



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

MAR 08 2012

REPLY TO THE ATTENTION OF:

Richard Nelson
Field Supervisor
Rock Island Illinois Field Office
United States Fish and Wildlife Service
1511 47th Avenue
Moline, Illinois 61265

Dear Mr. Nelson:

Pursuant to Section 7 of the Endangered Species Act, (87 Stat. 884, as amended; 16 U.S. C. 1531 et seq.), the U. S. Environmental Protection Agency has reviewed the biological information and analysis related to a Prevention of Significant Deterioration (PSD) permit for the proposed Taylorville Energy Center which will be located in Taylorville, Illinois, to determine what impact there may be to any threatened or endangered species in the area around the facility. EPA and the U. S. Fish and Wildlife Service had concluded consultation on this project on April 16, 2007; however, since that time various design changes to the proposed facility have required an amendment to the original PSD permit. Cambridge Environmental Inc. has prepared a revised analysis for the Taylorville project on behalf of Christian County Generation, L.L.C., dated January 24, 2012 (See enclosure). EPA has reviewed the analysis and has determined that the project may affect, but is not likely to adversely affect, any federally listed species. The purpose of this letter is to seek concurrence from the U. S. Fish and Wildlife Service on our determination. If you have any questions with respect to this letter, please contact Rachel Rineheart, of my staff, at (312) 886-7017.

Sincerely,

A handwritten signature in cursive script that reads "Genevieve Damico".

Genevieve Damico
Chief
Air Permits Section

Enclosure

cc: Laurel Kroak, IEPA

**Taylorville Energy Center
Supplemental Ecological Screening Assessment
for
Threatened and Endangered Wildlife Species**

Prepared for:
Christian County Generation, L.L.C.

Prepared by:
Stephen G. Zemba, Ph.D., P.E.



Cambridge Environmental Inc.
58 Charles Street
Cambridge, MA 02141
617-225-0810
www.CambridgeEnvironmental.com

In cooperation with:



Trinity Consultants
1717 Dixie Hwy, Suite 900
Covington, KY 41011

January 24, 2012

Introduction and Background

Christian County Generation, L.L.C. (CCG) has proposed to construct a nominal 716 MW_{gross} substitute natural gas (SNG)-fired Integrated Gasification Combined Cycle (IGCC) power plant to be located in Christian County, Illinois, within the city of Taylorville [herein referred to as the Taylorville Energy Center (TEC)]. A final revised PSD permit application was submitted to the Illinois Environmental Protection Agency (IEPA) in October 2010.¹ IEPA issued a Draft PSD Construction Permit (No. 05040027) on October 17, 2011.

The October 2011 draft permit addresses various design changes to the facility's configuration as originally described in the June 2007 construction permit for the project (Final PSD Construction Permit Number 05040027). The primary design changes are (1) the addition of an extra step in the gasification process that converts syngas into substitute natural gas (SNG) and (2) the addition of equipment for separation of CO₂ from the synthesis gas.

A previous Endangered Species Act (ESA) Screening Level Ecological Risk Assessment (SLERA) was developed for the TEC in December 2006 by Kentuckiana Engineering Company, Inc., and was used as information in consultation between the U. S. Environmental Protection Agency (U.S. EPA) and the U.S. Fish and Wildlife Service (FWS). Based on the SLERA results for the chemicals of potential environmental concern (COPECs) recommended for evaluation in the scoping document, U.S. EPA concluded in an April 5, 2007 letter to FWS that the TEC was not likely to affect any threatened and endangered (T&E) species.² Upon reviewing the SLERA and recommended conclusions from U.S. EPA, FWS issued a letter of concurrence which agreed that the TEC "will not likely adversely affect federally listed species in the action as defined in the biological evaluation (*i.e.*, the SLERA)."³ As a matter of policy, FWS also stated in the concurrence letter that if the design of the proposed project is modified or new information indicating potential affects on endangered species is discovered a consultation with U.S. EPA Region 5 and FWS should be initiated.

The aforementioned design changes to the TEC were substantial enough that CCG contacted U.S. EPA Region 5 to initiate a supplemental consultation process with FWS. Through this process, U.S. EPA and FWS confirmed that the "Recommended Scope of Analysis" issued for the TEC on August 24, 2006 is still valid and that a new evaluation of the T&E species habitats within the action area is not necessary. In addition, U.S. EPA and FWS concluded that only those COPECs with an increase in annual potential emissions from the original SLERA would

¹ General references to the permit application in this comment letter refer to the three volume "Updated Prevention of Significant Deterioration and State Construction Permit Application for the Taylorville Energy Center" submitted by Christian County Generation in the following three parts: 1) Volume 1 of 3 - Updated Permit Application submitted on September 24, 2010, 2) Volume 2 of 3 - Class II Area Air Quality Modeling Report submitted on October 14, 2010, and 3) Volume 3 of 3 - Greenhouse Gas Best Available Control Technology Analysis submitted October 27, 2010. In this comment letter, these application submittals are generally referred to as "the Permit Application."

² Letter from Pamela Blakley, U.S. EPA Region 5, to Richard Nelson, Rock Island Illinois Field Office, U.S. Fish & Wildlife Service, dated April 5, 2007.

³ Letter from Richard Nelson, Rock Island Illinois Field Office, U.S. Fish & Wildlife Service to Pamela Blakley, U.S. EPA Region 5.

require evaluation. As shown in the annual potential emissions comparison for all relevant COPECs between the original and revised TEC designs provided in Appendix A, the only pollutants experiencing an increase as a result of the design changes are some polycyclic aromatic hydrocarbons (PAHs) and formaldehyde.

This Supplemental Ecological Screening Assessment (SESA) evaluates whether the increased emissions of these pollutants from the proposed Taylorville Energy Center (TEC) might affect threatened and endangered wildlife species. A detailed description of the TEC can be found in the Illinois Environmental Protection Agency's *Project Summary for a Construction Permit Application from Christian County Generation, LLC for the Taylorville Energy Center, Christian County, Illinois*. The *Project Summary* reviews and relies upon information submitted by Christian County Generation, LLC in required permit applications. For brevity, relevant information from the draft permit, project summary, and permit application are referenced as necessary throughout this SESA to avoid unnecessary repetition of previously provided information for the project.

Relevant Threatened and Endangered Species⁴

There are at present two Federally Endangered, Threatened, Proposed, and Candidate Species for Christian County: the Indiana Bat (*Myotis sodalists*) is designated as endangered, and the Eastern prairie fringed orchid (*Platanthaera leucophaea*) is designated as threatened (<http://www.fws.gov/midwest/endangered/lists/illinois-cty.html>).

The Indiana Bat is a small, dark-brown bat weighing approximately one-quarter of an ounce. The bats can be found in caves and mines, and forage in small stream corridors with well developed riparian woods and upland forests.⁵ The Indiana Bat hibernates during winter in caves or, occasionally, in abandoned mines. After hibernation, Indiana bats migrate to their summer habitat in wooded areas where they usually roost under loose tree bark on dead or dying trees. Indiana Bats forage in or along the edges of forested areas and eat a variety of flying insects found along rivers or lakes and in uplands.

Indiana bats occupy distinct home ranges, particularly in the summer. However, relatively few studies have determined the home ranges of Indiana bats, and these studies based their calculations on a small number of individuals. Studies identified home ranges as small as 28 ha (69 acres) to as large as 1,584 ha (3,825 acres).

The Eastern prairie fringed orchid is an 8 to 40 inch tall plant that has an upright leafy stem with a flower cluster called an inflorescence. Each plant has one single flower spike composed of 5 to

⁴ This SESA focuses on animals and plants on the federal threatened and endangered species list. Illinois maintains a larger state list of threatened and endangered species. A search of the ECOCAT database (<http://dnrecocat.state.il.us/ecopublic/>), however, found no records of state-listed threatened or endangered wildlife species in the vicinity of the proposed TEC project.

⁵ Sources: <http://www.fws.gov/midwest/endangered/mammals/inba/index.html>; <http://www.fws.gov/midwest/Endangered/section7/s7process/mammals/inba/inbaMlifehist.html>; and <http://www.fws.gov/midwest/endangered/mammals/inba/inbafactsht.html>.

40 creamy white flowers. The Eastern prairie fringed orchid is a perennial herb that grows from an underground tuber. Flowering begins from late June to early July, and lasts for 7 to 10 days. The Eastern prairie fringed orchid occurs in a wide variety of habitats, from mesic prairie to wetland communities such as sedge meadows, marsh edges, and even bogs.

The Eastern prairie fringed orchid was once widespread across the upper Midwest, but after it had declined in range by more than 70 percent, it was listed as threatened in 1989.⁶ Early decline was due to the loss of habitat, mainly conversion of natural habitats to cropland and pasture. Current decline is mainly due to the loss of habitat from the drainage and development of wetlands. Other reasons for the current decline include succession to woody vegetation, competition from non-native species and over-collection.

According to the findings of the U.S. EPA Region 5's April 5, 2007 opinion letter to the FWS, the Eastern prairie fringed orchid is not known to exist within the TEC's study area.

The 2006 SLERA also considered the Bald eagle (*Haliaeetus leoccephalus*) and the Leafy prairie clover (*Dalea foliosa*) as potential species of concern. The Bald eagle has been removed from the list of threatened and endangered species in the intervening period since the 2006 SLERA. Also, like the Eastern prairie fringed orchid, there is no suitable habitat for the Leafy prairie clover in the vicinity of the TEC that might be affected by pollutant emissions.

Consequently, the principal species of concern for this SESA is the Indiana bat.

