ADDENDUM

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

St. Regis Paper Company Site
Cass Lake, MN

Prepared for

International Paper

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Prepared for International Paper pursuant to
Unilateral Administrative Order Docket No. V-W-04-C-796

May 30, 2008

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ST. REGIS PAPER COMPANY SITE, CASS LAKE, MN

INTRODUCTION

International Paper submitted a revised Human Health and Ecological Risk Assessment (HHERA) for the St. Regis Paper Company Site (Site) to the U.S. Environmental Protection Agency (EPA), Region 5, on September 28, 2007. EPA provided comments on the HHERA on February 8, 2008. In its comments, EPA directed International Paper to prepare an addendum to the HHERA incorporating the changes required by the comments.

This addendum incorporates the directives and requirements imposed by EPA in its February 8, 2008, comments. None of the major conclusions of the September 2007 version of the Risk Assessment Report is substantially altered by the additional analyses performed and information provided in this addendum. As such, International Paper continues to maintain that the September 2007 Risk Assessment Report provided a technical foundation that is appropriate and sufficient to support risk management decisions for the Site. The contents of the addendum are organized as follows:

- Front Material
- Body of Main Document
- References Cited
- Appendix A
- Appendix B
- Appendix C Tables
- Appendix D
- Appendix E.

FRONT MATERIAL

The following acronyms and abbreviations used in the text are added to or corrected in the list of acronyms and abbreviations:

ASTM	American Society for Testing and Materials
BNSF	Burlington Northern Santa Fe Railway Company
CAS	Columbia Analytical Services

CLP	Contract Laboratory Program
dw	dry weight
ED_{05}	effective dose at the 5 percent response level
ED_{10}	effective dose at the 10 percent response level
LC_{50}	lethal concentration in 50 percent of population
NPDES	National Pollutant Discharge Elimination System
ww	wet weight

The following acronyms and abbreviations are now defined at their first use on the page indicated, and then used consistently thereinafter.

BaP	benzo[a]pyrene, p. 2-14 (duplication removed from p. 4-105)
BCF	bioconcentration factor, p. 4-46 (duplication removed from p. 5-38)
CTE	central tendency exposure, p. 1-1 (duplication removed from p. 4-50)
DDx	DDT and metabolites, p. 2-7
GPS	global positioning system, p. 2-9
LC50	lethal concentration in 50 percent of test population, p. 5-65
MPCA	Minnesota Pollution Control Agency, p. 1-5 (duplication removed from p. 2–17)
SQG	sediment quality guidelines p. 5-10 (duplication removed from same page)
TEQ	toxic equivalent, p. 2-7
TEQdfp	toxic equivalent concentrations of dioxins/furans and coplanar, dioxin-like PCB congeners, p. 5-80
UAO	Unilateral Administrative Order, p. 1-10
UCL	upper confidence limit, p. 4-35
WHO	World Health Organization, p. 2-13 (duplication removed from p. 4-102)
ww	wet weight, p. 4-29

The following acronym is identified correctly at first use as submitted and stands as is:

2,4-D 2,4-dichlorophenoxyacetic acid, p. 4-145

The acronym RAL identified in the text both as "response action level" and "removal action level" is elided from the quotation on p. 1-10 and is now intended to mean only "response action level" thereinafter.

A list of units of measure used within the document is added immediately after the acronyms and abbreviations and includes the following:

Units of Measure

°F	degree(s) Fahrenheit
atm	atmosphere(s)
cm	centimeter(s)
cm^2	square centimeter(s)
cm^3	cubic yard(s)
ft	foot(feet)
g	gram(s)
gpm	gallon(s) per minute
h	hour(s)
in.	inch(es)
K	degrees Kelvin
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
L	liter(s)
lb	pound(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mg	milligram(s)
min	minute(s)
mm	millimeter(s)
mol	mole(s)

ng	nanogram(s)
pg	pictogram(s)
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
s	second(s)
μg	microgram(s)
μL	microliter(s)
μm	micrometer(s)

BODY OF DOCUMENT

Section 1—Introduction

Section 1.1. *On p. 1-2, the second sentence of paragraph one is revised as follows:*

Potential adverse noncancer effects under current conditions are limited to a short-term utility worker scenario assuming a worst case condition, in which an unprotected worker digs a trench in the immediate vicinity of the groundwater extraction systems at the Site without adequate protective wear.

On p. 1-2, the word "current" is inserted before "Site-related cancer risks…" in the first sentence of paragraph two.

On p. 1-2, the following new paragraphs are inserted after paragraph two.

In addition to current scenarios, the HHRA evaluated a range of assumptions about possible future exposure conditions and land use, specifically:

- For current residential areas, two sets of assumptions were explored regarding the long-term protectiveness of the interim remedial measures (IRM) initiated in 2006 to address exposures to house dust and residential soil: future Case 1 assumes that 4 in. of clean topsoil placed during the IRM is mixed with 8 in. of potentially contaminated deeper soil; future Case 2 assumes that the IRM has no long-term effectiveness and future soil concentrations revert to pre-IRM levels.
- Consumption of homegrown produce was evaluated assuming gardens are grown in unamended soil, using the same two sets of assumptions described above regarding the long-term protectiveness of the IRM.

- Potential future residential use was evaluated for City-owned property in the former operational area of the Site; this property is currently zoned for light industrial use.

Potential future adverse noncancer effects in the residential area are limited to a hypothetical future child resident scenario at a single location where a home does not currently exist. No future cancer risks in the residential area exceeded EPA's target risk range. These findings were the same for both sets of assumptions regarding the long-term protectiveness of the IRM. Gardening in unamended soil, under both sets of assumptions regarding the future protectiveness of the IRM, was found to have marginal impacts on cancer and noncancer risk results. If the land use of the City-owned property changed to residential in the future, potential adverse noncancer effects to child residents were identified for locations with dioxin/furan and BaPE concentrations at or above the median concentrations and potential excess cancer risks exceeding $1x10^{-4}$ were identified at the location of maximum dioxin/furan and BaPE concentrations.

In addition, risks associated with eating fish and wild rice from Cass Lake and Pike Bay were evaluated and compared with risks from reference locations. Risks from consumption of wild rice were not found to be significant. For Cass Lake and Pike Bay as well as for reference locations, noncancer hazards and cancer risks associated with ingestion of fish are much higher than those associated with exposures to soil, garden produce, sediment, surface water, and groundwater at the Site. The primary contributor to risks associated with intake of fish from Cass Lake and Pike Bay is PCBs, which are not associated with Site operations. The primary contributor to risks associated with background fish intake is also PCBs. Dioxins/furans were also evaluated in fish. The concentrations of dioxins/furans in fish from Cass Lake and Pike Bay were within the range of concentrations of dioxins/furans in the reference fish data sets.

Section 1.4. *On p. 1-4, the following sentence is added after the second sentence of the section:*

The Site lies within the exterior boundaries of the Leech Lake Indian Reservation.

Section 1.4.1. *On p. 1-7, the second sentence of the first paragraph is deleted and replaced with:*

Between 1957 and 1975, sludge from the wood-treating operations was reportedly transported to a pit at the city dump pit (see Figure 1-2) and periodically burned. A former site worker reports that the burning of the pit contents was conducted by the City (Ross 2006, pers. comm.); EPA has stated that the City denies any direct participation in the burning of wood-treatment sludge at the city dump.

Section 1.4.2. *On p. 1-7, the fifth sentence of the first paragraph in this section is deleted and replaced with:*

Between 1957 and 1975, sludge from the wood-treating operations was reportedly transported to a pit at the city dump (Figure 1-2) and periodically burned. A former site worker reports that the burning of the pit contents was conducted by the City (Ross 2006, pers. comm.); EPA has stated that the City denies any direct participation in the burning of wood-treatment sludge at the city dump.

Section 1.4.4. *On p. 1-10, the following sentence is added at the end of the first paragraph:*

The LLBO and MPCA are EPA's designated Agency Partners for the Site and provide support to EPA in the Site's regulatory process.

Section 1.4.4. *On p. 1-11, the following text is added at the end of the first paragraph:*

EPA considers the presence of chemicals (primarily dioxins/furans) in house dust at concentrations exceeding risk-based benchmarks for settled dust developed for the World Trade Center Indoor Environment Assessment (USEPA 2003l) as the primary basis for its decision to address house dust in the interim remedial measures. A summary of specific activities carried out in the removal actions and interim remedial measures at the Site is provided below in Section 1.4.5.

Section 1.4.5. *On p. 1-14, th*e text *of the first bullet under "2004 – 2005 Soil Removal Actions" is revised as follows (new text is underlined):*

International Paper performed a removal action of surface soils, required by UAO V-W-'04-C-771 (USEPA 2003j) in 2004 and 2005 at the Site. The removal action fieldwork was performed from June to October 2004, with final restoration being completed in June 2005. The removal action involved excavating the surface and shallow subsurface soils on City-owned property and the Allen property where validated analytical results had shown dioxin/furan toxic equivalent (TEQdf-WHO98) concentrations in soils exceeding 1 ppb. <u>Confirmation samples were collected from the base of excavated areas to ensure that residual dioxin/furan concentrations in surface soil were below 1 ppb. The edges of the excavated areas were graded to eliminate abrupt changes in grade, and the areas were sown with grass seed mix to reestablish vegetation. The excavated areas were not covered with imported soil. EPA considers these restoration actions to be final only for the purposes of this time-critical removal action.</u> A total of 3,321 tons of contaminated soils was excavated, transported offsite, and disposed of at a RCRA Subtitle D landfill operated by Onyx FCR near Buffalo, Minnesota.

