Ecological Screening Evaluation for the Proposed Detroit Heavy Oil Upgrade Project

Prepared for:

Marathon Petroleum Company LLC

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Background and Purpose

Marathon Petroleum Company LLC ("MPC") operates a petroleum refinery in Detroit, Michigan (the "Detroit Refinery"). Petroleum refining is the physical and thermal separation of crude oil into its major distillation fractions. These fractions are then further processed through a series of separation and conversion steps into finished petroleum products. The principal products from the Detroit Refinery are gasoline, fuel oils, asphalt, propane, and propylene. The Detroit Refinery has the capacity to process 100,000 barrels of crude oil per day.

MPC proposes to install a coking unit to process a new source of crude oil and to expand the total crude oil processing capacity of the Detroit Refinery to 115,000 barrels per day. The proposed changes are referred to as the "Detroit Heavy Oil Upgrade Project" (the "Detroit HOUP"). The Detroit HOUP will include changes to many existing process units at the Detroit Refinery and the construction of new process units and supporting equipment. The proposed increase in processing capacity, as well as the installation of new process units and supporting equipment, will result in an increase in emissions of some air pollutants from the Detroit Refinery.

Figure 1 identifies the location of the MPC refinery and depicts land use characteristics in its vicinity. The facility is located in a highly urbanized area in the southern portion of the City of Detroit. The red and yellow outlines superimposed on the aerial photograph indicate distances of one and two miles, respectively, away from Marathon's facility. There are other industrial facilities nearby, as well as high intensity residential areas. The most significant green area to the facility's northeast comprises the Woodmere Cemetery and the Patton Memorial Park (an urban recreational area). The Rouge River flows to the north of the Marathon facility within a half mile of the main refinery complex, with a small portion of the facility maintaining frontage on the riverbank. The Rouge River discharges to the Detroit River at a point about two miles to the east of the facility.

This Ecological Screening Evaluation (ESE) assesses whether the increased pollutant emissions from the MPC refinery complex are likely to have either direct or indirect adverse effects on wildlife species listed as threatened or endangered under the federal Endangered Species Act (ESA). The ESE is designed to provide information to the U.S. Environmental Protection Agency (EPA) and U.S. Fish and Wildlife Service (F&WS), which are required to enter consultation per Section 7 of the ESA. This study augments a detailed air quality evaluation required by the federal Clean Air Act, under which the Michigan Department of Environmental Quality (DEQ) is responsible for evaluating the consequences of the increased levels of air pollutant emissions that may result from the proposed Detroit HOUP. MPC has submitted detailed information to the DEQ that will likely result in modification of the facility's operating permit that limits facility emissions per the requirements of federal and state air pollution control regulations. The ESE builds on the emissions and air quality analyses that have been developed to support the Clean Air Act's permitting analysis.

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Methodology and Scope

The ESE follows the Recommended Scope of Analysis (RSA) outline for the federal ecological consultation provided by EPA Region 5 (Attachment A). The ESE focuses on three federally-listed threatened and endangered species for Wayne County, Michigan, in which county the MPC refinery is located. The three listed wildlife species, along with brief descriptions of their habitats, are provided in Table 1. The habitats of the species of concern cover both terrestrial and aquatic environments, and hence, in addition to the direct effects of pollutants in air, it is important to also evaluate potential indirect effects of pollutants that may deposit from air and enter soil, water, and sediment. Many of the pollutants are already present in the environment, and hence the ESE attempts to characterize the increases in concentrations that will result from the Detroit HOUP relative to existing background conditions. In evaluating the potential increases due to facility emissions, the ESE evaluates worst-case analyses that are designed to overestimate impacts from the Detroit HOUP. The ESE follows some of the methodologies recommended by EPA in its draft *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA 530-D-99-001A), which are generally applicable to evaluating multi-pathway impacts of air pollutant emissions from industrial facilities.

Per the EPA Region 5 RSA, an approximate 3 km distance extending way from the MPC refinery has been considered as the study area, though this distance has been expanded to 15 km to consider the specific habitat characteristics of the Eastern prairie fringed orchid. The 3 km distance approximately corresponds to the 2 mile outline depicted on Figure 1.

The ESE depends principally on comparing projected increases of pollutant concentrations in environmental media (air, soil, water, and sediment) to ecotoxicity benchmarks designed to be "safe" for all wildlife species (not just the three threatened and endangered species of concern). This is, in general, a protective method as threatened and endangered species are not always the species most sensitive to adverse effects from environmental pollutants. Where appropriate, consideration is also given to specific characteristics of the threatened and endangered species.

Pollutants of Potential Concern, Emission Rates, and Concentrations in Ambient Air

Rates of expected pollutant emissions and the subsequent impacts to ambient air have been estimated by Horizon Environmental, and this information has been submitted the DEQ in support of MPC's Clean Air Act application for a revised operating permit. The ESE builds on the air quality analyses that have been conducted according to procedures required by DEQ and EPA. The Detroit HOUP involves numerous processes and pieces of equipment that emit pollutants. Most of the emissions result from the combustion of either natural gas or refinery (process) gas[1] used as heat/energy sources. The selection of pollutants of potential concern in the ESE is based on information about facility operations/processes and emissions measurements from similar facilities compiled by EPA, as embodied in EPA's AP-42 emission factors and related databases. Where emission factors are available for combustion of both fuels, the higher

[1] Refinery gas is produced as part of petroleum processing at the refinery.

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of the two values for natural gas or refinery gas is generally selected to characterize emissions because natural gas can be a major constituent in the refinery fuel gas.

The ESE focuses on the evaluation of Hazardous Air Pollutants (HAPs) and similar chemicals, though some evaluation of Criteria Pollutants is also included. Three general categories of pollutants are considered:

- *Metals* and other inorganic compounds mostly associated with particulate matter;
- *Polycyclic aromatic hydrocarbons* (PAHs), a class of two and three rings hydrocarbons, also typically associated with particulate matter; and
- *Volatile organic compounds* predominantly found as vapors in the atmosphere.

Per the EPA Region 5 RSA and similar ESA evaluations, the ESE focuses on increases in facility emissions with respect to existing background conditions. As such, incremental emissions from the Detroit HOUP are estimated as the difference between future potential emissions (assuming the proposed modifications are permitted) and the actual present emissions of the MPC refinery. For consistency with Clean Air Act permitting analyses, actual present emissions are evaluated for the 2000-2001 baseline timeframe. The second column of Table 2 summarizes the net emission increases for various pollutants.

Horizon Environmental has developed an air quality analysis in support of the MPC refinery's Clean Air Act permit application. Details of the air quality analysis have been provided to DEQ, and the analysis has been extended to meet the additional needs of the ESE. AERMOD, EPA's recommended dispersion model for regulatory applications, has been applied to estimate concentrations of pollutants in ambient air that may result from MPC refinery emissions. As a first step, worst-case screening-level concentrations were estimated by adding together the maximum modeled concentrations due to each of the twenty-five different proposed and existing emission sources. This procedure overestimates the maximum combined concentration as the locations of maxima differ among the individual sources. These results are presented in the third column of Table 2. To examine the degree of overestimation, additional modeling runs were performed for four pollutants using the suite of HAP-specific emission rates simultaneously, as indicated in the fourth column of Table 2. The degree of overestimation among the four pollutants ranges from factors of 1.7 to 2.1. Thus, HAP-specific modeling, if developed for all pollutants, could be expected to yield worst-case ambient concentration predictions about two times lower than those estimated by superimposing the spatially non-coincident maximum values for each source. Figure 2, which depicts modeled mercury concentrations in ambient air, illustrates the reason for the difference, as emission sources at the MPC refinery are spread over a wide area, hence leading to spatially separated local maxima.

As a first comparison, worst-case predicted pollutant concentrations in air are compared to representative background concentrations. Table 3 summarizes data available for background concentrations of pollutants in ambient air. The Detroit Air Toxics Initiative (DATI)[2] measured

[2] See http://www.michigan.gov/documents/DATI_-_COMPLETE_FINAL_REPORT_11-9-05_142053_7.pdf

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the concentrations of various pollutants from 2000 to 2001 at three locations close to the MPC refinery. Measurements are also available for a number of additional pollutants as reported to the U.S. EPA's Air Quality System.[3] In addition, the EPA National Air Toxics Assessment[4] provides modeled concentrations of HAPs for the 1999 calendar year for the census tract in which the MPC refinery is located. Representative background concentrations are selected preferentially as first, the lowest concentration measured in the DATI study for pollutants detected in one or more samples; second, other local air quality measurements reported to EPA (again, selecting the lowest available concentrations); and third, the modeled 1999 NATA concentration, as indicated in Table 3.

Table 4 compares modeled increases in pollutant concentrations in ambient air to the representative background concentrations. In most cases, the projected increases due to the Detroit HOUP are a small fraction (less than 2%) of existing background levels.

Ecotoxicity benchmarks are generally not available for ambient air, although EPA Region 5 has published Ecological Screening Limits (ESLs) for a limited number of HAPs.[5] Modeled increases in pollutant concentrations are compared against available ESLs in Table 5. Both projected increments in ambient concentrations and existing background levels are lower than pollutant-specific ESLs, in most cases by considerable margins.

Additionally, EPA's 1980 screening procedure for assessing impacts to plants, soils, and animals[6] provides an ambient air screening concentration of 0.01 $\mu g/m^3$ (one month average) designed to protect animals. To one significant digit, the worst-case projected impact from the Detroit HOUP is 0.000003 $\mu g/m^3$, and the representative background level is 0.0001 $\mu g/m^3$, both expressed as annual average values (Table 4). Though both the facility impact and background concentration can be expected to be somewhat higher on a monthly basis, they are not likely to come close to the value of the screening-level concentration of 0.01 $\mu g/m^3$.[7]

Soil, surface water, and sediment comparisons

The potential for pollutants to deposit from the air and to be transported to soil, water, and sediment depends principally on the pollutant's fate and transport characteristics. Of the three basic categories of pollutants under consideration, metals (inorganics) and PAHs can be expected to be removed from the atmosphere via wet and dry deposition processes, whereas most VOCs will remain in air (a consequence of their volatile nature). Simple screening-level models are

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[3] These data were accessed from the AirData website (http://www.epa.gov/oar/data/) and downloaded for calendar year 2005.

[4] See http://www.epa.gov/ttn/atw/nata1999/tables.html

[5] See http://www.epa.gov/reg5rcra/ca/edql.htm

[6] U.S. EPA (1980), *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals*, EPA 450/2-81-078

[7] At most, the single monthly values could be twelve times larger than the annual average (assuming that all contributions occurred during a single month of the year). In this case, both the background level and the incremental facility impact would still be well below the benchmark concentration.

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used to estimate worst-case incremental concentrations of metals and PAHs that might result in soil, surface water, and sediment due to emissions from the proposed Detroit HOUP. The models are in fact designed to overestimate potential environmental impacts — in some cases by substantial degrees. For each medium, projected increases in concentrations due to MPC refinery emissions are compared against available background concentrations and screening-level ecological benchmarks.

The following sources of screening-level ecological benchmarks were examined to identify region-appropriate values for the chemicals of interest:

- the Michigan Department of Environmental Quality Rule 57 Water Quality Values for surface water benchmarks (http://www.michigan.gov/documents/deq/wb-swas-rule57_210455_7.xls);
- the U.S. EPA Ecological Soil Screening Levels (SSLs) for soil benchmarks (http://www.epa.gov/ecotox/ecossl/);
- the U.S. EPA Region 5, RCRA Ecological Screening Levels (ESLs) for surface water, soil, and sediment benchmarks (http://www.epa.gov/reg5rcra/ca/edql.htm); and
- the Risk Assessment Information System (RAIS, http://rais.ornl.gov/), developed and supported by the Oak Ridge National Laboratory (ORNL), which has compiled media-based ecological benchmarks from a number of regulatory databases and sources that collectively cover a wide variety of potential ecological endpoints.

As the last potential source of benchmarks, the RAIS was searched to identify the lowest (and hence most protective) ecotoxicity benchmarks from any of its data sources. This non-selective method is designed to identify the lowest ecotoxicity benchmark established by regulatory authorities under any conditions, and is therefore not necessarily relevant to the specific threatened and endangered species of concern in the vicinity of the MPC refinery.