Chemicals of Potential Environmental Concern

The Permit Application includes an evaluation of potential adverse impacts to soils and vegetation from the various criteria pollutants and hazardous air pollutants (HAPs) expected to be emitted by the TEC. The results of this analysis demonstrated that expected impacts from the TEC are below all relevant acute and chronic ecological risk thresholds. As recommended by U.S. EPA and FWS, this SESA undertakes a more detailed evaluation of HAP emissions. The updated HAP emission calculations for the TEC design changes (included in Sections C-22 to C-23 of Appendix C to Volume 1 of the Application and summarized in Appendix A) indicate that fourteen (14) HAPs could have higher annual potential emissions than the emissions presented in the 2006 ESA. With one exception (formaldehyde), these compounds are members of the PAH family. Table B-1.1 in Appendix B lists these COPECs along with upper estimates of the anticipated annual average emission rates from the TEC.

⁶ Sources: http://www.fws.gov/midwest/endangered/img_coll/plants/easternp.jpg; <http://www.fws.gov/midwest/endangered/plants/epfo.html>; http://ecos.fws.gov/docs/recovery_plan/990929.pdf; <http://www.fws.gov/endangered/bulletin/2003/07-12/14-15.pdf>.

Dispersion and Deposition Modeling

Atmospheric dispersion and deposition modeling of the COPECs that may be emitted from the TEC was performed with the AERMOD modeling system using facility and site-specific parameters and methodologies as described in Volume 2 of the Permit Application. Modeling procedures follow those used for benzo(a)anthracene (a member of the PAH family of pollutants), which was modeled in support of the soils and vegetation analysis required for the PSD permit. Modeling procedures have been reviewed and approved by the Illinois EPA and are described in detail in Volume 2 of the Permit Application.

Modeling methods were extended to estimate pollutant deposition rates to terrestrial and aquatic habitats for this analysis. To properly model the wet and dry deposition (*i.e.*, deposition with and without precipitation) of pollutants from the atmosphere, it is necessary to consider the physical form of the COPECs, and how they interact with moisture in the air and with the complex surfaces to which they may deposit. Each compound's emissions were divided into particulate-phase and vapor-phase emissions using the vapor fraction parameter, F_v , from the U.S. EPA's Screening Level Ecological Risk Assessment Protocol (SLERAP, U.S. EPA, 1999) chemical properties database. The particulate-phase and vapor-phase emissions were then divided into categories based on the particle and vapor deposition-related properties.

For those COPECs that in part or whole are associated with particles, deposition rates from the atmosphere are largely governed by the particles' sizes. Two different types of particle size distributions are generally used to assess deposition based on how the specific pollutants are found in the particles: (1) mass-weighted values are used for pollutants that are likely to be distributed uniformly throughout particles in the stack emissions; and (2) surface-weighted values are used for pollutants that are likely to condense (or form) onto the surfaces of existing particles as combustion gases cool prior to their release from the stack. In accordance with U.S. EPA methods, COPECs with a vapor-phase fraction, F_v , of less than 0.05 are assumed to be emitted with a mass-weighted particle size distribution, and those with a vapor-phase fraction, F_v , of greater than 0.05 but less than 1.0 are assumed to be emitted with a surface-weighted particle size distribution. Values of F_v are available from the SLERAP for all but two COPECs – 3-methylcholanthrene and 7,12-dimethylbenz(a)anthracene – both of which are solids at standard conditions. For these COPECs, F_v values are estimated according to methods recommended in the SLERAP (refer to Equations A-2-10 and A-2-11 in Appendix A-2 of the SLERAP):

$$\text{Equation 1} \quad F_v = 1 - \frac{c S_T}{P_L^o + c S_T}$$

$$\text{Equation 2} \quad \ln\left(\frac{P_L^o}{P_S^o}\right) = \frac{\Delta S_f (T_m - T)}{R T}$$

where the terms are:

F_v	Fraction of COPEC in vapor phase;
c	Junge constant = 0.00017 atm-cm;
S_T	Whitby's average surface area of particulates (aerosols) = 0.0000035 cm ² /cm ³ for non-urban areas;
P_L^o	Vapor pressure of the COPEC above the liquid phase (atm);
P_S^o	Vapor pressure of the COPEC above the solid phase (atm, for COPECs that are solids at standard temperature and pressure);
R	Universal gas constant (0.00008205 atm-m ³ /mol-K);
ΔS_f	Entropy of fusion ($\Delta S_f/R = 6.79$, non-dimensional);
T_m	Melting temperature of the COPEC if solid at standard temperature and pressure (K); and
T	Standard temperature (298 K).

The F_v values and supporting property values required for conducting vapor phase deposition modeling of the selected COPECs are provided in Table 1.

The deposition behavior of vapor-phase compounds from the atmosphere is governed by a variety of factors including how the compound partitions between the vapor and aqueous-phases (*i.e.*, its Henry's Law constant), its diffusivity in both air and water, its resistance to cuticular uptake by lipids in leafy vegetation, and the surface characteristics of the area being considered (*e.g.*, whether the area is open water, forested, or urban). These chemical properties are taken per U.S. EPA recommendation from modeling guidance used to support the AERMOD system (Wesely, 2002), and are summarized in Table 1. The AERMOD deposition algorithms also require information on land surface characteristics, and this information is described in the documentation for the soils and vegetation analysis in Volume 2 of the Permit Application.

A summary of the results of the air dispersion modeling analysis are provided in Table 2, in which the highest offsite annual average COPEC concentrations predicted at ground-level are compared with typical background concentrations. Because the atmospheric dispersion modeling is the first step employed in assessing the impacts of the facility's emissions, predicted concentrations in air contain the lowest degree of uncertainty (compared against the soil, water, and sediment concentrations which rely on the further modeling of deposition phenomena and numerous fate-and-transport assumptions). Thus, the comparison of modeled air quality impacts from the proposed facility against measured and modeled background air quality data provides a simple means of assessing the magnitude of the facility's likely impacts relative to current impacts from other sources.

The background concentrations labeled "NATA values" are from the U.S. EPA's most recent National-Scale Air Toxics Assessment (NATA), which produced modeled concentrations of HAPs for each U.S. Census Tract based on emissions estimates for the year 2005. The data shown are for tract 958600 which contains the proposed facility.⁷ The NATA 2005 estimates do not distinguish individual PAHs, so a total PAH value is provided at the bottom of Table 2.

⁷ NATA data for Christian County, IL, U.S. Census Tract 958600 from the U.S. EPA's 2005 National-Scale Air Toxics Assessment (NATA). Accessed at <http://www.epa.gov/ttn/atw/nata2005/tables.html>.

Other background data included in Table 2 are derived from the air quality monitoring program at St. Louis, MO (the closest location with data available for PAHs).

All of the modeled worst-case impacts due to TEC emissions are well below existing background levels. Consequently, the air quality impacts at receptor locations of significant ecological interest are all expected to be fairly small relative to current levels.

Estimation of COPEC Concentrations in Environmental Media

COPECs depositing from the atmosphere enter terrestrial and aquatic ecosystems. U.S. EPA Region 5 and other regulatory authorities have established screening-levels in environmental media such as soil, surface water, and sediment to identify situations in which COPEC concentrations might be high enough to present risk to environmental receptors through contact and dietary exposure.

Estimates of the incremental increases in the concentrations of various COPECs in soil, surface water, and sediment are estimated according to methods recommended in the SLERAP. The methods begin with the concentrations in air and deposition rates predicted by AERMOD. A summary of the equations, assumptions, and predicted results of the SLERAP-based algorithms follows. Detailed lists of inputs and intermediate calculations are provided in Appendix B.

Modeling incremental soil concentrations

The modeled, incremental concentrations of COPECs in nearby soils due to emissions from the proposed TEC facility are dependent on each compound's deposition rate from the atmosphere, the rate at which the compound is lost from or degraded in the soil, and the length of time over which these processes have occurred.

Equation 3 was used to calculate soil concentrations of compounds emitted from the TEC.

$$\text{Equation 3} \quad C_{S,tD} = \frac{D_s \cdot [1 - \exp(-ks \cdot tD)]}{ks}$$

where the terms are:

- $C_{S,tD}$ Soil concentration at time tD (mg/kg);
- D_s Deposition term (mg/kg soil/yr);
- ks Compound soil loss constant due to all processes (yr^{-1}); and
- tD Time period over which deposition occurs (time period of combustion, yr).

Default values for $T_1=0$, and $tD=100$ years are taken from the SLERAP Appendix Table B-1-1. The deposition term, D_s , is calculated using Equation 4 from the compound-specific atmospheric concentrations and deposition rates determined by the AERMOD modeling described above. In contrast to the modeling approach assumed in the SLERAP, CCG modeled each selected COPEC separately instead of conducting a single modeling scenario with unitized emission rates. The unitized emission rate approach would be more difficult to implement at the TEC

given the larger number of modeled sources as compared to a hazardous waste combustor (*i.e.*, the industrial source type for which the SLERAP was originally developed). Under this alternate approach, the compound-specific AERMOD results for wet and dry deposition of particles and vapors are converted directly into a soil concentration deposition term D_s by including the soil mixing depth and density in the denominator as shown in Equation 4 (without the need to first calculate a compound-specific modeled deposition rate from the unitized deposition results and the compound-specific emission rate as envisioned by the SLERAP equations).

$$\text{Equation 4} \quad D_s = \left[\frac{100}{Z_s \cdot BD} \right] \cdot [(Dydv + Dywv) + (Dydp + Dywp)]$$

where the terms are:

D_s	Deposition term (mg/kg soil-yr);
100	Units conversion factor (mg-m ² /kg-cm ²);
Z_s	Soil mixing zone depth (cm);
BD	Soil bulk density (g soil/cm ³ soil);
$Dydv$	Annual average dry deposition from vapor-phase (g/m ² -yr);
$Dywv$	Annual average wet deposition from vapor-phase (g/m ² -yr);
$Dydp$	Annual average dry deposition from particle-phase (g/m ² -yr); and
$Dywp$	Annual average wet deposition from particle-phase (g/m ² -yr).

