



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

APR 10 2007

REPLY TO THE ATTENTION OF:
(AR-18J)

Richard Nelson, Field Supervisor
Rock Island Illinois Field Office
United States Fish and Wildlife Service
4469 48th Avenue Court
Rock Island, Illinois 61201

Dear Mr. Nelson:

Pursuant to Section 7 of the Endangered Species Act (ESA), (87 Stat. 884, as amended; 16 U.S. C. 1531 et seq.), the United States Environmental Protection Agency (U.S. EPA) has reviewed the biological information and analysis related to a Prevention of Significant Deterioration (PSD) permit for the Archer Daniels Midland (ADM) Company's Decatur, Illinois, Glycols Plant to determine what impact there may be to any threatened or endangered species in the area around the proposed facility. The purpose of this letter is to seek concurrence from the United States Fish and Wildlife Service (U.S. FWS) on our determination that the proposed project is not likely to adversely affect any federally listed species in relation to the proposed air quality permit for this facility.

The parties utilized the informal consultation process as specified in the "Endangered Species Consultation Handbook, procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act, (March 1998 final)," by the U.S. FWS and National Marine Fisheries Service. The U.S. EPA prepared this biological assessment following the guidance provided in the ESA consultation handbook, as well as the recommended content suggested in the ESA regulations found in 50 CFR Part 402.12(f). As part of developing the biological evaluation, U.S. EPA prepared a document, "Recommended Scope of Analysis for Endangered Species Evaluation Archer Daniel Midland Company, Decatur, Illinois – Glycols Plant," dated December 20, 2006, which described the general topics of need, species of concern, effects analysis, and literature search, needed in the biological assessment. ADM provided two documents, one dated February 16, 2007, and one dated March 15, 2007, which contained the project impact analysis.

Project Description

ADM plans to install a new Glycols production plant at its Decatur, Illinois facility. The plant will process byproduct glycerol and/or sorbitol into higher value products and byproducts. The plant will reuse much of the existing equipment at ADM's Vitamin C plant; however, the project may include installation of up to 4 new natural gas fired combustion sources. Increases in criteria air pollutants are predicted as follows:

Particulate Matter (PM)	30.6 tons per year
Particulate Matter less than 10 microns in aerodynamic diameter (PM10)	28.4 tons per year
Nitrogen Oxides (NOx)	316.8 tons per year
Sulfur Dioxide (SO ₂)	565.2 tons per year
Carbon Monoxide (CO)	102.8 tons per year
Volatile Organic Compounds (VOC)	86.2 tons per year

The project may also result in the release of several VOC and PM Hazardous Air Pollutants (HAPs) as outlined in the February 16, 2007, impacts assessment document which has been included as Enclosure 2 to this letter.

Action Area

ADM's Decatur Complex is located in central Illinois in Macon County. Based on the land use/land cover map for the area, which has been included as Enclosure 1, the area surrounding the facility is predominantly agricultural with some residential, commercial and industrial areas. There are also some deciduous forest lands and reservoirs in the vicinity of the facility.

List of Species

There are four listed species potentially occurring in Macon County. These species include:

- Indiana bat (*Myotis sodalist*);
- Bald eagle (*Haliaeetus leucocephalus*);
- Eastern prairie fringed orchid (*Platanthera leucophaea*); and
- Prairie bush clover (*Lespedeza leptostachya*).

After review of the land use/land-cover data and consultation with U.S. FWS, U.S. EPA has concluded that the only species potentially affected by the project are the Indiana bat and the bald eagle.

Summary of Analysis

Cambridge Environmental, Inc. performed modeling for emissions associated with the planned project. Maximum ambient air concentrations were estimated using the AERMOD model. In order to narrow the list of chemicals of potential concern (COPCs), contaminant concentrations resulting from the proposed increase were compared to ambient background concentrations. Contaminants that contributed less than 2% of background were initially eliminated from further review. The remaining 10 contaminants were considered to be COPCs and further analysis was performed. Soil modeling for most of the COPCs were estimated using a simple mixing model that assumed pollutants deposit from the atmosphere over a thirty year period and remain with a shallow layer of soil near the surface. The fugacity modeling approach developed by

the Canadian Environmental Modelling Centre was used to estimate potential concentration of dimethyl sulfate, ethylene glycol, and methanol. Surface water concentrations were estimated using a screening-level model to estimate worst-case concentrations assuming that all stack emissions are mixed within Lake Decatur, the most significant surface water feature near the ADM facility. Sediment concentrations were estimated assuming that all stack emissions deposit within Lake Decatur and remain in the bottom sediment. Soil concentrations were estimated using a simple mixing model that assumed that hazardous air pollutants deposit from the atmosphere over a period of thirty years of facility operation and remain within a shallow layer near the surface. A more detailed discussion of the modeling performed can be found in the impact analysis which has been included as Enclosure 2 to this letter. In a meeting on March 1, 2007, U.S. FWS requested additional analysis on four contaminants that were contributed less than 2% of ambient background. These contaminants are chromium, lead, mercury, and polychlorinated dibenzo(p)dioxins and furans. ADM provided the results of this analysis in a document dated March 15, 2007, which has been included as Enclosure 3.

ESA Effects Analysis

Model results for all COPCs are provided as Enclosures 2 and 3. Enclosure 4 provides tables showing project contribution, background, benchmarks and hazard quotients for each contaminant with respect to soil, water and sediment. The benchmarks used in this analysis were taken from U.S. EPA Region 5's, Resource Conservation and Recovery Act Ecological Screening Levels (<http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf>) for most contaminants. The U.S. EPA Ecological Soil Screening Levels (<http://www.epa.gov/ecotox/ecossl>) for mammalian insectivores were used for lead and chromium.

Criteria Pollutants

Ozone: The project will result in a small increase in VOC emissions of 86.2 tons per year. At the current time, U.S. EPA is unaware of any reliable means to assess ozone changes through "point source" modeling. Although point source screening models have been developed, they have not been consistently applied with success for source changes of this small magnitude. Such screening models were developed for much larger VOC and NO_x sources and/or emissions changes. Urban scale photochemical ozone models, such as the Urban Airshed Model, could be employed to assess the ambient impact of emission increases as well as emission decreases resulting from the implementation of emissions control programs. Past experience, however, with such models indicates that a VOC change of 86.2 tons per year would not produce a predicted change in ozone concentrations. The Urban Airshed Model, for example, has been shown to be relatively insensitive to changes in VOC emissions. Past modeling results considering VOC emissions changes on the order of hundreds to several thousand tons per year of VOC in major urban areas have shown only modest decreases in predicted peak ozone concentrations. Therefore, it is concluded that such models would likely show a zero ozone change for a VOC increase of 86.2 tons per year. Stated another way, based on the best available tools and information that exist today, one would not expect any measurable change in ambient ozone concentrations due to the Project's projected worst

case VOC emissions increase of 86.2 tons per year. Based on this information, U.S. EPA concludes the project will have no measurable effect, if not no effect, on the endangered species with respect to ozone. At a minimum, the project is not likely to adversely effect the endangered species as no measurable change in ozone will result from the project.

SO₂ and NO_x: The projected increase in emissions for SO₂ is 565.2 tons per year. The projected increase in NO_x emissions is 316.8 tons per year. The project increases will not cause an exceedence of the primary or secondary National Ambient Air Quality Standards (NAAQS), which are assumed to be protective of both species potentially affected by this project.

PM/PM10: The project will result in an increase in PM emissions of 30.6 tons per year, of which 28.4 tons per year consist of PM10. The portion of PM/PM10 emissions of concern for the potentially affected species would be the hazardous air pollutant (HAP) component.

Lead: A small increase of lead emissions is projected for this project. While lead was not identified as a COPC using the 2% of ambient background concentration screen, ADM agreed to provide additional modeling for this pollutant. The additional analysis shows a potential concern when the sum of project contribution and background is compared to the benchmark value for surface water. Testing performed at nearby water sources showed the average levels of lead to be below the detection limit of 5 µg/l; therefore, when calculating the hazard quotient for lead, U.S. EPA assumed the background concentration was 5 µg/l, which is greater than the benchmark for this pollutant. The estimated contribution of the project alone is 0.78% of the assumed background and 3.33% of the benchmark. Due to the small contribution of the project in comparison to both background and benchmark, U.S. EPA finds that the project is not likely to adversely impact a species of concern with respect to emissions of lead.

CO: All modeled increases are below the significant impact levels. In addition, modeling performed for the PSD permit shows compliance with the primary and secondary NAAQS. USEPA believes that compliance with the NAAQS would be protective of the listed species.

Hazardous Air Pollutants

The modeling performed for this analysis is very conservative, and likely over-predicts some impacts by several orders of magnitude. U.S. EPA has reviewed the explanation of modeled results provided by Cambridge Environmental in it's analysis in the section titled "Screening-level Ecotoxicity Hazard Ratios." Based on this information, U.S. EPA does not believe that an adverse impact is likely to occur based on the emissions from the project.

The modeling performed by Cambridge Environmental shows a hazard quotient greater than 1 for magnesium, vanadium, zinc and mercury. All pollutants with a hazard quotient less than one are assumed to not likely adversely impact either of the species of concern in this area.

Magnesium: A hazard quotient of 39.6 was predicted for water impacts with respect to this pollutant. This is due to the high level of magnesium in background. The project contribution of magnesium is approximately 0.004% of background and 0.15% of the benchmark for this pollutant. The project impacts are insignificant in comparison to existing background. It would not likely be possible to measure or detect any negative response to an endangered species in response to the project contribution.

Vanadium: Modeling predicted a hazard quotient for soil of 3.23 for vanadium. The background value used for this pollutant exceeds the benchmark. The project contribution is approximately 0.12% of background and 0.34% of the benchmark. The project impacts are insignificant in comparison to existing background. It would not likely be possible to measure or detect any negative response to an endangered species in response to the project contribution.

Zinc: Modeling predicted a hazard quotient for soil of 1.44 for zinc. The background value alone exceeds the benchmark for this contaminant. The project contribution of zinc is approximately 0.36% of background and 5.1% of the benchmark. The project impacts are insignificant in comparison to existing background. It would not likely be possible to measure or detect any negative response to an endangered species in response to the project contribution.

Mercury: Like lead, the project impacts of mercury were initially excluded from review based upon the 2% of ambient background screening. At the request of U.S. FWS additional analysis was performed for this pollutant. This analysis shows a hazard quotient of 38.6 for water impacts. This is due to the background assumed. Test data of nearby water sources was on average below the detection limit of 0.05 µg/l. The background was assumed to be equal to the detection limit. Project contributions of mercury are approximately 0.36% of the assumed background and 14% of the benchmark. The project impacts are insignificant and it would not likely be possible to measure or detect any negative response to an endangered species in response to the project contribution.

ESA Determination

After reviewing the analysis provided by Cambridge Environmental, the pollutants with the greatest potential for adverse impact would include magnesium, vanadium, zinc, lead and mercury. However, due to the conservative assumptions made and the small contribution of these contaminants in comparison to existing background conditions, U.S. EPA has concluded that it would not likely be possible to measure or detect an adverse response as a result of the proposed project.

Considering this analysis in its entirety, U.S. EPA concludes that the proposed construction and operation of this facility may affect, but is not likely to adversely affect, any of the threatened and endangered species. U.S. EPA respectfully requests U.S. FWS concurrence on this determination.

Sincerely yours,

A handwritten signature in black ink that reads "Pamela Blakley". The signature is written in a cursive, flowing style.

Pamela Blakley, Chief
Air Permits Section

Enclosures

cc: Laurel Kroak, IEPA

Enclosures

1. Letter Dated October 23, 2006
2. Letter Dated February 16, 2007
3. Letter Dated March 15, 2007
4. Estimated Impact Tables



RTP

Environmental Associates, Inc.

