	3.35E-04	1.01E-03	116	0.93
2019 EPA SSRA Recommended Emission Rates Based on Highest Specific Hazard (Unit 3)	3.64E-04 (Facility Total)			25	0.25

a U.S. EPA 2007a
b ENSR 2008a, 2008b, 2008c
c Veolia 2014

The new SSRA methylmercury HI at the site-specific emission rates derived from the MACT standards is 59-percent lower than EPA's 2007 SSRA. Several parameter values have been updated since 2007. We account for most of this difference with three significant parameter value and model differences. First, EPA changed the calculated site-specific emission rates derived from the MACT standards due to updated stack flowrates. Next, the most significant difference between the 2007 EPA SSRA and this assessment is the upgrade to the AERMOD modeling software. Using the updated site-specific emission rates derived from the MACT standards, the AERMOD software model, updated meteorological data, updated methylmercury Henry's Law Constant and other parameter value updates, the mercury vapor deposition values at the waterbodies for this assessment are approximately 50% lower than the estimates produced by the ISCST3 modeling program EPA used in the 2007 SSRA. Lastly, to account for the conditions that some local residents who fish locally would catch and consume a combination of trophic level 3 and trophic level 4 fish species that are available at the lakes, EPA used a combined methylmercury BAF factor that is 26% lower than the BAF EPA used in the 2007 SSRA. These model and parameter value changes account for most of the differences in HI from the new SSRA and the 2007 SSRA.

Table 10-3 compares risks at the site-specific emission rates derived from the MACT standards to the emissions measured during the 2013 CPT.

Table 10-3 Comparison of Risks to 2013 CPT Emission Risks by Receptor Scenarios

Maximum Individual Receptor Total Risk and Hazard from Three Units and All COPCs				
	Site-specific Emission Rates Derived from the MACT Standards		2013 CPT Emission Rates	
Receptor Scenario	Total Cancer Risk	Total Hazard Index	Total Cancer Risk	Total Hazard Index
Resident Adult	2.00E-06	0.038	1.04E-07	0.0015
Resident Child	4.05E-07	0.042	2.10E-08	0.0020
Farmer Adult	1.39E-06	0.022	1.21E-07	0.0018
Farmer Child	2.40E-07	0.026	2.28E-08	0.0025
Fisher Adult	2.02E-06	**0.97**	1.06E-07	0.21
Fisher Child	4.07E-07	**0.70**	2.13E-08	0.15

One can use unit-hazard from this SSRA to evaluate metal feedrates that are demonstrated during future stack testing by converting the measured emissions during these tests to estimated hazard indices and comparing them to the risk management target of 0.25. It will be important to confirm that future stack testing and corresponding feedrate testing are representative of facility operations and meet all appropriate quality assurance and quality control requirements. This comparison is only valid provided the future stack characteristics evaluated are similar to those EPA used in this SSRA. The example in Table 10-4 applies to the results of the 2013 CPT:

Table 10-4 Example Mercury Feedrate Evaluation for 2013 CPT Results						
	Tested Mercury Feedrate	Tested Mercury Emission Rate	x	Specific Hazard	=	Estimated Hazard Index
Incinerator	(lbs/hour)	(g/s)		HI per g/s		
Unit 2	0.00212	1.87E-04	x	6.54E+02	=	0.122
Unit 3	0.00220	8.51E-05	x	6.87E+02	=	0.058
Unit 4	0.0401	4.94E-05	x	4.85E+02	=	0.024
Conclusion: These mercury feedrates would be acceptable.				Sum	=	0.204

10.7.2 Chromium

Table 10-5 compares the overall chromium emissions and cancer risk to previous SSRAs and Veolia's CPT report results.

Table 10-5 Chromium Emission Rate Limits (As LVM Emission Rates)				
Emission Rate Basis	Unit 2 (g/s)	Unit 3 (g/s)	Unit 4 (g/s)	Estimated Chromium Cancer Risk
2007 EPA SSRA Calculated Site-Specific LVM Emission Rates Derived from the MACT Standard[a]	1.66E-04	1.62E-04	4.53E-04	7.64E-07
2008 CPT Report[b]	1.01E-04[c]	3.87E-05	5.08E-05	3.48E-07
2013 CPT Report[d]	4.76E-06	1.69E-05	4.76E-05	1.00E-07
2019 EPA SSRA Calculated Site-Specific LVM Emission Rates Derived from the MACT Standard	2.27E-04	2.37E-04	7.15E-04	1.57E-06
2019 EPA SSRA Recommended LVM Emission Rates	4.83E-04 (Facility Total)			1.00E-06

a U.S. EPA 2007a
b ENSR 2008a, 2008b, 2008c
c Maximum of Two Datasets
d Veolia 2014

The individual unit specific-risk estimates from this SSRA can be used to evaluate metal feedrates that are demonstrated during stack testing by converting the measured emissions from each unit during these tests to estimated cancer risks and comparing them to the target cancer risk of 1.00E-06. It will be important to confirm that future stack testing and corresponding feedrate testing are representative of facility operations and meet all appropriate quality assurance and quality control requirements. (Note, the chromium risk is based on a 50-percent hexavalent speciation that could be modified with adequate stack-emissions chromium-speciation testing.) This comparison is only valid provided the future stack characteristics evaluated are similar to those EPA used in this SSRA. The example in Table 10-6 applies to the results of the 2013 CPT:

Table 10-6 Example Chromium Feedrate Evaluation for 2013 CPT Results

Incinerator	Tested Chromium Feedrate (as total LVM) (lbs/hour)	Tested Chromium Emission Rate (as total LVM) (g/s)	x	Specific Risk Cancer Risk per g/s	=	Estimated Chromium Cancer Risk
Unit 2	46.3	4.76E-06	x	2.07E-03	=	9.85E-09
Unit 3	46.1	1.69E-05	x	2.03E-03	=	3.43E-08
Unit 4	46.2	4.76E-05	x	1.18E-03	=	5.62E-08
Conclusion: These LVM feedrates would be acceptable.				Sum	=	1.00E-07

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12 Appendices

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Appendix 2	Select IRAP Input Reports
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Appendix 5	Selected Correspondence and Records
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Appendix 1

Dispersion Modeling of Emissions from Hazardous Waste Combustion: Veolia ES Technical Solutions, Sauget, Illinois

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Appendix 2

Select IRAP Input Reports

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Appendix 3

Select IRAP Results Reports

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Appendix 4

IRAP and AERMOD Archived Projects (Electronic Format)

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Appendix 5

Correspondence and Records

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Appendix 6

IEUBK Lead Exposure Effects Reports