Note that Equation 4 is adapted from the SLERAP guidance (U.S. EPA, 1999) to accommodate AERMOD's ability to model COPEC-specific vapor deposition. Additionally, COPEC emissions were modeled directly in AERMOD (rather than using the SLERAP-recommended indirect method of unitized emission rates) to handle TEC's multiple emission sources. A soil mixing zone depth of 1 cm was used as the default for untilled soils. The soil bulk density, BD , is 1.5 g/cm³. Locations of the modeled maximum deposition impacts to some extent differ among COPECs and modes (wet vs. dry) based on the influence of chemical-specific properties. For matters of both simplicity and conservatism, the maximum predicted rates of deposition across the study area (*i.e.*, modeled receptor grid) for each deposition mode are evaluated independently and are treated as occurring at a common location irrespective of the actual geographic patterns of the predictions.

The loss rate for compounds from soils, ks , is the sum of terms as shown in Equation 5.

$$\text{Equation 5} \quad ks = ksg + kse + ksr + ksl + ksv$$

where the terms are:

ks	Compound soil loss constant due to all processes (yr ⁻¹);
ksg	Compound loss constant due to biotic and abiotic degradation (yr ⁻¹);
kse	Compound loss constant due to soil erosion (yr ⁻¹);
ksr	Compound loss constant due to surface runoff (yr ⁻¹);
ksl	Compound loss constant due to leaching (yr ⁻¹); and
ksv	Compound loss constant due to volatilization (yr ⁻¹).

Based on SLERAP Appendix Table B-1-2, k_{se} is taken as zero. k_{sg} values are compound-specific and are taken either from the SLERAP database or derived per its recommendations (see Table 3 for values). Losses of compounds due to surface runoff, k_{sr} , and leaching, k_{sl} , are dependent on the compound's soil-water partitioning coefficient and the amount of water available for these processes as given in Equation 6 and Equation 7.

$$\text{Equation 6} \quad k_{sr} = \frac{RO}{\theta_{sw} \cdot Z_s} \cdot \left(\frac{1}{1 + \left(Kd_s \cdot BD / \theta_{sw} \right)} \right)$$

$$\text{Equation 7} \quad k_{sl} = \frac{P + I - RO - E_v}{\theta_{sw} \cdot Z_s \cdot \left[1 + \left(Kd_s \cdot BD / \theta_{sw} \right) \right]}$$

where the terms are:

- k_{sr} Compound loss constant due to surface runoff (yr^{-1});
- k_{sl} Compound loss constant due to leaching (yr^{-1});
- RO Average annual surface runoff from pervious areas (cm/yr);
- P Average annual precipitation (cm/yr);
- I Average annual irrigation (cm/yr);
- E_v Average annual evapotranspiration (cm/yr);
- θ_{sw} Soil volumetric water content (ml water/cm^3 soil);
- Z_s Soil mixing zone depth (cm);
- Kd_s Soil-water partition coefficient (ml water/g soil); and
- BD Soil bulk density (g soil/cm^3 soil).

Based on SLERAP Appendix B-1-5 and its recommended sources (see Appendix B), appropriate region-specific values are $RO = 25.4 \text{ cm/yr}$, $P = 89.54 \text{ cm/yr}$, $I = 25 \text{ cm/yr}$, and $E_v = 55 \text{ cm/yr}$. Default values are used for $BD = 1.50 \text{ g/cm}^3$ and $\theta_{sw} = 0.2 \text{ ml/cm}^3$, and compound-specific values are used for Kd_s , as taken from either the SLERAP or derived per its recommended sources (see Table 3 for values).

The calculation of the compound loss constant due to volatilization, k_{sv} , is the product of the gas equilibrium coefficient, Ke , and the gas-phase mass transfer coefficient, K_t , as shown in Equation 8.

$$\text{Equation 8} \quad k_{sv} = Ke \cdot K_t$$

The equilibrium coefficient, Ke , is given by Equation 9.

$$\text{Equation 9} \quad Ke = \frac{3.1536 \times 10^7 \cdot H}{Z_s \cdot K_{ds} \cdot R \cdot T_a \cdot BD}$$

where the terms are:

Ke	Compound gas equilibrium coefficient (s/yr-cm);
3.1536×10^7	Units conversion (s/yr);
H	Henry's Law constant (atm-m ³ /mol, see Table 1 for Pa-m ³ /mol values);
Z_s	Soil mixing zone depth (cm);
K_{ds}	Soil-water partition coefficient (ml/g, Table 3);
R	Ideal gas constant (atm-m ³ /mol-K) = 8.205×10^{-5} atm-m ³ /mol-K;
T_a	Average ambient air temperature (K); and
BD	Soil bulk density (g soil/cm ³ soil).

The gas-phase mass transfer coefficient, K_t , is given by Equation 10.

$$\text{Equation 10} \quad K_t = \frac{D_a}{Z_s} \left(1 - \left(\frac{BD}{\rho_s} \right) - \theta_{sw} \right)$$

where the terms are:

K_t	Gas-phase mass transfer coefficient (cm/s);
D_a	Diffusion coefficient in air (cm ² /s, Table 1);
Z_s	Soil mixing zone depth (cm);
BD	Soil bulk density (g soil/cm ³ soil);
ρ_s	Density of soil solids (g/cm ³); and
θ_{sw}	Volumetric soil water content (unitless).

SLERAP default values were used for $Z_s = 1$ cm, $T_a = 298$ K, $BD = 1.50$ g/cm³, $\theta_{sw} = 0.2$ ml/cm³, and $\rho_s = 2.7$ g/cm³. Compound-specific values were used for H , K_{ds} and D_a , as provided in Table 1 and Table 3 and are either SLERAP-recommended values or derived from its recommended methods.

Modeling incremental water body concentrations

Incremental concentrations of compounds in local surface water bodies due to emissions from the TEC are calculated based on either a simple, conservative screening model or, for volatile organic compounds (those with a vapor pressure of 0.1 mm of Hg or greater), a simple bounding calculation based on each compound's Henry's Law constant. The screening model estimates the concentrations as the average deposition flux of each compound divided by the average precipitation level, as expressed in Equation 11.⁸

$$\text{Equation 11} \quad C_{wtot} = 100 \cdot \frac{[(Dydv + Dywv) + (Dydp + Dywp)]}{P}$$

⁸ The screening-level model provides worst-case estimates of COPEC concentrations in water over the long-term as all of the pollutant that deposits in the watershed is assumed to enter surface water.

where the terms are:

C_{wtot}	Total water body compound concentration, including water column and bed sediment (mg/l water column);
$Dydv$	Annual average dry deposition from vapor-phase (g/m ² -yr);
$Dyvw$	Annual average wet deposition from vapor-phase (g/m ² -yr);
$Dydp$	Annual average dry deposition from particle-phase (g/m ² -yr);
$Dywp$	Annual average wet deposition from particle-phase (g/m ² -yr);
P	Average annual precipitation (cm/yr) = 89.54 cm/yr (see Appendix B); and
100	Units conversion factor (mg-cm-m ² /g-l).

This screening model will over-estimate incremental concentrations in surface water because it does not include any loss terms for compounds that might either volatilize or be degraded either in the water itself or from other areas of the watershed, or for compounds that might become bound to soils in the watershed and not enter the water.

The partitioning of compounds between the water column and the benthic sediments is calculated using partitioning equations from the SLERAP guidance. The fraction of each compound in the total water body that is within the water column is given by Equation 12.

$$\text{Equation 12} \quad f_{wc} = \frac{(1 + Kd_{sw} \cdot TSS \cdot 1 \times 10^{-6}) \cdot d_{wc} / d_z}{(1 + Kd_{sw} \cdot TSS \cdot 1 \times 10^{-6}) \cdot d_{wc} / d_z + (\theta_{bs} + Kd_{bs} \cdot C_{BS}) \cdot d_{bs} / d_z}$$

The balance of each compound in the water body contained within the benthic sediment is then simply expressed as in Equation 13.

$$\text{Equation 13} \quad f_{bs} = 1 - f_{wc}$$

where the terms are:

f_{wc}	Fraction of total water body compound concentration in the water column (unitless);
f_{bs}	Fraction of total water body compound concentration in benthic sediment (unitless);
Kd_{sw}	Suspended sediments/surface water partition coefficient (l water/kg suspended sediment – see Table 3);
TSS	Total suspended solids concentration (mg/l);
1×10^{-6}	Units conversion factor (kg/mg);
d_z	Total water body depth (m);
θ_{bs}	Bed sediment porosity (unitless);
Kd_{bs}	Bed sediment/sediment pore water partition coefficient (l water/kg bottom sediment);
C_{BS}	Bed sediment concentration (g/cm ³ [equivalent to kg/l]);
d_{wc}	Depth of water column (m); and
d_{bs}	Depth of upper benthic sediment layer (m).

The values for total suspended solids concentration TSS of 10 mg/l, θ_{bs} of 0.6, C_{BS} of 1 g/cm³, and d_{bs} of 0.03 m, are default values from SLERAP guidance (see Appendix B). The water column depth d_{wc} is assumed to be 2.77 m based on measurements in Lake Taylorville (the most significant surface water body in the vicinity of the TEC).⁹ The total water body depth d_z is the sum of the water column depth d_{wc} and d_{bs} . The partitioning coefficients Kd_{sw} , and Kd_{bs} are compound-specific (see Table 3).