304-A West Millbrook Road
Raleigh, North Carolina 27609
Tel: (919) 845-1422 Fax: (919) 845-1424

October 23, 2006

Ms. Rachel Rineheart
U.S. EPA Region 5
77 W. Jackson Blvd.
Chicago, IL 60604

Subject: **Land Use / Land Cover Near Archer Daniels Midland (ADM) Company's
Decatur , Illinois Complex**

Dear Ms. Rineheart:

As we discussed last week, RTP Environmental Associates, Inc. (RTP) has reviewed the potential for impacts on certain endangered species in proximity to ADM's Decatur Complex in conjunction with permitting the construction of a new glycols production plant within the existing fence-line of the Complex. Note that I have confirmed that all property within 3 kilometers of this facility is located within Macon County, Illinois. The endangered species of interest are the:

- Eastern prairie fringed orchid (EPFO);
- Prairie bush clover (PBC); and
- Indiana bat.

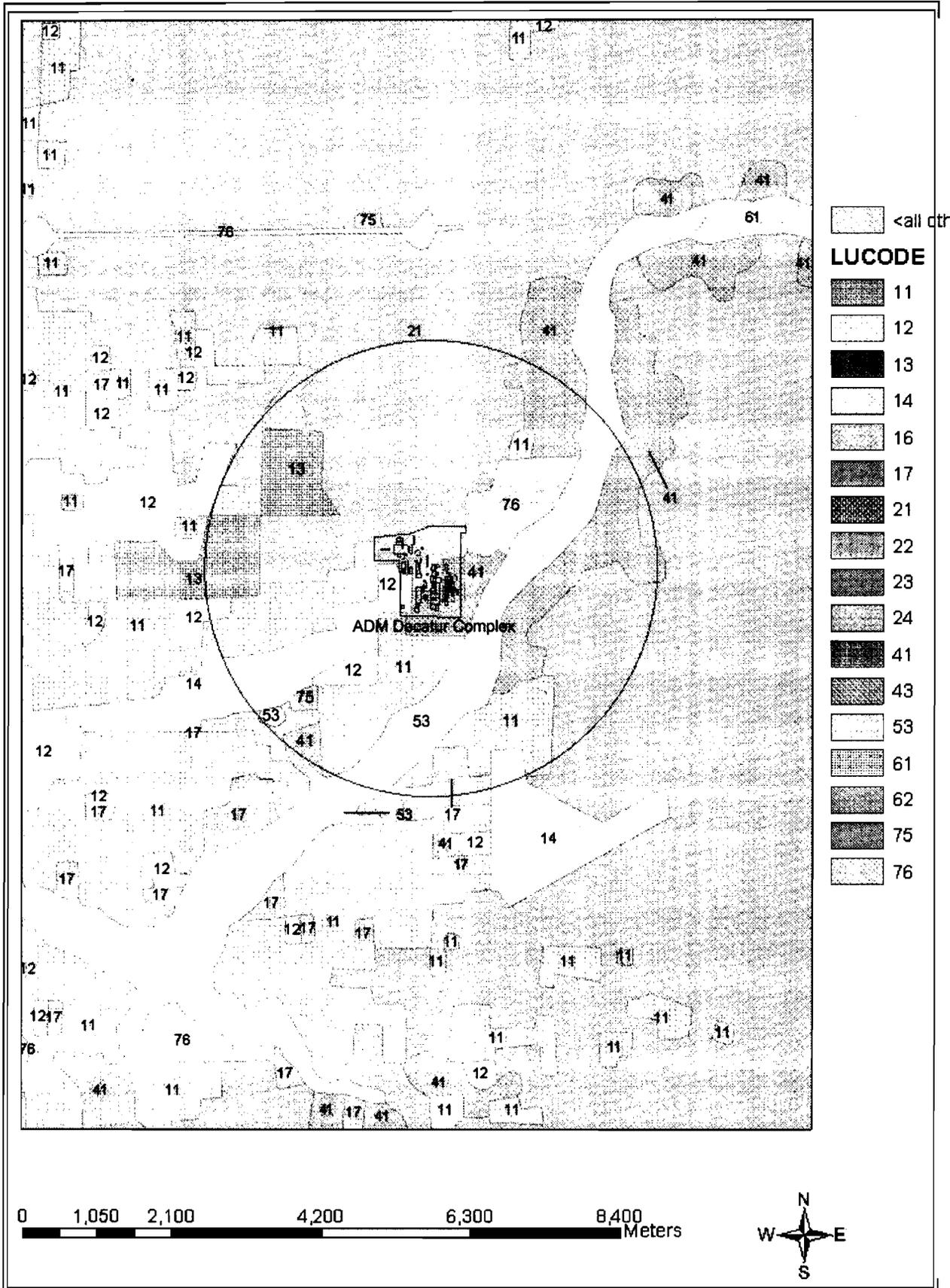
Based on RTP's review of the land use / land cover map for the area, the only species potentially affected by the project is the Indiana bat. This map is attached for your reference along with a listing of the land use types found in proximity of the plant. As this map shows, there are no suitable habitats for either the EPFO or the PBC in proximity to the complex. Due to the proximity of Lake Decatur and some forested land, it appears there may be some potential feeding areas for the Indiana Bat located near the complex.

As I understand the next step in this process, you will use the information in this letter to confer with the Fish and Wildlife Service. Should you have any questions on this information or on the project, please give me a call.

Sincerely,

A handwritten signature in black ink, appearing to read "Jack M. Burke", written in a cursive style.

Jack M. Burke



Land Use / Land Cover Map for the Area Surrounding ADM's Decatur Complex

LUCODE	DESCRIPTION
11:	Residential
12:	Commercial Services
13:	Industrial
14:	Transportation
16:	Mixed Urban or Built-up Land
17:	Other Urban or Built-up Land
21:	Croplands and Pasture
22:	Orchards, Groves, Vineyards, Nurseries
23:	Confined Feeding Operations
24:	Other Agricultural Land
41:	Deciduous Forest Land
43:	Mixed Forest Land
53:	Reservoirs
61:	Wetland
62:	Norforested Wetlands
75:	Strip Mines, Quarries, and Gravel Pits
76:	Transitional Areas*

* Note that the “Transitional Area” located just Northeast of the Decatur Complex is a golf course.



RTP
Environmental Associates, Inc.

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February 16, 2007

via email

Ms. Rachel Rineheart
U.S. Environmental Protection Agency
Region 5
77 W. Jackson Blvd.
Chicago, IL 60604

**Subject: Impacts Assessment Data for Archer Daniels Midland (ADM)
Company's Proposed Decatur, Illinois Glycols Plant**

Dear Ms. Rineheart:

Attached to this letter is a memorandum from Steve Zemba of Cambridge Environmental, Inc. This memo was prepared at my request to evaluate the impacts of emissions associated with Archer Daniels Midland (ADM) Company's proposed Glycols Production plant to be located on the grounds of ADM's existing complex in Decatur, Illinois. This document was prepared based on the procedures outlined in the "Roadmap" document provided by you on December 20th, 2006.

It is my hope that you will be able to review this document prior to our meeting on March 1st and my expectation that we can reach a consensus at that meeting on next steps, if any, that are required to finalize the ESA process for this facility. Please feel free to call me with any questions you may have on this information. Thanks in advance for your time and consideration of this matter. I look forward to our discussions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Jack M. Burke'.

Jack M. Burke, P.E.
Senior Project Manager

c: Mike Coffey, U.S. Fish and Wildlife Service
Staci Bogue-Buchholz, Archer Daniels Midland Company
Steve Zemba, Cambridge Environmental, Inc.

MEMORANDUM

To: Jack Burke – RTP Environmental Associates, Inc.
Staci Bogue-Buchholz – Archer Daniels Midland Company

From: Stephen G. Zemba, Ph.D., P.E. – Cambridge Environmental, Inc.

Subject: Ecological Consultation support for ADM's proposed Glycols production facility

Date: February 15, 2007

I write to provide the findings of a screening-level assessment of potential impacts to threatened and endangered wildlife species associated with the proposed construction of a Glycols Production Plant at the Archer Daniels Midland (ADM) facility in Decatur, Illinois. I have conducted some very conservative screening-level calculations that, even under extreme assumptions, indicate no potential adverse impacts should result from the increased emissions from the proposed Glycols plant.

The following text and tables describe my preliminary calculations.

Threatened and endangered species

U.S. EPA Region 5 provided a “roadmap” outline for the ecological consultation that identifies four federally-listed threatened and endangered species for Macon County, Illinois, in which ADM’s facility is located. These species are:

- Bald Eagle (*Haliaeetus leucocephalus*);
- Indiana Bat (*Myotis sodalists*);
- Eastern Prairie Fringed Orchid (*Platanthera leucophaea*); and
- Prairie Bush Clover (*Lespedeza leptostachya*).

RTP Environmental’s previous consideration of land use in the vicinity of ADM’s facility indicates no potentially suitable habitat for the two plant species. EPA Region 5 has agreed with RTP’s assessment. Hence, the Bald Eagle and Indiana Bat serve as the focus of my analysis.

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

I have built on the spreadsheet in which RTP provided estimates of facility emissions and air dispersion modeling results. I understand that the two main sources of potential pollutant emissions are the Glycols Production Plant and the increased consumption of fuels by existing equipment at the ADM facility to supply heat/energy to the proposed production process. All

Cambridge Environmental Inc

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relevant Hazardous Air Pollutant (HAP) emissions are considered. Emission rate estimates are based on the U.S. EPA's AP-42 emission factor methods, and the U.S. EPA's AERMOD model was used to predict the dispersion of pollutant emissions in ambient air. The spreadsheet estimates assume continuous emissions at full rates of production.¹ The modeled concentrations in air are the highest annual-average values (based on five year meteorological data set) predicted at any off-facility ground-level location within 3 km of the ADM's Decatur complex. As there are multiple emission sources, the locations of the maximum projected impacts for all pollutants do not necessarily coincide.

Table 1 provides estimates of the various HAP emission rates and projected worst-case annual average concentrations.² I have supplemented RTP's calculations to develop additional modeling estimates for polychlorinated dibenzo(p)dioxin and furan (PCDD/PCDF). The AP-42 emission factors for coal combustion (the potential source of PCDD/PCDF emissions) appear to have been developed prior to the now common treatment of PCDD/PCDF on a toxic equivalency (TEQ) basis, and hence do not reflect congener-specific test data. However, the U.S. EPA's dioxin reassessment work provides more recent and complete information on PCDD/PCDF emissions from coal combustion. These data are provided in Table 2 along with toxic equivalency (TEQ) weighting factors derived for ecological receptors. A total PCDD/PCDF TEQ emission factor is calculated as the summed products of the congener-specific emission factors and the receptor-specific TEQs. The highest overall TEQ emission factor of 0.273 ng TEQ/kg coal (5.45×10^{-10} lb/ton, estimated for birds) is used to derive the emission estimate of 7.64×10^{-9} lb PCDD/PCDF TEQ/hr in conjunction with the maximum coal consumption of 122,745 tons/year anticipated for capacity operation of the Glycols plant. The worst-case ambient PCDD/PCDF TEQ concentration of 7.57×10^{-12} $\mu\text{g}/\text{m}^3$ is estimated using a dispersion modeling transfer factor of 9.90×10^{-4} $\mu\text{g}/\text{m}^3$ per lb/hr for the coal-fired boiler emission source.

Ambient Air Background Screening

Pollutants can potentially affect ecological resources only if emissions are great enough to significantly change existing environmental conditions. For an air pollution source such as ADM's proposed Glycols Plant, the initial question of relevance is whether emissions will lead to substantial increases in the existing background concentrations of pollutants in ambient air. Table 1 compares the worst-case modeled concentrations of pollutants anticipated for Glycols Plant emissions to representative background concentrations taken from the U.S. EPA's 1999 National Air Toxics Assessment (NATA) and ambient sampling programs. Polycyclic aromatic hydrocarbons (PAHs) are grouped according to designations used in the NATA based on relative

¹ The emissions from increased utilization of existing equipment in ADM's Decatur facility are estimated based on the maximum demand placed on this equipment by the Glycols Plant operating at its full production rate.