On p. 1-14, the following language *is added after the bulleted text under Interim Remedial Action to Address House Dust:*

EPA considers the long-term protectiveness of the interim remedial measures to be uncertain and has expressed concerns that clean topsoil placed at the residences may become recontaminated by fugitive dust and/or runoff from other areas of the Site unless steps are taken to address these potential release and transport mechanisms. To address this concern in the human health risk assessment, a range of future surface soil concentrations are evaluated for future residential risk scenarios for the Site, as discussed in Sections 4.3 and 4.5.

Section 1.6 and Figure 1-6.*A not*e has *been added to Figure 1-6 to indicate that fish tissue samples collected from wider areas of Cass Lake and Pike Bay (i.e., beyond the limits of Area B established as in the RAWP attached to the 2004 UAO) are also included in the risk evaluation for Area B.*

Section 1.7. *On p. 1-18, Barr (2005a) cited in the second bullet is replaced with Barr (2005c), which is added to the reference list. Also on p. 1-18, in the fifth bullet, Barr (2004a) is replaced with Barr (2004b).*

Section 1.8. *In footnote 4 on p. 1-19, the following sentence is deleted:*

Given that copper and zinc concentrations in soil in all other areas of the Site are consistent with background, the higher concentrations of these two metals measured in city dump area soils are attributed to sources other than releases from former operations at the St. Regis Paper Company facility.

and replaced with:

Copper and zinc concentrations in soil in all other areas of the Site are consistent with background and do not indicate evidence of a release of these metals in former operation areas at the St. Regis Paper Company facility.

Section 1 Figures. *Revised Figures 1-1, 1-2, 1-3, 1-4, and 1-6 are attached, identifying the Site's location within the Leech Lake Indian Reservation.*

Section 2—Data Evaluation and Selection

Section 2.2, Table 2-1). *EPA comments expressed concern with some of the specific data selection decisions made in the risk assessment for soil samples and reflected in Table 2-1. A revised version of Table 2-1 acknowledging these concerns is provided with this addendum. Additional discussion of the basis and potential impact of the controversial data selection decisions is discussed below under Section 4.6.1.1, p. 4-153.*

Section 2.2, Table 2-7. *EPA expressed several concerns regarding the fish tissue split sample selections documented in Table 2-7 in its February 8, 2008, comments on the risk assessment. A revised version of Table 2-7 is included with this addendum, with changes indicated by gray shading. Additional discussion of the rationale for specific changes to Table 2-7 is provided below.*

First, EPA indicated concern that the decision to select analytical results for tullibee egg sample SL-T-0404-E (LLB-F) from the ETL laboratory rather than from the CAS laboratory on the basis of "more detected values" was not consistent with the decision rules laid out in Section 2.2.3, which do not include this as a specific data selection criterion. Also involved in the selection of SL-T-0404-E (LLB-F), however, was data selection rule No. 2, which specifies that split sample results will be given preference when they show a significant and obvious positive bias. For this sample, the higher number of detected values in the ETL analysis translates into higher concentrations (positive bias) for TEQdf than in the CAS analysis using both substitution methods for non-detects. The entry in Table 2-7 for this sample has been revised to clarify the complete basis for this decision.

Second, EPA noted that the selection of one data set over another for PAHs, PCBs (Aroclor), and PCBs (total) are not documented in all cases in Table 2-7. Additional documentation of the basis for selecting the risk assessment data sets for these analyte groups is provided in the revised Table 2-7. (Note: Although Table 2-7 indicates data selections for total PCBs, total PCBs in fish tissue were not used in any risk assessment calculations or in the background analysis.)

Third, EPA correctly noted that Table 2-7 misidentified the laboratory for three split samples (CL-WH-52, PB-W-31, and PB-WH-33) analyzed by International Paper in 2001. The Lab ID and Lab Name fields for these samples have been corrected to indicate the CAS laboratory in the revised Table 2-7.

Fourth, EPA requested that Table 2-7 be revised either to add the National Lake Fish Tissue Study (NLFTS) samples used in the fish tissue background evaluation or to provide a note directing the reader to Appendix C where these results are presented. A note directing the reader to Appendix C has been added to Table 2-7.

Finally, changes have been made to Table 2-7 to reflect EPA direction regarding the use of replicate analyses of Cass Lake whitefish sample CL-WH-14 and CL-S-29, which were collected as part of the fall 2001 fish tissue sampling event. EPA's February 8, 2008, comments clarified its direction to International Paper regarding the treatment of replicate analyses of these samples in the risk assessment data set. Specifically, EPA directed International Paper to use the average TEQ results of replicate analyses of CL-WH-14 and CL-S-29. In the September 2007 risk assessment, International Paper followed the data selection rules established for the project in the selection of the analytical results for CL-WH-14 and CL-S-29. EPA's direction to average the replicates for these samples deviates from these established protocols, and International Paper disagrees that these deviations are necessary or appropriate. Nevertheless, as directed by EPA, Table 2-7 has been revised to include the replicate results for use in the risk assessment data set. Replicate results for these samples are provided in the attached Addendum Tables 2-1 and 2-2.

Section 2.1. *On p. 2-2 in paragraph 3, the citations USEPA (1999a, 2002e) are replaced with USEPA (1999c, 2002i). Also on p. 2-2 in paragraph 3, Barr (2004b) is replaced with Barr (2004c), which is added to the reference list and the citation Tetra Tech (2002) is added.*

Section 2.2.2. *On p. 2-4, footnote 5, the USEPA (1992c) citation is replaced with USEPA (1992d), which is added to the reference list.*

Section 2.2.2. *On p. 2-5, the following sentence is added after the first full sentence at the top of the page:*

Application of these methods is discussed in Appendix E4, which presents methods for estimating tissue concentrations for the ERA.

Section 2.2.2.1. *On p. 2-5, the first full paragraph is revised as follows (new text is underlined):*

In some cases, elevated detection limits resulted in nondetected results exceeding the highest detected concentration for a given chemical in a given medium. For analytes detected at least once in a given medium, nondetected results that exceeded the highest detected concentration were excluded from the final risk assessment data set, because their inclusion would have introduced bias into the calculation of EPCs (USEPA 1989). Decisions relating to this rule for all media other than fish tissue were made independently for site and reference samples, because these two groups may represent statistically distinct populations of data. For fish tissue, biasing nondetects were determined per species and tissue type for the combined site and project-specific reference data sets. All site and reference samples excluded due to this rule are presented in Tables 2-8 to 2-19. These tables also identify, for each chemical, the maximum, medium-specific detected concentration that was used to screen out the biasing nondetect results. All other nondetected results that were within the range of detected concentrations were retained and addressed as described below. Special rules for identification of biasing nondetects in multi-constituent analytical totals are presented in Section 2.2.2.6.

Section 2.2.2.1, Tables 2-8 through 2-19. *Tables 2-8 through 2-19 identify biasing nondetect results that were screened out of the risk assessment data sets. The attached addendum Tables 2-3, 2-4, and 2-5 identify the maximum, medium-specific detected result for each chemical that was used for the screening of biasing nondetects.*

Section 2.2.2.2. *In an e-mail dated May 7, 2008, from Tim Drexler of USEPA to Bill Locke of Integral Consulting, EPA requested a definition of the term "method detection limit" as used in Section 2.2.2.2 and requested information on "the algorithm applied (if any) to the derivation of Site D/F chemistry data SQLs based on the following quote from [footnote 6 on p. 2-5]: '...method detection limits adjusted to reflect sample-specific actions such as dilutions.' The key word being 'adjusted'. "*

In Section 2.2.2.2 of the risk assessment report, the term "method detection limit" (MDL) is defined per EPA guidance as "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte" (USEPA 1992d).

For analysis of dioxins/furans by EPA Method 8290A, sample-specific estimated quantitation limits (EQLs) are developed rather than MDLs. Procedures for developing EQLs are specified in Section 11.9.5 of EPA Method 8290A. As stated in Section 12.2 of the method, all dilutions need to be taken into account in the reporting of final results. This also applies to EQLs, i.e., for sample extracts that are diluted prior to undergoing analysis, the calculated EDLs are adjusted upward to account for the dilution factor. For example, if a sample extract is diluted by a factor of 10 prior to analysis, the EQL for any congener(s) reported based on the diluted sample run is increased by a factor of 10.

Section 2.2.2.4. *On p. 2-6, the second paragraph is revised as follows (new text is underlined):*

For data sets with 10 or more samples, when the frequency of detection was greater than 20 percent but less than 50 percent, substitution values for censored data (i.e., nondetects) were imputed using Helsel's robust probability plotting method (Helsel 2005). This method employs a regression on order statistics (ROS) approach to impute replacement values for censored data. ROS applies a distributional assumption to only the ~~un~~censored portion of the data set, resulting in a partially parametric approach. The mean and the variance are estimated from the detected data and applied as the lognormal parameters for the censored data. The expected concentrations for the censored results are estimated from the quantiles ("order statistics"). This robust ROS method also accounts for multiple detection limits by factoring the probability of exceeding each detection limit into the quantile calculations. The ROS procedure requires an assumption of lognormality, which is an appropriate default distribution for environmental concentrations because it results in non-negative estimates and is flexible to differing amounts of skewness. In addition, in order to obtain a reliable model and thereby reliable extrapolated values, application of ROS requires that enough detected data points should be available. The guidance for the most recent version of EPA's ProUCL software package (Version 4; USEPA 2007e) recommends at least 8 to 10 detected data points be used in ROS modeling. All imputed data sets developed for calculation of EPCs in the HHRA and ERA are presented in Table 2-20. For the analytes listed in Table 2-20, the number of detected values used in generation of extrapolated nondetect substitution values ranged from 7 to 12 data points, which generally meets these minimum requirements.