The concentration of each compound in the water column (C_{wctot}) (as opposed to within the benthic sediments) is given by Equation 14.

$$\text{Equation 14} \quad C_{wctot} = f_{wc} \cdot C_{wtot} \cdot \frac{d_{wc} + d_{bs}}{d_{wc}}$$

where the terms are:

- C_{wctot} Total compound concentration in water column (mg/l water column);
- f_{wc} Fraction of total water body compound concentration in the water column (unitless);
- C_{wtot} Total water body compound concentration, including water column and bed sediment (mg/l water column);
- d_{wc} Depth of water column (m); and
- d_{bs} Depth of upper benthic sediment layer (m).

Finally, the concentrations of compounds within the benthic sediments are given by Equation 15.

$$\text{Equation 15} \quad C_{sed} = f_{bs} \cdot C_{wtot} \cdot \left(\frac{Kd_{bs}}{\theta_{bs} + Kd_{bs} \cdot C_{BS}} \right) \cdot \left(\frac{d_{wc} + d_{bs}}{d_{bs}} \right)$$

where the terms are:

- C_{sed} Compound concentration sorbed to bed sediment (mg/kg sediment);
- f_{bs} Fraction of total water body compound concentration in benthic sediment (unitless);
- C_{wtot} Total water body compound concentration, including water column and bed sediment (mg/l water column);
- Kd_{bs} Benthic sediments/sediment pore water partition coefficient (l water/kg sediment – see Table 3);
- θ_{bs} Bed sediment porosity (unitless);
- C_{BS} Bed sediment concentration (g/cm³);
- d_{wc} Depth of water column (m); and
- d_{bs} Depth of upper benthic sediment layer (m).

⁹ Depth of water column (average depth in Table 5-8 of the South Fork Sangamon River/Lake Taylorville TMDL Report prepared by the Illinois EPA in December 2007, IEPA/BOW/07-027).

The distribution fractions, f_{wc} and f_{bs} , have been calculated based on equations described above. The depth of the upper benthic sediment layer, d_{bs} , the bed sediment porosity, θ_{bs} , and the bed sediment concentration, C_{BS} , are default parameters as described above. The depth of the water column, d_{wc} is taken from the previously cited Lake Taylorville study. The partitioning coefficients, Kd_{yw} and Kd_{bs} , are compound-specific properties from the SLERAP database (or estimated according to SLERAP recommendations – see Table 3).

For volatile organic compounds with a vapor pressure of 0.1 mm of Hg or greater, a simple calculation, based on each compound's Henry's Law constant, was used to place an upper bound on the compound's incremental concentration in surface water, as shown in Equation 16.

$$\text{Equation 16} \quad C_{wtotH} = \frac{C_{yv} \cdot 24.45}{H \cdot 10^9}$$

where the terms are:

C_{wtotH}	Bounding total water body compound concentration based on Henry's Law constant (mg/l water column);
C_{yv}	Modeled COPEC concentration in air ($\mu\text{g}/\text{m}^3$) – see Table 2;
H	Henry's Law constant ($\text{atm}\cdot\text{m}^3/\text{mol}$) – see Table 1;
24.45	Molar gas volume (l/mole) at 298 K; and
10^9	Units conversion factor [$(\text{l}/\text{m}^3)^2 \times (\mu\text{g}/\text{mg})$].

Comparison of Media Concentrations to Benchmark Concentrations

The worst-case estimates of incremental increases of COPEC concentrations in soil, surface water, and sediment are summarized in Table 4 (see Appendix B for detailed calculations). All predicted incremental concentrations that might result from operation of the TEC are orders of magnitude smaller than the screening-level benchmark concentrations conservatively designed to identify potential environmental risks. The smallest margin of safety (defined as the ratio of the benchmark concentration to the predicted worst-case impact) is 2,000 (for formaldehyde in soil), and the median margin of safety (for all chemicals and media) is 680,000. Based on these results, it is highly unlikely that TEC emissions could adversely affect any environmental receptors, and hence there is no significant risk to threatened and endangered wildlife species.

Additional Qualitative Evaluation of Formaldehyde Impacts

For the sake of consistency with the screening methodologies used in Appendix G of the 2006 SLERA, CCG conducted an additional evaluation of the impacts of formaldehyde emissions on plants and animals using available exposure thresholds from available toxicological studies. Appendix C of the Permit Application mirrors the information included in Appendix G of the 2006 SLERA and includes a comparison of acute and chronic modeled formaldehyde air concentrations from the TEC to the available adverse effects levels for formaldehyde exposure to plants and animals that are available in the literature. Consistent with the 2006 SLERA, the

modeled air concentrations are well below any of the identified toxicological benchmarks. The lowest concentration of formaldehyde found to affect laboratory rats (animals sensitive to air pollutants) at the histopathological level on a chronic basis is 2,400 $\mu\text{g}/\text{m}^3$. The highest expected increase of formaldehyde concentrations in the ambient air due to TEC emissions is 0.007 $\mu\text{g}/\text{m}^3$ – a value more than 300,000 times lower than the level found to cause asymptomatic changes to nasal cells.

References

- Howard, P.H., Boethling, R.S., Jarvis, W.F., Meylan, W.M., and Michalenko, E.M. (1991). Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.
- RAIS (2012). Risk Assessment Information System. On-line database provided and maintained by the Oak Ridge National Laboratory, www.ornl.gov, accessed January 2012.
- Wesely, M.L., P.V. Doskey, and J.D. Shannon (2002). *Deposition Parameterizations for the Industrial Source Complex (ISC3) Model*. Draft ANL report ANL/ER/TRB01/003, June 2002.
- U.S. EPA (1999). Screening Level Ecological Risk Assessment Protocol (SLERAP) for Hazardous Waste Combustion Facilities. Office of Solid Waste and Emergency Response. EPA530-D-99-001A.

Table 1. Physiochemical Properties of Chemicals of Potential Environmental Concern Used in Air Dispersion and Deposition Modeling

Chemical of Potential Environmental Concern (COPEC)	CAS #	Properties to Estimate Vapor Fraction F_v (from RAIS, 2012)		COPEC Vapor Fraction F_v^a	Vapor Phase Deposition Modeling Properties (Wesely <i>et al.</i> , 2002, except as noted)			
		P_s^o (atm)	T_m (K)		Diffusivity in Air (cm^2/s)	Diffusivity in Water (cm^2/s)	Cuticular Resistance (s/cm)	Henry's Law Constant ($\text{Pa}\cdot\text{m}^3/\text{mol}$)
3-Methylcholanthrene	56-49-5	4.30E-08	453	0.765	0.04892	3.817E-06	2.73	0.145
7,12-Dimethylbenz(a)anthracene	57-97-6	2.53E-07	396	0.840	0.04483	3.875E-06	0.0696	1.97E-03
Anthracene	120-12-7	-	-	1	0.05978	6.090E-06	31.0	3.96
Benzo(a)anthracene	56-55-3	-	-	0.881	0.05290	4.745E-06	3.55	0.581
Benzo(b)fluoranthene	205-99-2	-	-	0.822	0.05130	4.370E-06	133	7.39
Benzo(k)fluoranthene	207-08-9	-	-	0.149	0.05130	4.370E-06	0.195	0.016
Chrysene	218-01-9	-	-	0.761	0.05290	4.745E-06	0.443	0.065
Dibenz(a,h)anthracene	53-70-3	-	-	0.011	0.04793	3.749E-06	0.00209	1.71E-04
Fluoranthene	206-44-0	-	-	0.992	0.05747	5.532E-06	5.01	1.04
Fluorene	86-73-7	-	-	0.9999	0.06249	6.350E-06	95.6	7.87
Formaldehyde	50-00-0	-	-	1	0.172	1.845E-05	49.5	0.032
Indeno(1,2,3-cd)pyrene	193-39-5	-	-	0.007	0.01900 ^b	5.660E-06 ^b	- ^b	4.92E-04 ^b
Phenanthrene	85-01-8	-	-	1	0.05978	6.090E-06	23.3	3.24
Pyrene	129-00-0	-	-	0.9946	0.05747	5.622E-06	3.88	0.92

Notes:

^a Refer to basis of referenced F_v values in Section B-3 of Appendix B.

^b Although no gaseous deposition modeling was required for indeno(1,2,3-cd)pyrene because its F_v is less than 0.05, the diffusivity in air and water and Henry's law constant from Table A-2-126 of Appendix A-2 of the SLERAP are provided for comparison purposes since these parameters are not provide in the Wesley document.