² Table 1 also includes several chemicals that are not designated as Hazardous Air Pollutants (HAPs) for which the U.S. EPA provides emission factors in its AP-42 database.

toxicity (*e.g.*, the projected incremental concentrations of ten different PAHs in Group 2 are summed and compared to the NATA Group 2 PAH background concentration). Using a nominal cut off of a 2% increase as a level of insignificant increase to background eliminates most Chemicals of Potential Concern (COPC). Two classes of pollutants require further evaluation: (1) production-related chemicals for which incremental impacts to air are projected to be many times background (ethylene glycol and methanol); and (2) certain COPCs associated with coal combustion emissions (*i.e.*, barium, magnesium, molybdenum, vanadium, zinc, dimethyl sulfate, 7,12-dimethylbenz(a)anthracene, and 3-methylcholanthrene).

Soil, surface water, and sediment comparisons

The ten Chemicals of Potential Concern (COPCs) not eliminated through ambient air background screening are further evaluated with respect to potential impacts to environmental media assuming contaminant deposition from the atmosphere. Simple screening-level models are used to estimate worst-case pollutant concentrations that might result in soil, surface water, and sediment due to emissions from the proposed Glycols Plant. 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 facility emissions are compared to available background concentrations and screening-level ecological benchmarks.

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

- The Illinois Water Quality Criteria for aquatic life for surface water benchmarks (<http://www.ipcb.state.il.us/documents/dsweb/Get/Document-33354/>);
- 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 (see <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 ADM's Decatur complex.

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 thirty years of facility operation and remain within a shallow (1 cm deep) layer of soil (of bulk density 1.5 g/cm³) 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. A high-end deposition velocity of 1 cm/s is used to estimate deposition based on modeled ground-level concentrations in air.

The fugacity modeling approach developed by the Canadian Environmental Modelling Centre (CEMC)¹ is used to estimate potential concentrations of dimethyl sulfate, ethylene glycol, and methanol in soil, as the volatility of these chemicals invalidates the simple mixing model assumptions. The CEMC Soil Model predicts the equilibrium distribution of a pollutant among solid (sorbed), liquid, and air phases in unsaturated soil systems. To apply the model to estimate a concentration in bulk soil from a modeled airborne concentration, the assumption is made that the pollutant concentration in soil air pores is equal to the modeled concentration in air just above the soil layer. Over the long-term, this assumption implies equilibrium conditions exist between the pollutant distribution in surficial soils and ground-level air.

The Soil Model requires the specification of various physicochemical properties as well as properties of the surface soil layer. Chemical-specific parameters include molecular weight, vapor pressure, solubility, octanol-water partition coefficient (K_{ow}), organic carbon partition coefficient (K_{oc}), mineral matter-water partition coefficient (K_{mw}), and degradation half-life, as specified at a standard temperature of 25°C. Relevant soil parameters include water- and air-filled porosities, organic matter content, and solids densities. Relevant physicochemical properties were obtained from the Risk Assessment Information System (<http://rais.ornl.gov/>). Model predictions were generated for the CEMC Soil Model's default (Version 3.00) soil profile, for which the key parameters include an overall soil porosity of 50% (30% water-filled pores, 20% air-filled pores) and a 2% organic carbon fraction (dry weight basis). Table 3 provides physicochemical property values and the resulting CEMC Soil Model predictions, transformed into ratios of the predicted concentration in bulk soil to that in the soil-air phase (the soil to air ratio, $C_{soil/soil-air}$).

Table 4 lists the predictions of the soil models, which are based on the worst-case air pollutant concentrations modeled at ground-level (Table 1). Observations relative to background concentrations (for inorganic COPCs) and ecological screening benchmarks include:

- There are no incremental soil concentrations predicted at levels above either background levels or ecotoxicity benchmarks;

¹ Soil version 3.00, Canadian Environmental Modelling Centre, Trent University, www.trentu.ca/cemc/.

- No ecotoxicity benchmarks were identified for magnesium or dimethyl sulfate; the predicted increment for magnesium, however, is substantially smaller than the background level (magnesium is a significant component of soil), and the modeled increment of dimethyl sulfate is much smaller than levels that can be measured by typical analytical methods; and
- Background concentrations of vanadium and zinc in soil exceed their respective screening-level ecotoxicity benchmarks.

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 Lake Decatur (a widened portion of the Sangamon River), the most significant surface water feature near the ADM facility. Concentrations are calculated by dividing the emission rate of each COPC (Table 1) by the measuring flow rate of the lake/river. The longest running stream gaging station is located at the outlet of Lake Decatur, near where it is crossed by State Route 48 (latitude 39°49'52", longitude 88°58'35", NAD27). Streamflow at this location averaged 699.3 cfs from 1983 to 2005 (http://il.water.usgs.gov/annual_report/data/discl_86/indices0/index.htm). This streamflow rate likely underestimates the amount of water that enters Lake Decatur, which serves as a drinking water supply to the City of Decatur (which actively withdraws water). Surface water concentrations of contaminants calculated by the simple mixing model are provided in Table 5 along with relevant background concentrations (for inorganic COPCs) and ecological screening benchmarks.

Relevant observations include:

- Incremental concentrations of COPCs are smaller than all of their respective surface water benchmark concentrations and background concentrations;
- Neither benchmark nor background concentrations are available for dimethyl sulfate and methanol; the worst-case modeled concentration of dimethyl sulfate is lower than typical detection limits for volatile organic compound analyses; and
- The background concentration of magnesium is significantly greater than its benchmark concentration.

Sediment modeling and comparisons

Sediment concentrations are estimated under the assumption that all stack emissions deposit within Lake Decatur and remain in the bottom sediment. COPC concentrations in sediment (Table 6) are estimated as the projected facility emission rates (Table 1) divided by the rate of sediment deposition. A recent study estimates that 8.3 acre-ft of sediment are deposited within Lake Decatur each year at an average density of 1,056 tons/acre-ft,³ which equates to an annual sediment deposition rate of 8,765 tons/yr. Table 6 compares worst-case sediment concentrations to background levels (as measured in Lake Decatur sediments) and benchmark concentrations.

Preliminary observations concerning predicted concentrations of COPCs in sediments include

- Few benchmark concentrations are available for COPCs in sediment; predicted incremental concentrations in sediment are much smaller than ecotoxicity benchmark concentrations for the three COPCs for which they are available;
- The modeled worst-case concentrations in sediment are smaller than representative background concentrations for the inorganic COPCs;
- Neither benchmark concentrations nor ecotoxicity thresholds are available for the three organic chemicals (dimethyl sulfate, ethylene glycol, and methanol);
- An alternate, yet still conservative, model for sediment might be to assume that all potential facility emissions mix into the water column and adhere to suspended sediment; based on an average total suspended solids concentration of 23.4 mg/l measured in 29 samples collected in Lake Decatur from 2001 to 2003 (<http://www.epa.gov/storet>) and the Lake's exit streamflow of 699.3 cfs from 1983 to 2005 (see surface water modeling), the alternate model would predict incremental COPC sediment concentrations about two times lower than those listed in Table 6; and
- The estimated concentrations in ethylene glycol and methanol in sediment are relatively high with respect to typical levels of organic compounds in sediment, a likely consequence of the overpredictive nature of the mixing model that assumes complete deposition of all emissions within Lake Decatur sediments; further, ethylene glycol and methanol share similar physicochemical properties of complete miscibility with water and limited (if any) tendency to associate with solids (as evidenced by low Kow/Koc values, Table 3), making the sediment retention model unrealistic as constructed for these COPCs – if introduced to aquatic systems, methanol will almost predominantly dissolve in the water phase and remain in the water column, where it is expected to rapidly biodegrade.⁴

³ Bogner, W., *Sedimentation Survey of Lake Decatur's Basin 6, Macon County, Illinois*, Illinois State Water Survey Champaign, IL, Contract Report 2001-07. The average sediment density of 1,056 tons/acre-ft is calculated as the total sediment weight (1,421,437 tons) divided by the accumulation volume (1,346 acre-ft) (see Table 3 of the Water Survey report).

⁴ An evaluation of methanol's fate and transport is available at <http://www.methanol.org/pdf/evaluation.pdf>.

Conclusions and Recommendations

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 models do not account for removal/degradation by chemical reactions, leaching, and/or biodegradation, a factor of potential significance to all of the organic chemicals (and still another reason to believe that the simple "mix in" models greatly over-predict the likely consequences of facility emissions. The organic process-related chemicals potentially emitted in the greatest amounts (ethylene glycol and methanol) are also not known to bioaccumulate to any significant degree, and hence potential risks from foodchain pathways to the predatory species of interest (Indiana bat and bald eagle) are not likely to be significant. Polychlorinated dioxins and furans, a potentially greater foodweb concern due to their bioaccumulative nature, are not likely to be of concern due to the low level of their impacts relative to background. Coal combustion is not a large emission source of these compounds, as reflected by the model estimates relative to background. The predicted worst-case ambient air concentration of PCDD/PCDF TEQs is less than 0.1% of the representative ambient background level (<0.1%, Table 1). Based on the low levels of projected impacts and the conservative assumptions used to develop them, I see no reason to conduct a more detailed foodweb evaluation for the threatened and endangered species of concern.

Table 1 Background Screening of Projected Ambient Air Impacts ^A
 Chemicals of Potential Concern are highlighted in color (see note A for explanation)

Air Pollutant (non-HAPs <i>italicized</i>)	Emission Rate (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$) ^B	Worst-case percentage increase to existing background
Metals and inorganic compounds				
Antimony	2.52E-04	2.50E-07	3.94E-04	0.1%
Arsenic	5.76E-03	6.21E-06	9.41E-03	0.1%
Barium	3.12E-04	8.14E-05	1.82E-02 (9.2%)	0.4%
Beryllium	2.95E-04	3.23E-07	4.63E-04	0.1%
Cadmium	7.93E-04	2.04E-05	1.16E-03	1.8%
Chromium	3.74E-03	2.60E-05	4.29E-03	0.6%
Chromium (VI)	1.21E-03	2.59E-05	3.94E-03	0.7%
Cobalt	1.41E-03	1.61E-06	2.37E-03	0.1%
Copper	6.02E-05	1.57E-05	3.53E-03 (45%)	0.4%
Hydrogen chloride	9.00E+01	8.91E-02	5.84E+00	1.5%
Lead	6.13E-03	8.66E-05	2.20E-02	0.4%
Magnesium	1.54E-01	1.53E-04	1.47E-02 (7.9%)	1.0%
Manganese	6.89E-03	7.79E-06	1.34E-02	0.1%
Mercury	1.35E-02	1.40E-05	1.63E-03	0.9%
Molybdenum	7.79E-05	2.04E-05	3.60E-03 (2.1%)	0.6%
Nickel	4.07E-03	3.89E-05	7.95E-03	0.5%
Selenium	1.82E-02	1.81E-05	2.89E-02	0.1%
Vanadium	1.63E-04	4.26E-05	1.70E-03 (6.9%)	2.5%
Zinc	2.05E-03	5.37E-04	2.27E-02 (98.3%)	2.4%

Table 1 Background Screening of Projected Ambient Air Impacts ^A
 Chemicals of Potential Concern are highlighted in color (see note A for explanation)