Section 2.2.2.6. *On p. 2.7, the following paragraph is inserted after the fourth paragraph of this section:*

In some cases, elevated detection limits resulted in nondetected results exceeding the highest detected concentration for a given chemical in a given medium. For all media other than fish tissue, "biasing nondetects" (see Section 2.2.2.1) identified for individual constituents contributing to a multiple-constituent total were excluded prior to the calculation of multi-constituent totals and TEQs. (Note: a slightly different approach was used for the 21 dioxin/furan results for 2001 sediment samples analyzed by EPA, which were added to the data set for the 2007 risk assessment at EPA's direction, as discussed below in Section 2.2.4.1. In these cases, all available sample results were included in the total and TEQ calculation sums without eliminating biasing nondetects.) For fish tissue, totals were calculated following the rules described above for other media, with the exception of TEQ calculations. For fish data TEQ calculations, all available results were included, including some biasing nondetects. This exception to the summation rules was made in order to maintain consistency with conventions for fish TEQ calculations that were established earlier in the project.

Section 2.2.4.1. *On p. 2-9 in the second* paragraph*, the words:*

…demonstrated a significant positive bias relative to…

are replaced with:

…were systematically higher than…

Section 2.2.4.1. *On p. 2-10 in the second full paragraph, the words,*

…that the reported concentrations may demonstrate positive bias

are replaced with:

…that other results from the 2001 EPA data set were systematically higher in comparison to split samples analyzed by International Paper in 2001 and collocated samples collected and analyzed by International Paper in 2004.

Section 2.2.4.2. *On p. 2-10 in the next to last paragraph, the occurrences of Barr (2004a) are replaced with Barr (2004c), which is added to the reference list, and in the last paragraph, USEPA (2004i) is replaced with USEPA (2004a).*

Section 2.2.4.2. *On p. 2-11, the following paragraph is added after the third paragraph:*

Lastly, in its February 8, 2008 comments on the HHERA, EPA clarified its direction regarding the use of laboratory split sample results for a sucker whole body sample (CL-S-29) and a whitefish fillet sample (CL-WH-14) collected during the fall 2001 fish tissue sampling event. Specifically, EPA directed International Paper to average the valid laboratory replicate TEQ results for these samples. For CL-S-29, there are two valid replicates for TEQdf and only one analysis for TEQp. For CL-WH-14, there are four valid replicates for TEQdf and three valid replicates for TEQp. In the September 2007 HHERA, International Paper followed the data selection rules established for the project (see Section 2.2.3) in the selection of the analytical results for CL-WH-14 and CL-S-29. EPA's direction to average the replicates for these samples deviates from these established protocols, and International Paper disagrees that averaging of the replicates is technically appropriate and justified. As an illustration, in the case of TEQdf results for CL-WH-14, differences among the replicates results are only evident using one-half of the detection limit for non-detected congeners. The TEQdf (ND=0) results are almost identical among the replicates for this sample. Because the differences in the results are almost entirely an artifact of substitution rules for non-detected congeners, averaging of the replicates results in an unnecessary loss of accuracy and precision in the sample concentration for TEQdf (ND=1/2 DL) for CL-WH-14. Nevertheless, as directed by EPA, replicate TEQ results for CL-S-29 and CL-WH-14 were averaged for use in the risk assessment.

Section 2.5. *Section 2.5 presents a discussion of background reference area data that was used to compare chemical* concentrations *at the Site with those in reference areas. Among the background media discussed in Section 2.5 is fish tissue. The background fish tissue dataset was drawn from multiple data sources and lakes, as summarized in Section 2.5 and described in substantially greater detail in Appendix C of the risk assessment.*

EPA's February 8, 2008 comments on Section 2.5 express concern with the use of trophic status of reference lakes as "the sole exclusionary criteria" for selecting/eliminating reference lakes for fish tissue, and state that "other criteria must be used" to select the fish tissue reference data set. EPA cited the possibility that trophic status may be misidentified in some cases in the MPCA source of this information, since these classifications are based solely on Secchi disk measurements. EPA also indicated that other criteria, such as lake habitat and fish population, may be more relevant.

Trophic status was not used as the sole exclusionary criterion for reference lakes. The discussion of trophic status and watershed position on p. 2-17 of the HHERA deals only with project-specific *reference lakes and lakes studied as part of the LLBO's pilot Superfund project. These lakes were selected for study by EPA and its agency partners. The text on p. 2-17 is intended only to provide general comparisons of conditions in Cass Lake and Pike Bay with this group of reference lakes.*

Regarding the National Lake Fish Tissue Study (NLFTS) lakes, a broader set of criteria was used to evaluate and screen data from the NLFTS for potential inclusion in the reference data set. The selection criteria for NLFTS lakes are described in detail in Appendix C (see p. C-4ff.). In addition to trophic status, the screening process considered Ecoregion/Ecological Province information, absence of known point-sources of contamination, availability in the NLFTS database of sampling results for relevant species, and a level of shoreline development similar to or less intensive to that of Cass Lake and Pike Bay to identify a subset of the NLFTS data for inclusion in the reference data set.

The following clarifications are made to Section 2.5:

On p. 2-17, new text is added and the first full sentence is revised, as follows (new text is underlined; deletions are shown in strikethrough):

Several factors are relevant for considering the suitability of reference lakes for comparison with Pike Bay and Cass Lake. These factors include watershed position, degree of development, information on the presence or absence of contaminant point sources, trophic status, and species presence, and food web structure. With the exception of Big Lake, none of the project-specific and LLBO Pilot Study reference ~~sample locations~~ lakes chosen for fish background sampling are located upstream of the Site and in the same flowage, and none have the same degree of development and human activity as does the Cass Lake/Pike Bay study area.

On p. 2-16 in the second paragraph, USEPA (1994a) is replaced with USEPA (1994b).

On p. 2-17, the following sentence is added at the end of the first partial paragraph:

Appendix C presents a full discussion of the considerations that were brought to bear on the identification of reference lakes and reference fish tissue data.

Figure 2-1. *Revised Figure 2-1 is attached, identifying the Site's location within the Leech Lake Indian Reservation.*

Section 3—Chemical Sources, Release Mechanisms, and Transport Pathways

Section 3.1.1.1. *On p. 3-2, the following sentence is deleted from footnote 8:*

It is EPA's accepted practice to designate EMPC values "not detected" and assign a U-qualifier to the estimated concentration (Tetra Tech EM 2002; 2007).

and replaced with:

EPA's current National Functional Guidelines (USEPA 2005g) state that "[t]he laboratory does not include Estimated Maximum Possible Concentration (EMPC) or Estimated

Detection Limit (EDL) values in the TEF calculations." The guidance further clarifies, "The *reviewer* may be required to recalculate the TEFs using EMPCs and EDLs. The *laboratory*, however, is not required to perform such calculations." In this risk assessment, all EMPC values were conservatively treated as detected results. An EMPC flag was applied to calculated TEQ values in cases where one or more individual congener contributing to the TEQ was flagged as EMPC.

Section 3.1.2.2. *On p. 3-7, the second sentence of the first paragraph in this section is deleted and replaced with:*

Between 1957 and 1975, sludge from the wood-treating operations was reportedly transported to a pit at the city dump pit (see Figure 1-2) and periodically burned. A former site worker reports that the burning of the pit contents was conducted by the City (Ross 2006, pers. comm.); EPA has stated that the City denies any direct participation in the burning of wood-treatment sludge at the city dump.

Section 4—Human Health Risk Assessment

Section 4.1.1. *On p. 4-1 in the fourth paragraph, the citation for Bureau of Indian Affairs, 2001 Labor Force Report is deleted, thus eliminating the redundancy.*

On p. 4-2, the following sentence is added after the first sentence in the last paragraph on the page:

The Site lies within the exterior boundaries of the Leech Lake Indian Reservation.

On p. 4-3, the following words are deleted from the first paragraph:

…and demolition debris…

Also on p. 4-3, paragraph 1, the following words are deleted:

A closed City of Cass Lake wastewater treatment plant lies…

and replaced with:

The City of Cass Lake also owns the site of a former municipal wastewater treatment plant, which was permanently closed in the mid-1980s,…

Section 4.1.3. *On p. 4-4, the fourth and fifth sentences of paragraph four are replaced with the following:*

The HHRA evaluated the possibility of City-owned property being converted to residential land use to support decision-making concerning land use restrictions.

Section 4.1.3.1. *On p. 4-5 in the last paragraph, USEPA (2006b) is replaced with USEPA (2006a).*

On p. 4-5, the second, third, and fourth sentences of the third paragraph the section (addressing subsurface soil exposures) are deleted and are replaced with:

EPA has expressed concerns that grading at the Site during closure and remediation activities in the 1980s may have resulted in mixing of chemicals in surface soils with deeper soil horizons. At this Site, sampling of subsurface soils occurred at only a limited number of locations. These subsurface samples were generally collected at locations where relatively high concentrations of chemical had been measured in surface samples. Where both surface and subsurface data are available for the same location, an analysis of the available data indicates that subsurface soil concentrations typically are lower than surface concentrations at the same location (see Section 4.3.3). Because of the limited number and biased spatial coverage of subsurface sampling results, and because the available data suggest generally decreasing concentrations with depth, estimates of exposure to subsurface soil were based on surface soil concentrations. Uncertainties associated with this assumption are discussed in the Uncertainty Analysis (Section 4.6.1).