Soil modeling and comparisons

Concentrations of most COPCs in soil are estimated with a simple mixing model that assumes pollutants deposit from the atmosphere over a period of one hundred years of facility operation and remain within a shallow layer of soil near the surface. This soil deposition/concentration model is recommended in the U.S. EPA's multi-pathway risk assessment protocol guidance for untilled soils. The potential increase in pollutant concentration in soil is predicted by the following equation:

$$C_{HAPsoil} = \frac{D_{HAP} T_{MPC}}{d_{soil} \rho_{soil}} \qquad \textbf{Equation 1}$$

where the terms are:

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$C_{HAPsoil}$	Concentration, or mass fraction, of the HAP in soil (mg/kg);
D_{HAP}	HAP deposition rate estimated by air dispersion/deposition modeling (mg/m^2–year)
T_{MPC}	Years of operation of the MPC refinery;
d_{soil}	Depth of the shallow soil layer (m); and
ρ_{soil}	Bulk density of soil (kg/m^3).

Parameter values recommended by EPA, and used in applying the model, are: an untilled soil mixing depth d_{soil} of 2 cm (0.02 m), a soil bulk density ρ_{soil} of 1.5 g/cm^3 (1500 kg/m^3), and a facility operating period T_{MPC} of 100 years.[8] The untilled soil depth reflects an unmixed surficial deposition layer into which contaminants that strongly adhere to soil may accumulate. The root zone of plants, however, is at its smallest about 15 cm. Since plants that uptake materials (including contaminants) throughout their root zones, a second incremental soil concentration applicable to vegetation is estimated using a root zone depth d_{soil} of 15 cm.

Due to the large number of HAPs and resources required for model runs, AERMOD deposition modeling was determined to be impractical to perform for all metals and PAHs. As such, HAP-specific deposition modeling was performed for a select group of HAPs. For this purpose, a particle distribution with a mass median particle diameter of 1 µm was assigned to each source as being representative of the small particles expected to be within natural/refinery gas combustion emissions. AERMOD was applied to the series of new or modified combustion sources from which increases in emissions are anticipated.

The results of the limited AERMOD deposition modeling indicate a consistent relationship that can be extrapolated to other HAPs. The results of representative deposition modeling are summarized in Table 6, expressed in terms of a deposition velocity, defined as the highest predicted deposition rate divided by the highest predicted concentration in ambient air at ground-level.[9] Most of the deposition velocity values for metals and PAHs are similar, both within modeling years and among HAPs, because most are tied to particulate matter emissions, and the distributions of emissions among the sources are similar and proportional. The two notable exceptions are hexavalent chromium and 7,12-dimethylbenz(a)anthracene, for which the deposition velocities differ from other metals and PAHs, respectively. These anomalies result because emission factors were not available for all sources for the HAPs, hence leading to different relative emission profiles among the sources (these exceptions are few in number).

The consistency of the limited AERMOD deposition modeling results permits a simplified method for estimating the maximum deposition rate, specifically as:[10]

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[8] U.S. EPA (2005). *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. EPA530-R-05-006.

[9] Emission rates for the series of combustion sources differed somewhat from those indicated in Table 2 as these deposition modeling runs tat were conducted at a preliminary project stage. As such, the modeled deposition rates do not correspond to the emission rates listed in Table 2.

[10] Strictly, deposition modeling should be conducted for each pollutant. However, the series of model runs would require a large expenditure of resources, and is unnecessary. The pattern discerned in the preliminary (limited)

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$$D_{HAP} = C_{HAPair} v_{HAP}$$ **Equation 2**

where the terms are:

D_{HAP}	Maximum deposition rate of HAP (mg/m^2-s);
C_{HAPair}	Maximum modeled concentration of HAP in air (mg/m^3); and
v_{HAP}	Representative HAP deposition velocity (m/s).

Based on the representative values in Table 6, the following deposition velocities v_{HAP} are assigned to estimate deposition rates:

- metals (except hexavalent chromium and mercury): v_{HAP} = 0.02 cm/s;
- PAHs: v_{HAP} = 0.03 cm/s;
- hexavalent chromium: v_{HAP} = 0.025 cm/s; and
- mercury: v_{HAP} = 0.3 cm/s.

The latter value for mercury is assigned based on the likely nature of mercury emissions from MPC refinery sources. The degree to which mercury emitted to the atmosphere can impact local soil and water concentrations is critically dependent on the physical and chemical form of the emissions. Vapor-phase elemental mercury is deposited from the air very slowly and may be ignored when considering local deposition of mercury emissions.[11] In contrast, divalent mercury species are readily deposited, especially mercury in the form of gaseous mercuric chloride ($HgCl_2$). Therefore, to estimate mercury deposition rates, it is necessary to estimate the fraction of divalent mercury present in the emissions of natural gas combustion sources. Divalent emissions are then assessed for their potential to impact local soil and water concentrations; emissions in the form of elemental mercury can be neglected in this assessment.

A 2001 EPA report estimating mercury emissions from the production, processing, and combustion of petroleum and natural gas products.[12] The report's estimate of the abundance of various forms of mercury in natural gas indicates that elemental mercury comprises at least 99% of the mercury in the gas, with the only other likely component being dimethyl mercury which is estimated to be present at a less than 1% level. The emission factor for mercury emissions from a natural gas-fired external combustion sources is based on the results of two tests.[13] Data for each of the three measurements for each of these tests are contained in a Microsoft Access File at the

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deposition runs allows the approximate method to be used with confidence as a reasonable, yet still conservative (i.e., tending to overestimate), means of estimating deposition

[11] U.S. EPA Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Office of Solid Waste and Emergency Response EPA document 530-R-05-006, September 2005

[12] Mercury in Petroleum and Natural Gas: Estimation of Emissions from Production, Processing, and Combustion, prepared for Office of Air Quality Planning and Standards United States Environmental Protection Agency EPA/600/R-01/066 September 2001.

[13] Emission Factor Documentation For AP-42 Section 1.4 Natural Gas Combustion (U.S. Environmental Protection Agency Office of Air Quality Planning and Standards March 1998)

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EPA's website.[14] These data indicate that mercury was measured using EPA Method 29, and was detected in only one of the six test runs. Detailed results for each portion of the Method 29 sampling trail are not available within this database or the background documentation. Therefore, it is not possible to estimate the fraction of divalent mercury present in the tests.

Speciated data for mercury emissions from natural gas combustion are available in a research report for a program to evaluate flue gas mercury speciation methods.[15] Natural gas-fired pilot-scale tests were run to test the influence of SO_2 and HCl on the conversion of elemental mercury to divalent mercury within the tests' sampling trains. During tests without SO_2 or HCl, and during tests using methods insensitive to SO_2 and HCl levels, divalent mercury was measured at between 1 and 8% of the total. Based on these data, it is assumed that, at most, 10% of mercury emitted from natural gas combustion may be in divalent form, with the remaining (non-depositing) fraction elemental. If particle-bound, a representative deposition velocity for the other pollutants would be appropriate. However, if in gaseous $HgCl_2$ form, EPA recommends a deposition velocity of as high as 3 cm/s,[16] a value significantly greater than the 0.02 to 0.03 cm/s values modeled for particle-bound metals and PAHs. Conservatively, the deposition velocity for mercury is assigned a value of 0.3 cm/s, estimated as 10% (in gaseous $HgCl_2$ form) of the 3 cm/s deposition velocity (ignoring the remaining 90% of elemental mercury that does not deposit).

Modeled worst-case concentrations in soil are presented in Table 7 along with representative background concentrations and appropriate ecological benchmark concentrations for comparison. Background concentrations for metals are available from a number of sources, and the values in Table 7 are selected from data summarized in Table 8. Observations regarding potential impacts to local soils include:

- Predicted worst-case increments to soil are all smaller than their respective ecological benchmarks, in many cases by considerable margins;
- Representative background concentrations of several metals (chromium, cobalt, manganese, nickel, selenium, vanadium, and zinc) exceed their ecological benchmarks; in these cases, the additional projected worst-case increases due to MPC refinery emissions do not add substantially to total (facility plus background) concentrations; and
- The total concentration of mercury, when summing the worst-case facility impact to the representative background level, exceeds its ecological benchmark.

Mercury is the single pollutant for which the projected worst-case impact is of the same order of magnitude as both background and the ecological screening benchmark concentration. The area over which the ecological benchmark is predicted to be exceeded by the sum of background plus facility impact, however, is very small in extent and located close to the MPC refinery. This area can be located in Figure 2 as the small region for which the projected increase in the ambient air

[14] Available at: http://www.epa.gov/ttn/chief/ap42/ch01/related/r01s04.zip

[15] Research sponsored by the U.S. Department of Energy (DOE) and the Electric Power Research Institute (U.S. DOE Contract DE-FC21-93MC30098).

[16] U.S. EPA Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Office of Solid Waste and Emergency Response EPA document 530-R-05-006, September 2005

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concentration is 30 pg/m^3 (3.0E-05 µg/m^3) and higher (a limited area adjacent to the MPC refinery's property line on its northeast parcel, extending less than 100 m away from the property).

Further, a more realistic comparison indicates an even smaller relative contribution from the MPC refinery. The ecological benchmark for mercury of 0.1 mg/kg is designed to protect earthworms.[17] Since earthworms burrow to considerable depths in soil, it is more appropriate to consider the MPC facility's modeled root zone concentration increment of 0.0034 mg/kg as opposed to the 2 cm deposition layer increment of 0.025 mg/kg (Table 7). Also, at locations close to the refinery, it is arguably more appropriate to select a mercury background concentration of 0.2 mg/kg as opposed to the value of 0.08 mg/kg, given the predominance of industrial land use close to the refinery.[18] With these values, background mercury at 0.2 mg/kg exceeds the ecological benchmark of 0.1 mg/kg, but the facility increment of 0.0034 mg/kg represents a less than 2% increase in total soil mercury at the location of highest projected impact.

EPA's 1980 screening procedure for evaluating industrial source impacts to soils, plants, and animals includes a method to estimate the concentrations of a number of metals in plant tissue and compare them to benchmarks designed to be protective of plants and animals.[6] Concentrations in plant tissue are estimated from concentrations in soils:

$$C_{HAPplant} = C_{HAPsoil} R_{SoilPlant} \qquad \textbf{Equation 3}$$

where the terms are:

$C_{HAPplant}$	Concentration, or mass fraction, of the HAP in plant tissue (mg/kg);
$C_{HAPsoil}$	Concentration, or mass fraction, of the HAP in soil (mg/kg); and
$R_{SoilPlant}$	Concentration ratio between plant tissue and soil.

Table 9 compares concentration estimates in plant tissue to relevant benchmarks for the metals for which data are available in EPA's guidance. Root-zone concentrations in soil (averaged over a 15 cm depth) are used in the calculations (Table 7). As for the soil-based comparisons, the predicted concentrations of metals in plant tissue due to Detroit HOUP emissions are well below benchmark concentrations.

[17] U.S. EPA Region 5 Ecological Screening Level, http://www.epa.gov/Region5/rcraca/ESL.pdf

[18] The representative background concentrations in Table 7 are selected as the lowest values among three land use categories (industrial, commercial and residential) in Table 8 for data available for the Rouge River watershed. The lowest values are selected to identify the greatest fraction by which Detroit HOUP emissions could increase existing background levels.

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Surface water modeling and comparisons

The screening-level model to estimate worst-case concentrations in surface water assumes that all stack emissions are mixed within the Detroit River, which is selected as the appropriate surface waterway to evaluate because it houses a known habitat for the Northern riffleshell.[19] This is an extremely conservative model, as it assumes that 100% of pollutant emissions deposit into the Detroit River's watershed and enter the river. This model is used as an initial screening tool, and applied to VOCs as well as metals/inorganics and PAHs despite the fact that volatile compounds will not enter surface water at significant rates.

Worst-case screening-level concentrations in water are calculated by dividing the emission rate of each HAP (Table 2) by the streamflow rate of the Detroit River, which is 186,000 ft^3/s.[20] Surface water concentrations of contaminants calculated by the simple mixing model are provided in Table 10 along with ecological screening benchmarks.

Background water quality data are available for a few metals based on measurements in the upper Detroit River,[21] and are presented for comparison in Table 11. Background data reflect total concentrations of the pollutants measured in water, and represent averages over 53 to 55 samples.

Relevant observations include:

- Incremental concentrations of all pollutants are smaller than their respective surface water benchmark concentrations and background concentrations, in most cases by substantial margins (Table 10); the smallest benchmark to impact ratio (a measure of the margin of safety) of 7 is predicted for hexane, a volatile pollutant not expected to enter surface water; of the inorganic pollutants and PAHs, the smallest benchmark to impact ratio is about 200 (for ammonia); and
- Modeled worst-case facility impacts are considerably smaller than available background measurements, and background levels in turn are smaller than ecological benchmarks.