Air Pollutant (non-HAPs <i>italicized</i>)	Emission Rate (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$) ^B	Worst-case percentage increase to existing background
Organic compounds (except PAHs)				
1,1,1-Trichloroethane	2.80E-04	2.77E-07	1.21E+00	0.0%
2,4-Dinitrotoluene	3.92E-06	3.88E-09	1.31E-05	0.0%
2-Chloroacetophenone	9.81E-05	9.71E-08	8.17E-06	1.2%
Acetaldehyde	7.99E-03	7.91E-06	7.97E-01	0.0%
Acetophenone	2.10E-04	2.08E-07	3.49E-04	0.1%
Acrolein	4.06E-03	4.02E-06	1.95E-02	0.0%
Benzene	1.84E-02	3.92E-05	6.91E-01	0.0%
Benzyl chloride	9.81E-03	9.71E-06	8.19E-04	1.2%
Biphenyl	2.38E-05	2.36E-08	3.97E-05	0.1%
Bis(2-ethylhexyl)phthalate (DEHP)	1.02E-03	1.01E-06	1.60E+00	0.0%
Bromoform	5.46E-04	5.41E-07	2.10E-02	0.0%
Carbon disulfide	1.82E-03	1.80E-06	4.99E-02	0.0%
Chlorobenzene	3.08E-04	3.05E-07	1.24E-02	0.0%
Chloroform	8.27E-04	8.18E-07	4.76E-02	0.0%
Cumene	7.43E-05	7.35E-08	1.00E-04	0.1%
Dichlorobenzene	8.50E-05	2.22E-05	1.33E-02	0.2%
Dimethyl sulfate	6.73E-04	6.66E-07	5.65E-08	1179.3%
Ethyl benzene	1.32E-03	1.30E-06	1.22E-01	0.0%
Ethyl chloride	5.89E-04	5.83E-07	1.89E-03	0.0%
Ethylene dibromide	1.68E-05	1.66E-08	1.91E-02	0.0%
Ethylene dichloride	5.60E-04	5.55E-07	3.30E-02	0.0%
Ethylene Glycol	1.81E+00	4.05E+00	7.99E-03	50768.0%
Formaldehyde	8.68E-03	1.39E-03	9.86E-01	0.1%
Hexane	1.28E-01	3.33E-02	9.85E+00	0.3%
Isophorone	8.13E-03	8.05E-06	1.11E-03	0.7%
Methanol	9.12E+00	1.92E+01	6.26E-01	3060.7%
Methyl bromide	2.24E-03	2.22E-06	7.70E-02	0.0%
Methyl chloride	7.43E-03	7.35E-06	1.20E+00	0.0%

Table 1 Background Screening of Projected Ambient Air Impacts^A
Chemicals of Potential Concern are highlighted in color (see note A for explanation)

Air Pollutant (non-HAPs <i>italicized</i>)	Emission Rate (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$) ^B	Worst-case percentage increase to existing background
Methyl hydrazine	2.38E-03	2.36E-06	1.74E-04	1.4%
Methyl methacrylate	2.80E-04	2.77E-07	1.31E-04	0.2%
Methyl tert butyl ether	4.90E-04	4.86E-07	1.87E-02	0.0%
Methylene chloride	4.06E-03	4.02E-06	3.39E-01	0.0%
Napthalene	2.25E-04	1.13E-05	1.67E-02	0.1%
Phenol	2.24E-04	2.22E-07	2.42E-02	0.0%
PCDD/PCDF TEQs ^C	7.64E-09	7.57E-12	1.50E-08 ^C	0.1%
Propionaldehyde	5.32E-03	5.27E-06	1.95E-01	0.0%
Styrene	3.50E-04	3.47E-07	1.12E-02	0.0%
Tetrachloroethylene	6.03E-04	5.96E-07	1.51E-01	0.0%
Toluene	3.60E-03	6.30E-05	9.88E-01	0.0%
Vinyl acetate	1.06E-04	1.05E-07	7.97E-03	0.0%
Xylenes	5.18E-04	5.13E-07	7.09E-01	0.0%
Polycyclic Aromatic Hydrocarbons (PAHs)^D				
Group 2 PAHs^D				
2-Methylnaphthalene	3.44E-06	5.65E-07		
Acenaphthene	7.40E-06	4.25E-08		
Acenaphthylene	3.76E-06	4.24E-08		
Anthracene	3.29E-06	5.65E-08		
Benzo(b,j,k)fluoranthene	1.54E-06	1.53E-09		
Benzo(g,h,i)perylene	5.50E-07	2.82E-08		
Fluoranthene	1.04E-05	7.08E-08		
Fluorene	1.32E-05	6.61E-08		
Phenanathrene	4.03E-05	4.01E-07		
Pyrene	5.34E-06	1.18E-07		
Total Group 2 PAHs		1.39E-06	3.04E-03	0.0%

Table 1 Background Screening of Projected Ambient Air Impacts ^A
 Chemicals of Potential Concern are highlighted in color (see note A for explanation)

Air Pollutant (non-HAPs <i>italicized</i>)	Emission Rate (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$) ^B	Worst-case percentage increase to existing background	
Group 3 PAHs ^D					
7,12-Dimethylbenz(a)anthracene	2.29E-06	3.76E-07			
Total Group 3 PAHs		3.76E-07	7.70E-07	48.9%	
Group 4 PAHs ^D					
3-Methylcholanthrene	2.58E-07	4.23E-08			
Total Group 4 PAHs		4.23E-08	0.00E+00	#N/A	
Group 5 PAHs ^D					
5-Methyl chrysene	3.08E-07	3.05E-10			
Benzo(a)pyrene	7.04E-07	2.82E-08			
Dibenzo(a,h)anthracene	1.72E-07	2.82E-08			
Total Group 5 PAHs		5.68E-08	4.09E-05	0.1%	
Group 6 PAHs ^D					
Benzo(a)anthracene	1.38E-06	4.24E-08			
Benzo(b)fluoranthene	2.58E-07	4.23E-08			
Benzo(k)fluoranthene	2.58E-07	4.23E-08			
Indeno(1,2,3-cd)pyrene	1.11E-06	4.24E-08			
Total Group 6 PAHs		1.38E-06	1.69E-07	2.10E-04	0.1%
Group 7 PAHs ^D					
Chrysene	1.66E-06	4.24E-08			
Total Group 7 PAHs		4.24E-08	1.45E-04	0.0%	

Table 1 Background Screening of Projected Ambient Air Impacts ^A
 Chemicals of Potential Concern are highlighted in color (see note A for explanation)

Air Pollutant (non-HAPs <i>italicized</i>)	Emission Rate (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$) ^B	Worst-case percentage increase to existing background
<p>Notes:</p> <p>A Chemicals of Potential Concern are those highlighted in green for which projected worst-case facility-related incremental concentrations exceed 2% of the existing representative ambient background concentration and those highlighted in blue for which incremental concentrations may exceed the 2% background threshold (due to uncertainty in the background estimate) Background concentrations for most chemicals are those predicted in the U.S. EPA's 1999 National Air Toxics Assessment modeling study for the census tract in which the ADM facility is located (http://www.epa.gov/ttn/atw/nata1999/nsata99.html). Concentrations followed by parenthetical percentages reflect measured values in Decatur, IL in 2005 based on speciation of fine particle (PM2.5) samples. Since PM2.5 constitutes only a portion of total suspended particulate matter, the measured values underestimate background, and the degree of underestimation is likely substantial for chemicals such as magnesium that typically derive from crustal sources and hence are predominantly found on coarse particles. The percentage values that follow the background concentrations indicate frequency of detection with respect to analytical detection limits. Since the background concentrations of infrequently detected chemicals influence the reported annual average concentrations (non-detects are included in averages at 1/2 of reported detection limits), background estimates for some chemicals are uncertain, and hence barium, magnesium, and molybdenum are retained as Chemicals of Potential Concern even though projected incremental concentrations are smaller than 2% of background.</p> <p>B PCDD/PCDF TEQs represent the sum of polychlorinated dibenzo(<i>p</i>)dioxin and furan congeners weighted by toxicity equivalency factors relative to the 2,3,7,8-tetrachlorodibenzo(<i>p</i>)dioxin congener. The background concentration of 15 fg/m³ (1.5E-08 $\mu\text{g}/\text{m}^3$) is a representative background concentration for rural areas in Illinois derived from the National Dioxin Air Monitoring Network (see http://www.epa.gov/ncea/pdfs/dioxin/dei/NDAMN_PAPER3a.pdf and http://esm.versar.com/pprp/features/Atmosdep/national_site_links/NDAMN-2002.ppt).</p> <p>C 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).</p>				

Table 2 Polychlorinated dibenzo(*p*)dioxin and furan (PCDD/PCDF) emission factors expressed on a toxic equivalency (2,3,7,8-tetrachlorodibenzo(*p*)dioxin TEQ) basis

PCDD/PCDF Congener	Emission factor (ng/kg coal) ^A		Toxic Equivalency (TEQ) Factor ^B			TEQ Emission Factor (ng TEQ/kg coal)		
	ND=0	ND=1/2 DL	Mammals	Birds	Fish	Mammals	Birds	Fish
2,3,7,8-TCDD	0.005	0.018	1	1	1	0.018	0.018	0.018
1,2,3,7,8-PeCDD	0	0.016	1	1	1	0.016	0.016	0.016
1,2,3,4,7,8-HxCDD	0	0.034	0.1	0.05	0.5	0.0017	0.017	0.0017
1,2,3,6,7,8-HxCDD	0.004	0.028	0.1	0.01	0.01	0.00028	0.00028	0.00028
1,2,3,7,8,9-HxCDD	0.004	0.035	0.1	0.1	0.01	0.0035	0.00035	0.0035
1,2,3,4,6,7,8-HpCDD	0.216	0.241	0.01	0.001	0.001	0.00024	0.00024	0.00024
OCDD	0.513	0.644	0.0001	0.0001	0.0001	6.4E-05	6.4E-05	6.4E-05
2,3,7,8-TCDF	0.109	0.117	0.1	1	0.05	0.0117	0.117	0.00585
1,2,3,7,8-PeCDF	0.007	0.021	0.05	0.1	0.05	0.00105	0.0021	0.00105
2,3,4,7,8-PeCDF	0.074	0.084	0.5	1	0.5	0.042	0.084	0.042
1,2,3,4,7,8-HxCDF	0.098	0.12	0.1	0.1	0.1	0.012	0.012	0.012
1,2,3,6,7,8-HxCDF	0.014	0.03	0.1	0.1	0.1	0.003	0.003	0.003
1,2,3,7,8,9-HxCDF	0.013	0.038	0.1	0.1	0.1	0.0038	0.0038	0.0038
2,3,4,6,7,8-HxCDF	0.043	0.06	0.1	0.1	0.1	0.006	0.006	0.006
1,2,3,4,6,7,8-HpCDF	0.354	0.385	0.01	0.01	0.01	0.00385	0.00385	0.00385
1,2,3,4,7,8,9-HpCDF	0.087	0.112	0.01	0.01	0.01	0.00112	0.00112	0.00112
OCDF	0.158	0.281	0.0001	0.0001	0.0001	2.8E-05	2.8E-05	2.8E-05
PCDD/PCDF TEQ Totals	1.699	2.264				0.13072	0.27268	0.13063

Notes: A EPA/600/P-00/001Cb, December 2003 Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds National Academy Sciences (NAS) Review Draft www.epa.gov/ncea, Table 4-19.
B EPA/630/P-03/002A, June 2003, External Review Draft, Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans and Biphenyls in Ecological Risk Assessment

Table 3 CEMC Soil Model (version 3.00) input parameters and predictions ^A

Parameter ^B	Methanol	Ethylene Glycol	Dimethyl Sulfate
Molecular weight (g/mol)	32.04	62.07	126.13
Vapor Pressure (Pa)	16500	12.3	90.3
Solubility (g/m ³)	1.00E+06	1.00E+06	28000
Log(Octanol-water partition coefficient – K _{ow})	-0.77	-1.36	0.16
Organic carbon partition coefficient (K _{oc}) (l/kg)	1	1	24.17
Mineral matter-water partition coefficient (K _{mw}) (l/kg) ^C	1	1	1
Degradation half-life (hours) ^D	1.00E+11	1.00E+11	1.00E+11
Soil to air ratio (C _{soil} /C _{air}) derived from CEMC Soil Model predictions (mg/kg per µg/m ³)	0.00464	3.22	0.00828
Worst-case modeled concentration in air C _{air} (µg/m ³) (Table 1)	1.92E+01	4.05E+00	6.66E-07
Predicted equilibrium concentration in soil (mg/kg) (C _{soil} /C _{air} × C _{soil-air})	8.89E-02	1.31E+01	5.51E-09

Notes:

^A The CEMC Soil Model (Soil version 3.00, Canadian Environmental Modelling Centre, Trent University, is available on-line at www.trentu.ca/cemc/.

^B Property values (specified at 25°C) from the Human Health Risk Assessment Protocol's chemical database (http://www.epa.gov/earth1r6/6pd/rcra_c/protocol/protocol.htm) unless otherwise noted.