Table 2. Maximum Modeled COPEC Concentrations in Air Compared with Existing Representative Background Levels

COPEC	Maximum Modeled Offsite Impact ($\mu\text{g}/\text{m}^3$)	Background Concentrations ($\mu\text{g}/\text{m}^3$)	
		NATA ^a	EPA National Air Toxics Trends Network ^b
3-Methylcholanthrene	7.84E-08	-	-
7,12 Dimethylbenz(a)anthracene	5.84E-07	-	-
Anthracene	4.90E-07	-	3.64E-04
Benzo(a)anthracene	4.20E-07	-	1.59E-04
Benzo(b)fluoranthene	3.04E-07	-	3.84E-04
Benzo(k)fluoranthene	1.34E-07	-	1.04E-04
Chrysene	3.94E-07	-	3.91E-04
Dibenz(a,h)anthracene	1.55E-05	-	2.93E-05
Fluoranthene	1.71E-06	-	3.68E-03
Fluorene	6.24E-06	-	6.57E-03
Formaldehyde	7.09E-03	1.36E+00	1.13E+00
Indeno(1,2,3-cd)pyrene	2.29E-05	-	1.80E-04
Phenanthrene	8.56E-06	-	1.41E-02
Pyrene	1.20E-06	-	1.89E-03
Total PAHs	5.84E-05	7.23E-04	2.79E-02

Notes:

^a National Scale Air Toxics Assessment (NATA) U.S. Census Tract, Christian County, Illinois. <http://www.epa.gov/ttn/atw/nata2005/tables.html>

^b National Air Toxic Trend data for St. Louis (AQS Site ID: 29-510-0085) from EPA AirData at http://www.epa.gov/airdata/ad_maps.html

Table 3. Property-derived Parameters used in Soil, Surface water, and Sediment Modeling

COPEC	Vapor pressure (mm Hg) ^a	Soil and Surface Water Modeling Parameters			
		ksg ^b (yr ⁻¹)	Kd _s ^c (ml water / g soil)	Kd _{sw} ^d (l water / kg sediment)	Kd _{bs} ^e (l water / kg sediment)
3-Methylcholanthrene	4.30E-08 (f)	1.81E-01 (g)	9.62E+03 (h)	7.22E+04 (h)	3.85E+04 (h)
7,12 Dimethylbenz(a)anthracene	2.53E-07 (f)	9.04E+00 (g)	4.94E+03 (h)	3.71E+04 (h)	1.98E+04 (h)
Anthracene	2.55E-05	5.50E-01	2.35E+02	1.76E+03	9.40E+02
Benzo(a)anthracene	1.54E-07	3.72E-01	2.60E+03	1.95E+04	1.04E+04
Benzo(b)fluoranthene	8.06E-08	4.15E-01	8.36E+03	6.27E+04	3.34E+04
Benzo(k)fluoranthene	1.00E-09	1.18E-01	8.32E+03	6.24E+04	3.33E+04
Chrysene	7.83E-09	2.53E-01	2.97E+03	2.23E+04	1.19E+04
Dibenz(a,h)anthracene	2.05E-11	2.69E-01	1.79E+04	1.34E+05	7.16E+04
Fluoranthene	8.13E-06	5.75E-01	4.91E+02	3.68E+03	1.96E+03
Fluorene	6.21E-04	4.22E+00	7.71E+01	5.78E+02	3.08E+02
Formaldehyde	3.88E+03	3.61E+01	2.62E-02	1.96E-01	1.05E-01
Indeno(1,2,3-cd)pyrene	1.43E-10	3.47E-01	4.11E+04	3.08E+05	1.64E+05
Phenanthrene	1.03E+00	1.26E+00	2.09E+02	1.57E+03	8.35E+02
Pyrene	4.25E-06	1.33E-01	6.80E+02	5.10E+03	2.72E+03

Notes:

^a COPEC Vapor Pressure (COPEC-specific SLERAP Tables A-2-1 through A-2-204) unless noted

^b COPEC loss constant due to biotic and abiotic degradation (COPEC-specific SLERAP Tables A-2-1 through A-2-204) unless noted

^c Soil-water partition coefficient (COPEC-specific SLERAP Tables A-2-1 through A-2-204) unless noted

^d Suspended sediments/surface water partition coefficient (COPEC-specific SLERAP Tables A-2-1 through A-2-204) unless noted

^e Bed sediment/sediment pore water partition coefficient (COPEC-specific SLERAP Tables A-2-1 through A-2-204) unless noted

^f Vapor pressure values from the RAIS (2012)

^g Values estimated per SLERAP equation A-2-9; based on half-lives of 3.84 years (3-methylcholanthrene) and 28 days (7,12-Dimethylbenz(a)anthracene) as obtained from Howard (1991)

^h Values estimated per SLERAP equation A-2-8a, A-2-8b, and A-2-8c using default recommendations for organic fractions and organic carbon partitioning coefficients of 962,000 l/kg (3-methylcholanthrene) and 494,000 l/kg (7,12-Dimethylbenz(a)anthracene) as obtained from the RAIS (2012)

Table 4. Comparison of Worst-case TEC Impacts to U.S. EPA Region 5 Ecological Screening Levels (ESLs)

COPEC	Soil (mg/kg)		Surface Water (µg/l)		Sediment (mg/kg)	
	TEC Impact	US EPA Region 5 ESL (unless noted)	TEC Impact	US EPA Region 5 ESL (unless noted)	TEC Impact	US EPA Region 5 ESL (unless noted)
3-Methylcholanthrene	0.0000034	0.0779	0.000000043	0.0891	0.000000096	8190
7,12 Dimethylbenz(a)anthracene	0.0000080	16.3	0.0000040	0.548	0.000057	66.4
Anthracene	0.0000029	1,480	0.0000012	0.035	0.0000011	0.0572
Benzo(a)anthracene	0.0000063	5.21	0.0000046	0.025	0.0000040	0.108
Benzo(b)fluoranthene	0.0000071	59.8	0.00000028	9.07	0.0000057	10.4
Benzo(k)fluoranthene	0.0000056	148	0.00000052	0.027 (b)	0.0000011	0.24
Chrysene	0.0000090	4.73	0.00000038	7 (c)	0.0000037	0.166
Dibenz(a,h)anthracene	0.0000026	18.4	0.00000035	5 (c)	0.0000011	0.033
Fluoranthene	0.000011	122	0.0000079	1.9	0.000015	0.423
Fluorene	0.0000022	122	0.000016	19	0.0000048	0.0774
Formaldehyde	0.00015	0.3 (a)	0.55	49600 (b)	0.000058	5.2 (b)
Indeno(1,2,3-cd)pyrene	0.0000022	109	0.00000030	4.31	0.0000012	0.2
Phenanthrene	0.0000050	45.7	0.00000067	3.6	0.0000055	0.204
Pyrene	0.000022	78.5	0.0000045	0.3	0.000012	0.195

Notes:

^a Dutch Intervention Screening-Level (from RAIS, 2012)

^b Toxicity Reference Value (TRV) from the SLERAP (U.S. EPA, 1999)

^c U.S. EPA Region 6 Surface Water Screening Benchmark (from RAIS, 2012)

Appendix A

Pollutant Emission Calculations and Comparisons for the Taylorville Energy Center Project

A-1. Annual Potential Emissions Comparison of Original and Revised TEC Designs

Pollutants ³	Plant-wide Annual Potential Emission Rate for Original Design ¹ (tpy)	Plant-wide Annual Potential Emission Rate for Revised Design ² (tpy)	Difference in Annual Potential Emission Rate (Rev - Orig) (tpy)	Difference in Annual Potential Emission Rate [(Rev - Orig)/Orig] (%)
<u>PSD Regulated Pollutants</u>				
CO	1,044	1,249	205	19.6%
NO _x	752	228	-524	-69.7%
SO₂	436	697	261	59.9%
PM ₁₀	424	156	-268	-63.1%
VOM	33.4	90.2	57	170.1%
Sulfuric Acid Mist	76.7	5.18	-72	-93.2%
TOTAL for PSD Pollutants	2,766	2,425	-341	-12.3%
<u>Metallic HAPs</u>				
Arsenic 7440-38-2	5.11E-03	1.86E-03	-3.25E-03	-63.6%
Beryllium 7440-41-7	5.11E-03	8.21E-04	-4.29E-03	-83.9%
Cadmium 7440-43-9	1.15E-02	1.84E-03	-9.66E-03	-84.0%
Chromium 7440-47-3	8.94E-02	3.00E-03	-8.64E-02	-96.6%
Lead 7439-92-1	2.63E-02	2.25E-02	-3.79E-03	-14.4%
Mercury 7439-97-6	6.75E-02	0.01	-5.75E-02	-85.2%
Nickel 7440-02-0	0.10	1.19E-02	-8.91E-02	-88.3%
Selenium 7782-49-2	0.10	1.42E-03	-9.96E-02	-98.6%
Total Metallic HAPs	0.41	5.33E-02	-0.35	-86.9%
<u>Organic HAPs</u>				
Methylnaphthalene 91-57-6	2.68E-08	7.05E-04	7.05E-04	2.63E+06%
3-Methylcholanthrene 56-49-5	2.01E-09	4.46E-05	4.46E-05	2.22E+06%
7,12-Dimethylbenz(a)anthracene 57-97-6	1.79E-08	3.97E-04	3.97E-04	2.22E+06%
Acenaphthene 83-32-9	2.01E-09	1.04E-04	1.04E-04	5.15E+06%
Acenaphthylene 206-96-8	6.39E-03	1.55E-04	-6.23E-03	-97.6%
Anthracene 120-12-7	2.68E-09	8.19E-05	8.19E-05	3.06E+06%
Benzo(a)anthracene 56-55-3	5.88E-05	6.43E-05	5.50E-06	9.4%
Benzo(a)pyrene 50-32-8	1.43E-04	3.31E-05	-1.10E-04	-76.9%
Benzo(b)fluoranthene 205-99-2	2.01E-09	5.82E-05	5.82E-05	2.90E+06%
Benzo(g,h,i)perylene 191-24-2	2.45E-04	3.80E-05	-2.07E-04	-84.5%
Benzo(k)fluoranthene 207-08-9	2.01E-09	4.74E-05	4.74E-05	2.36E+06%
Chrysene 218-01-9	2.01E-09	6.30E-05	6.30E-05	3.14E+06%
Dibenzo(a,h)anthracene 53-70-3	1.34E-09	3.64E-05	3.64E-05	2.72E+06%
Fluoranthene 206-44-0	3.35E-09	1.69E-04	1.69E-04	5.03E+06%
Fluorene 86-73-7	3.13E-09	4.16E-04	4.16E-04	1.33E+07%
Indeno (1,2,3-cd)pyrene 193-39-5	2.01E-09	5.00E-05	5.00E-05	2.49E+06%
Naphthalene 91-20-3	1.82E-02	1.14E-02	-6.75E-03	-37.1%
Phenanthrene 85-01-8	1.90E-08	4.95E-04	4.95E-04	2.60E+06%
Pyrene 129-00-0	5.58E-09	1.84E-04	1.84E-04	3.29E+06%
Formaldehyde 50-00-0	4.34E-01	5.07	4.64E+00	1.07E+03%
Total PAH	2.50E-02	1.46E-02	-1.04E-02	-41.7%
Total Organic HAPs	0.46	5.09	4.63	1.01E+01%
TOTAL for HAPs	0.87	5.14	4.27	493.7%

¹ PSD regulated pollutant annual potential emissions taken from Attachment 1 Table III of the June 2007 final PSD construction permit for the original project design. HAP annual potential emissions taken from Table 5-1 and Appendix G of the 2006 SLERA.