Sediment modeling and comparisons

Sediment concentrations are evaluated under the assumption that the whole of pollutant emission increases from the Detroit HOUP enter the Detroit River, become mixed with suspended sediment in the river, then deposit to form bed sediment. As for the surface water model, this simple model will greatly overestimate pollutant concentrations in sediments as it assumes the

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[19] Threatened and endangered species listing, Final Rule, Federal Register, Volume 58, no. 13, January 22, 1993, pp. 5638-5642. The Northern riffleshell is found in the northern two miles of the Detroit River from Lake St. Clair to Belle Isle, a few miles upstream of where the Rouge River joins.

[20] U.S. Geological Survey, *A Two-Dimensional, Transient Flow Model of the St. Clair – Detroit River Waterway*. February 2000. Fact sheet available at http://mi.water.usgs.gov/progproj/SCDInfoSheet.pdf.

[21] Background data for surface water downloaded from the EPA's modern STORET database (http://www.epa.gov/storet)

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unlikely case that all emissions deposit in the local area and enter the river. Concentrations in sediment are calculated as the pollutant emission rate divided by the flux of suspended sediment in the river, estimated as the product of the stream flow rate 186,000 ft^3/s and an average suspended sediment concentration of 9.65 mg/l.[22] A more realistic analysis of impacts over a watershed would yield considerably lower estimates.

Table 12 presents worst-case estimates of pollutant concentrations in sediments along with relevant benchmark concentrations for sediments. The model is applied to inorganic pollutants and PAHs (VOCs are excluded as they are not expected to deposit in appreciable amounts from the atmosphere, or to bind to sediments). Preliminary observations concerning predicted screening-level impacts to sediments include:

- Despite the conservative nature of the screening-level model, all estimates of facility-related impacts are smaller than benchmark values by at least an order of magnitude (as reflected by the benchmark to impact ratios all being a factor of ten or larger); and
- Benchmark concentrations for sediment are not available for some metals (barium, beryllium, hexavalent chromium, molybdenum, selenium, and vanadium); however, the project increases in sediment concentrations are of the order of a hundred to ten thousand times smaller than to representative background concentrations in soil (Table 8); and
- Readily available background concentrations of pollutants in sediment were not identified in a preliminary search, though the Detroit River sediments are known to contain elevated levels of metals and PAHs. It is likely that background levels of some pollutants exceed the ecological benchmarks listed in Table 12. However, given the low levels of projected impacts to sediments due to emissions from the Detroit HOUP, the proposed project is not likely to significantly increase existing pollutant levels in sediments.

Criteria Pollutant Emissions

This ecological screening evaluation focuses on HAPs emissions, but the EPA Region 5 RSA also demands consideration of Criteria Pollutant impacts. Criteria Pollutants are the pollutants generally emitted by industrial facilities such as the MPC refinery in the greatest quantities. These pollutants also receive considerable attention in facility permitting (under the auspices of the Michigan Department of Environmental Quality). Secondary National Ambient Air Quality Standards are designed to protect public welfare, including potential impacts to the environment, but are broad in nature and do not consider all endpoints.

The Criteria Pollutants emitted by the MPC refinery include particulate matter (PM), volatile organic compounds (VOCs), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and carbon monoxide

[22] The 9.65 mg/l value is the average of 53 Total Suspended Sediment samples collected from 1998 to 2005 by the Michigan Department of Environmental Quality at a Detroit River sampling station located slightly more than a mile upstream of Belle Isle (habitat area to the Northern riffleshell). These data are available from the EPA's modern STORET database (http://www.epa.gov/storet).

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(CO). The Detroit HOUP will involve both increases and decreases the various Criteria Pollutant emissions. Evaluated on a net basis with respect to the 2000-2001 baseline period and in consideration of contemporaneous changes, NO_x, SO_2, and VOC emissions (overall) will decrease, while PM and CO emissions will increase. The evaluation of HAPs includes consideration of some of the specific components of PM and VOCs. As a whole, VOCs at typical ambient levels are not associated with adverse ecological effects, although they do contribute to the formation of ozone, another Criteria Pollutant (not emitted by the MPC refinery) known to be detrimental to the growth of plants. Since NO_x and VOCs contribute to ozone production, net decreases in their emissions that will result from the Detroit HOUP can be expected to favor lower levels of ozone, though the emission levels are low relative to regional NO_x and VOCs emissions, and hence likely to yield little (if any) discernible effect on ozone concentrations. However, the relationship between ozone and its precursors NO_x and VOCs is quite complex and its evaluation, typically performed by EPA on a regional basis, is beyond the scope of this ecological screening analysis.

Carbon monoxide is not known to be more toxic to ecological receptors than to humans, and hence demonstration of compliance with National Ambient Air Quality Standards (as required to gain an operating permit) is sufficient to conclude there will be no significant effects on the environment due to CO emissions.

Although the Detroit HOUP will increase neither NO_x nor SO_2 emissions, the deposition of nitrogen-containing pollutants could be affected by deposition of the non-Criteria Pollutant ammonia (NH_3).[23] Nitrogen deposition serves as a source of nutrients to plants, favoring those species that benefit from nitrogen augmentation to soil (as is accomplished through the use of fertilizers that promote the growth of crops). Nitrogen deposition adversely affects plants such as the Eastern prairie fringed orchid by providing nutrients to competing plant species that do not similarly thrive in nitrogen-poor soils.

Anthropogenic activities such as fuel combustion have increased the level of nitrogen deposition well above pre-industrial conditions. The relevant question in this case is whether emissions from the Detroit HOUP will lead to increased or decreased nitrogen deposition at habitat locations for the Eastern prairie fringed orchid. This question is difficult to address because nitrogen deposition depends on various interactions among multiple pollutants (both from the Detroit HOUP and all other sources), atmospheric chemistry, meteorology, and other factors. However, qualitatively the decreases in NO_x and SO_2 emissions will likely lead to a decrease in nitrogen deposition that will tend to offset any increases due to ammonia emissions.

Ammonia can be evaluated independently as a worst-case consideration. The screening-level modeling indicates emissions from the Detroit HOUP will increase the ambient ammonia concentration by about 8% at the worst-case location. This location occurs close to the MPC refinery, however, in habitat not suitable to the Eastern prairie fringed orchid. To improve the estimate, an evaluation of GIS layers developed by the National Wetlands Inventory and Flood

[23] SO_2 can lead to associated nitrogen deposition when deposited as sulfate, as this species typically is found as ammonium sulfate.

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Insurance Maps was undertaken to identify suitable habitat areas for the Eastern prairie fringed orchid. Per the EPA Region 5 RSA, a 15 km distance from the facility was considered and areas were searched for PEM series wetlands not located within 100-year flood-plain areas in order to identify potential prairies (mesic to wet) and meadows. A total of eight potential habitat locations were identified in different directions from the facility at distances ranging from 5 to 20 km (extending the 15 km range slightly).[24] An additional air dispersion modeling simulation was conducted by Horizon Environmental using to predict ammonia concentrations at these locations.[25] The AERMOD simulation predicts the highest annual-average concentration of ammonia to be 0.0094 µg/m^3 at a location roughly 5 km to the southwest of the MPC refinery. This habitat-specific value is about 15 times smaller than that predicted at the worst-case location near the MPC refinery (0.14 µg/m^3, Table 4), and constitutes a 0.5% increase compared with the existing background ammonia concentration (1.8 µg/m^3, Table 4).

Potential adverse effects of PM constituents (various metals and PAHs) have been evaluated in the consideration of HAPs. As an additional consideration, sufficiently high deposition rates of total PM can interfere with normal plant respiration. Specifically, sufficiently thick coatings of particles can reduce levels of photosynthesis and interfere with stomatal activity. PM deposition modeling for emission increases from the Detroit HOUP at potential habitat locations for the Eastern prairie fringed orchid predicts a maximum annual particle deposition rate of 0.054 g/m^2,[26] a level much smaller than the range of 1-10 g/m^2 that affects photosynthesis.[27] Even discounting the periodic cleaning of plant surfaces by precipitation, deposition of PM from increased facility emissions will not significantly reduce levels of photosynthesis. The steady-state level of dust on plant surfaces can be estimated with the following model (as simplified from EPA):[28]

$$S_{plant} = \frac{D_{dry} + f_{wet} D_{wet}}{k_p} \qquad \textbf{Equation 4}$$

where the terms are:

S_{plant}	Steady-state loading on the plant surface (g/m^2);
D_{dry}	Rate of dry deposition (g/m^2-yr);

[24] Potential habitat locations have not been confirmed and simply reflect indications on the GIS data layers. Given the urban/suburban character of the Detroit metropolitan area, it is likely that some of the locations do not provide suitable habitat for the Eastern prairie fringed orchid.

[25] Model parameters and assumptions are consistent with values used to support the permit modification application.

[26] PM deposition modeling considered the same eight locations evaluated for ammonia impacts (the closest PEM series wetlands outside of floodplains) and included fugitive and cooling tower PM sources (characteristic particle diameter 10 µm) as well as the combustion sources evaluated in the HAP analyses (characteristic diameter 1 µm)..

[27] Glenn, D., and Puterka, G. (2005). Particle Films: A New Technology for Agriculture. *Horticultural Reviews* **31**:1–44.

[28] U.S. EPA (2005). *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. EPA530-R-05-006.

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D_{wet}	Rate of wet deposition (g/m^2-yr);
f_{wet}	Fraction of wet deposition that remains on the plant surface; and
k_p	Plant surface loss coefficient (1/yr).

EPA recommends values of 0.6 for f_{wet} and 18 yr^{-1} for k_p, respectively.[28] Since the total worst-case deposition estimate of 0.054 g/m^2-yr is dominated by dry deposition, the second (wet deposition) term of the Equation 4 is negligible, and the estimate for particulate loading on plants is 0.003 g/m^2, a value well below the lower end of the range (1 g/m^2) at which reduced photosynthesis levels have been observed in some plant species.

Conclusions

Taken as a whole, this Ecological Screening Evaluation indicates little reason to expect adverse impacts to threatened and endangered wildlife species due to increased pollutant emissions associated with the Detroit HOUP. A series of very conservative (perhaps unrealistically overpredictive) models are used to estimate worst-case pollutant concentrations in air, soil, surface water, and sediment, and in only a single case (mercury concentrations in soil) is an ecological benchmark concentration exceeded. Even in this case, the area over which the benchmark may be exceeded is limited to close proximity to the MPC refinery, an industrial/urban area not likely to serve as habitat for the threatened and endangered species of interest. An evaluation of potential habitat areas for the Eastern prairie fringed orchid finds that facility emissions could increase ambient ammonia concentrations by 0.5% , but this level of increase is not likely to cause significant change in local nitrogen deposition levels and may be offset by the effects of net decreases in emissions of other pollutants such as SO_2 and NO_x.

Considering the simplicity/conservatism of the models considered, there is no reason to believe that there are any potential concerns with respect to ecological risks, as judged by the comparisons with available ecotoxicity benchmark concentrations. The simple fate-and-transport model in soil does not account for removal processes such as biodegradation, chemical reactions, and leaching, and the simple bounding-type “mix in” models could greatly over-predict the likely consequences of facility emissions as they assume that all pollutant emissions deposit locally and enter surface water.

The low likelihood of adverse effects on ecological receptors suggested by this analysis is perhaps not surprising given that combustion of natural/refinery gas (the principal fuels used at the MPC refinery) is not a large source of HAP emissions compared with the combustion of other fossil fuels. Based on the low levels of projected impacts and the conservative assumptions used to develop them, adverse impacts to threatened and endangered species seem very unlikely.