Also on p. 4-5, in the fourth paragraph of Section 4.1.3.1, Barr (2005a) is replaced with Barr (2005b).

Section 4.1.3.4. *On p. 4-7, the second sentence of paragraph four is revised as follows:*

However, some of the nonresidential property in Area A (i.e., City of Cass Lake property and BNSF railroad property) is open, undeveloped, and vegetated, and it is used for recreation by unauthorized individuals.

Section 4.1.4.1. *On p. 4-9 in footnote 11, USEPA (2004g) is replaced with USEPA (2004e).*

Section 4.2.2. *On p. 4-12, the fourth sentence of paragraph one is revised as follows:*

The essential nutrients magnesium, calcium, sodium, potassium, and iron were not included in the COPC selection process.

Section 4.2.4.1. *On p. 4-16, the second sentence of paragraph two is revised as follows:*

The 2,3,7,8-TCDD TEQ concentration exceeded the modified Region 9 PRG in all of the residential and wind deposition soil samples and exceeded the ATSDR interim screening level of 50 ng/kg in 11 residential soil samples and in one wind deposition sample collected north of the railroad tracks.

On p. 4-17, the following words are deleted from the third sentence of paragraph two:

…and based on the USEPA (1992c) criteria for establishing an observed release.

On p. 4-17, the following words are deleted from the fifth sentence of paragraph three:

… and based on the USEPA (1992c) criteria for establishing an observed release, as described above.

On p. 4-17, the following words are deleted from the fourth sentence of paragraph five:

…and based on the USEPA (1992c) criteria for establishing an observed release, as described above.

On p. 4-18, the following words are deleted from the fourth sentence of paragraph one:

…and based on the USEPA (1992c) criteria for establishing an observed release, as described above.

On p. 4-18, the following words are deleted from the third sentence of paragraph two:

…and based on the USEPA (1992c) criteria for establishing an observed release, as described above.

Section 4.2.4.4. *On p. 4-19, the following new sentences are added to the end of paragraph four:*

Exposures to NAPL were not evaluated in the HHRA. Such exposures would be relevant only to the utility worker scenario, only if the utility work were conducted in areas where NAPL is present, and only if the work were performed without protective wear, which would violate established health and safety procedures for Site-related work. In the unlikely event that a utility worker contacted NAPL, the contact would increase dermal exposure to such chemicals as dioxins/furans and PCP present in the NAPL.

Section 4.3.1.1. *On p. 4-23, the following sentence is deleted from paragraph three:*

Evaluation of dermal contact with surface soil is protective of exposure to house dust because it typically is assumed that concentrations in house dust and soil are similar.

and is replaced with:

The uncertainty associated with not quantifying dermal exposures to house dust is discussed in the uncertainty analysis (Section 4.6.1).

Section 4.3.2.1. *On p. 4-29, the third and fourth sentences of paragraph one are revised as follows:*

All other BaPE concentrations in plant tissue are below 0.0001 mg/kg dw (Barr 2005b). For non-garden vegetation growing in soils not affected by PAH releases, ATSDR (1995b) reported total PAH concentrations ranging from 0.02 to 1.0 mg/kg dw.

On p. 4-29 in the fourth and fifth paragraphs, Integral (2005b) is replaced with Integral (2005a).

Section 4.3.3.1. *On p. 4-34, the following new sentence is added at the end of paragraph six:*

EPCs for hypothetical future residential use of City-owned property were limited to the minimum, median, and maximum concentration locations.

Section 4.3.3.2. *On p. 4-35 in the last paragraph, the USEPA (1992c) citation is replaced with USEPA (1992d), which is added to the reference list.*

Section 4.3.3.2. *EPA's February 8, 2008, comments on Section 4.3.3.2 and Appendix D requested additional documentation of exposure point calculations (EPCs) and several other improvements to the transparency of presentations of data and calculations that support the HHRA. In response to these concerns, several modifications have been made to Appendix D, which are provided with this addendum. A summary of the specific changes is provided below under the heading "Appendix D".*

On p. 4-36, the fifth, sixth, seventh, and eighth sentences of paragraph two are replaced with the following:

For these 17 locations, EPCs were calculated four ways:

- **Pre-IRM**: Using the sample data (which was collected prior to implementation of the IRM) to represent pre-IRM conditions.

- **Current:** Using concentrations in a sample of the clean topsoil used during the interim remedial action to represent current conditions.

- **Future Case 1**: Using a weighted average of these two concentrations to represent a hypothetical future situation in which the clean topsoil is mixed with deeper native soil. The hypothetical future mixture was assumed to occur over a 1-ft interval, 4 in. of which is clean topsoil. Maximum concentrations of TEQdf and carcinogenic PAHs in three samples of clean topsoil were obtained from Barr (2006, Table 3). BaPEs were recalculated using the data in Barr (2006, Table 3) and the RPFs presented in Table 2-22 of this HHRA report.

- **Future Case 2**: Using pre-IRM concentrations to represent an upper bound of possible future exposure. This case assumes that the IRM has no long-term effectiveness in reducing exposure concentrations in soils at residences where it was implemented. The Future Case 2 assumptions have been included at the direction of EPA. International Paper disagrees with the validity of EPA's assumption that the IRM may have no long-term effectiveness for reducing exposures.

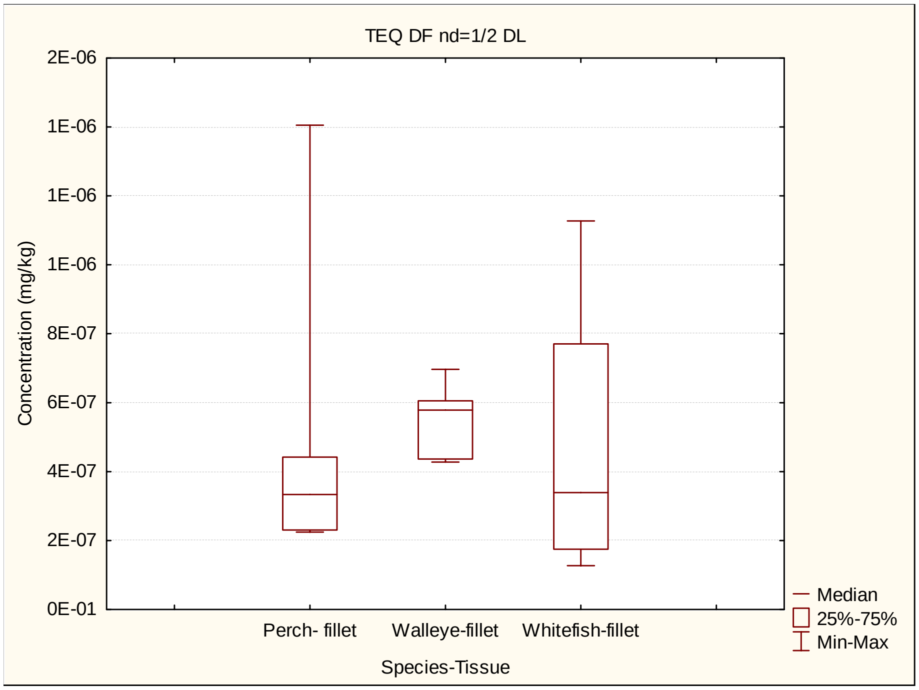
On p. 4-36 in the second paragraph, the citation for Barr (2006, Table 3) is replaced with Barr (2006b, Table 3).

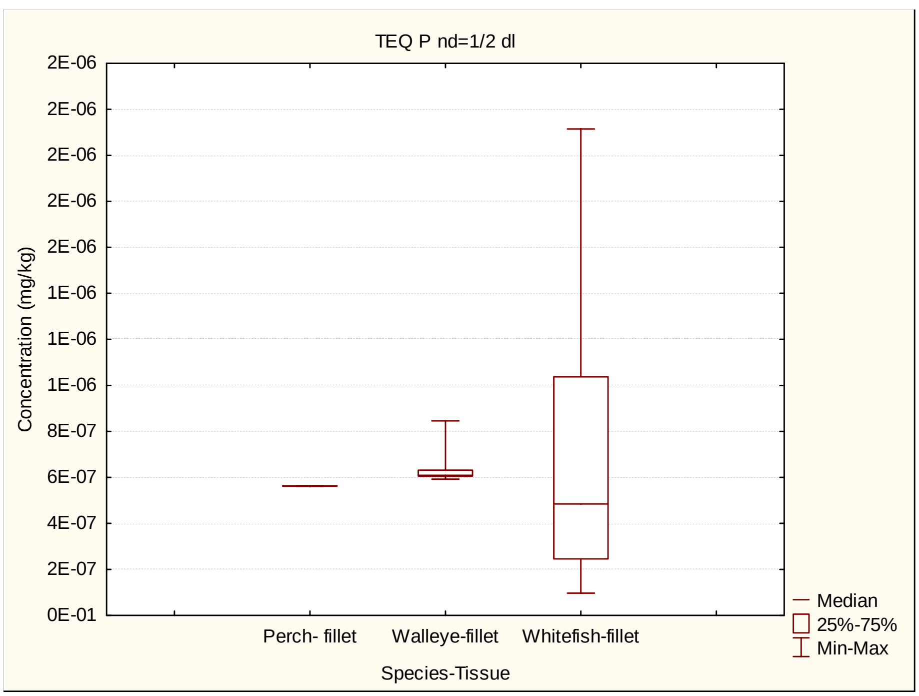
On p. 4-37, the following paragraph is added after paragraph one:

For the hypothetical future residential scenario on the City-owned portion of the north storage area, exposure units are defined by the approximately 100 x 100 ft sample grid established for the soil sampling conducted on the City-owned property in 2001, 2003, and 2004. Therefore, there was no statistical reduction of these data other than selection of the minimum, median, and maximum concentration locations from the data set. The minimum concentration of TEQdf was combined with the minimum concentration of BaPE, regardless of whether they were co-located. The same was true of the median and maximum concentrations.