² PSD regulated pollutant annual potential emissions taken from Attachment 1 Table IV of the draft PSD construction permit issued in October 2011 for all pollutant other than sulfur acid mist. Sulfuric acid emission rate is taken from Table 3-2 of Volume 1 of the Application. HAP annual potential emissions taken from Table C-23.1 of Appendix C to Volume 1 of the Application.

³ Pollutants shown in **bold red** text with green highlights are expected to increase as a result of the proposed design changes reflected in the October 2011 draft permit.

Appendix B

Media-Specific Estimation of Concentrations of Chemicals of Potential Concern in Soil, Surface Water, and Sediment

B-1. Summary of Modeled Emission Rates for Soils and Vegetation

Model ID	EP ID(s) ²	CAS Number Fv Gaseous (G) or Particulate (P) Phase Averaging Period Emission Point Description	3-MCHLOR (lb/hr) 56-49-5 0.840			FLUORE (lb/hr) 86-73-7 0.9999			IND (lb/hr) 193-39-5 0.007			PHEN (lb/hr) 85-01-8 1.000			PYR (lb/hr) 129-00-0 0.995		
			P Ann.	G Ann.	Note	P Ann.	G Ann.	Note	P Ann.	Basis Note	G Ann.	Note	P Ann.	G Ann.	Note		
FLRAN	EP1	Flare- Annual Average Conditions	3.08E-09	1.61E-08	A	7E-10	1.27E-06	A	7.44E-08	A	2.69E-06	A	2.90E-09	5.34E-07	A		
SRUAN	EP2	SRU Thermal Oxidizer- Annual Average Conditions	2.15E-09	1.13E-08	A	9E-12	2.09E-06	A	1.34E-08	A	0.00E+00	A	2.01E-10	3.70E-08	A		
AGRAN	EP3	AGR Unit CO2 Vent - Annual Average Conditions	0.00E+00	0.00E+00	A	5E-10	1.74E-06	A	7.76E-08	A	3.78E-06	A	3.66E-09	6.75E-07	A		
CT1NOS1	EP11	Combined Cycle Combustion Turbine #1-100%	7.74E-07	4.05E-06	A	0E-10	7.50E-06	A	4.82E-06	A	0.00E+00	A	7.24E-08	1.33E-05	A		
CT1NOS2	EP11	Combined Cycle Combustion Turbine #1-75%	6.34E-07	3.32E-06	B	5E-10	6.15E-06	B	3.95E-06	B	0.00E+00	B	5.93E-08	1.09E-05	B		
CT1NOS3	EP11	Combined Cycle Combustion Turbine #1-60%	5.81E-07	3.04E-06	B	4E-10	5.64E-06	B	3.62E-06	B	0.00E+00	B	5.43E-08	1.00E-05	B		
CT1SUSD	EP11	Combined Cycle Combustion Turbine #1-Startup/Shutdown	-	-	-	-	-	-	-	-	-	-	-	-	-		
CT2NOS1	EP12	Combined Cycle Combustion Turbine #2-100%	7.74E-07	4.05E-06	B	0E-10	7.50E-06	B	4.82E-06	B	0.00E+00	B	7.24E-08	1.33E-05	B		
CT2NOS2	EP12	Combined Cycle Combustion Turbine #2-75%	6.34E-07	3.32E-06	B	5E-10	6.15E-06	B	3.95E-06	B	0.00E+00	B	5.93E-08	1.09E-05	B		
CT2NOS3	EP12	Combined Cycle Combustion Turbine #2-60%	5.81E-07	3.04E-06	B	4E-10	5.64E-06	B	3.62E-06	B	0.00E+00	B	5.43E-08	1.00E-05	B		
CT2SUSD	EP12	Combined Cycle Combustion Turbine #2-Startup/Shutdown	-	-	-	-	-	-	-	-	-	-	-	-	-		
CMDBH	EP21	Coal Milling & Drying Baghouses	4.19E-08	2.19E-07	A	6E-11	4.06E-07	A	2.61E-07	A	0.00E+00	A	3.92E-09	7.22E-07	A		
AUXBL100	EP28	Auxiliary Boiler- 100% Load	3.95E-08	2.07E-07	A	9E-11	3.83E-07	A	2.46E-07	A	0.00E+00	A	3.69E-09	6.80E-07	A		
AUXBL25	EP28	Auxiliary Boiler- 25% Load	9.87E-09	5.17E-08	A	7E-12	9.57E-08	A	6.15E-08	A	0.00E+00	A	9.23E-10	1.70E-07	A		
SUHEAT	EP29	Methanation Startup Heater	7.27E-10	3.81E-09	A	5E-13	7.05E-09	A	4.53E-09	A	0.00E+00	A	6.80E-11	1.25E-08	A		

B-1. Summary of Modeled Emission Rates for Soils and Vegetation

Model ID	EP ID(s) ²	CAS Number Fv Gaseous (G) or Particulate (P) Phase Averaging Period Emission Point Description	3-MCHLOR (lb/hr) 56-49-5 0.840			FLUORE (lb/hr) 86-73-7 0.9999			IND (lb/hr) 193-39-5 0.007		PHEN (lb/hr) 85-01-8 1.000		PYR (lb/hr) 129-00-0 0.995		
			P Ann.	G Ann.	Note	P Ann.	G Ann.	Note	P Ann.	Basis Ann.	Note	G Ann.	P Ann.	G Ann.	Note
EG1WEEK	EP30	Emergency Generator #1- Weekly Readiness Testing	0.00E+00	0.00E+00	C	3E-11	9.22E-07	C	1.31E-08	C	1.29E-06	C	8.16E-10	1.50E-07	C
EG2WEEK	EP31	Emergency Generator #2- Weekly Readiness Testing	0.00E+00	0.00E+00	C	3E-11	9.22E-07	C	1.31E-08	C	1.29E-06	C	8.16E-10	1.50E-07	C
FP1	EP32	Fire Pump Engine #1	0.00E+00	0.00E+00	A	7E-10	6.37E-06	A	9.03E-08	A	8.90E-06	A	5.63E-09	1.04E-06	A
FP2	EP33	Fire Pump Engine #2	0.00E+00	0.00E+00	A	7E-10	6.37E-06	A	9.03E-08	A	8.90E-06	A	5.63E-09	1.04E-06	A

¹ Modeled hourly emission rates shown for the gaseous and particulate phase deposition modeling are based on COPEC with a Fv of 1.0, only gas phase modeling is required. Modeled emission rates for pollutant modeled with both a particulate and gas phase are calculated using the Fv (i.e., total emission rate).

COPEC Naming Key:

- 3-Methylcholanthrene = 3-MCHLOR
- 7,12-Dimethylbenz(a)anthracene = 7,12-DIMETH
- Anthracene = ANTH
- Benzo(a)anthracene = BENZ(A)
- Benzo(b)fluoranthene = BENZ(B)
- Benzo(k)fluoranthene = BENZ(K)
- Chrysene = CHRY
- Dibenz(a,h)anthracene = DIBENZ
- Fluoranthene = FLUORA
- Fluorene = FLUORE
- Formaldehyde = FORM
- Indeno(1,2,3-cd)pyrene = IND
- Phenanthrene = PHEN
- Pyrene = PYR

Basis for Modeled Emission Rates

- A = Modeled annual average hourly emission rates are based on the maximum annual potential emission rate.
- B = Modeled annual average hourly emission rates for the CTs include a contribution from normal steady-state operation and startup/shutdown. Appendix C to Volume 1, the maximum CT heat input rate in MMBtu/hr for each modeled load case, an emission rate is based on the lb COPEC/lb CO emission factors in Table C-23.2 and the maximum annual average hourly heat input in MMBtu/hr associated with weekly testing at 50 percent load for 0.5 hours, a
- C = Consistent with the approach used for criteria pollutant modeling, the modeled annual average hourly emission rate is based on the maximum annual average hourly heat input in MMBtu/hr associated with weekly testing at 50 percent load for 0.5 hours, a
- D = Hourly potential emissions from Table C-23.1.
- E = Modeled hourly emission rates for the CTs during normal steady-state operation are based on the maximum annual average hourly heat input in MMBtu/hr associated with weekly testing at 50 percent load for 0.5 hours, a
- F = Hourly potential emission rate during startup/shutdown from Table C-23.2 of Section C-23 of Appendix C to Volume 1.
- G = Hourly potential emission rate for the emergency generator engines shown in Table C-23.1 of Section C-23 of Appendix C to Volume 1.