^C Value of 1 l/kg is provided for the default value for all chemicals in the CEMC Soil Model library.

^D Value assigned a very large number to discount the potential effects of degradation (note that this parameter is not important to predicting the equilibrium distribution among phases in soil).

Table 4 Estimated impacts of facility emissions to soil

Chemical of Potential Concern	Concentrations in Soil (mg/kg)		
	Worst-case modeled increment due to proposed facility emissions ^A	Background ^C	Benchmark ^E
Metals and Inorganic Compounds			
Barium	5.14E-02	1.10E+02	3.30E+02 ^H
Magnesium	9.62E-02	4.82E+03	#N/A
Molybdenum	1.28E-02	1.20E+00 ^D	2.00E+00 ^F
Vanadium	2.68E-02	2.52E+01	7.80E+00 ^H
Zinc	3.38E-01	9.50E+01	6.62E+00
Organic Compounds			
Dimethyl Sulfate	5.51E-09 ^B	#N/A	#N/A
Ethylene Glycol	1.31E+01 ^B	#N/A	9.00E+01 ^G
Methanol	8.89E-02 ^B	#N/A	3.30E+01 ^G
7,12-Dimethylbenz(a)anthracene	2.37E-04	#N/A	1.63E+01
3-Methylcholanthrene	2.67E-05	#N/A	7.79E-02
Notes: A Concentrations in soil are calculated with the deposition/surface mixing model, unless noted B Concentrations calculated with the CEMC/equilibrium approach C Background values from a statewide survey of soils located within Metropolitan Statistical Areas (see http://www.ilga.gov/commission/jcar/admincode/035/03500742ZZ9996agR.html) 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, <i>Major- and Trace-Element Concentrations in Soils from Two Continental-Scale Transects of the United States and Canada</i> , U.S. Geological Survey) E Benchmark concentrations are U.S. EPA Ecological Screening Levels (ESLs) unless noted (see http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf for ESL descriptions) F U.S. EPA Region 4 Soil Screening Benchmark, as obtained from the Oak Ridge National Laboratory's Risk Assessment Information System (http://rais.ornl.gov/) G Dutch Intervention Soil Screening Benchmark, as obtained from the Oak Ridge National Laboratory's Risk Assessment Information System (http://rais.ornl.gov/) U.S. EPA Interim Ecological Soil Screening Level (ECO-SSL) of 330 mg/kg for barium based on soil invertebrate toxicity (the interim ECO-SSL for mammalian toxicity is 2000 mg/kg); U.S. EPA Interim H Ecological Soil Screening Level (ECO-SSL) of 7.8 mg/kg for vanadium based on avian toxicity (the interim ECO-SSL for mammalian toxicity is 280 mg/kg); see http://www.epa.gov/ecotox/ecossl/			

Table 5 Estimated impacts of facility emissions to surface water

Chemical of Potential Concern	Concentrations in Surface Water ($\mu\text{g/l}$)		
	Worst-case modeled increment due to proposed facility emissions ^A	Background ^B	Benchmark ^C
Metals and Inorganic Compounds			
Barium	1.98E-03	5.16E+01	5.00E+03 ^F
Magnesium	9.81E-01	2.56E+04	6.47E+02 ^D
Molybdenum	4.96E-04	#N/A	7.30E+01 ^E
Vanadium	1.04E-03	#N/A	1.20E+01
Zinc	1.31E-02	5.00E+00	1.00E+03 ^F
Organic Compounds			
Dimethyl Sulfate	4.28E-03	#N/A	#N/A
Ethylene Glycol	1.15E+01	#N/A	1.92E+05 ^E
Methanol	5.80E+01	#N/A	#N/A
7,12-Dimethylbenz(a)anthracene	1.46E-05	#N/A	5.48E-01
3-Methylcholanthrene	1.64E-06	#N/A	8.91E-02
Notes:	<p>A Concentrations in surface water are worst-case estimates that assume 100% of the proposed emission increases mix into Lake Decatur</p> <p>B Background values from sampling conducted in Lake Decatur in 2001 to 2003. Values represent the averages of five samples except for zinc, for which the value of 5 $\mu\text{g/l}$ represents the single detected value in five samples (also the approximate value of the method detection limit). Values obtained from the U.S. EPA's STORET database (http://www.epa.gov/storet).</p> <p>C Benchmark concentrations are U.S. EPA Ecological Screening Levels (ESLs) unless noted (see http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf for ESL descriptions)</p> <p>D U.S. EPA Region 6 Surface Water Screening Benchmark, as obtained from the Oak Ridge National Laboratory's Risk Assessment Information System (http://rais.ornl.gov/)</p> <p>E Canadian Water Quality Guideline Surface Water Screening Benchmark, as obtained from the Oak Ridge National Laboratory's Risk Assessment Information System (http://rais.ornl.gov/)</p> <p>F Values are Illinois Water Quality Standards based on the protection of Indigenous Aquatic Life (see http://www.ipcb.state.il.us/documents/dsweb/Get/Document-33354/)</p>		

Table 6 Estimated impacts of facility emissions to sediment

Chemical of Potential Concern	Concentrations in Sediment (mg/kg)		
	Worst-case modeled increment due to proposed facility emissions ^A	Background ^B	Benchmark ^D
Metals and Inorganic Compounds			
Barium	1.56E-01	1.85E+02	#N/A
Magnesium	7.70E+01	8.30E+03 ^C	#N/A
Molybdenum	3.89E-02	< 2.00E+00 ^C	#N/A
Vanadium	8.14E-02	7.50E+01 ^C	#N/A
Zinc	1.03E+00	8.75E+01	1.21E+02
Organic Compounds			
Dimethyl Sulfate	3.36E-01	#N/A	#N/A
Ethylene Glycol	9.03E+02	#N/A	#N/A
Methanol	4.56E+03	#N/A	#N/A
7,12-Dimethylbenz(a)anthracene	1.15E-03	#N/A	6.64E+01
3-Methylcholanthrene	1.29E-04	#N/A	8.19E+03
Notes:	<p>A Concentrations in sediment are worst-case estimates that assume 100% of the proposed emission increases mix into Lake Decatur bottom sediments</p> <p>B Unless noted, background values from sampling conducted in Lake Decatur in 2003, unless noted. Values represent the averages of two samples. Values obtained from the U.S. EPA's STORET database (http://www.epa.gov/soret).</p> <p>C Background values sampled and reported in 1996 by the U.S. Geological Survey for bed sediment in the Sangamon River near Monticello, IL, the main tributary that feeds Lake Decatur. See http://pubs.usgs.gov/wdr/2005/wdr-il-05/data/swq_m_96/alt_1.htm for data.</p> <p>D Benchmark concentrations are U.S. EPA Ecological Screening Levels (ESLs) (see http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf for ESL descriptions)</p>		



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March 15, 2007

Ms. Rachel Rineheart
U.S. Environmental Protection Agency
Region 5
77 W. Jackson Blvd.
Chicago, IL 60604

Subject: **Impacts Assessment Data for Archer Daniels Midland (ADM)
Company's Proposed Decatur, Illinois Glycols Plant**

Dear Ms. Rineheart:

Attached to this letter is a memorandum from Dr. Steve Zemba of Cambridge Environmental, Inc. This memo was prepared as a follow-up to our March 1, 2007 meeting at which, Mr. Michael Coffey of the U.S. Fish and Wildlife Service (FWS) requested some additional assessment in relation to four chemicals of potential concern (COPCs) – chromium, lead, mercury, and polychlorinated dibenzo(p)dioxins and furans (PCDD/PCDFs) associated with ADM's Glycols Plant Project in Decatur, Illinois. Steve has addressed the requests made, and has concluded that there is no likely cause for concern regarding threatened and endangered species due to the increased emissions of ADM's proposed project.

I hope this additional analysis provides U.S. EPA and the FWS with the information needed to complete your review of this project. If you have any questions or need additional information, please contact me or Staci Bogue-Buchholz of ADM.

Sincerely,

Jack M. Burke, P.E.
Senior Project Manager

c: Mike Coffey, U.S. Fish and Wildlife Service
Staci Bogue-Buchholz, Archer Daniels Midland Company
Steve Zemba, Cambridge Environmental, Inc.

MEMORANDUM

To: Jack Burke – RTP Environmental Associates, Inc.
Staci Bogue-Buchholz – Archer Daniels Midland Company

From: Stephen G. Zemba, Ph.D., P.E. – Cambridge Environmental, Inc.

Subject: Further Ecological Consultation support ADM's proposed Glycols production facility

Date: March 14, 2007

I write to provide further information regarding potential impacts to threatened and endangered wildlife species associated with the proposed construction of a Glycols Production Plant at the Archer Daniels Midland (ADM) facility in Decatur, Illinois. This information supplements the calculations previously described in my February 15, 2007 memo, and addresses requests made at our recent meeting with Ms. Rachel Rinehart (U.S. EPA Region 5) and Mr. Michael Coffey (U.S. Fish and Wildlife Service, U.S. F&WS) on March 1, 2007. Specifically, I provide modeling information on four chemicals of potential concern (COPCs) – chromium, lead, mercury, and polychlorinated dibenzo(*p*)dioxins and furans (PCDD/PCDFs) – although the project's emissions of these COPCs are expected to increase existing ambient air concentrations by less than the criterion initially applied for COPC screening (an increase of 2%). I also consider foodchain analyses for the Indiana Bat for two of these COPCs (mercury and PCDD/PCDFs) based on spreadsheet models provided by U.S. F&WS.¹

As I noted at our March 1, 2007 meeting, my screening-level calculations are very conservative. In fact these calculations are too conservative to conclude that project-related impacts for mercury and polychlorinated dibenzo(*p*)dioxins and furans (PCDD/PCDFs) are sufficiently negligible. The supplemental calculations in this memo emphasize the extreme conservatism built into the surface water and sediment modeling in which I assume that all plume emissions enter and mix into Lake Decatur. As such, I have developed an alternate (yet still conservative model) to assess potential impacts to surface water and sediment.

These further screening-level models indicate that emissions from ADM's proposed glycols production facility are not likely to result in adverse impacts to threatened and endangered species. The projected worst-case concentration of lead in soil is very slightly greater than the U.S. EPA Region 5 Ecological Screening Level (ESL), though the ESL is many times smaller than typical background levels of lead in soil. The Indiana Bat dietary exposure model for mercury predicts a conservative exposure level about twice the level shown not to cause adverse effects, but only about 40% of the exposure level at which adverse effects have actually been observed. Given the likely conservatism in the simple fate-and-transport models and the initial

¹ The Indiana Bat is one of two threatened and endangered species of concern for which dietary pathways are potentially relevant (the other is the Bald Eagle). The Indiana Bat is evaluated per the request of U.S. F&WS as screening-level dietary intake models have been developed specifically for this species.

finding that the projected concentrations of these COPCs in ambient air are all less than 1% of background levels, I find no likely cause for concern regarding threatened and endangered species due to the increased emissions of ADM's proposed project.

The following text and tables describe my supplemental calculations and analyses.

Ambient Air Background Comparison

The four COPCs of interest were not carried through the initial fate and transport modeling because the predicted worst-case concentrations in ambient air are only a small fraction of background concentrations. As indicated in Table 1 (and excerpted from my March 12, 2007 memo), the predicted concentrations in ambient air are all less than 1% of existing background levels for the four COPCs. An important implication to consider with respect to fate and transport modeling is that background can be expected to contribute more than one hundred times as much as the project to all media. In cases for which the potential incremental effects of some COPCs due to ADM emissions seem to be high, the implied effects due to the background COPC presence in air is unrealistically high (i.e., at least 100 times greater than the project's effects), pointing to a high level of model conservativeness.

Soil, sediment, and surface water comparisons

Tables 2 through 4 present estimates of pollutant concentrations in soil, sediment, and surface water, based on the same models described in my February 16, 2007 memo. In addition, Tables 2 through 4 provide representative background concentrations (where available), and values of the U.S. EPA Region 5's Ecological Screening Levels (ESLs, see <http://www.epa.gov/reg5rcra/ca/edql.htm>).