On p. 4-37, the third sentence of the fourth full paragraph is revised as follows and additional information is added:

Data for multiple species were combined into one data set because a nonparametric Kruskal Wallis evaluation did not find statistically significant differences among perch, walleye, and whitefish fillets for TEQdf ($p=0.2197$) and BaPE ($p=0.1660$) with nondetects set to half detection limits. Box plots of the fillet data sets are shown below for TEQdf and BaPE, respectively.





EPCs were calculated for background fish based on reference samples collected during Site investigations, NLFTS samples, and a data set combining both sets of samples. The EPC based on the combined data set was used for calculating risks associated with background fish.

On p. 4-38, the word "three"is deleted and replaced with "four" in the third sentence of paragraph three.

On p. 4-38, the following sentence is added at the end of paragraph three:

For the hypothetical future residential scenario for the city-owned property, dust EPCs were set equal to soil EPCs.

Section 4.3.3.2. *On p. 4-39, the word "Only" is deleted from the first sentence of the last partial paragraph and replaced with:*

EPA has expressed concerns that grading at the Site during closure and remediation activities in the 1980s may have resulted in mixing of chemicals in surface soils with deeper soil horizons. In the HHRA, however, only…

Section 4.3.3.3. *On p. 4-42, the first four sentences of paragraph three are revised as follows:*

For trench volume calculations, a trench depth of 7 ft was used, taking into account that utilities might be buried below the depth of frost (6 ft) in the project area. In portions of the Site with shallow groundwater, this would entail dewatering of the trench.

On p. 4-44, paragraph two is revised as follows:

The trench depth assumed for both Areas A and B is 7 ft, based on the depth at which utilities in the area might be buried. The heads of most workers in such a trench will be close to the surface where air exchange rates likely will be much higher than 2 per hour.

On p. 4-44, the last two sentences of paragraph five are revised as follows:

Assuming the ratio of trench width (relative to the wind direction) to trench depth is 0.4 (which agrees with the street canyon experimental condition and meets the VDEQ requirement), the corresponding ACH rate can be estimated as 238. This value was used for both Areas A and B.

Table 4-7. Two parameters values are revised as follows:

- Air changes per hour (ACH): 238
- Volume (V): 4.76 m^3

On p. 4-48, the third sentence of paragraph five is deleted and replaced with the following:

Root vegetable EPCs are summarized in Appendix D2 for gardens grown in both past and future conditions. For residential locations that did not participate in the IRM, past and future conditions are the same. For residential locations that participated in the IRM, past conditions are modeled using pre-IRM soil concentrations while future conditions are modeled in two ways to reflect a range of assumptions about future conditions at these properties: future Case 1 assumes that 4 in. of clean top soil are mixed with 8 in. of potentially contaminated deeper soil; future Case 2 assumes that the IRM has no long-term effectiveness and future soil concentrations revert to pre-IRM levels.

Section 4.3.4.1. *On p. 4-52 in the second paragraph, USEPA (2002e) is replaced with USEPA (2002g).*

Section 4.3.4.2. *On p. 4-53 in the third paragraph, (1994) is revised to read (Bornschein 1994) and the corresponding reference is retained in the list in Section 6.*

On p. 4-53, the second sentence of paragraph three is revised as follows:

When ground is frozen and snow-covered, contact with soil is reduced or prevented.

On p. 4-53, the last sentence of paragraph four is deleted and replaced with the following:

Average monthly high and low temperatures for Cass Lake, based on climate summary data for Cass Lake collected by the National Weather Service (http://climate.umn.edu/doc/historical.htm), demonstrate a consistent average temperature below freezing. This indicates a high probability that soils will be frozen for the duration of the five-month winter period and unavailable for incidental ingestion and dermal contact. To the extent that snow cover is sometimes absent and soil temperatures sometimes reach above freezing levels during the five-month winter period, the soil exposure frequency could be underestimated in this HHRA.

Section 4.3.5.2. *On p. 4-65, the last sentence of paragraph one is revised as follows and the following new paragraphs are added after paragraph one (end of Section 4.3.5.2):*

To account for variability expected among different soil types and doses, a soil RBA value of 1.0 was selected to represent PCP in the HHRA.

Because of a lack of data on relative bioavailability in house dust, the RBA values discussed above were applied to both soil and house dust. It appears that both the smaller particle size and increased digestible organic content of house dust may lead to increased bioavailability of metals (Freeman et al. 1995, Kissel et al. 1996, Rasmussen 2004). It is unknown, however, whether this difference is applicable to organic contaminants. A literature search revealed no data regarding bioavailability of organic chemicals in house dust.

The RBA factors used in this HHRA are conservative, experimentally-based values. For four of the COPCs (A1254, A1260, manganese, and PCP), a highly conservative RBA value of 1 was used. The value of 0.6 used for both BaPE and naphthalene corresponds to the 90th percentile, and is nearly twice the mean, from the study on which these values were based (Magee et al. 1996). The value of 0.5 used for TEQdf is greater than the maximum value observed in the study on which this value was based (Ruby et al. 2002). While relative bioavailability may be higher for organic chemicals in house dust than in soil, it is unlikely that the RBA values used in this HHRA underestimate relative bioavailability for house dust.

Section 4.3.6.1. *On p. 4-71 in the second paragraph, USEPA (2004a) is replaced with USEPA (2004i).*

Section 4.3.6.3. *On pp. 4-73 and 4-74, the last paragraph on p. 4-73 and the first paragraph on p. 4-74 are revised as follows:*

Two recent papers by Shoaf et al. (2005a; 2005b) investigated sediment adherence for adults clamming and children playing in tidal flats. Weighted median and 95 percent upper confidence interval loading for five body parts combined were reported as 0.35 and 0.87 mg/cm^2, respectively, for adults and 4.8 and 7.0 mg/cm^2, respectively, for children. Establishing a correlation between the particle size and adherence factor necessary to achieve a monolayer is important to understanding the potential for chemical absorption. Monolayer loading is defined as the complete coverage of skin with one layer of particles. Experimental results show that the monolayer is a critical level: soil layers above the monolayer contribute very little to dermal absorption (USEPA 2007c). Using the approach presented in Duff and Kissel (1996), the following equation was used to calculate the adherence factor necessary to achieve monolayer for the scenarios in Shoaf et al. (2005a, 2005b):

$$AF_{monolayer} = \frac{\rho * \pi * d}{6}$$

where:

$AF_{monolayer}$ = Adherence factor necessary to achieve monolayer (g/cm^2)

ρ = Sediment particle density (2.65 g/cm^3)

d = Particle diameter (cm)

To account for different particle sizes within the sample, unit coverage factors were established by dividing the percent of total mean mass of each particle size by the adherence factor for that particle size. This results in a unit coverage factor: the surface coverage attributable to a given size fraction for a hypothetical total loading of 1 mg/cm^3. Summing the unit coverage factors for each particle size fraction yields an overall weighted coverage factor that can be used to estimate the total loading that would be necessary to achieve monolayer coverage. The soils at both of the experimental sites were very sandy (i.e., large particle size), resulting in predicted monolayer loadings of 13 and 31 mg/cm^2 for the adult and child scenarios, respectively.

Of the three sediment sample locations in Area B, only the Pike Bay shoreline has a similar grain size to the sediments found in the Shoaf et al. (2005a, 2005b) studies. The sediment grain sizes found at Fox Creek and the channel area were much smaller. Applying the same methods as described above, it was estimated that the total loading needed to achieve an approximate monolayer is 8.9 mg/cm^2 for Pike Bay, 1.5 mg/cm^2 for Fox Creek and 1.0 mg/cm^2 for the channel area.

The smaller grain size in Fox Creek and the channel area are well outside the range used to develop adherence factors in the Shoaf et al. studies. Given the lack of published correction factors for particle size differences, the adherence factor values from USEPA (2004a) of 0.2 mg/cm^2 for the CTE and 0.6 mg/cm^2 for the RME were used for Fox Creek and the channel area.

Sections 4.3.6.3 and 4.3.6.4. *On p. 4-74 in the second and third paragraphs, and pp. 4-76, 4-77, and 4-79 in Exhibits 4-3 and 4-4, USEPA (2004a) in every occurrence is replaced with USEPA (2004i).*

Section 4.3.8.2. *On p. 4-87, the following new sentences are inserted at the end of paragraph four:*

For the purpose of defining a high end exposure scenario for the utility worker, it was assumed the worker would be involved with trench excavation. This is a common scenario for HHRAs. Other high exposure utility/construction activities that might occur on Site include soil grading or other soil disturbing activities and construction work involving groundwater dewatering due to the shallow water table. The exposure assumptions selected for the utility worker scenario are very conservative and are believed to be protective of a wide range of construction activities on Site.