B-2. Constituent of Potential Ecological Concern (COPEC) Concentrations in Air

Pollutant	CAS No.	Maximum Modeled Impacts ($\mu\text{g}/\text{m}^3$)	Background Concentration	
			NATA ¹ ($\mu\text{g}/\text{m}^3$)	EPA National Air Toxics Trends Network ² ($\mu\text{g}/\text{m}^3$)
3-Methylcholanthrene	56-49-5	7.84E-08	-	-
7,12 Dimethylbenz(a)anthracene	57-97-6	5.84E-07	-	-
Anthracene	120-12-7	4.90E-07	-	3.64E-04
Benzo(a)anthracene	56-55-3	4.20E-07	-	1.59E-04
Benzo(b)fluoranthene	205-99-2	3.04E-07	-	3.84E-04
Benzo(k)fluoranthene	207-08-9	1.34E-07	-	1.04E-04
Chrysene	218-01-9	3.94E-07	-	3.91E-04
Dibenz(a,h)anthracene	53-70-3	1.55E-05	-	2.93E-05
Fluoranthene	206-44-0	1.71E-06	-	3.68E-03
Fluorene	86-73-7	6.24E-06	-	6.57E-03
Formaldehyde	50-00-0	7.09E-03	1.36E+00	1.13E+00
Indeno(1,2,3-cd)pyrene	193-39-5	2.29E-05	-	1.80E-04
Phenanthrene	85-01-8	8.56E-06	-	1.41E-02
Pyrene	129-00-0	1.20E-06	-	1.89E-03
Total PAHs	-	5.84E-05	7.23E-04	2.79E-02

¹ National Scale Air Toxics Assessment (NATA) U.S. Census Tract, Christian County, Illinois.
<http://www.epa.gov/ttn/atw/nata2005/tables.html>

² National Air Toxic Trend data for St. Louis (AQS Site ID: 29-510-0085) from EPA AirData at
http://www.epa.gov/airdata/ad_maps.html

B-3. Constituent of Potential Ecological Concern (COPEC) Soil Conc

COPEC ID: 3-MCHLOR 7,12-DIMETH				
CAS No.: 56-49-5 57-97-6				
Vapor Fraction (F _v): 0.765 0.840 vapor phase (SLERA Protocol Table A-2-19)				
$C_s = D_s * [1 - \exp(-k_s * tD)] / k_s$				
C_s	(µg COPEC/kg soil)	3.37E-03	7.95E-04	
TRV	(µg/kg)			RAP Appendix E)
ESL	(µg/kg)	78	16,300	(except Dutch Intervention Level for formaldehyde) from
tD	(yr)	100	100	(default value from SLERA Protocol Table B-1-1)
$D_s = 100 / (Z_s * BD) * [(Dydv + Dywv) + (Dywp + Dydp)]$				
D_s	(mg COPEC/kg soil/yr)	6.28E-07	7.19E-06	
	(m2-mg/cm2-kg)	100	100	
Z_s	(cm)	1	1	ool Table B-1-1, use 1 cm for untilled and 20 cm tilled soil)
BD	(g/cm3)	1.5	1.5	RA Protocol Table B-1-1)
Dydv + Dywv	(g/m2-yr)	7.97E-09	8.89E-08	deposition from vapor phase from model
Dywp + Dydp	(g/m2-yr)	1.45E-09	1.89E-08	deposition from particle phase from model
$k_s = k_{sg} + k_{se} + k_{sr} + k_{sl} + k_{sv}$				
k_s	(yr ⁻¹)	1.86E-01	9.04E+00	processes
k_{sg}	(yr ⁻¹)	1.81E-01	9.04E+00	biotic degradation [COPEC-specific SLERA Protocol Tables A-2-1 through A-2-204, methylbenz(a)anthracene which are calculated based on equation A-2-13 in the I (HHRAP)]
k_{se}	(yr ⁻¹)	0	0	(default value from SLERA Protocol Table B-1-2)
k_{sr}	(yr ⁻¹)	1.76E-03	3.43E-03	off (see calculation below)
k_{sl}	(yr ⁻¹)	2.37E-03	4.61E-03	ae calculation below)
k_{sv}	(yr ⁻¹)	1.53E-03	3.71E-05	1 (see calculation below)
$k_{sr} = RO / (\theta_{sw} * Z_s) * \{1 / [1 + (Kd_s * BD / \theta_{sw})]\}$				
k_{sr}	(yr ⁻¹)	1.76E-03	3.43E-03	off
RO	(cm/yr)	25.4	25.4	ious areas (USGS Groundwater Atlas of the United States: Illinois, Indiana, Kentucky, ;usgs.gov/ha/ha730/ch_k/k-regionalsum.html)
θ_{sw}	(mL/cm ³ soil)	0.2	0.2	ue from SLERA Protocol Table B-1-4)
Z_s	(cm)	1	1	ool Table B-1-4, use 1 cm for untilled and 20 cm tilled soil)
Kd_s	(mL/g)	9.62E+03	4.94E+03	pecific SLERA Protocol Tables A-2-1 through A-2-204, except 3-Methylcholanthrene ich are calculated based on equation A-2-10 in the HHRAP)
BD	(g/cm ³)	1.5	1.5	RA Protocol Table B-1-4)
$k_{sl} = (P + I - RO - E_v) / (\theta_{sw} * Z_s * [1.0 + (BD * Kd_s / \theta_{sw})])$				
k_{sl}	(yr ⁻¹)	2.37E-03	4.61E-03	
P	(cm/yr)	89.54	89.54	al Climatological Data for Springfield Capital Airport, Normal Yearly Precipitation)
I	(cm/yr)	25	25	ge to SLERA Protocol Table B-1-5)
RO	(cm/yr)	25.4	25.4	ious areas
E_v	(cm/yr)	55.0	55.0	s Reference to SLERA Protocol Table B-1-5)
θ_{sw}	(mL/cm ³ soil)	0.2	0.2	ue from SLERA Protocol Table B-1-5)
Z_s	(cm)	1	1	ool Table B-1-5, use 1 cm for untilled and 20 cm tilled soil)
BD	(g/cm ³)	1.5	1.5	RA Protocol Table B-1-5)
Kd_s	(mL/g)	9.62E+03	4.94E+03	pecific SLERA Protocol Tables A-2-1 through A-2-204)

B-3. Constituent of Potential Ecological Concern (COPEC) Soil Con

COPEC ID: 3-MCHLOR 7,12-DIMETH				
CAS No.:		58-49-5	57-97-6	
Vapor Fraction (F _v):		0.765	0.840	vapor phase (SLERA Protocol Table A-2-19)
$k_{sv} = [3.1536 \times 10^7 * H / (Z_g * K_d * R * T_b * BD)] * [D_a / Z_g] * [1 - (BD/\rho_s) - \theta_{sw}]$				
k_{sv}	(yr ⁻¹)	1.53E-03	3.71E-05	on
	(s/yr)	3.1536E+07	3.1536E+07	
H	(atm-m ³ /mol)	1.43E-06	1.94E-08	2 report)
Z _g	(cm)	1	1	Protocol Table B-1-6, use 1 cm for untilled and 20 cm tilled soil)
K _d	(mL/g)	9.62E+03	4.94E+03	specific SLERA Protocol Tables A-2-1 through A-2-204)
R	(atm-m ³ /mol-K)	8.205E-05	8.205E-05	
T _b	(K)	298	298	from SLERA Protocol Table B-1-6)
BD	(g/cm ³)	1.5	1.5	SLERA Protocol Table B-1-6)
ρ _s	(g/cm ³)	2.7	2.7	from SLERA Protocol Table B-1-6)
D _a	(cm ² /s)	4.89E-02	4.48E-02	(2002 report)
θ _{sw}	(mL/cm ³)	0.2	0.2	value from SLERA Protocol Table B-1-6)

COPEC Naming Key:

3-Methylcholanthrene	= 3-MCHLOR
7,12 Dimethylbenz(a)anthracene	= 7,12-DIMETH
Anthracene	= ANTH
Benzo(a)anthracene	= BENZ(A)
Benzo(b)fluoranthene	= BENZ(B)
Benzo(k)fluoranthene	= BENZ(K)
Chrysene	= CHR
Dibenz(a,h)anthracene	= DIBENZ
Fluoranthene	= FLUORA
Fluorene	= FLUORE
Formaldehyde	= FORM
Indeno(1,2,3-cd)pyrene	= IND
Phenanthrene	= PHEN
Pyrene	= PYR