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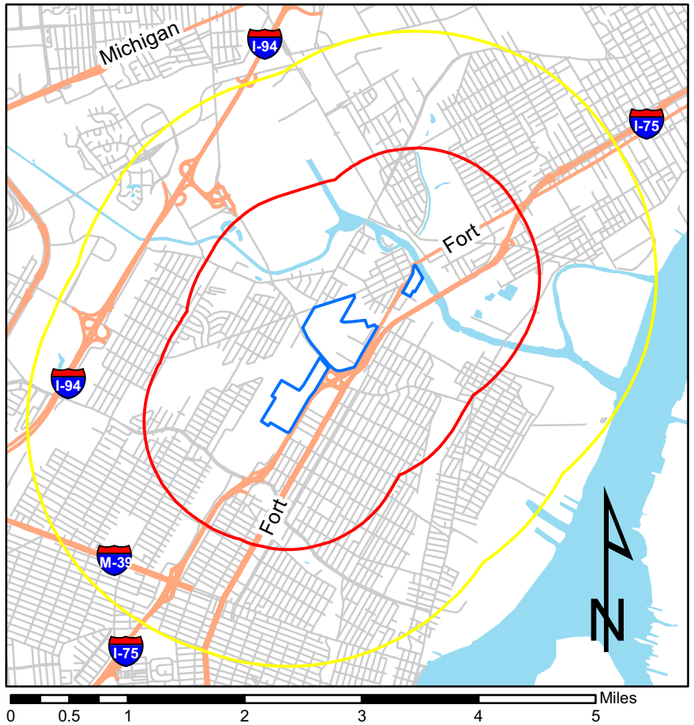
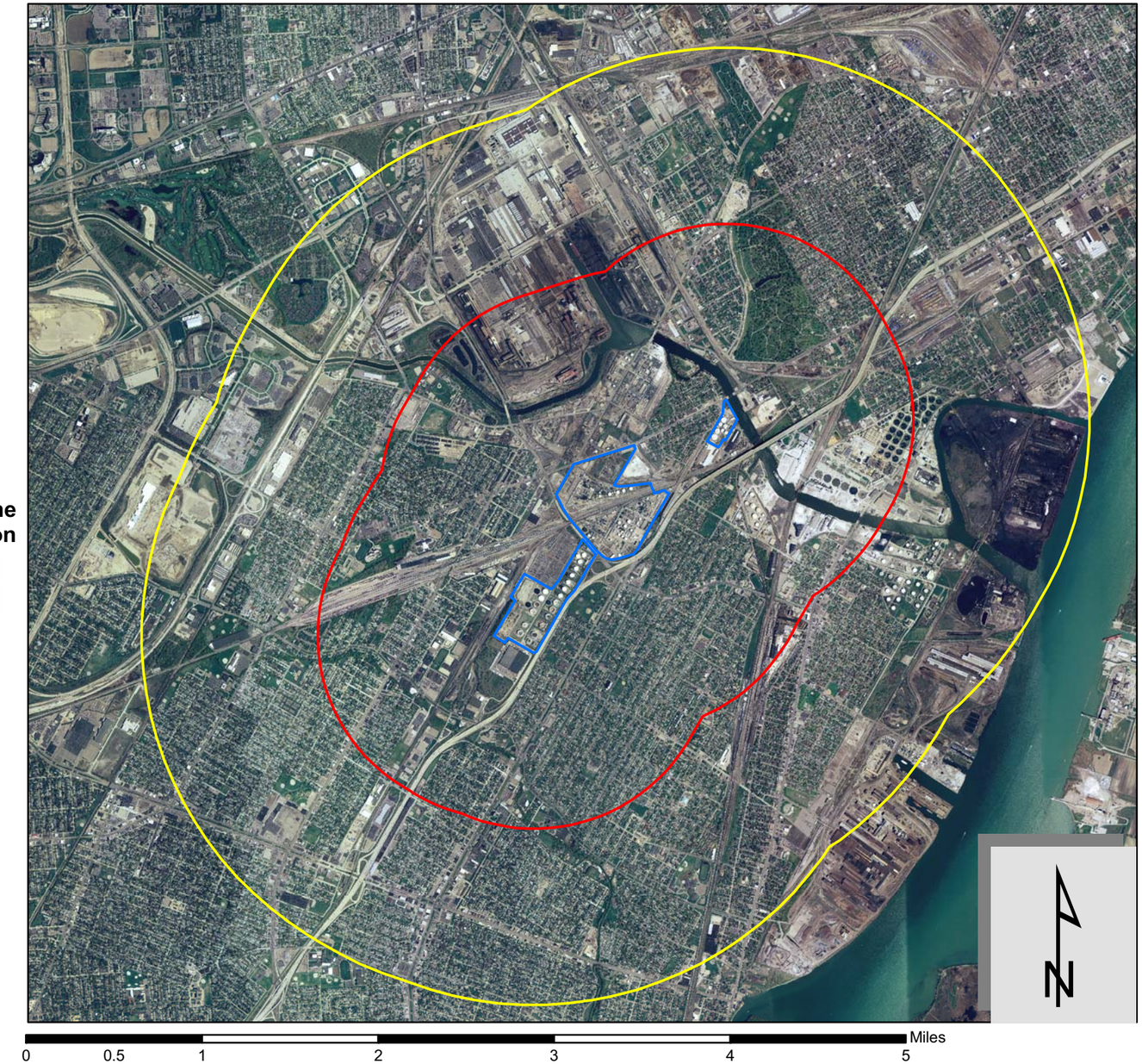


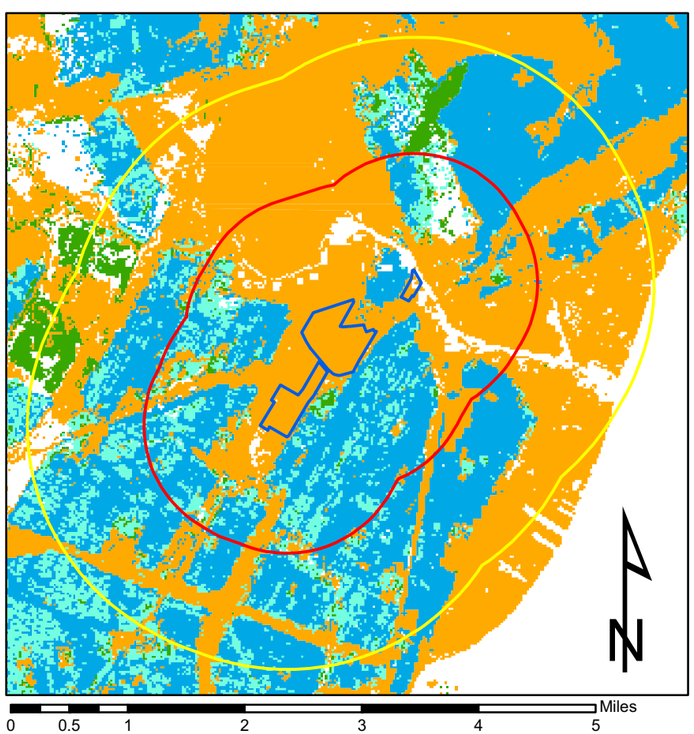
Road System Around Marathon

- Marathon Refinery
- 1 Mile Buffer of Marathon
- 2 Mile Buffer of Marathon
- State Roads
- County and Local Roads

Aerial Photography of the Area Around Marathon

- Marathon Refinery
- 1 Mile Buffer of Marathon
- 2 Mile Buffer of Marathon

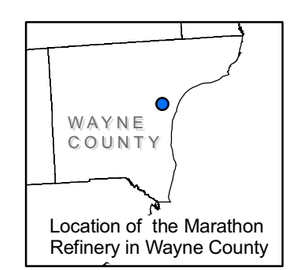




Land Cover Around Marathon

- Marathon Refinery
- 1 Mile Buffer of Marathon
- 2 Mile Buffer of Marathon
- Urban / Recreational Grasses
- Low Intensity Residential
- High Intensity Residential
- Commercial / Industrial / Transportation

Information Derived From:
Michigan 1992 NLCD Shapefile by County
Michigan Geographic Framework: Wayne County
Wayne County 2005 True Color Orthoimagery



Location of the Marathon Refinery in Wayne County

FIGURE 1
Features Located Around The Marathon Refinery

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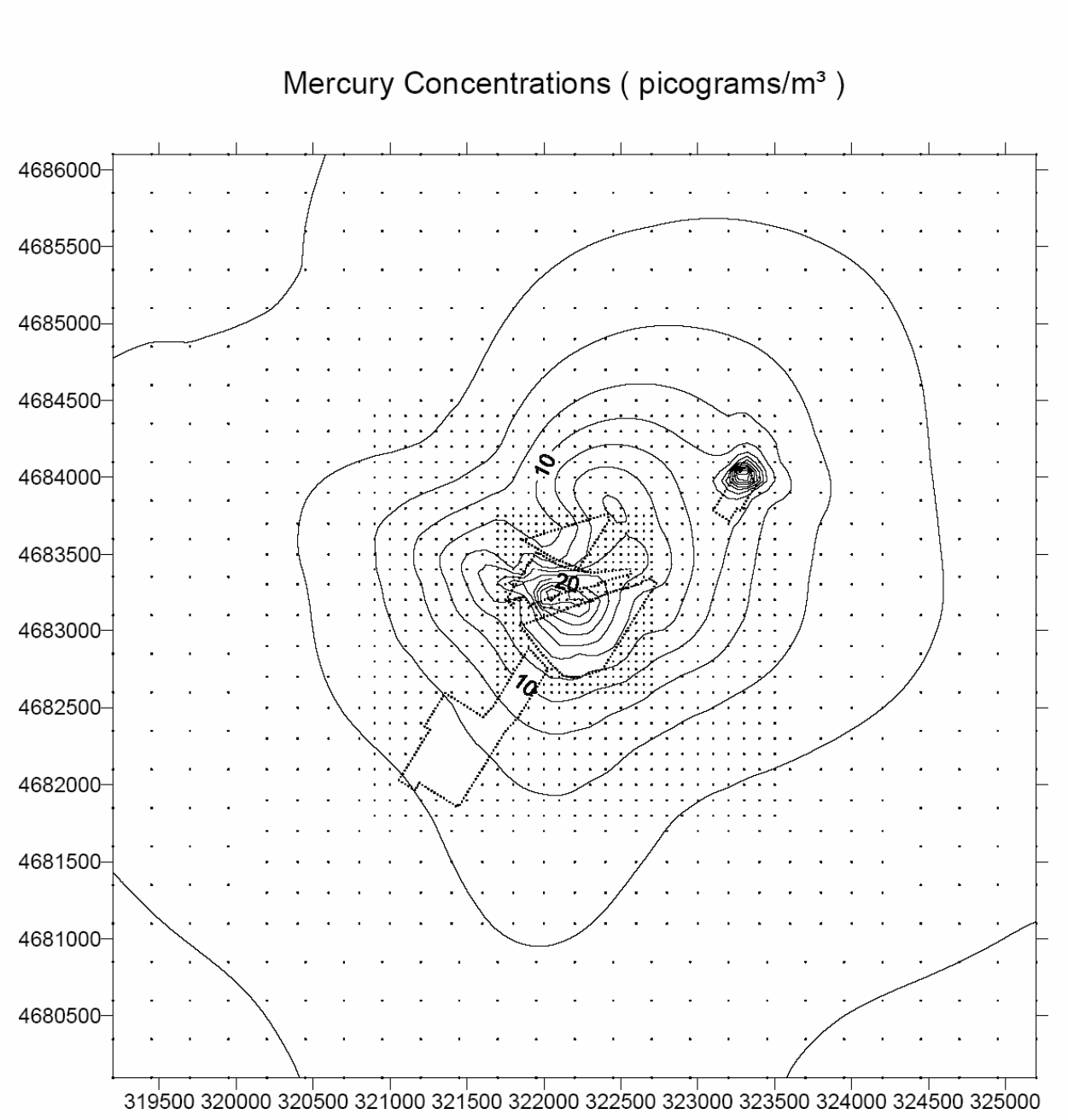

Figure 2 Modeled concentrations of mercury in ambient air (at in ground-level) due to emission increases from the Detroit HOUP. Isopleths are plotted at increments of 2 pg/m^3 (106 pg = 1 µg), and the x-y axes indicate UTM spatial coordinates (in m). The highest value of 38µg/m^3 occurs at a location on the facility property line. (Courtesy of Horizon Environmental).