Concentrations of COPCs in soil (Table 2) are estimated with a simple mixing model that assumes pollutants deposit from the atmosphere over a period of thirty years of facility operation and remain within a shallow (1 cm deep) layer of soil (of bulk density 1.5 g/cm³) 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. A high-end deposition velocity of 1 cm/s is used to estimate deposition based on modeled ground-level concentrations in air.

Observations for the four inorganic COPCs relative to background concentrations in soil and ecological screening benchmarks include:

- The predicted worst-case incremental soil concentrations of three of the four COPCs (chromium, mercury, and PCDD/PCDFs) are well below both background levels and ecotoxicity benchmarks;

- The predicted worst-case incremental soil concentration of lead is slightly above (approximately 2% above) the ecotoxicity benchmark, but only a small fraction (approximately 0.2%) of the cited background level.

Sediment modeling and comparisons

As in my 2/15/07 memo, sediment concentrations are initially estimated under the assumption that all ADM stack emissions deposit within Lake Decatur and remain in the bottom sediment. Estimated worst-case COPC concentrations in sediment (Table 3) are thus calculated as the projected facility emission rates (Table 1) divided by the rate of sediment deposition. A recent study estimates that 8.3 acre-ft of sediment are deposited within Lake Decatur each year at an average density of 1,056 tons/acre-ft,² which equates to an annual sediment deposition rate of 8,765 tons/yr. Table 3 compares worst-case sediment concentrations based on these estimates (column 2) to background levels (as measured in Lake Decatur sediments) and benchmark concentrations.

Preliminary observations concerning predicted concentrations of the four COPCs in sediments include:

- For chromium and lead, estimated worst-case incremental concentrations in sediments are lower than both background concentrations and screening-level benchmark concentrations; and
- For mercury and PCDD/PCDFs, however, estimated worst-case incremental concentrations in sediments are greater than both background concentrations and screening-level benchmark concentrations.

Given that the predictions of mercury and PCDD/PCDFs in ambient air from the project are small fractions of background levels (Table 1), the simple model of mixing all plume emissions into Lake Decatur appears to be a gross and extremely conservative oversimplification for mercury and PCDD/PCDFs. If sediment concentrations are assumed to scale with concentrations in air, the ratios of facility impacts to background levels in air (Table 1) imply sediment concentrations of 780 mg/kg and 0.0076 mg/kg, respectively, for mercury and PCDD/PCDFs (based on scaling the incremental concentrations predicted by the plume mix-in model). These values are implausibly large given actual background concentrations observed in sediments (which exist coincidentally with the background concentrations in air).

² Bogner, W., *Sedimentation Survey of Lake Decatur's Basin 6, Macon County, Illinois*, Illinois State Water Survey Champaign, IL, Contract Report 2001-07. The average sediment density of 1,056 tons/acre-ft is calculated as the total sediment weight (1,421,437 tons) divided by the accumulation volume (1,346 acre-ft) (see Table 3 of the Water Survey report).

Another perspective on the degree conservatism in the initial plume mix-in model can be obtained by considering the deposition model used to estimate concentrations in soil. If the maximum modeled COPC deposition rate (evaluated at the point at which the concentration in air is predicted to be the highest) is assumed to occur over the entire 938 mile² (2,430 km²) Lake Decatur watershed,³ the total deposition over this area accounts for only 20% of the stack emissions of mercury and PCDD/PCDFs. Thus, if mercury and PCDD/PCDFs deposit at their maximum modeled rates over the entire watershed and all of it enters Lake Decatur, the COPC fluxes into the lake would be five times smaller than the full stack emission rate assumed in the simple plume mix-in model. Further, the average deposition rate over the entire watershed is expected to be considerably smaller than the maximum rate. Averaged over the 36 km² modeling domain, the modeled dry deposition rate is a factor of four smaller than the maximum rate. Expanding the modeling domain over the entire watershed would yield an even greater ratio between the maximum and average deposition rates. Thus, even without significantly more extensive modeling, it is easy to see that the plume mix-in model overestimates sediment concentrations by at least a factor of twenty (and probably much more).

Developing more accurate estimates of sediment and surface water concentrations demands more detailed consideration of impacts to the watershed. As one option, watershed algorithms could be implemented such as those described in the U.S. EPA's Human Health Risk Assessment Protocol (HHRAP), which considers the various potential loadings to water bodies. Our experience with the HHRAP algorithms in similar settings indicates that soil erosion can be expected to contribute the bulk of the COPC loading to Lake Decatur. As a simplification, if one assumes that soil erosion is responsible for COPC loading to Lake Decatur, then an alternate worst-case model of the potential concentrations of COPCs in sediment is that they equal worst-case modeled concentrations in surficial soil.

Adopting an alternate worst-case model of setting the COPC concentrations in sediment equal to the worst-case modeled concentrations in soil, the sediment/soil concentrations of COPCs listed in Table 3 (column 3) are considerably lower than those predicted by the plume mix-in model, and similarly lower than both representative background concentrations and screening-level benchmark concentrations.

Surface water modeling and comparisons

As described in my 2/15/07 memo, the initial screening-level model to estimate worst-case concentrations in surface water assumes that all stack emissions are mixed within Lake Decatur (a widened portion of the Sangamon River), the most significant surface water feature near the ADM facility. Concentrations are calculated by dividing the emission rate of each COPC (Table 1) by the measuring flow rate of the lake/river. The longest running stream gaging station

³ The watershed area of 938 mile² corresponds to the U.S. Geological Survey's stream gaging station located at the outlet of Lake Decatur (39°49'52", longitude 88°58'35", NAD27).

is located at the outlet of Lake Decatur, near where it is crossed by State Route 48 (latitude 39°49'52", longitude 88°58'35", NAD27). Streamflow at this location averaged from 1983 to 2005 is 699.3 cfs (http://il.water.usgs.gov/annual_report/data/discl_86/indices0/index.htm). This streamflow rate likely underestimates the amount of water that enters Lake Decatur, which serves as a drinking water supply to the City of Decatur (which actively withdraws water). Surface water concentrations of contaminants calculated by this simple mixing model are provided in Table 4 (column 2) along with bounding-level background concentrations (sampling typically fails to detect these COPCs) and ecological screening benchmarks.

Applied to the four COPCs of concern, predictions of the simple plume mix-in model for surface water shares similar tendencies as that of the comparable sediment model:

- For chromium and lead, estimated worst-case incremental concentrations in surface water are lower than screening-level benchmark concentrations;
- For mercury and PCDD/PCDFs, however, these bounding estimates of incremental concentrations in surface water are greater than screening-level benchmark concentrations; and, additionally,
- The analytical detection limits of background concentrations of lead and mercury available for local monitoring data do not permit reliable judgments with respect to benchmark concentrations.

An alternate model to estimate worst-case surface water concentrations is based on an assumed equilibrium between COPC concentrations in bottom sediment (C_{BS}) and surface water (C_{dw}). The equilibrium equation depends on the sediment/water partition coefficient (Kd_{BS}) and is used as a fundamental equation in the U.S. EPA's Human Health Risk Assessment Protocol model for partitioning COPC concentrations in a water body:

$$C_{dw} = \frac{C_{BS}}{Kd_{BS}}$$

This equilibrium model is a conservative estimate of the concentration of the COPC that could dissolve into the water column from a sediment source, as the equilibrium equation is a predictor of the COPC concentration in sediment pore water, and extrapolating this concentration to the entire water column likely overestimates the COPC concentration in open lake water. The partitioning coefficients and estimates of C_{dw} using this model (Table 4, column 5) are calculated using the alternate sediment concentrations provided in Table 3 (the sediment = soil model). The predicted concentrations of chromium and lead are higher than those predicted by the plume mix-in model, and are hence unrealistically high as mass conservation is violated by allowing the river to transport COPCs at a higher rate than emitted from the ADM facility. The predicted mercury and PCDD/PCDF concentrations in surface water, however, are lower than those of the plume-mix-in model as the equilibrium model better accounts for the tendency of these COPCs

to remain in sediment (a reflection of their higher Kd_{BS} values). Conservative estimates of COPC concentrations in surface water, taken from the combined use of the plume mix-in and sediment equilibrium models, are indicated as bold entries in Table 4.

Foodchain analyses based on the F&WS Indiana Bat models

Spreadsheet-based models to assess dietary intakes of mercury and PCDD/PCDFs were provided by the U.S. Fish and Wildlife Service (F&WS, personal communication from Michael Coffey) and adapted to project-specific modeled COPC concentrations and background data. Food intake rates, bioconcentration/bioaccumulation factors, and dietary assumptions were retained in the spreadsheets as received from F&WS. Area and seasonal use factors were set to one (the spreadsheet defaults).

Two changes have been made to the spreadsheets to correct inaccurate or inappropriate parameters. First, in the mercury spreadsheet, a piscivorous wildlife criterion of 6.41×10^{-10} mg/l has been changed to 6.41×10^{-7} mg/l (in cell M8) to reflect the proper conversion of units from the referenced value of 641 pg/l provided in the U.S. EPA's 1997 Mercury Report to Congress (<http://www.epa.gov/mercury/report.htm>, Volume VII). Second, in the PCDD/PCDF spreadsheet, the sediment to invertebrate bioaccumulation factor (cell F11) has been changed to a value of 0.9 l/kg, reflecting the high-end value of the range of values (0.5 l/kg to 0.9 l/kg) for 2,3,7,8-tetrachlorodibenzo(*p*)dioxin recommended by the U.S. EPA in a review of contaminant bioaccumulation literature (<http://www.epa.gov/waterscience/cs/biotesting/>). The 0.9 l/kg biota-to-sediment accumulation factor (BSAF) for invertebrates replaces a spreadsheet default value of 19,576 that is not supported by published/available values.

The following project-specific data were entered into the F&WS mercury model:

- Future emissions enrichment – soil: 0.00886 mg/kg (Table 2);
- Past emissions enrichment – soil: 0 mg/kg (has not been modeled);
- Background soil concentration: 0.033 mg/kg (Table 2);
- Future emissions enrichment – sediment: 0.00886 mg/kg (Table 3);
- Past emissions enrichment – sediment: 0 mg/kg (has not been modeled);
- Background sediment concentration: 0.12 mg/kg (Table 3);
- Future emissions enrichment – water: $0.00000018 = 1.8 \times 10^{-7}$ mg/l (Table 4);
- Past emissions enrichment – water: 0 mg/l (has not been modeled); and
- Background water concentration: $0.0000066 = 6.6 \times 10^{-6}$ mg/l (value in original F&WS spreadsheet).

No modeling of past facility emissions was developed in conjunction with the project. The background measurement in sediment, taken recently in Lake Decatur, probably reflects local

conditions (including any past contributions from the ADM facility). The local representativeness of the background soil and water concentrations, however, cannot be determined. The soil concentration derives from a regional study throughout central and southern Illinois, and the concentration in water is the value provided in the F&WS spreadsheet, as local measurements were not sufficiently sensitive to detect the levels of mercury present in Lake Decatur.

The mercury model predicts a NOAEL-based hazard quotient of 1.8 and a LOAEL-based hazard quotient of 0.36. Background mercury concentrations entered into the model account for about 90% of the risk estimates. A spreadsheet printout of the F&WS mercury model is provided in Figure 1.

The following project-specific data were entered into the F&WS PCDD/PCDF model:

- Future soil concentration: 4.77×10^{-9} mg/kg (Table 2);
- Existing soil concentration: 0 mg/kg (value in original F&WS spreadsheet);
- Future sediment concentration: 4.77×10^{-9} mg/kg (Table 3);
- Existing sediment concentration: 0 mg/kg (value in original F&WS spreadsheet); and
- Future water concentration: 3.11×10^{-14} mg/l (Table 4).

The PCDD/PCDF model predicts a NOAEL-based hazard quotient of 0.003 and a LOAEL-based hazard quotient of 0.0003. These values are many times smaller than one, the point at which projected dietary intake becomes as large as the ecotoxicity threshold. A spreadsheet printout of the F&WS PCDD/PCDF model is provided in Figure 2.