On pp. 4-87 and 4-90, USEPA (2004a) in every occurrence is replaced with USEPA (2004i).

Section 4.3.9. *On p. 4-91, in the second and third paragraphs (three instances), on p. 4-92 in the fourth and fifth paragraphs (two instances), and on p. 4-93 in the second paragraph only, USEPA (2000d) is replaced with (USEPA 2000c).*

Section 4.3.9.3. *On p. 4-96 in Exhibit 4-8, USEPA (2004a) in every occurrence is replaced with USEPA (2004i).*

Sections 4.3.10 and 4.3.11. *On p. 4-99 in Exhibit 4-9 and p. 4-101 in Exhibit 4-10, USEPA (2004a) in every occurrence is replaced with USEPA (2004i).*

Section 4.4. *EPA's February 8, 2008 General Comment 1 and Specific Comment 40 on the HHRA express concerns regarding the presentation of information on toxicity of mixtures of dioxins, furans, and dioxin-like coplanar PCBs in Sections 4.4 of HHRA. This section has been rewritten in an attempt to address EPA's concerns and is included in redline-strikeout format as an attachment to this addendum.*

Regarding General Comment 1, we agree that there is scientific consensus regarding the general nature of dioxin toxicity, but there is clearly not scientific consensus regarding the specifics of the carcinogenicity classification for TCDD or the dose response assessment for the cancer endpoint. Similarly, while there is consensus that the use of the TEF approach is reasonable, there is also consensus that the specific values are subject to substantial uncertainty and will continue to evolve. To address this comment we have cited and attached to our addendum the two EPA information sheets (USEPA 2004l, 2004m) that provide excellent overviews of the reassessment documents. We have also *carefully reviewed and revised our text to ensure that we are not casting doubt regarding the general toxicity of dioxins or the utility and broad acceptance of the TEF approach.*

Section 4.4.2 of the HHERA has also been revised to more fully describe the recommendations of the SAB and NAS reviews. In the previous draft, the charge and recommendations were quoted selectively in an attempt at brevity. A complete quote of the NRC key findings has now been included in our revised text. It did not seem useful to include the complete charge to the NRC committee as our quotes provide an accurate summary. The main complimentary aspects of the SAB and NAS comments were to commend EPA for the comprehensive nature of their literature review and their success in coherently describing this enormous body of literature. Nevertheless, both groups had significant concerns about aspects of EPA's TCDD carcinogen classification and dose response analysis, which is the focus of the risk assessment toxicity summary. We have included the SAB summary comments on the dioxin carcinogen classification, to make it clear that we are not selectively representing those findings.

The EPA reviewer acknowledges that the CSF provided in the 1984 dioxin risk assessment is used throughout EPA. This statement supports International Paper's long-held position that EPA's request to apply the 2003 slope factor in the HHRA (which in turn triggered our text supporting use of the 1984 value) was inconsistent with EPA policy and standard risk assessment practice. We look forward to new EPA dose response analyses incorporating the new data and physiologically based pharmacokinetic models that address the dose dependent half-life of dioxins. Our text clearly describes the critical role of the Ah receptor in dioxin carcinogenicity. We have added an explanation of the need to consider background exposures when assessing the potential impact of a sublinear dose response.

Section 4.4.2 has also been revised to describe noncancer effects using EPA language. We note that the WHO TDI includes a 10-fold uncertainty factor below the LOAEL. The chronic MRL is based on data from monkeys, and includes substantial uncertainty factors to address extrapolation from monkeys to humans.

The text has been revised to describe the fact that this risk assessment was first prepared prior to the development of the 2005 TEFs and that by EPA's direction, the 1998 TEFs are still used despite the broad acceptance of the 2005 TEFs and the likelihood that the 1998 TEFs overestimate risks by up to 25 percent. Other aspects of the EPA comment on this topic, such as the planned periodic reevaluation of the TEFs, are also addressed in the revised text. EPA notes that a limited number of the 29 congeners which have TEF values drive the total TEQ in people, with TCDD, 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, and PCB 126 accounting for 70 percent or more of the TEQ, and that there is extensive experimental data to derive TEFs for these congeners. We note that while these congeners may represent the majority of background exposures, they may not have a similar dominance on a site-specific basis.

Section 4.4.5 and 4.4.6. *On p. 4-123 in the last paragraph and on p. 4-124 in the third paragraph, (1997b) is replaced with (USEPA 1997b).*

Section 4.4.7. *On p. 4-124 in the last paragraph, USEPA (1997a) is replaced with USEPA (1997b).*

Section 4.5.1. *Revised Table 4-14 is attached. Changes include revised results for the utility worker scenario and results for two new scenarios: future case 2 for current residential properties and hypothetical future residential use of City property.*

Section 4.5.1.1. *EPA expressed concern in its February 8, 2008 comments regarding the statements in paragraph 5 on p. 128 and in paragraph three on p. 4-135 that gardens were not evaluated under the current scenario. EPA had previously agreed, however, to presentation of the homegrown produce scenario as a hypothetical future scenario only. The produce scenarios presented in the HHRA consider ingestion of produce grown in unamended soil for both the Case 1 and Case 2 future soil conditions. These evaluations provide the information requested by the comment regarding risks associated with consumption of homegrown produce now and in the future.*

On p. 4-128, the following sentences are added after the first sentence of paragraph three:

As described in Section 4.1.3.1, the HHRA considers both current and future residential exposure scenarios in Area A. The future residential risk scenarios for Area A assume (a) that gardens may be grown in unamended soil and (b) that the vacant City-owned property in the north storage area, which is currently zoned for small scale industrial use, may become available for residential use if zoning changes in the future. For properties that participated in the IRM to address outdoor soil and house dust, future soil EPCs were estimated as described in Section 4.3.3.2. In brief, two future soil EPCs were developed for these properties: Case 1 assumes that topsoil placed during the IRM is mixed with the underlying soil to a depth of 1 ft, and Case 2 assumes that IRM has no long-term effectiveness and future soil EPCs are set equal to pre-IRM soil EPCs.

On p. 4-128, the first sentence in paragraph four is revised as follows:

For Area A, hazard indices greater than 1 are limited to a child resident at one location under a future scenario (Table D4-7c); a utility worker digging a trench below the water table in the immediate vicinity of the active groundwater remediation system (Table 4-14); and a future child resident on City-owned property locations with dioxin/furan and BaPE concentrations at and above the median (Appendix D4-7c). A more detailed discussion of these results, including the COPCs driving the hazards, is presented below.

On p. 4-128, the first two sentences of the last paragraph (carried onto the next page) are deleted and replaced with the following:

For the Case 1 future scenario, CTE hazard indices for child residents would range from 0.02 to 1 and RME hazard indices would range from 0.04 to 2 without consumption of homegrown produce (Table D4-7c). The inclusion of garden produce consumption for the Case 1 future scenario has minimal effect, increasing CTE hazard indices by up to a factor of 0.02 and RME hazard indices by up to a factor of 0.07. The inclusion of garden produce consumption for the Case 2 future scenario also has minimal effect, increasing CTE hazard indices by up to a factor of 0.02 and RME hazard indices by up to a factor of 0.07 (Table D4-7a). The Case 2 future scenario reflects soil conditions if clean topsoil were removed through erosion or excavation or if the surface were recontaminated through wind deposition or surface runoff. If soil conditions changed in this way, total noncancer hazards for all soil exposures would revert to the pre-IRM conditions, which are discussed in Section 4.5.1.2.

Section 4.5.1.2. *Revised Table 4-16 is attached. On p. 4-130, the second and third sentences of paragraph two are revised as follows:*

For children and adults, the current hazard indices at the location with minimum pre-IRM soil concentrations (RES-05) are 27 and 29 percent, respectively, of the pre-IRM values (Table 4-16). The current hazard indices at the location with the maximum pre-IRM soil concentration that also underwent interior house cleaning (RES-09) are 0.4 percent of the pre-IRM value for both children and adults.

Section 4.5.1.3. *On p. 4-131, the second and third sentences of paragraph two are revised as follows:*

Risks for wild rice and fish consumption, including summation of wild rice and fish risks with other exposure pathways, are discussed in Section 4.5.3. These dietary exposure pathways were evaluated separately from other pathways in the main body of the HHRA because, as described in Section 4.5.3 and Appendix C, concentrations of dioxins/furans (as TCDD TEQdf) and PAHs (as BaPE) in wild rice from Cass Lake and Pike Bay are not higher than concentrations of these chemicals in wild rice from background reference lakes and there is equivocal evidence regarding whether these chemicals are higher in fish from Cass Lake and Pike Bay than in fish from background reference lakes.

On p. 4-131, the following new sentence is added to the end of paragraph four:

A more detailed discussion of the results for the utility worker, including the COPCs driving the noncancer hazards, is presented later in this section.