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Table 1 Threatened and Endangered Wildlife Species

Species	Status	Habitat
Indiana bat (*Myotis sodalis*)	Endangered	Summer habitat includes small to medium river and stream corridors with well developed riparian woods; woodlots within 1 to 3 miles of small to medium rivers and streams; and upland forests. Caves and mines as hibernacula.
Northern riffleshell (*Dysnomia torulosa rangiana*)	Endangered	Large streams and small rivers in firm sand of riffle
Eastern prairie fringed orchid (*Plantathera leucohaea*)	Threatened	Mesic to wet prairies and meadows

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Table 2 Projected Ambient Air Impacts

Air Pollutant		Net Emission Rate Increases (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu g/m^3$) [A]	
			Screening Level	Refined
Metals and organics				
Arsenic		3.92E-04	4.74E-05	2.70E-05
Barium		8.63E-03	1.04E-03	
Beryllium		2.35E-05	2.85E-06	
Cadmium		2.16E-03	2.61E-04	
Chromium (total)		2.74E-03	3.32E-04	
Chromium (hexavalent)		1.18E-04	7.76E-06	4.60E-06
Cobalt		1.65E-04	1.99E-05	
Copper		1.67E-03	2.02E-04	
Manganese		1.18E-02	7.72E-04	
Mercury		8.15E-04	8.07E-05	3.80E-05
Molybdenum		2.16E-03	2.61E-04	
Nickel		4.15E-03	4.98E-04	
Selenium		4.71E-05	5.69E-06	
Vanadium		4.51E-03	5.45E-04	
Zinc		5.69E-02	6.88E-03	
Ammonia		6.27E+00	1.41E-01	
Polycyclic aromatic hydrocarbons (PAHs)				
PAH	NATA Group			
2-Methylnaphthalene	2	4.65E-05	5.67E-06	
3-Methylcholanthrene	4	3.48E-06	4.25E-07	
7,12-Dimethylbenz(a)anthracene	3	3.10E-05	3.78E-06	
Acenaphthene	2	6.40E-06	2.56E-05	
Acenaphthylene	2	1.64E-05	1.12E-04	
Anthracene	2	6.74E-05	5.43E-04	
Benz(a)anthracene	6	6.62E-05	5.43E-04	
Benzo(a)pyrene	5	1.89E-03	1.27E-04	7.00E-05
Benzo(b)fluoranthene	6	6.62E-05	5.43E-04	
Benzo(ghi)perylene	2	3.29E-06	8.63E-06	
Benzo[k]fluoranthene	6	6.62E-05	5.43E-04	
Chrysene	7	7.44E-04	6.06E-05	
Dibenz(ah)anthracene	5	6.51E-05	5.43E-04	

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Table 2 Projected Ambient Air Impacts

Air Pollutant		Net Emission Rate Increases (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu g/m^3$) [A]	
			Screening Level	Refined
Fluoranthene	2	3.51E-03	2.42E-04	
Fluorene	2	4.88E-04	4.24E-03	
Indeno(1,2,3-cd)pyrene	6	6.62E-05	5.43E-04	
Phenanthrene	2	5.72E-05	2.14E-04	
Pyrene	2	1.28E-05	2.86E-05	
NATA PAH Group Totals [A]				
Group 2		4.21E-03	5.42E-03	
Group 3		3.10E-05	3.78E-06	
Group 4		3.48E-06	4.25E-07	
Group 5		1.96E-03	6.70E-04	
Group 6		2.65E-04	2.17E-03	
Group 7		7.44E-04	6.06E-05	
Volatile organic compounds (VOCs)				
1,3-Butadiene		6.23E-04	5.38E-03	
Acetaldehyde		2.19E-02	1.69E-01	
Acrolein		1.20E-02	1.04E-01	
Benzene		7.79E-01	5.78E-02	
Butane		4.06E+00	4.96E-01	
Dichlorobenzene		2.32E-03	2.83E-04	
Formaldehyde		2.46E-01	1.08E+00	
Hexane		3.48E+00	4.25E-01	
Naphthalene		3.19E-03	1.76E-03	
Pentane		5.03E+00	6.14E-01	
Phenol		7.24E-03	4.53E-04	
Propylene		6.02E-03	5.20E-02	
Toluene		1.32E+00	9.10E-02	
Xylenes		4.29E-04	3.71E-03	

Notes:

A Screening Level estimates add the highest impacts predicted for each source together despite their occurrence at differing geographic locations. Refined estimates consider the combined impacts of all sources at each location in identifying the maximum.

B Polycyclic aromatic hydrocarbons (PAHs) are grouped according to their relative toxicity as considered in the U.S. EPA's 1999 National Air Toxics Assessment (http://www.epa.gov/ttn/atw/nata1999/99pdfs/pomapproachjan.pdf).

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Table 3 Background Concentrations of HAPs in Ambient Air [E]

Air Pollutant	Measured Background Concentrations by the Detroit Air Toxics Initiative (µg/m^3) (Percent values in parentheses indicate frequency of detection) [A]			1999 NATA Modeled Background (µg/m^3) [B]	Representative Background Concentration (µg/m^3) [C]	Note [C]
	River Rouge	South Delray	Dearborn			
Metals and organics						
Arsenic	1.91E-03 (100.0%)	3.36E-03 (100.0%)	2.41E-03 (100.0%)	2.03E-05	1.91E-03	DATI
Barium	5.29E-02 (100.0%)	5.75E-02 (100.0%)	4.84E-02 (100.0%)	4.84E-02	5.29E-02 (100.0%)	AQS
Beryllium	1.07E-04 (100.0%)	3.63E-04 (100.0%)	1.22E-04 (100.0%)	5.37E-06	1.07E-04	DATI
Cadmium	6.21E-04 (100.0%)	1.13E-03 (100.0%)	6.06E-04 (100.0%)	4.55E-04	6.06E-04	DATI
Chromium (total)	5.09E-03 (100.0%)	7.78E-03 (100.0%)	6.02E-03 (100.0%)	2.21E-03	5.09E-03	DATI
Chromium (hexavalent)	3.92E-05 (62.5%)		3.63E-05 (54.5%)	1.48E-04	3.63E-05	DATI
Cobalt		5.40E-04 (100.0%)	4.30E-04 (100.0%)	3.39E-05	4.30E-04	AQS
Copper	7.27E-01 (100.0%)	2.72E-01 (100.0%)	1.90E-01 (100.0%)	1.90E-01	7.27E-01 (100.0%)	AQS
Manganese	7.50E-02 (100.0%)	2.74E-01 (100.0%)	1.98E-01 (100.0%)	1.60E-02	7.50E-02	DATI
Mercury		2.40E-03		1.81E-03	2.40E-03	DATI
Molybdenum			3.40E-03 (1.8%)	3.40E-03	3.40E-03	AQS2
Nickel	2.50E-03 (100.0%)	4.91E-03 (100.0%)	3.07E-03 (100.0%)	2.11E-03	2.50E-03	DATI
Selenium			2.70E-03 (34.5%)	4.26E-05	2.70E-03	AQS2

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		River Rouge	South Delray	Dearborn			
Vanadium		6.22E-03 (100.0%)	8.50E-03 (100.0%)	5.64E-03 (100.0%)		5.64E-03	AQS
Zinc		7.45E-02 (100.0%)	7.40E-02 (100.0%)	2.06E-01 (100.0%)		7.40E-02	AQS
Ammonia						1.80E+00 (96.4%)	AQS3
Polycyclic aromatic hydrocarbons (PAHs)							
PAH	NATA Group						
2-Methylnaphthalene	2	1.72E-01 (100.0%)	1.62E+00 (98.3%)	2.24E-01 (100.0%)		1.72E-01	DATI
3-Methylcholanthrene	4	1.60E-02 (0.0%)	1.60E-02 (0.0%)	1.60E-02 (0.0%)			NS
7,12-Dimethylbenz(a)anthracene	3	4.76E-02 (0.0%)	4.76E-02 (0.0%)	4.76E-02 (0.0%)			NS
Acenaphthene	2	1.98E-02 (93.3%)	6.25E-01 (98.3%)	3.30E-02 (95.9%)		1.98E-02	DATI
Acenaphthylene	2	2.04E-02 (16.7%)	3.99E-02 (77.6%)	1.65E-02 (38.8%)		1.65E-02	DATI
Anthracene	2	3.64E-02 (16.7%)	9.87E-02 (81.0%)	3.72E-02 (14.3%)		3.64E-02	DATI
Benz(a)anthracene	6	2.08E-02 (0.0%)	2.16E-02 (51.7%)	2.08E-02 (0.0%)		2.08E-02	DATI
Benzo(a)pyrene	5	4.54E-02 (0.0%)	4.37E-02 (6.9%)	4.54E-02 (0.0%)		4.37E-02	DATI
Benzo(b)fluoranthene	6	4.34E-02 (0.0%)	3.70E-02 (25.9%)	4.34E-02 (0.0%)		3.70E-02	DATI

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Table 3 Background Concentrations of HAPs in Ambient Air [E]

Air Pollutant		Measured Background Concentrations by the Detroit Air Toxics Initiative (µg/m^3) (Percent values in parentheses indicate frequency of detection) [A]			1999 NATA Modeled Background (µg/m^3) [B]	Representative Background Concentration (µg/m^3) [C]	Note [C]
		River Rouge	South Delray	Dearborn			
Benzo(ghi)perylene	2	3.76E-02 (0.0%)	3.76E-02 (0.0%)	3.76E-02 (0.0%)			NS
Benzo[k]fluoranthene	6	5.90E-02 (0.0%)	4.75E-02 (25.9%)	5.90E-02 (0.0%)		4.75E-02	DATI
Chrysene	7	2.64E-02 (0.0%)	2.67E-02 (53.4%)	2.64E-02 (0.0%)		2.64E-02	DATI
Dibenz(ah)anthracene	5	3.96E-02 (0.0%)	3.96E-02 (0.0%)	3.96E-02 (0.0%)			NS
Fluoranthene	2	3.31E-02 (20.0%)	6.20E-02 (91.4%)	2.57E-02 (42.9%)		2.57E-02	DATI
Fluorene	2	1.67E-02 (96.7%)	4.54E-01 (96.6%)	2.58E-02 (93.9%)		1.67E-02	DATI
Indeno(1,2,3-cd)pyrene	6	3.64E-02 (0.0%)	3.64E-02 (0.0%)	3.64E-02 (0.0%)			NS
Phenanthrene	2	9.13E-02 (93.3%)	6.25E-01 (98.3%)	5.32E-02 (98.0%)		5.32E-02	DATI
Pyrene	2	2.43E-02 (10.0%)	1.03E-01 (89.7%)	2.23E-02 (24.5%)		2.23E-02	DATI
NATA PAH Group Totals [D]							
Group 2					9.62E-03	3.63E-01	DATI
Group 3					7.77E-07	7.77E-07	NATA
Group 4						0.00E+00	N/A
Group 5					1.16E-04	4.37E-02	DATI
Group 6					6.60E-04	1.05E-01	DATI
Group 7					1.89E-04	2.64E-02	DATI

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Air Pollutant	Measured Background Concentrations by the Detroit Air Toxics Initiative (µg/m^3) (Percent values in parentheses indicate frequency of detection) [A]			1999 NATA Modeled Background (µg/m^3) [B]	Representative Background Concentration (µg/m^3) [C]	Note [C]
	River Rouge	South Delray	Dearborn			
Volatile organic compounds (VOCs)						
1,3-Butadiene	1.10E-01 (33.3%)	1.90E-01 (80.0%)	1.18E-01 (55.8%)		1.10E-01	DATI
Acetaldehyde	2.11E+00 (96.8%)	1.72E+00 (100.0%)	2.09E+00 (98.1%)	2.30E+00	1.72E+00	DATI
Acrolein				1.50E-01	1.50E-01	NATA
Benzene	2.14E+00 (100.0%)	2.16E+01 (100.0%)	1.93E+00 (99.4%)	2.60E+00	1.93E+00	DATI
Butane					3.14E+00 (100%)	AQS4
Dichlorobenzene (*p*- assumed)	1.35E-01 (100.0%)	1.48E-01 (87.9%)	1.44E-01 (96.0%)	1.13E-01	1.35E-01	DATI
Formaldehyde	5.55E+00 (96.8%)	3.00E+00 (100.0%)	2.87E+00 (98.5%)	2.30E+00	2.87E+00	DATI
Hexane				1.11E+00	1.11E+00	NATA
Naphthalene	4.86E-01 (100.0%)	1.84E+01 (100.0%)	6.31E-01 (100.0%)	1.09E-01	4.86E-01	DATI
Pentane					2.14E+00 (100%)	AQS4
Phenol	7.10E-02 (13.3%)	9.42E-01 (74.1%)	9.18E-01 (40.8%)	2.43E-02	7.10E-02	DATI
Propylene	1.74E+00 (100.0%)	1.63E+00 (98.3%)	2.08E+00 (100.0%)		1.63E+00	DATI
Toluene	4.31E+00 (100.0%)	1.06E+01 (100.0%)	4.07E+00 (99.7%)	6.03E+00	4.07E+00	DATI
Xylenes	8.83E-01 (98.3%)	5.55E+00 (100.0%)	3.12E+00 (97.7%)	4.00E+00	8.83E-01	DATI

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Table 3 Background Concentrations of HAPs in Ambient Air [E]

Air Pollutant	Measured Background Concentrations by the Detroit Air Toxics Initiative (µg/m^3) (Percent values in parentheses indicate frequency of detection) [A]			1999 NATA Modeled Background (µg/m^3) [B]	Representative Background Concentration (µg/m^3) [C]	Note [C]
	River Rouge	South Delray	Dearborn			

Notes:

A See http://www.michigan.gov/documents/DATI_-_COMPLETE_FINAL_REPORT_11-9-05_142053_7.pdf for details. The percent values in parentheses indicate frequency of detection. Non-detects (in cases of percentages smaller than 100%) are averaged at one-half of the analytical detection limits.