Conclusions and Observations

These additional calculations illustrate an important point concerning bounding-level fate-and-transport models: the model predictions are known to conservatively estimate environmental impacts and must be interpreted accordingly. My original calculations (as described in my 2/15/07 memo) eliminated the four COPCs considered in these supplemental calculations because the worst-case modeled concentration in air due to facility emissions is projected to be less than 2% of the existing background concentration in air (actually, less than 1% for these four COPCs). Simple screening-level models for sediment and surface water, however, were not able to demonstrate that project impacts will be less than ecological benchmark concentrations. It is counterintuitive to have one model suggest indiscernible impacts and then have follow-on models indicate cause for concern, as there should be some general correspondence to the relative presence of COPCs in air and their subsequent behavior in the environment. Either background air quality is very dangerous (since it contains concentrations a hundred-fold greater than projected facility impacts) or there is distortion in relative impacts induced by the screening

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level multi-pathway fate-and-transport models that simulate the deposition and potential accumulation of COPCs from air into soil, surface water, and sediment.

In this case, the apparent gap between relative impacts in air and subsequent terrestrial/aquatic impacts stems largely from the overly conservative nature of the screening-level models that assume all facility emissions enter and mix into Lake Decatur. A second set of conservative models, based on the assumption that sediment is not likely to accumulate greater concentrations of COPCs than soil, was able to demonstrate lower projections of facility impacts. Other factors also contribute to the conservatism of these screening assessments. For example, benchmark concentrations are sometimes considerably smaller than background levels, perhaps due to the safety factors incorporated in the calculation of the benchmarks. The soil benchmark concentration of 0.0537 mg/kg for lead (Table 2) is far lower than typical background levels that are (in my experience) rarely lower than 10 mg/kg. The issue of background levels exceeding benchmark concentrations is potentially relevant to many COPCs.

Screening-level models are thus useful if they can eliminate COPCs, but perhaps raise more questions if they cannot. The degree of appropriate model refinement necessary to reach confident conclusions is not always clear. For example, the mercury dietary exposure analysis for the Indiana Bat results in ambiguous hazard quotients. If viewed from the basis of a no observed adverse effects level (NOAEL), the hazard quotient of 1.8 is perhaps a cause for concern, as adverse effects have been observed at an exposure level about two times smaller than tested. However, the projected exposure level does not exceed the level at which adverse effects have actually been observed (the LOAEL). In this model, the predicted concentration in soil is the single most important factor in deriving the risk estimate, as it also serves as the basis for estimating concentrations in sediment and surface water. The mercury concentration in soil is based on an estimate of mercury deposition at the worst-case point, and not an average over the Lake Decatur watershed, and hence likely overestimates aquatic impacts. The estimates of mercury in sediment and surface water could be refined by using the AERMOD dispersion model to predict location-specific deposition and the HHRAP algorithms to simulate COPC loadings and watershed dynamics. If this were done, I would expect that a lower concentration would be predicted. This lower concentration, however, would still embody a likely (and difficult to assess) degree of conservatism.

I note that tentative consideration of background concentrations has a dramatic effect on the F&WS PCDD/PCDF model. As obtained from F&WS, the model lacks background concentrations of PCDD/PCDF in environmental media. Although I could not locate background data for PCDD/PCDFs measured near the site, these compounds are ubiquitous in soil and sediment. The U.S. EPA's recent dioxin reassessment document suggests that 5 ppt, or 5 ng/kg = 5×10^{-6} mg/kg, is a typical background concentration in sediments (see <http://www.epa.gov/ncea/pdfs/dioxin/nas-review/>, Volume 2, Chapter 3). This background value is about one thousand times greater than the projected site-specific impact, about forty times

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greater than U.S. EPA's benchmark concentration (1.2×10^{-7} mg/kg, Table 3), and by itself produces hazard quotients of more than 0.3 (NOAEL-based) and 0.03 (LOAEL-based) in the F&WS spreadsheet.

In my opinion, a more complex analysis for the ADM facility is not warranted. Rather, recognizing (1) the likely conservatism in the simple fate-and-transport models described above and (2) the initial finding that the projected concentrations of these COPCs in ambient air are all less than 1% of background levels, I find no likely cause for concern regarding threatened and endangered species due to the increased emissions of ADM's proposed project.

Table 1 Projected Ambient Air Impacts for Select Air Pollutants

Air Pollutant (non-HAPs <i>italicized</i>)	Emission Rate (lb/hr)	Highest Predicted Increment to Ambient Air ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$) ^A	Worst-case percentage increase to existing background
Chromium	3.74E-03	2.60E-05	4.29E-03	0.6%
Lead	6.13E-03	8.66E-05	2.20E-02	0.4%
Mercury	1.35E-02	1.40E-05	1.63E-03	0.9%
PCDD/PCDF TEQs ^B	7.64E-09	7.57E-12	1.50E-08	0.1%

Notes:

A National Air Toxics Assessment modeling study for the census tract in which the ADM facility is located (<http://www.epa.gov/ttn/atw/nata1999/nsata99.html>). Concentrations followed by parenthetical percentages reflect measured values in Decatur, IL in 2005 based on speciation of fine particle (PM2.5) samples. Since PM2.5 constitutes only a portion of total suspended particulate matter, the measured values underestimate background, and the degree of underestimation is likely substantial for chemicals such as magnesium that typically derive from crustal sources and hence are predominantly found on coarse particles. The percentage values that follow the background concentrations indicate frequency of detection with respect to analytical detection limits. Since the background concentrations of infrequently detected chemicals influence the reported annual average concentrations (non-detects are included in averages at 1/2 of reported detection limits), background estimates for some chemicals are uncertain, and hence barium, magnesium, and molybdenum are retained as Chemicals of Potential Concern even though projected incremental concentrations are smaller than 2% of background.

B PCDD/PCDF TEQs represent the sum of polychlorinated dibenzo(*p*)dioxin and furan congeners weighted by toxicity equivalency factors relative to the 2,3,7,8-tetrachlorodibenzo(*p*)dioxin congener. Derivation of the emission rate is described in a 2/15/07 memo from Stephen Zemba, Cambridge Environmental Inc., to Jack Burke, RTP Environmental Associates Inc. The background concentration of 15 fg/m³ (1.5E-08 $\mu\text{g}/\text{m}^3$) is a representative background concentration for rural areas in Illinois derived from the National Dioxin Air Monitoring Network (see http://www.epa.gov/ncea/pdfs/dioxin/dei/NDAMN_PAPER3a.pdf and http://esm.versar.com/pprp/features/Atmosdep/national_site_links/NDAMN-2002.ppt).

Table 2 Estimated impacts of facility emissions to soil

Chemical of Potential Concern	Concentrations in Soil (mg/kg)		
	Worst-case modeled increment due to proposed facility emissions ^A	Background	Benchmark ^E
Chromium	1.64E-02	1.62E+01 ^B	4.00E-01
Lead	5.46E-02	3.60E+01 ^B	5.37E-02
Mercury	8.86E-03	3.30E-02 ^C	1.00E-01
PCDD/PCDF TEQs	4.77E-09	#N/A ^D	1.99E-07

Notes: A Concentrations in soil are calculated with the deposition/surface mixing model.
 B Background values from a statewide survey of soils located within Metropolitan Statistical Areas (see <http://www.ilga.gov/commission/jcar/admincode/035/03500742ZZ9996agR.html>).
 C Average concentration in recent surface soils collected in central and southern Illinois (Dreher, G.B. and Follmer, L.R., Mercury Content of Illinois Soils, *Water, Air, and Soil Pollution* 156: 299-315, 2004).
 D Rachel Rineheart, U.S. EPA Region 5, personal communication.
 E Benchmark concentrations are U.S. EPA Region 5 Ecological Screening Levels (ESLs)

Table 3 Estimated impacts of facility emissions to sediment

Chemical of Potential Concern	Concentrations in Sediment (mg/kg)			
	Worst-case modeled increment due to proposed facility emissions ^A		Background ^B	Benchmark ^D
	Based on plume-mix in model used in 2/15/07 memo	Based on assumption of worst-case modeled concentration in surface soil (Table 1)		
Chromium	1.87E+00	1.64E-02	2.20E+01	4.34E+01
Lead	3.06E+00	5.46E-02	2.05E+01	3.58E+01
Mercury	6.76E+00	8.86E-03	1.20E-01	1.74E-01
PCDD/PCDF TEQs ^B	3.82E-06	4.77E-09	#N/A	1.20E-07

Notes:

- A Concentrations in sediment are worst-case estimates that assume 100% of the proposed emission increases mix into Lake Decatur bottom sediments
- B Unless noted, background values from sampling conducted in Lake Decatur in 2003, unless noted. Values represent the averages of two samples. Values obtained from the U.S. EPA's STORET database (<http://www.epa.gov/soret>).
Background values sampled and reported in 1996 by the U.S. Geological Survey for bed sediment
- C in the Sangamon River near Monticello, IL, the main tributary that feeds Lake Decatur. See http://pubs.usgs.gov/wdr/2005/wdr-il-05/data/swq_m_96/alt_1.htm for data.
- D Benchmark concentrations are U.S. EPA Ecological Screening Levels (ESLs) (see <http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf> for ESL descriptions)

Table 4 Estimated impacts of facility emissions to surface water

Chemical of Potential Concern	Concentrations in Surface Water ($\mu\text{g/l}$ unless noted); values in boldface indicate appropriately conservative estimates					
	Worst-case modeled increment from facility emissions based on plume mix-in model (as described in 2/15/07 memo) ^A	Sediment concentration based on alternate soil/sediment model (C_{BS} , mg/kg) ^B	Sediment/water partition coefficient (K_{dBS} , l/kg) ^C	Worst-case modeled concentration in water based on assumed equilibrium with bed sediment C_{dw} (based on sediment/soil concentrations) ^D	Background	Benchmark ^F
Chromium	2.4E-02	1.64E-02	1.90E+01	8.6E-01	< 5.0E+00 ^E	4.20E+01
Lead	3.9E-02	5.46E-02	9.00E+02	6.1E-02	< 5.0E+00 ^E	1.17E+00
Mercury	8.6E-02	8.86E-03	5.00E+04	1.8E-04	< 0.05 ^E	1.30E-03
PCDD/PCDF TEQs	4.9E-08	4.77E-09	1.56E+05	3.1E-11	#N/A	3.00E-09

- Notes:
- A Concentrations in surface water are worst-case estimates that assume 100% of the proposed emission increases mix into Lake Decatur.
 - B Input for alternate surface water model based on alternate sediment concentration model (Table 3) that assumes worst-case sediment concentrations are equal to maximum modeled soil concentrations (Table 2).
 - C Sediment/water partition coefficients obtained from the on-line database of the U.S. EPA's Human Health Risk Assessment Protocol (http://www.epa.gov/earth1/r6/6pd/rcra_c/protocol/protocol.htm). Mercury K_{dBS} value selected for mercuric chloride (the most prevalent species in surface water).
 - D Calculated as the sediment concentration divided by the sediment/water partition coefficient.
 - E Neither lead nor chromium was detected in five dissolved (unfiltered) samples collected in Lake Decatur in 2003 (U.S. EPA's STORET database – <http://www.epa.gov/storet> – detection limit: 5 $\mu\text{g/l}$). Additional samples were collected from the Sangamon River just downstream of Lake Decatur near Niantic, IL from 1994 to 1997 (USGS National Water Quality Assessment Data Warehouse. <http://infotrek.er.usgs.gov/traverse/f?p=NAWQA:HOME:1516752920773994>). Chromium and lead were detected infrequently: dissolved chromium in 1 of 24 samples (at 5 $\mu\text{g/l}$), total chromium is 2 of 26 samples (at 5 $\mu\text{g/l}$ and 7 $\mu\text{g/l}$), dissolved lead in 1 of 25 samples (at 7.3 $\mu\text{g/l}$), and total lead in 2 of 26 samples (at 6.9 $\mu\text{g/l}$ and 8.7 $\mu\text{g/l}$). The detection limit in these samples was 5 $\mu\text{g/l}$. Total mercury was not detected in any of 24 samples at the Niantic location at a detection limit of 0.05 $\mu\text{g/l}$.
 - F Benchmark concentrations are U.S. EPA Ecological Screening Levels (ESLs) unless noted (see <http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf> for ESL descriptions).