Section 4.5.1.4. *On p. 4-133, paragraph two is revised as follows:*

The only combined hazard indices exceeding 1 involve RME exposures for hypothetical future child residents at the Allen-C location and on City-owned property locations with dioxin/furan and BaPE concentrations at and above the median (Tables 4-17, D4-9b, D4-11b). In each case, combined hazard indices exceed 1 for both a standard child resident who resides in Area A and participates in recreational activities in Area B and for a tribal child resident who resides in Area A and participates in traditional tribal lifeways in Area B. The combined RME hazard indices are indistinguishable from the RME hazard indices for Area A exposures alone at the same locations. The risks are not affected noticeably by consumption of homegrown produce or by exposures in the city dump area (Tables D4-9c, D4-11c). The combined CTE hazard indices for the Allen-C location and the median City location are 1 and 0.7, respectively, for both tribal and standard children. The combined CTE hazard index for the maximum City location is 2 for both tribal and standard children. If the Allen-C location remains adjoined as a single property with RES-02/40, the combined CTE and RME hazard indices for a child are 0.6 and 1, respectively. The combined CTE and RME hazard indices at the next highest current residence (RES-16A) are 0.7 and 1, respectively, for both tribal and standard children.

Section 4.5.1.5. Noncancer Health Hazards for Combined Scenarios involving Workers

This new section is added as follows:

Noncancer hazards were summed across multiple scenarios to evaluate a variety of situations in which a person lives in Area A, visits Area B to participate in recreational or traditional tribal lifeways activities, and works in either Area A or Area B. Residential exposures were evaluated for standard and tribal residents at the minimum, median, and maximum risk locations in Area A, assuming Case 1 future soil concentrations (i.e., 4 in. of clean topsoil is mixed to a depth of 1 ft with 8 in. of potentially contaminated deeper soil). Standard residents were assumed to engage in recreational activities in Area B while tribal residents were assumed to engage in traditional tribal lifeways in Area B. It was assumed that the city dump area would not be open to recreation. As discussed in Section 4.5.1.3, ingestion of wild rice and fish were not included in this evaluation. Cumulative scenarios including ingestion of wild rice and fish are discussed in Section 4.5.3. Worker exposures were evaluated for the BNSF property, which yielded the maximum noncancer hazards under the worker scenario. Utility worker exposures were assumed to occur in Area B because that location yielded the maximum noncancer hazards under the utility worker scenario. Exposure frequencies for soil exposure pathways were adjusted to avoid assuming the physically impossible situation of a person being present at home, at work, and in Area B all at the same time. Although precautions were taken to prevent double counting exposure frequencies, the adjustments were designed to allow the total exposure across multiple scenarios to be higher than the exposures in individual scenarios. The exposure frequency adjustments are shown on the A+B Adjustments page in the Parameter_Risk file of Appendix D4.

Cumulative noncancer hazards for various scenario combinations are shown in Addendum Tables 4-1 and 4-2 for the CTE and RME cases, respectively. Patterns similar to those discussed in Section 4.5.1.4 are evident in Addendum Tables 4-1 and 4-2. For example, if the hazard index for the residential scenario is much smaller than for the worker scenario, the combined hazard is dominated by the worker scenario and the addition of the residential scenario to the total has little discernible impact. The reverse is true if the hazard index for the worker scenario is much smaller than for the residential scenario. If the hazard indices for the two scenarios are close in magnitude, the relative effect on the combined hazard index is larger.

The only combined hazard indices that exceed 1 are CTE combinations involving the utility worker (hazard index is 20 for each scenario), RME combinations involving the worker scenario for a resident (standard or tribal) at the maximum residential location (hazard index of 2), and RME combinations that involve the utility worker (hazard indices range up to 70). It is important to remember that summing multiple RME scenarios likely overstates the total risk. It is unlikely that one person will experience high-end exposures through every pathway in every scenario. As discussed previously (Section 4.5.1.3), the utility worker scenario represents an unlikely event in which an unprotected worker digs a trench in a restricted location with the highest groundwater impacts.

Section 4.5.2. *On pp. 4-133 and 4-134, in paragraphs 4 and 0, USEPA (1991b) is replaced with (1991c), which is added to the reference list.*

Section 4.5.2. *On p. 4-134, the* following *new sentence is inserted after the first partial sentence in paragraph zero (carried over from the previous page):*

The OSWER directive also states, "A risk manager may also decide that a baseline risk level less than [1x10^{-4}] is unacceptable due to site-specific reasons and that remedial action is warranted."

Revised Table 4-18 is attached. Changes include revised results for the utility worker scenario and results for two new scenarios: future case 2 for current residential properties and hypothetical future residential use of City property.

Section 4.5.2.1. *On p. 4-135, the following sentences are added after first sentence of paragraph one:*

Future residents in Area A also may be exposed to COPCs through consumption of homegrown produce grown in unamended garden soil. In addition, the future residential risk evaluation for Area A includes a scenario in which the vacant City-owned property in the north storage area, which is currently zoned for small scale industrial use, may become available for residential use if zoning changes in the future. For properties that participated in the IRM to address outdoor soil and house dust, future soil EPCs were estimated as described in Section 4.3.3.2. In brief, two future soil EPCs were developed for these properties: Case 1 assumes that topsoil placed during the IRM is assumed to mix with the underlying soil to a depth of 1 ft, and Case 2 assumes that IRM has no long-term effectiveness and future soil EPCs are set equal to pre-IRM soil EPCs.

On p. 4-135, paragraph two is revised as follows:

The estimated incremental cancer risks calculated for exposure scenarios at current residential locations are within or below EPA's acceptable cancer risk range of 1x10^{-6} to 1x10^{-4} (Table 4-18). Cancer risks for current residential locations are predominated by dioxins/furans, but BaPE contributes a significant portion of risk at some locations. Incremental cancer risks for worker exposure scenarios are also all within or below EPA's acceptable cancer risk range. Cancer risks for workers are also predominated by dioxins/furans.

The RME cancer risks for hypothetical future residents (standard or tribal) on City-owned property range up to 2x10^{-4} at locations with maximum dioxin/furan and BaPE concentrations (Tables D4-4e, D4-1b). The addition of a homegrown garden to the future residential scenario on City property makes no discernable difference for the standard resident, but it increases the cancer risk for the tribal resident to 3x10^{-4} at the maximum concentration location. RME cancer risks at the median concentration location on City property are 3x10^{-5} and 4x10^{-5} for standard and tribal residents, respectively, without gardens. CTE cancer risks at the maximum location on City property are $3x10^{-5}$ and $8x10^{-5}$ for standard and tribal residents, respectively, without gardens. Cancer risks on City property are predominated by dioxins/furans, but BaPE contributes a significant portion of risk at some locations.

On p. 4-136, the third sentence of *paragraph three is revised as follows:*

Consumption of produce grown in gardens with unamended soil (Case 1 assuming mixing over the top foot) increases CTE cancer risks by $7x10^{-9}$ to $1x10^{-5}$ (Tables D4-1b, D4-4e). Consumption of produce grown in gardens with pre-IRM soil concentrations (Case 2) increases CTE cancer risks by up to $1x10^{-6}$ and RME cancer risks by up to $1x10^{-5}$ (Tables D4-1c, D4-4f). The scenario involving a garden grown in pre-IRM soil reflects soil conditions if clean top soil were removed through erosion or excavation or if the surface were re-contaminated through wind deposition or surface runoff. If soil conditions changed in this way, total cancer risks for all soil exposure pathways would revert to the pre-IRM conditions, which are discussed in Section 4.5.2.2.

Section 4.5.2.2. *Revised Table 4-16 is attached.*

Section 4.5.2.3. *On p. 4-138, the second and third sentences of paragraph two are revised as follows:*

Risks for wild rice and fish consumption, including summation of wild rice and fish risks with other exposure pathways, are discussed in Section 4.5.3. These dietary exposure pathways were evaluated separately from other pathways in the main body of the HHRA because, as described in Section 4.5.3 and Appendix C, concentrations of dioxins/furans (as TCDD TEQdf) and PAHs (as BaPE) in wild rice from Cass Lake and Pike Bay are not higher than concentrations of these chemicals in wild rice from background reference lakes and there is equivocal evidence regarding whether these chemicals are higher in fish from Cass Lake and Pike Bay than in fish from background reference lakes. Risks for wild rice and fish consumption, including summation of wild rice and fish risks with other exposure pathways, are discussed in Section 4.5.3.

On p. 4-138, the fifth sentence of paragraph five is revised as follows and a new sentence is added at the end of the paragraph:

The risks for current recreational and traditional tribal lifeways activities in Area B (not including the city dump area) are due mostly to incidental ingestion of and dermal contact with sediment and soil containing carcinogenic PAHs (Tables D4-3b, D4-6d). If the city dump area were opened to recreation in the future, the contribution of soil to risks in Area B would increase (Tables D4-3f, D4-6f).

On p. 4-138, the first sentence *of paragraph six is revised as follows:*

For current and future workers in the southwest area, CTE and RME incremental cancer risks are $4x10^{-7}$ and $4x10^{-6}$, respectively, due mostly to dioxins/furans.

On p. 4-138, the following new sentence is added to the end of paragraph six:

Cancer risks for workers in the city dump area are due mostly to carcinogenic PAHs.

Section 4.5.2.4. *On p. 4-140, a new paragraph is added at the end of Section 4.5.2.4 as follows:*

RME combined cancer risks for hypothetical future standard and tribal residents on City property range up to $2x10^{-4}$ at the maximum concentration location (Tables D4-3d, D4-6e). The opening of the city dump area for recreation has no discernable impact on this risk result (Tables D4-3f, D4-6f). The addition of a garden to the scenario has no discernible impact for the standard resident, but it increases the risk for the tribal resident to $3x10^{-4}$. RME combined cancer risks for the median concentration location are $3x10^{-5}$ and $5x10^{-5}$ for standard and tribal residents, respectively, assuming the city dump area is not open to recreation and there are no gardens. CTE combined cancer risks for the maximum concentration location are $3x10^{-5}$ and $7x10^{-5}$ for standard and tribal residents, respectively. Cancer risks are predominated by dioxins/furans, but BaPE contributes significantly at some locations.