B 1999 National Air Toxics Assessment concentrations predicted by the U.S. EPA's ASPEN model are available for downloading at http://www.epa.gov/ttn/atw/nata1999/tables.html. The values selected are for the census tract in which the MPC refinery is located.

C The representative background concentration is selected as the lowest concentration at the three Detroit Air Toxics Initiative monitors if the pollutant was detected in the study. These cases are noted as DATI. Secondarily, if a National Air Toxics Assessment is available, it is used and noted as NATA. The NS note indicates that a representative background concentration was not assigned because it was sought but not detected in the Detroit Air Toxics Initiative. The N/A note indicates no information was available in either the Detroit Air Toxics Initiative or National Air Toxics Assessment studies. AQS designations indicate data obtained from the U.S. EPA'a Air Quality System at its on-line AirData website (http://www.epa.gov/oar/data/) for calendar year 2005, with metals measured as a component of Total Suspended Particulate Matter (TSP). For molybdenum and selenium (AQS2), metals are measured as a component of PM2.5 (local conditions). For ammonia (AQS3), available monitoring data were available for a location in Allen Park (14700 Goddard), and the percentage value in parentheses indicates frequency of detection. For butane and pentane (AQS4), available monitoring data were available for a location in northeast Detroit (11600 E. Seven Mile Rd), and the percentage value in parentheses indicates frequency of detection.

D Polycyclic aromatic hydrocarbons (PAHs) are grouped according to their relative toxicity as considered in the U.S. EPA's 1999 National Air Toxics Assessment (http://www.epa.gov/ttn/atw/nata1999/99pdfs/pomapproachjan.pdf). Background levels noted as DATI sum the concentrations of PAHs in the grouping that were detected in the Detroit Air Toxics Initiative study, whereas the NATA note indicates a modeled concentration from the National Air Toxics Assessment.

E Blank cells indicate values not available

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Table 4 Comparison of Modeled Air Impacts to Background [A]

Air Pollutant		Worst-case (maximum) modeled impact (µg/m^3) (Table 2)	Representative background concentration (maximum) modeled impact (µg/m^3) (Table 3)	Expected increase due to the Detroit HOUP (as a percentage of background)
Metals and organics				
Arsenic		2.70E-05	1.91E-03	1.4%
Barium		1.04E-03	4.84E-02	2.2%
Beryllium		2.85E-06	1.07E-04	2.7%
Cadmium		2.61E-04	6.06E-04	43.1%
Chromium (total)		3.32E-04	5.09E-03	6.5%
Chromium (hexavalent)		4.60E-06	3.63E-05	12.7%
Cobalt		1.99E-05	4.30E-04	4.6%
Copper		2.02E-04	1.90E-01	0.1%
Manganese		7.72E-04	7.50E-02	1.0%
Mercury		3.80E-05	2.40E-03	1.6%
Molybdenum		2.61E-04	3.40E-03	7.7%
Nickel		4.98E-04	2.50E-03	19.9%
Selenium		5.69E-06	2.70E-03	0.2%
Vanadium		5.45E-04	5.64E-03	9.7%
Zinc		6.88E-03	7.40E-02	9.3%
Ammonia		1.41E-01	1.80E+00	7.9%
Polycyclic aromatic hydrocarbons (PAHs)				
PAH	NATA Group			
2-Methylnaphthalene	2	5.67E-06	1.72E-01	0.0%
3-Methylcholanthrene	4	4.25E-07	#N/A	#N/A
7,12-Dimethylbenz(a)anthracene	3	3.78E-06	#N/A	#N/A
Acenaphthene	2	2.56E-05	1.98E-02	0.1%
Acenaphthylene	2	1.12E-04	1.65E-02	0.7%
Anthracene	2	5.43E-04	3.64E-02	1.5%
Benz(a)anthracene	6	5.43E-04	2.08E-02	2.6%
Benzo(a)pyrene	5	7.00E-05	4.37E-02	0.2%
Benzo(b)fluoranthene	6	5.43E-04	3.70E-02	1.5%
Benzo(ghi)perylene	2	8.63E-06	#N/A	#N/A
Benzo[k]fluoranthene	6	5.43E-04	4.75E-02	1.1%
Chrysene	7	6.06E-05	2.64E-02	0.2%
Dibenz(ah)anthracene	5	5.43E-04	#N/A	#N/A

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Table 4 Comparison of Modeled Air Impacts to Background [A]

Air Pollutant		Worst-case (maximum) modeled impact (µg/m^3) (Table 2)	Representative background concentration (maximum) modeled impact (µg/m^3) (Table 3)	Expected increase due to the Detroit HOUP (as a percentage of background)
Fluoranthene	2	2.42E-04	2.57E-02	0.9%
Fluorene	2	4.24E-03	1.67E-02	25.4%
Indeno(1,2,3-cd)pyrene	6	5.43E-04	#N/A	#N/A
Phenanthrene	2	2.14E-04	5.32E-02	0.4%
Pyrene	2	2.86E-05	2.23E-02	0.1%
NATA PAH Group Totals [B]				
Group 2		5.42E-03	3.63E-01	1.5%
Group 3		3.78E-06	7.77E-07	486.6%
Group 4		4.25E-07	#N/A	#N/A
Group 5		6.13E-04	4.37E-02	1.4%
Group 6		2.17E-03	1.05E-01	2.1%
Group 7		6.06E-05	2.64E-02	0.2%
Volatile organic compounds (VOCs)				
1,3-Butadiene		5.38E-03	1.10E-01	4.9%
Acetaldehyde		1.69E-01	1.72E+00	9.8%
Acrolein		1.04E-01	1.50E-01	69.2%
Benzene		5.78E-02	1.93E+00	3.0%
Butane		4.96E-01	3.14E+00	15.8%
Dichlorobenzene (*p*- assumed)		2.83E-04	1.35E-01	0.2%
Formaldehyde		1.08E+00	2.87E+00	37.7%
Hexane		4.25E-01	1.11E+00	38.2%
Naphthalene		1.76E-03	4.86E-01	0.4%
Pentane		6.14E-01	2.14E+00	28.8%
Phenol		4.53E-04	7.10E-02	0.6%
Propylene		5.20E-02	1.63E+00	3.2%
Toluene		9.10E-02	4.07E+00	2.2%
Xylenes		3.71E-03	8.83E-01	0.4%

Notes:
A #N/A indicates that the pollutant either was not detected in the Detroit Air Toxics Initiative or is not a HAP (and hence not considered in the National Air Toxics Assessment).
B Polycyclic aromatic hydrocarbons (PAHs) are grouped according to their relative toxicity as considered in the U.S. EPA's 1999 National Air Toxics Assessment (http://www.epa.gov/ttn/atw/nata1999/99pdfs/pomapproachjan.pdf).

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Table 5 Comparison of Modeled Air Impacts to Ecological Screening Levels [A]

Air Pollutant	Worst-case (maximum) modeled impact ($\mu g/m^3$) (Table 2)	EPA Region 5 Ecological Screening Level (ESL) for ambient air ($\mu g/m^3$) [A]	Ratio of ESL to worst-case projected impact
Volatile organic compounds (VOCs)			
Acrolein	1.04E-01	5.78E+02	5.58E+03
Benzene	5.78E-02	9.76E+03	1.69E+05
Dichlorobenzene (*p*- assumed)	2.83E-04	2.75E+05	9.70E+08
Naphthalene	1.76E-03	8.01E+04	4.55E+07
Phenol	4.53E-04	4.31E+03	9.52E+06
Toluene	9.10E-02	1.04E+06	1.14E+07
Xylenes	3.71E-03	1.35E+05	3.64E+07

Note: A U.S. EPA Region 5 Ecological Screening Levels (ESLs) for air published at http://www.epa.gov/reg5rcra/ca/edql.htm. Values are presented only for pollutants for which ambient air ESLs are available.

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Table 6 Deposition velocities estimated from representative AERMOD modeling results [A]

Pollutant	Average deposition velocity (cm/s) (Maximum deposition rate divided by maximum concentration in air, as predicted by AERMOD) by modeling year				
	2006	2005	2004	2003	2002
Arsenic	0.014	0.013	0.014	0.018	0.015
Beryllium	—	0.011	0.011	—	—
Cadmium	0.014	0.014	0.014	0.016	0.015
Chromium, VI, particulate	0.023	0.023	0.034	0.023	0.023
Nickel	0.011	0.010	0.011	0.015	0.013
7,12-Dimethylbenz(a)anthracene	0.011	0.011	0.011	0.011	0.011
3-Methylchloranthrene	—	—	—	—	—
Benzo(a)pyrene	0.026	0.027	0.026	0.026	0.026
Dibenzo(a,h)anthracene	0.026	0.027	0.027	0.027	0.027
Benzo(a)anthracene	0.026	0.027	0.027	0.027	0.027
Benzo(b)fluoranthene	0.026	0.027	0.027	0.027	0.027
Benzo(k)fluoranthene	0.026	0.027	0.027	0.027	0.027
Indeno(1,2,3-cd)pyrene	0.026	0.027	0.027	0.027	0.027
Chrysene	0.027	0.027	0.026	0.027	0.029

Note: A Deposition velocities are derived from facility-specific modeling based on pollutant emission rates slightly different than those indicated in Table 2. Since the same series of sources are considered, however, the modeling is reasonably representative of impacts based on relative scaling of emissions. To derive deposition velocities, estimates of the highest total pollutant deposition (wet plus dry) were divided by the highest ground-level concentrations in air.

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Table 7 Comparison of projected worst-case increases in soil concentrations to background and ecological benchmarks
Values that exceed benchmarks indicated in **boldface**

Pollutant	All values in mg/kg						
	Predicted worst-case increment in soil [A]		Background (Table 8) [B]	Some of facility increment plus background		Ecological screening benchmark	Source of ecological benchmark
	2 cm deposition layer	15 cm root zone layer		2 cm deposition layer	15 cm root zone layer		
Arsenic	9.97E-04	1.33E-04	5.10E+00	5.10E+00	5.10E+00	5.70E+00	EPA Region 5 ESL
Barium	2.19E-02	2.93E-03	6.90E+01	6.90E+01	6.90E+01	3.30E+02	EPA ECO-SSL Invertebrates
Beryllium	5.98E-05	7.98E-06	7.34E-01	7.34E-01	7.34E-01	4.00E+01	EPA ECO-SSL Invertebrates
Cadmium	5.48E-03	7.31E-04	1.10E+00	1.10E+00	1.11E+00	1.40E+02	EPA ECO-SSL Invertebrates
Chromium	6.98E-03	9.31E-04	**2.70E+01**	**2.70E+01**	**2.70E+01**	4.00E-01	EPA Region 5 ESL
Chromium, VI, particulate	2.04E-04	2.72E-05				4.00E-01	Lowest RAIS Value
Cobalt	4.19E-04	5.58E-05	**4.61E+00**	**4.61E+00**	**4.62E+00**	1.40E-01	EPA Region 5 ESL
Copper	4.24E-03	5.65E-04	3.00E+01	3.00E+01	3.00E+01	8.00E+01	EPA ECO-SSL Invertebrates
Manganese	1.62E-02	2.16E-03	**1.90E+02**	**1.90E+02**	**1.90E+02**	1.00E+02	Lowest RAIS Value
Mercury	2.54E-02	3.39E-03	8.00E-02	**1.05E-01**	8.34E-02	1.00E-01	EPA Region 5 ESL
Molybdenum	5.48E-03	7.31E-04	1.20E+00	1.20E+00	1.21E+00	2.00E+00	Lowest RAIS Value
Nickel	1.05E-02	1.40E-03	**1.60E+01**	**1.60E+01**	**1.60E+01**	1.36E+01	EPA Region 5 ESL
Selenium	1.20E-04	1.60E-05	**6.00E-01**	**6.00E-01**	**6.00E-01**	2.76E-02	EPA Region 5 ESL
Vanadium	1.15E-02	1.53E-03	**1.09E+01**	**1.09E+01**	**1.09E+01**	1.59E+00	EPA Region 5 ESL
Zinc	1.45E-01	1.93E-02	**1.20E+02**	**1.20E+02**	**1.20E+02**	6.62E+00	EPA Region 5 ESL
2-Methylnaphthalene	1.79E-04	2.38E-05				3.24E+00	EPA Region 5 ESL
3-Methylcholanthrene	1.34E-05	1.79E-06				7.79E-02	EPA Region 5 ESL
7,12-Dimethylbenz(a)anthracene	1.19E-04	1.59E-05				1.63E+01	EPA Region 5 ESL
Acenaphthene	8.08E-04	1.08E-04				6.82E+02	EPA Region 5 ESL
Acenaphthylene	3.53E-03	4.71E-04				6.82E+02	EPA Region 5 ESL
Anthracene	1.71E-02	2.28E-03				1.48E+03	EPA Region 5 ESL
Benzo(a)anthracene	1.71E-02	2.28E-03				5.21E+00	EPA Region 5 ESL
Benzo(a)pyrene	4.00E-03	5.34E-04				1.52E+00	EPA Region 5 ESL