B-4. Constituent of Potential Ecological Concern (COPEC) Water Column

		COPEC ID: 3-MCHLOR	7,12-DIMETHYLBENZ(A)ANTHRACENE
		CAS No.: 56-49-5	57
$Cwctot = fwc * Cwtot * (dwc+dbs)/dwc$			
Cwctot	(mg/L)	4.28E-12	3.9 ⁱⁿ
TRV	(mg/L)		SLERAP protocol Appendix E)
ESL	(mg/L)	8.91E-05	5.4g Level Benchmarks (except Chrysene and Dibenz(a,h)anthracene, EPA Region 6 tools/eco_search.php)
Vapor Pressure	(mm of Hg)	2.53E-07	4.3 Specific SLERA Protocol Tables A-2-1 through A-2-204, RAIS for 3-Methylcholanthrene
$Cwtot = 100 * ((Dydv+Dyvw)+(Dydp+Dywp))/P$			
Cwtot	(mg/L)	1.05E-08	1.2 ^{on} , including water column and bed sediment
	(mg-cm-m ² /g-L)	100	
Dyvw+Dydv	(g/m ² -yr)	7.97E-09	8.8 ^{dry} deposition from gas phase from model
Dywp+Dydp	(g/m ² -yr)	1.45E-09	1.8 ^{dry} deposition from particle phase from model
P	(cm/yr)	89.54	8 Local Climatological Data for Springfield Capital Airport, Normal Yearly Precipitation)
$CwtoH = Cyv * Mv / (H * 10^3)$			
CwtoH	(mg/L)	1.03E-09	6.0 ^{on} , including water column and bed sediment for volatile compounds
	[(1/m ³) ² x (µg/mg)]	1.00E+09	1.0
H	(atm-m ³ /mol)	1.43E-06	1.002 report)
Cyv	(µg/m ³)	6.00E-08	4.0
Mv	(#/mole)	24.50	2
$fwc = [(1+Kdsw * TSS * 1E-6) * dwc/dz] / [(1+Kdsw * TSS * 1E-06) * dwc/dz + ((θbs + Kdbs * BS) * dbs/dz)]$			
fwc		4.12E-03	6.0 ^{oncentration in the water column}
	(kg/mg)	1.00E-06	1.0
BS	(g/cm ³ , equivalent to kg/L)	1	value per SLERAP protocol pg 3-97)
Kd _{bs}	(L water/kg bottom sediments)	3.85E+04	1.0 partition coefficient (COPEC-specific SLERA Protocol Tables A-2-1 through A-2-204, 2 dimethylbenz(a)anthracene which are calculated based on Eqn A-2-12 of HHRAP)
Kd _{sw}	(L water/kg suspended sediments)	7.22E+04	3.0 partition coefficient (COPEC-specific SLERA Protocol Tables A-2-1 through A-2-204, 2 dimethylbenz(a)anthracene which are calculated based on Eqn A-2-11 of HHRAP)
TSS	(mg/L)	10	1 (default value per SLERAP page 3-95)
d _{wc}	(m)	2.77	th in Table 5-8 of the South Fork Sangamon River/Lake Taylorville TMDL Report ; IEPA/BOW/07-027)
d _{bs}	(m)	0.03	layer (default value per SLERAP page 3-97)
d _z	(m)	2.80	
θ _{bs}	(L water/L sediment)	0.6	per SLERAP page 3-97)

COPEC Naming Key:

- 3-Methylcholanthrene = 3-MCHLOR
- 7,12 Dimethylbenz(a)anthracene = 7,12-DIMETH
- Anthracene = ANTH
- Benzo(a)anthracene = BENZ(A)
- Benzo(b)fluoranthene = BENZ(B)
- Benzo(k)fluoranthene = BENZ(K)
- Chrysene = CHRY
- Dibenz(a,h)anthracene = DIBENZ
- Fluoranthene = FLUORA
- Fluorene = FLUORE
- Formaldehyde = FORM
- Indeno(1,2,3-cd)pyrene = IND
- Phenanthrene = PHEN
- Pyrene = PYR

B-5. Constituent of Potential Ecological Concern (COPEC) Sediment C

		COPEC ID: 3-MCHLOR	7,12-D
		CAS No.: 56-49-5	57-
Csed = fbs*Cwtot*((Kdbs/(fbs+Kdbs*BS))*(dwc+dbs/dbs))			
Csed	(mg/kg)	9.56E-08	5.7 sediment
TRV	(mg/kg)		SLERAP protocol Appendix E)
ESL	(mg/kg)	8.19E+03	6.6 benchmark from http://rais.ornl.gov/tools/feco_search.php
Vapor Pressure	(mm of Hg)	4.30E-08	2.5 specific SLERA Protocol Tables A-2-1 through A-2-204, RAIS for 3-Methylcholanthrene
Cwtot	(mg/L)	1.05E-08	1.2 on, including water column and bed sediment
CwtotH	(mg/L)	1.03E-09	6.1 on, including water column and bed sediment for volatile compounds
BS	(g/cm3) (equivalent to kg/L)	1	value per SLERAP protocol pg 3-97)
Kdbs	(L water/Kg bottom sediments)	3.85E+04	1.9 partition coefficient (COPEC-specific SLERA Protocol Tables A-2-1 through A-2-204)
dwc	(m)	2.77	2.77 water column depth
dbs	(m)	0.03	0.03 water layer (default value per SLERAP page 3-97)
θbs	(L water/L sediment)	0.6	0.6 per SLERAP page 3-97)
fbs = 1-fwc			
fbs		9.96E-01	9.9 concentration in benthic sediment
fwc		4.12E-03	6.3 concentration in the water column

COPEC Naming Key:

- 3-Methylcholanthrene = 3-MCHLOR
- 7,12 Dimethylbenz(a)anthracene = 7,12-DIMETH
- Anthracene = ANTH
- Benzo(a)anthracene = BENZ(A)
- Benzo(b)fluoranthene = BENZ(B)
- Benzo(k)fluoranthene = BENZ(K)
- Chrysene = CHRY
- Dibenz(a,h)anthracene = DIBENZ
- Fluoranthene = FLUORA
- Fluorene = FLUORE
- Formaldehyde = FORM
- Indeno(1,2,3-cd)pyrene = IND
- Phenanthrene = PHEN
- Pyrene = PYR

B-6. Additional Qualitative Evaluation of Formaldehyde Impacts

Table B-6.1. Summary of Acute and Chronic Modeled Impacts for Formaldehyde

Pollutant	CAS No.	Averaging Period	Maximum Modeled Impacts (µg/m ³)
Formaldehyde	50-00-0	Annual	7.09E-03
		24-hr	10.54
		3-hr	24.61

Table B-6.2. Comparison of Modeled Impacts to Plant and Animal Toxicity Data

Affected Species	Concentration for Adverse Effects ¹ (µg/m ³)	Exposure Regime	Modeled Impact for Comparison (µg/m ³)	Avg.	Modeled Impact as a Percentage of the Adverse Effects Level (%)	Observed Adverse Effects
<i>Plants</i>						
Common Bean	78-438	7 h/d, 3 d/w, 4 w	24.6	3-hr	31.6%	Increased shoot growth, not root growth
Lilly	440	5 h	24.6	3-hr	5.6%	Reduction of pollen tube length
Alfalfa	840	5 h	24.6	3-hr	2.9%	Atypical signs of injury
<i>Mammals</i>						
<i>Acute Impacts</i>						
Rat	3,700	22 h/d, 3 d	24.6	3-hr	0.7%	Lowest observed adverse effects level (LOAEL) histopathological effects and increased cell proliferation in the nasal cavity
Rat	3,800	6 h/d, 3 d	24.6	3-hr	0.6%	LOAEL histopathological effects and increased cell proliferation in the nasal cavity
Rat	6,000	8 h/d, 5 d/w, 4 w	24.6	3-hr	0.4%	LOAEL histopathological effects and increased cell proliferation in the nasal cavity
Rat	7,100	6 h/d, 5 d/w, 1 to 14 d	24.6	3-hr	0.3%	LOAEL histopathological effects in nasal cavity
Rat	7,200	6 h/d, 3 d	24.6	3-hr	0.3%	LOAEL increased cell proliferation in nasal cavity
Monkey	7,200	6 h/d, 5 d/w, 1 to 6 w	24.6	3-hr	0.3%	LOAEL histopathological effects and increased cell proliferation in nasal cavity and upper portions of respiratory tract
Rat	7,400	6 h/d, 5 d/w, 1, 4, or 9 d or 6 w	24.6	3-hr	0.3%	LOAEL histopathological effects and increased cell proliferation in the nasal cavity
Mouse	18,000	6 h/d, 3 d	24.6	3-hr	0.1%	LOAEL increased cell proliferation in nasal cavity
<i>Subchronic Impacts</i>						
Rat	3,600	5 d/w, 13 w	10.5	24-hr	0.3%	LOAEL histopathological effects and increased cell proliferation in the nasal cavity
Rat	4,800	5 d/w, 13 w	10.5	24-hr	0.2%	LOAEL histopathological effects in the nasal cavity
Rat	7,100	6 hr/d, 5 d/w, 11 w	10.5	24-hr	0.1%	LOAEL histopathological effects and increased cell proliferation in the nasal cavity
Rat	11,600	6 hr/d, 5 d/w, 13 w	10.5	24-hr	0.1%	LOAEL histopathological effects in the nasal cavity
Rat	11,300	6 h/d, 5 d/w, 13 w	10.5	24-hr	0.1%	LOAEL histopathological effects in the nasal cavity
<i>Chronic Impacts</i>						
Rat	2,400	6 h/d, 5 d/w, 24 mo	7.09E-03	Ann	0.0003%	LOAEL histopathological effects in the nasal cavity
Rat	2,600	6 h/d, 5 d/w, 28 mo	7.09E-03	Ann	0.0003%	LOAEL histopathological effects in the nasal cavity
Monkey, Rat	3,600	22 h/d, 7 d/w, 26 w	7.09E-03	Ann	0.0002%	LOAEL histopathological effects in the nasal cavity
Rat	7,200	6 h/d, 5 d/w, 24 mo	7.09E-03	Ann	0.0001%	LOAEL histopathological effects and increased cell proliferation in the nasal cavity
Rat	11,000	6 h/d, 5 d/w, 3 mo	7.09E-03	Ann	0.0001%	LOAEL histopathological effects in the nasal cavity
Rat	11,300	6 h/d, 5 d/w, 52 w	7.09E-03	Ann	0.0001%	LOAEL histopathological effects in the nasal cavity
Rat	11,800	6 h/d, 5 d/w, 28 mo	7.09E-03	Ann	0.0001%	LOAEL histopathological effects in the nasal cavity

¹ Refer to Table C-1 of Appendix G to the 2006 SLERA for the basis of the plant and animal toxicity data used in the qualitative evaluation of formaldehyde impacts.