Clean Air Act permit Endangered Species Act consultation
 Indiana bat (*Myotis sodalis*) food exposure pathway risk calculations
 Chemical: Total Mercury
 DRAFT

Future Emissions Enrichment -Soil	0.0088600000	mg/Kg dw
Past Emissions Enrichment -Soil	0.0000000000	mg/Kg dw
Background Soil Concentration	0.033	mg/Kg dw
Soil to Invert Bioaccumulation Factor	8.5	unitless
Future Emissions Enrichment - Sediments	0.00886	mg/Kg dw
Past Emissions Enrichment -Sediments	0	mg/Kg dw
Background Sediment Concentration	0.12	mg/Kg dw
Sediment to Invert Bioaccumulation Factor	0.48	unitless
Future Emissions Enrichment - Water	0.000000180000	mg/L
Past Emissions Enrichment - Water	0.000000000000	mg/L
Background Water Concentration	0.0000066	mg/L
Water to Invert Bioaccumulation Factor	55000	unitless
Normalized Food Ingestion Rate	0.333	Kg/Kg-bw/d ww
Percent terrestrial insects	0.33	%
Percent infaunal aquatic insects	0.33	%
Percent epifaunal aquatic insects	0.34	%
Normalized Water Intake Rate	0.16	L/Kg-bw/d
Area Use Factor	1	unitless
Seasonal Use Factor	1	unitless
Safety Factor	1	unitless
Incidental Exposures (e.g on insects)	0.01	% of food rate
Methyl Mercury	0.65	% of total Hg
Body Weight	0.0075	Kg
Toxicity Reference Value NOAEL	0.032	mg/kg-bw/d
Toxicity Reference Value LOAEL	0.16	mg/kg-bw/d
Soil to invertebrate burden	0.35581	mg/kg
Sediment to invertebrate burden	0.0618528	mg/kg
Water to invertebrate burden	0.3729	mg/L
Normalized Food dose	0.088116703	mg/kg-bw/d
Drinking water dose	0.00000002880	mg/kg-bw/d
Normalized Food & Water Dose	0.088997899	mg/kg-bw/d
Hazard Quotient NOAEL	1.8078	unitless
Hazard Quotient LOAEL	0.3616	unitless

Soil enrichment percent background 26.8 %
 Water enrichment percent background 2.7 %
 Sediment enrichment percent background 7.4 %
 Water enrichment HQ USEPA wildlife criteria 0.3
 Water enrichment HQ Mich. wildlife criteria 0.1

Sediment concentration is an actual baseline measurement

piscivorous wildlife water criteria 0.000000641 mg total mercury / L (USEPA 1997)
 piscivorous wildlife water criteria 0.0000013 mg total mercury / L (Michigan numeric)

These three values must be ≤ 1

TRVs for methylmercury chloride from Sample *et al.* 1996 (rat) - primary reference Verschuuren *et al.* 1976, USEPA 1997 provides chronic NOAEL 0.018 mg/Kg-bw/d
 Food ingestion and water intake rates from Sample *et al.* 1996 for little brown bat
 [Sum (Abiotic Media Concentration X Bioaccumulation Factor) X Ingestion or Intake Rate / Body Weight] X Use Factors = Dose / Toxicity Reference Value = Hazard Quotient
 Modeled on dry weight basis (dw to ww conversion use X 0.2978)

1 ng = 0.001 µg = 0.000001 mg 1.5E-03 = 0.0015
 ppm = mg/Kg = µg/g = ng/mg = 1000 ppb
 ppb = µg/Kg = ng/g = pg/mg 0.001 ppm
 ppt = ng/Kg = pg/g = fg/mg = ng/L
 ppq = pg/L

Last Updated 2/20/2007

Figure 1 Mercury dietary assessment for the Indiana Bat (F&WS model)

Clean Air Act permit Endangered Species Act consultation
 Indiana bat (*Myotis sodalis*) food exposure pathway risk calculations
 Chemical: TCDD-TEQ
 DRAFT

Future Soil Concentration	4.77E-09 mg/Kg dw
Existing Soil Concentration	0 mg/Kg dw
Soil to Invert BAF	1.59 unitless
Future Sediment Concentration	4.77E-09 mg/Kg dw
Existing Sediment Concentration	0.00E+00 mg/Kg dw
Sediment to Invert BAF	0.9 unitless
Future Water Concentration	3.11E-14 mg/L
Water to Invert BAF	1560 unitless
Normalized Food Ingestion Rate	0.333 Kg/Kg-bw/d ww
Percent terrestrial insects	0.8 %
Percent infaunal aquatic insects	0.2 %
Percent epifaunal aquatic insects	0 %
Normalized Water Intake Rate	0.16 L/Kg-bw/d
Area Use Factor	1 unitless
Seasonal Use Factor	1 unitless
Incidental Exposures (e.g. grooming)	0.1 % of food rate
Body Weight	0.007 Kg
Toxicity Reference Value NOAEL	0.000001 mg/kg-bw/d
Toxicity Reference Value LOAEL?	0.00001 mg/kg-bw/d
Soil to bug burden	7.5843E-09 mg/kg/d
Sediment to bug burden	4.293E-09 mg/kg/d
Water to bug burden	4.8516E-11 mg/L/d
Normalized Food dose	2.30637E-09 mg/kg-bw/d
Drinking water dose	4.976E-15 mg/kg-bw/d
Normalized Food & Water Dose	2.53701E-09 mg/kg-bw/d
Hazard Quotient	0.003 unitless
Hazard Quotient	0.0003 unitless

Effects analysis:

Direct affects (chemical): see risk calculation

Direct affects (physical): see tree removal mitigation plan

Indirect affects (chemical): see direct tox to invert HQs

Interrelated affects (physical): powerline construction (not considered)

Cumulative affects (chemical): Considered in risk calculation

Model considered dw to ww conversion or may use X 0.2978

Did not consider existing water concentration because retention time assumed low

Diet rates from Sample *et al.* 1996 for little brown bat

These three values must be < 1

TRVs from Murray *et al.* 1979 rat multigeneration reproduction

S Weighted (Abiotic Media Concentration X Bioaccumulation Factor) X Food Ingestion Rate/Body Weight X Use Factors = Dose / Toxicity Reference Value = Hazard Quotient

1 ng = 0.001 :g = 0.000001 mg

.15E-03 = 0.0015

ppm = mg/Kg = :g/g = ng/mg = 1000 ppb

ppb = :g/Kg = ng/g = pg/mg 0.001 ppm

ppt = ng/Kg = pg/g = fg/mg

Figure 2 PCDD/PCDF dietary assessment for the Indiana Bat

Estimated Soil Impacts

Pollutant	Project Contribution (mg/kg)	Background (mg/kg)	Project + Background (mg/kg)	Benchmark (mg/kg)	Hazard Quotient
Barium	5.14E-02	1.10E+02	1.10E+02	3.30E+02	3.33E-01
Magnesium	9.62E-02	4.82E+03	4.82E+03	NA	No benchmark
Molybdenum	1.28E-02	1.20E+00	1.21E+00	2.00E+00	6.06E-01
Vanadium	2.68E-02	2.52E+01	2.52E+01	7.80E+00	3.23E+00
Zinc	3.38E-01	9.50E+01	9.53E+01	6.62E+00	1.44E+01
Dimethyl Sulfate	5.51E-09	NA	5.51E-09	NA	No benchmark
Ethylene Glycol	1.31E+01	NA	1.31E+01	9.00E+01	1.46E-01
Methanol	8.89E-02	NA	8.89E-02	3.30E+01	2.69E-03
7,12-Dimethylbenz(a)anthracene	2.37E-04	NA	2.37E-04	1.63E+01	1.45E-05
3-Methylcholanthrene	2.67E-05	NA	2.67E-05	7.79E-02	3.43E-04

Pollutant	Project Contribution (mg/kg)	Background (mg/kg)	Project + Background (mg/kg)	Benchmark (mg/kg)	Hazard Quotient
Chromium	1.64E-02	1.62E+01	1.62E+01	3.40E+01	4.77E-01
Lead	5.46E-02	3.60E+01	3.61E+01	5.60E+01	6.44E-01
Mercury	8.86E-03	3.30E-02	4.19E-02	1.00E-01	4.19E-01
PCDD/PCDF TEQs	4.77E-09	NA	4.77E-09	1.99E-07	2.40E-02

Estimated Water Impacts

Pollutant	Project Contribution (µg/l)	Background ((µg/l)	Project + Background (µg/l)	Benchmark ((µg/l)	Hazard Quotient
Barium	1.98E-03	5.16E+01	5.16E+01	5.00E+03	1.03E-02
Magnesium	9.81E-01	2.56E+04	2.56E+04	6.47E+02	3.96E+01
Molybdenum	4.96E-04	NA	4.96E-04	7.30E+01	6.79E-06
Vanadium	1.04E-03	NA	1.04E-03	1.20E+01	8.67E-05
Zinc	1.31E-02	5.00E+00	5.01E+00	1.00E+03	5.01E-03
Dimethyl Sulfate	4.28E-03	NA	4.28E-03	NA	No benchmark
Ethylene Glycol	1.15E+01	NA	1.15E+01	1.92E+05	5.99E-05
Methanol	5.80E+01	NA	5.80E+01	NA	No benchmark
7,12-Dimethylbenz(a)anthracene	1.46E-05	NA	1.46E-05	5.48E-01	2.66E-05
3-Methylcholanthrene	1.64E-06	NA	1.64E-06	8.91E-02	1.84E-05

Pollutant	Project Contribution ((µg/l)	Background ((µg/l)	Project + Background ((µg/l)	Benchmark ((µg/l)	Hazard Quotient
Chromium	2.40E-02	5.00E+00	5.02E+00	4.20E+01	1.20E-01
Lead	3.90E-02	5.00E+00	5.04E+00	1.17E+00	4.31E+00
Mercury	1.80E-04	5.00E-02	5.02E-02	1.30E-03	3.86E+01
PCDD/PCDF TEQs	3.10E-11	NA	3.10E-11	3.00E-09	1.03E-02

Estimated Sediment Impacts

Pollutant	Project Contribution (mg/kg)	Background (mg/kg)	Project + Background (mg/kg)	Benchmark (mg/kg)	Hazard Quotient
Barium	1.56E-01	1.85E+02	1.85E+02	NA	No benchmark
Magnesium	7.70E+01	8.30E+03	8.38E+03	NA	No benchmark
Molybdenum	3.89E-02	2.00E+00	2.04E+00	NA	No benchmark
Vanadium	8.14E-02	7.50E+01	7.51E+01	NA	No benchmark
Zinc	1.03E+00	8.75E+01	8.85E+01	1.21E+02	7.32E-01
Dimethyl Sulfate	3.36E-01	NA	3.36E-01	NA	No benchmark
Ethylene Glycol	9.03E+02	NA	9.03E+02	NA	No benchmark
Methanol	4.56E+03	NA	4.56E+03	NA	No benchmark
7,12-Dimethylbenz(a)anthracene	1.15E-03	NA	1.15E-03	6.64E+01	1.73E-05
3-Methylcholanthrene	1.29E-04	NA	1.29E-04	8.19E+03	1.58E-08

Pollutant	Project Contribution (mg/kg)	Background (mg/kg)	Project + Background (mg/kg)	Benchmark (mg/kg)	Hazard Quotient
Chromium	1.64E-02	2.20E+01	2.20E+01	4.34E+01	5.07E-01
Lead	5.46E-02	2.05E+01	2.06E+01	3.58E+01	5.74E-01
Mercury	8.86E-03	1.20E-01	1.29E-01	1.74E-01	7.41E-01
PCDD/PCDF TEQs	4.77E-09	NA	4.77E-09	1.20E-07	3.98E-02