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Table 7 Comparison of projected worst-case increases in soil concentrations to background and ecological benchmarks
Values that exceed benchmarks indicated in **boldface**

Pollutant	All values in mg/kg						
	Predicted worst-case increment in soil [A]		Background (Table 8) [B]	Some of facility increment plus background		Ecological screening benchmark	Source of ecological benchmark
	2 cm deposition layer	15 cm root zone layer		2 cm deposition layer	15 cm root zone layer		
Benzo(b)fluoranthene	1.71E-02	2.28E-03				5.98E+01	EPA Region 5 ESL
Benzo(g,h,i)perylene	2.72E-04	3.63E-05				1.19E+02	EPA Region 5 ESL
Benzo(k)fluoranthene	1.71E-02	2.28E-03				1.48E+02	EPA Region 5 ESL
Chrysene	1.91E-03	2.55E-04				4.73E+00	EPA Region 5 ESL
Dibenzo(a,h)anthracene	1.71E-02	2.28E-03				1.84E+01	EPA Region 5 ESL
Fluoranthene	7.64E-03	1.02E-03				1.22E+02	EPA Region 5 ESL
Fluorene	1.34E-01	1.78E-02				1.22E+02	EPA Region 5 ESL
Indeno(1,2,3-cd)pyrene	1.71E-02	2.28E-03				1.09E+02	EPA Region 5 ESL
Phenanthrene	6.74E-03	8.99E-04				4.57E+01	EPA Region 5 ESL
Pyrene	9.02E-04	1.20E-04				7.85E+01	EPA Region 5 ESL

Notes:

A Concentrations in soil are predicted using Equations 1 and 2 using the maximum ground-level concentrations in air provided in Table 2 and model parameters described in the text, including the following deposition velocities (v_{HAP}):

- metals (except hexavalent chromium and mercury): v_{HAP} = 0.02 cm/s;
- PAHs: v_{HAP} = 0.03 cm/s;
- hexavalent chromium: v_{HAP} = 0.025 cm/s;
- mercury: v_{HAP} = 0.3 cm/s.

B Blank values indicate that no representative background values were identified. PAHs are often found in urban soils at low levels (of the order of 1 ppm)

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Table 8 Representative background concentrations of metals in soils (all values in mg/kg)

Pollutant	DEQ Soil Study [A]	ECO-SSL database [B]	Rouge River Watershed [C]			Other	Representative Background Concentration	Notes
			Residential	Commercial	Industrial			
Arsenic	3.8	4.2	6.3	5.1	7		5.1	E
Barium	38	127.3	128	69	148		69	E
Beryllium	< 2	0.7					0.7	F
Cadmium	< 0.5	0.9	1.1	2.2	4.5		1.1	E
Chromium	10	13.8	31	27	55		27	E
Cobalt	< 5	4.6					4.6	F
Copper	10	11.8	30	32	113		30	E
Manganese	190	229.4					190	G
Mercury	< 0.1		0.08	0.2	0.2		0.08	E
Molybdenum	< 5					1.2 [D]	1.2	H
Nickel	11	11.7	24	16	58		16	E
Selenium	< 0.5	0.3	0.8	0.6	1.9		0.6	E
Vanadium	10.9	43.8					10.9	G
Zinc	32	32.9	120	130	257		120	E

Notes:

A Median values reported in the *Michigan Background Soil Survey 2005*, Michigan Department of Environmental Quality. Available at: http://www.deq.state.mi.us/documents/deq-whm-hw-Michigan-Background-Soil-revJuly2005.pdf

B Mean values reported in the U.S. EPA's ECO-SSL database, as derived from Michigan-specific data. Available at: http://www.epa.gov/ecotox/ecossl/pdf/ecossl_attachment_4-1_all_ref_data_compiled.xls

C Mean values reported for a study in the Rouge River Watershed at locations near the MPC refinery. Reference: K.S. Murray, D.T. Rogers, and M.M. Kaufman, Heavy Metals in an Urban Watershed in Southeastern Michigan, *J. Environ. Qual.* **33**:163–172 (2004). Available on-line at: http://jeq.scijournals.org/cgi/content/abstract/33/1/163

D Average concentration measured in seven Illinois surface soil samples in a recent nationwide transect crossing southern Illinois – see http://pubs.usgs.gov/of/2005/1253/pdf/OFR1253.pdf (Open file report 2005-1253, *Major- and Trace-Element Concentrations in Soils from Two Continental-Scale Transects of the United States and Canada*, U.S. Geological Survey)

E Value selected as the lowest average found in the three categories of soils in the local River Rouge study

F Value from the ECO-SSL database selected in preference to the detection-limit based value of the DEQ 2005 soil study

G Lower median value selected in preference to higher average

H Value for IL soils selected due to improved detection limits of recent U.S. Geological Survey study

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Table 9 Estimates of Metal Concentrations in Plant Tissue Compared with Benchmarks [A]

Air Pollutant	Worst-case modeled concentration in root-zone soil (mg/kg) [B] $C_{HAPsoil}$	Plant to Soil Concentration Ratio [A] $R_{PlantSoil}$	Worst-case modeled concentration in plant tissue (mg/kg) [C] $C_{HAPplant}$	Plant tissue benchmark concentrations (mg/kg) based on protection of:	
				Plants [A]	Animals [A,D]
Arsenic	1.33E-04	1.40E-01	1.86E-05	2.50E-01	3.00E+00
Cadmium	7.31E-04	5.30E+00	3.88E-03	3.00E+00	1.50E+01
Chromium (total)	9.31E-04	2.00E-02	1.86E-05	1.00E+00	Not Available
Cobalt	5.58E-05	1.10E-01	6.14E-06	1.90E+01	1.00E+00
Copper	5.65E-04	4.70E-01	2.66E-04	7.30E-01	2.00E+01
Manganese	2.16E-03	6.60E-02	1.43E-04	4.00E+02	5.00E+02
Nickel	1.40E-03	4.50E-02	6.28E-05	6.00E+01	1.00E+03
Selenium	1.60E-05	1.00E+00	1.60E-05	1.00E+02	5.00E+00
Vanadium	1.53E-03	1.00E-02	1.53E-05	Not Available	1.00E+01
Zinc	1.93E-02	6.40E-01	1.23E-02	3.00E+02	5.00E+02

Notes:

A Method and values from U.S. EPA (1980), *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals*, EPA 450/2-81-078

B See third column of Table 7

C Predicted by Equation 4

D Values represent the lower end of ranges (where provided)

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Table 10 Comparison of Bounding-Level Impacts in Surface Water to Benchmarks

Air Pollutant	Worst-case modeled impact to surface water (µg/l) [A]	Ecological benchmark for surface water [B]		Ratio of benchmark to worst-case projected impact
		Value (µg/l)	Source	
Metals and organics				
Arsenic	9.38E-06	1.50E+02	Rule 57 FCV	1.60E+07
Barium	2.06E-04	4.33E+02	Rule 57 FCV	2.10E+06
Beryllium	5.63E-07	2.33E+00	Rule 57 FCV	4.15E+06
Cadmium	5.16E-05	2.22E+00	Rule 57 FCV	4.31E+04
Chromium (total)	6.57E-05	7.35E+01	Rule 57 FCV	1.12E+06
Chromium (hexavalent)	2.83E-06	1.10E+01	Rule 57 FCV	3.89E+06
Cobalt	3.94E-06	1.00E+02	Rule 57 FCV	2.54E+07
Copper	3.99E-05	8.88E+00	Rule 57 FCV	2.23E+05
Manganese	2.83E-04	1.91E+03	Rule 57 FCV	6.76E+06
Mercury	1.95E-05	7.70E-01	Rule 57 FCV	3.95E+04
Molybdenum	5.16E-05	3.20E+03	Rule 57 FCV	6.20E+07
Nickel	9.93E-05	5.16E+01	Rule 57 FCV	5.19E+05
Selenium	1.13E-06	5.00E+00	Rule 57 FCV	4.44E+06
Vanadium	1.08E-04	1.20E+01	Rule 57 FCV	1.11E+05
Zinc	1.36E-03	1.17E+02	Rule 57 FCV	8.61E+04
Ammonia	9.38E-06	2.90E+01	Rule 57 FCV	1.93E+02
Polycyclic aromatic hydrocarbons (PAHs)				
2-Methylnaphthalene	1.11E-06	3.30E+02	EPA R5 ESL	2.97E+08
3-Methylcholanthrene	8.33E-08	8.91E-02	EPA R5 ESL	1.07E+06
7,12-Dimethylbenz(a)anthracene	7.41E-07	5.48E-01	EPA R5 ESL	7.40E+05
Acenaphthene	1.53E-07	3.80E+01	Rule 57 FCV	2.48E+08
Acenaphthylene	3.92E-07	4.84E+03	EPA R5 ESL	1.23E+10
Anthracene	1.61E-06	3.50E-02	EPA R5 ESL	2.17E+04
Benz(a)anthracene	1.58E-06	2.50E-02	EPA R5 ESL	1.58E+04
Benzo(a)pyrene	4.53E-05	1.40E-02	EPA R5 ESL	3.09E+02
Benzo(b)fluoranthene	1.58E-06	9.07E+00	EPA R5 ESL	5.72E+06
Benzo(ghi)perylene	7.87E-08	7.64E+00	EPA R5 ESL	9.71E+07
Benzo(k)fluoranthene	1.58E-06			
Chrysene	1.78E-05	7.00E+00	Lowest RAIS	3.93E+05
Dibenz(ah)anthracene	1.56E-06	4.00E+00	EPA R5 ESL	2.57E+06

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Table 10 Comparison of Bounding-Level Impacts in Surface Water to Benchmarks

Air Pollutant	Worst-case modeled impact to surface water (µg/l) [A]	Ecological benchmark for surface water [B]		Ratio of benchmark to worst-case projected impact
		Value (µg/l)	Source	
Fluoranthene	8.40E-05	1.60E+00	Rule 57 FCV	1.91E+04
Fluorene	1.17E-05	1.20E+01	Rule 57 FCV	1.03E+06
Indeno(1,2,3-cd)pyrene	1.58E-06	4.31E+00	EPA R5 ESL	2.72E+06
Phenanthrene	1.37E-06	1.40E+00	Rule 57 FCV	1.02E+06
Pyrene	3.07E-07	3.00E-01	EPA R5 ESL	9.76E+05
Volatile organic compounds (VOCs)				
1,3-Butadiene	1.49E-05			
Acetaldehyde	5.24E-04	1.30E+02	Rule 57 FCV	2.48E+05
Acrolein	2.87E-04	1.90E-01	EPA R5 ESL	6.62E+02
Benzene	1.86E-02	2.00E+02	Rule 57 FCV	1.07E+04
Butane	9.72E-02			
Dichlorobenzene	5.56E-05	1.70E+01	Rule 57 FCV	3.06E+05
Formaldehyde	5.88E-03	1.20E+02	Rule 57 FCV	2.04E+04
Hexane	8.33E-02	5.80E-01	Lowest RAIS	6.96E+00
Naphthalene	7.63E-05	1.30E+01	Rule 57 FCV	1.70E+05
Pentane	1.20E-01			
Phenol	1.73E-04	4.50E+02	Rule 57 FCV	2.60E+06
Propylene	1.44E-04	5.00E+05	Lowest RAIS	
Toluene	3.15E-02	2.70E+02	Rule 57 FCV	8.57E+03
Xylenes	1.03E-05	4.10E+01	Rule 57 FCV	3.99E+06

Notes:

A Screening level estimate is derived by assuming that all of plume emissions mix into the Detroit River (known location of the Northern riffleshelll)

B Benchmarks are selected to the following hierarchy:

1. Michigan Department of Environmental Quality Rule 57 Water Quality Values for surface water benchmarks (http://www.michigan.gov/documents/deq/wb-swas-rule57_210455_7.xls), with hardness dependent values based on an average hardness of 99 mg/l per data from EPA's STORET database for locations in the Detroit River (indicated as "Rule 57 FCV")
2. U.S. EPA Region 5, RCRA Ecological Screening Levels (ESLs) for surface water, available at http://www.epa.gov/reg5rcra/ca/edql.htm (indicated as "EPA R5 ESL")
3. Lowest surface water screening benchmark available from the Oak Ridge National Laboratory's Risk Assessment Information System (RAIS), available at http://rais.ornl.gov/ (indicated as "Lowest RAIS")

Blank values indicate that no benchmark value was identified

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Table 11 Comparison of projected worst-case increases in surface water to background and ecological benchmarks

Pollutant	All values in µg/l				
	Predicted worst-case increment in surface water [A]	Background measured in Detroit River [B]	Some of facility increment plus background	Ecological screening benchmark [A]	Source of ecological benchmark
Cadmium	5.16E-05	9.12E-03	9.17E-03	2.22E+00	Rule 57 FCV
Chromium	6.57E-05	4.44E-01	4.44E-01	7.35E+01	Rule 57 FCV
Copper	3.99E-05	8.32E-01	8.32E-01	8.88E+00	Rule 57 FCV
Mercury	1.95E-05	6.55E-03	6.57E-03	7.70E-01	Rule 57 FCV
Nickel	9.93E-05	1.21E+00	1.21E+00	5.16E+01	Rule 57 FCV
Zinc	1.36E-03	1.49E+00	1.49E+00	1.17E+02	Rule 57 FCV

Notes:

A See Table 10

B Background data downloaded from the U.S. EPA's modern STORET database (http://www.epa.gov/storet). Average concentrations of 53 to 55 samples collected from 1998 to 2005 by the Michigan Department of Environmental Quality are presented for a Detroit River sampling station located slightly more than a mile upstream of Belle Isle (habitat area to the Northern riffleshell).

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Table 12 Comparison of Bounding-Level Impacts in Sediment to Benchmarks

Air Pollutant	Worst-case modeled impact to sediment (mg/kg) [A]	Ecological benchmark for sediment [B]		Ratio of benchmark to worst-case projected impact
		Value (mg/kg)	Source	
Metals and organics				
Arsenic	9.72E-04	9.79E+00	EPA R5 ESL	1.01E+04
Barium	2.14E-02			
Beryllium	5.83E-05			
Cadmium	5.34E-03	9.90E-01	EPA R5 ESL	1.85E+02
Chromium (total)	6.80E-03	4.34E+01	EPA R5 ESL	6.38E+03
Chromium (hexavalent)	2.93E-04			
Cobalt	4.08E-04	5.00E+01	EPA R5 ESL	1.23E+05
Copper	4.13E-03	3.16E+01	EPA R5 ESL	7.65E+03
Manganese	2.93E-02	4.60E+02	Lowest RAIS	1.57E+04
Mercury	2.02E-03	1.74E-01	EPA R5 ESL	8.61E+01
Molybdenum	5.34E-03			
Nickel	1.03E-02	2.27E+01	EPA R5 ESL	2.21E+03
Selenium	1.17E-04			
Vanadium	1.12E-02			
Zinc	1.41E-01	1.21E+02	EPA R5 ESL	8.59E+02
Ammonia	9.72E-04	9.79E+00	EPA R5 ESL	1.01E+04
Polycyclic aromatic hydrocarbons (PAHs)				
2-Methylnaphthalene	1.15E-04	2.02E-02	EPA R5 ESL	1.75E+02
3-Methylcholanthrene	8.63E-06	8.19E+03	EPA R5 ESL	9.49E+08
7,12-Dimethylbenz(a)anthracene	7.67E-05	6.64E+01	EPA R5 ESL	8.65E+05
Acenaphthene	1.59E-05	6.71E-03	EPA R5 ESL	4.23E+02
Acenaphthylene	4.06E-05	5.87E-03	EPA R5 ESL	1.45E+02
Anthracene	1.67E-04	5.72E-02	EPA R5 ESL	3.43E+02
Benz(a)anthracene	1.64E-04	1.08E-01	EPA R5 ESL	6.58E+02
Benzo(a)pyrene	4.69E-03	1.50E-01	EPA R5 ESL	3.20E+01
Benzo(b)fluoranthene	1.64E-04	1.04E+01	EPA R5 ESL	6.34E+04
Benzo(ghi)perylene	8.15E-06	1.70E-01	EPA R5 ESL	2.09E+04
Benzo[k]fluoranthene	1.64E-04	2.40E-01	EPA R5 ESL	1.46E+03
Chrysene	1.84E-03	1.66E-01	EPA R5 ESL	9.00E+01
Dibenz(ah)anthracene	1.61E-04	4.49E-01	EPA R5 ESL	2.78E+03
Fluoranthene	8.70E-03	4.23E-01	EPA R5 ESL	4.86E+01

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Table 12 Comparison of Bounding-Level Impacts in Sediment to Benchmarks

Air Pollutant	Worst-case modeled impact to sediment (mg/kg) [A]	Ecological benchmark for sediment [B]		Ratio of benchmark to worst-case projected impact
		Value (mg/kg)	Source	
Fluorene	1.21E-03	7.74E-02	EPA R5 ESL	6.40E+01
Indeno(1,2,3-cd)pyrene	1.64E-04	2.00E-01	EPA R5 ESL	1.22E+03
Phenanthrene	1.42E-04	2.04E-01	EPA R5 ESL	1.44E+03
Pyrene	3.18E-05	1.95E-01	EPA R5 ESL	6.12E+03

Notes:

A Screening level estimate is derived by assuming that pollutant concentrations in sediment are derived from suspended solids that incorporate the entire amount of projected emission increases from the MPC refinery

B Benchmarks are selected to the following hierarchy:

1. U.S. EPA Region 5, RCRA Ecological Screening Levels (ESLs) for surface water, available at http://www.epa.gov/reg5rcra/ca/edql.htm (indicated as "EPA R5 ESL")
2. Lowest surface water screening benchmark available from the Oak Ridge National Laboratory's Risk Assessment Information System (RAIS), available at http://rais.ornl.gov/ (indicated as "Lowest RAIS")

Blank values indicate that no benchmark value was identified

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Attachment A

Recommended Scope of Analysis
for Endangered Species Evaluation

Provided to:

Marathon Petroleum Company LLC

Provided by:

U.S. EPA Region 5

Cambridge Environmental Inc
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Recommended Scope of Analysis
for Endangered Species Evaluation
Marathon Petroleum Company LLC

September 6, 2007

Purpose of analysis:

The analysis is intended to determine whether the proposed modifications to the Marathon Petroleum Company LLC (Marathon) refinery complex located in Detroit, Michigan are likely to directly or indirectly adversely affect federally listed species. This recommended scope of analysis or roadmap recommends using USEPA's ecological risk assessment process to inform the decision points in section 7 of the Endangered Species Act. Portions of the USEPA's draft Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 530-D-99-001A) provides useful guidance for this analysis. Although this guidance was designed specifically to assess the impact of hazardous waste combustion facilities, it offers general approaches for assessing the fate of chemicals released to the air that can be applied to all types of industrial facilities.

Overall, the evaluation should focus on increased emissions from the facility. To complete this analysis we need an understanding of the background concentrations and deposition patterns. The anticipated emissions from permitted but not yet operational facilities should be included in background. The anticipated concentration in air or deposition at sites supporting listed species should be compared against NOEL (No observed effects level) benchmarks thought to be protective of the appropriate group (e.g., plants). The evaluation should look at the incremental addition in the context of background concentrations.

Benchmarks:

For these analyses, commonly accepted NOEL (no observed effects levels) benchmarks should be used. Where more than one benchmark can be found the most conservative value should be used, unless an explanation is given to justify a less conservative benchmark. When there is no commonly accepted benchmark, there should be a search of the scientific literature for relevant toxicity information to provide a basis for risk assessment for the species of concern.

Modeling protocol:

Modeling should follow the general guidance provided in Chapter 3 of USEPA's SLERA protocol for assessing chemical fate and transport. The modeling should show air concentrations and deposition rates for all pollutants (where appropriate). The air emissions resulting from the project should be modeled at the facility level, not on a unit basis. Total impacts should be evaluated looking at the combined effects of the vapor phase, particle phase and particle-bound phase of pollutants. AERMOD is an acceptable

model for this analysis. For chemicals amenable to deposition, models in the SLERA guidance should be used to estimate concentrations in soil, sediment and surface water in conjunction with relevant fate and transport parameters.

Assessment Area:

For the chemicals amenable to deposition, the majority should deposit within a 3 km radius of the facility. We recommend using the maximum deposition value within that 3 km radius in performing the analysis.

Background Levels:

Background levels of pollutants of concern should be located for soil, water and sediment. If actual values cannot be located, representative values may be used.

Suite of pollutants to consider:

The assessment should cover all air pollutants emitted from the facility including ozone, sulfur compounds, oxides of nitrogen, carbon monoxide, particulates, and hazardous air pollutants. USEPA will provide the analysis for ozone for this project.

Types of impact to consider:

1. Short term, depending on pollutant compare worst 1 hr, 8 hr, and 24 hr. concentration in air with appropriate bench marks for acute effects. A discussion of each pathway should be included with an explanation of which is considered most sensitive. This includes, but is not limited to, impact to physical structures, cuticle uptake, stomatal uptake, root uptake, and particulate clogging of stomates for plant species. For the bald eagle and the Inidana bat determine the exposure to via food sources that would be taking up contaminants through soil, water and sediment.
2. Long term, depending upon pollutant compare worst 1 yr of 5 concentration in air or deposition on soil with appropriate bench marks for chronic effects.
3. For compounds that may accumulate, evaluate estimated total deposition over life of project. These concentrations should be compared against benchmarks.

Listed Species:

The following species may occur within a short distance of the facility:

1. Indiana Bat (*Myotis sodalist*): can occur in caves, mines and forage in small stream corridors with well developed riparian woods and upland forests.
2. Eastern Prairie Fringed Orchid (*Platanthera leucophaea*): can occur in Mesic to wet prairies.
3.. Northern riffleshell (*Dysnomia torulosa rangiana*): Large streams and small rivers in firm sand of riffle areas.

Marathon may rely on GIS data to exclude certain species from the analysis. The eastern prairie fringed orchid would most likely be associated with wet meadows or wet prairies not in a stream or river floodplain; however, it may also occur on mesic prairie habitat. We suggest using the National Wetlands Inventory (NWI) and the Land Use and Land Cover map to determine if suitable habitat is present. The NWI code that best illustrates the wet prairie habitat would be the PEM series outside of the 100 year floodplain. On the Land Use and Land Cover maps, look for nonagricultural grassland. For the Indiana Bat, look for grassy field, stream corridors and forested, non-developed areas. If there are none, then the Indiana Bat may be excluded. Consider the area within a 15 km radius of the facility.

Literature Search:

Conduct a literature search for the issues related to the effects of air pollutants on the listed species, on species within the same genus, and on species within the same family. Pair these terms with appropriate air pollution related key words such as the following: air pollution, power plant emissions, nitrogen deposition, sulfur deposition, particulate matter, phyto-toxicity, hazardous air pollutants, etc. Document the data bases, search terms, and results. This task may add on to the results already obtained for previous consultations. The source of all factual statements should be clearly indicated.