Section 4.5.2.5. Cancer Risk Estimates for Combined Scenarios Involving Workers.

This new section is added as follows:

Cancer risks were summed across multiple scenarios to evaluate a variety of situations in which a person lives in Area A, visits Area B to participate in recreational or traditional tribal lifeways activities, and works in either Area A or Area B. Residential exposures were evaluated for standard and tribal residents at the minimum, median, and maximum risk locations in Area A, assuming Case 1 future soil concentrations (i.e., 4 in. of clean topsoil is mixed to a depth of 1 ft with 8 in. of potentially contaminated deeper soil). Standard residents were assumed to engage in recreational activities in Area B while tribal residents were assumed to engage in traditional tribal lifeways in Area B. It was assumed that the city dump area would not be open to recreation. As discussed in Section 4.5.2.3, ingestion of wild rice and fish were not included in this evaluation. Cumulative scenarios including ingestion of wild rice and fish are discussed in Section 4.5.3. Worker exposures were evaluated for the BNSF property, which yielded the maximum cancer risks under the worker scenario. Utility worker exposures were assumed to occur in Area B because that location yielded the maximum cancer risks under the utility worker scenario. Exposure frequencies for soil exposure pathways were adjusted to avoid assuming the physically impossible situation of a person being present at home, at work, and in Area B all at the same time. Although precautions were taken to prevent double counting exposure frequencies, the adjustments were designed to allow the total exposure across multiple scenarios to be higher than the exposures in individual scenarios. The exposure frequency adjustments are shown on the A+B Adjustments page in the Parameter_Risk file of Appendix D4.

Cumulative cancer risks for various scenario combinations are shown in Addendum Tables 4-1 and 4-2 for the CTE and RME cases, respectively. Patterns similar to those discussed in Section 4.5.2.4 are evident in Addendum Tables 4-1 and 4-2. For example, if the cancer risk for the residential scenario is much smaller than for the worker scenario, the combined risk is dominated by the worker scenario and the addition of the residential scenario to the total has little discernible impact. The reverse is true if the cancer risk for the worker scenario is much smaller than for the residential scenario. If the cancer risks for the two scenarios are close in magnitude, the relative effect on the combined risks is larger.

None of the combined CTE scenarios yields a total cancer risk greater than $1x10^{-4}$. The only combined RME scenarios yielding total cancer risks greater than $1x10^{-4}$ are those involving utility work (risks range up to $2x10^{-4}$). It is important to remember that summing multiple RME scenarios likely overstates the total risk. It is unlikely that one person will experience high-end exposures through every pathway in every scenario. As discussed previously (Section 4.5.2.3), the utility worker scenario represents an unlikely event in which an unprotected worker digs a trench in a restricted location with the highest groundwater impacts.

Section 4.5.3. *On p. 4-140, the following new sentences are added to the end of paragraph one:*

Pathway-specific risks for fish and wild rice are addressed in Sections 4.5.3.1 and 4.5.3.2, respectively. Cumulative risks for ingestion of fish and wild rice and for the other exposure pathways evaluated are discussed in Section 4.5.3.3.

Section 4.5.3.1. *On p.4-141, paragraph one is replaced with the following:*

Based on the graphical and statistical comparisons presented in Appendix C, International Paper concluded that concentrations of dioxins/furans (expressed as TEQdf) are not higher in Cass Lake and Pike Bay than in reference lakes. This conclusion was drawn for all tissue types (fillet, whole body, and eggs). There is some evidence, as discussed in Appendix C, that concentrations of coplanar, dioxin-like PCB congeners (expressed as TEQp) are higher in Cass Lake and Pike Bay fish than in reference lakes. Concentrations of Aroclor 1260 are higher in some fish tissue types in Cass Lake and Pike Bay than in reference lakes. Carcinogenic PAHs (expressed as BaPE) were undetected in all Cass Lake, Pike Bay, and reference fillet samples.

In its February 15, 2008, comments on the risk assessment, EPA characterized the findings of the background fish tissue comparison for TEQdf as equivocal and directed International Paper to include risks associated with consumption of fish as part of total risk estimates. Cumulative risks for ingestion of fish in combination with the other exposure pathways evaluated for the Site are discussed in Section 4.5.3.3.

Section 4.5.3.1. *On p. 4-141, the fourth and fifth sentences of paragraph four are deleted and replaced with the following:*

It is important to note that the EPC for TEQdf (ND=1/2 DL) in fish from Cass Lake and Pike Bay ($6.11x10^{-7}$ mg/kg ww) is within the range of EPCs presented in Appendix D2 for the background fish data sets ($5.14x10^{-7}$ mg/kg ww for Site reference samples to $6.2x10^{-7}$ mg/kg ww for NLFTS data). This suggests that risks from dioxins/furans associated with eating fish from Cass Lake and Pike Bay are not distinguishable from risks associated with eating fish from reference areas.

Section 4.5.3.2. *On p. 4-142, the words"As with fish" are deleted and the word " Comparisons" is capitalized in the first sentence of paragraph one.*

Section 4.5.3.3. Risk Estimates for Cumulative Exposure Scenarios Involving Consumption of Fish and Wild Rice.

This new section is added as follows:

At EPA's request, risks were summed across multiple scenarios to evaluate a variety of situations in which people live in Area A, visit Area B to engage in recreational or traditional tribal lifeways activities, and eat fish and wild rice from Cass Lake and Pike Bay. Residential exposures were evaluated for standard and tribal residents at the minimum, median, and maximum residential risk locations in Area A. Standard residents were assumed to engage in recreational activities in Area B while tribal residents were assumed to engage in traditional tribal lifeways in Area B. Hazard indices are presented for standard and tribal children. Cancer risks are presented for standard and tribal adults, for which the evaluations include childhood exposures. For comparison with risks from consumption of fish from Cass Lake and Pike Bay, risks from ingestion of fish from reference lakes are also calculated. Exposure frequencies for soil exposure pathways were adjusted to avoid double counting between residential and recreational or traditional tribal lifeways exposures, as discussed in Sections 4.5.1.4 and 4.5.2.4.

Cumulative cancer risks and noncancer hazards for the Case 1 future scenario are shown in Addendum Tables 4-3 and 4-4 for the CTE and RME cases, respectively, and illustrated in Addendum Figures 4-1 through 4-4. The Case 1 future scenario assumes post-IRM soil concentrations at residential locations in Area A and gardens grown in soil mixed over a 1 ft depth (4 in. of clean topsoil and 8 in. of potentially contaminated deeper soil). The city dump area is assumed not to be open for recreation.

Cumulative cancer risks and noncancer hazards for the Case 2 future scenario are shown in Addendum Tables 4-5 and 4-6 for the CTE and RME cases, respectively. The Case 2 scenario assumes pre-IRM soil concentrations at residential locations in Area A, which represents conditions if the clean topsoil were removed through erosion or excavation or if the surface were re-contaminated through windblown deposition or surface runoff from the former operations area. The city dump area is assumed to be open for recreation.

Addendum Figures 4-1 through 4-4 illustrate that noncancer hazards and cancer risks associated with ingestion of fish are much higher than those associated with residential, recreational, or traditional tribal lifeways scenarios or ingestion of wild rice. This is true for both fish from Cass Lake/Pike Bay and fish from reference lakes. The primary contributor to risks associated with Site fish intake (58 percent) is PCBs, which are not associated with Site operations. The primary contributor to risks associated with background fish intake (56 percent) is also PCBs. Adding fish intake (Site or background) to residential, recreational, or traditional tribal lifeways scenarios increases the noncancer hazards and cancer risks associated with these scenarios dramatically. Adding wild rice intake also increases the noncancer hazards and cancer risks, but to a smaller extent than adding fish intake.

None of the cumulative CTE cancer risks for the Case 1 future scenario exceeds $1x10^{-4}$ and none of the CTE noncancer hazards for the standard child exceeds 1 (Addendum Table 4-3). Most of the cumulative CTE noncancer hazards involving site fish intake for the tribal child exceed 1 (hazard indices range up to 3) and so do the cumulative CTE noncancer hazards involving background fish intake for the maximum residential location (hazard indices of 2). The results for the cumulative CTE Case 2 future scenario are indistinguishable from those for the Case 1 future scenario (Addendum Table 4-5).

For standard residents, none of the cumulative RME cancer risks for the Case 1 future scenario exceeds $1x10^{-4}$ (Addendum Table 4-4). For tribal residents, all of the cumulative RME cancer risks involving ingestion of either site or background fish exceed $1x10^{-4}$ (total risks range up to $1x10^{-3}$). For standard residents, hazard indices for the maximum residential locations exceed 1 (hazard indices range up to 3). For tribal residents, all of the hazard indices involving ingestion of either site or background fish exceed 1 (hazard indices range up to 20). The results for the cumulative RME Case 2 future scenario are indistinguishable from those for the Case 1 future scenario (Addendum Table 4-6).

RME cancer risks and noncancer hazards for individual residential exposure pathways are compared with risks and hazards for ingestion of fish and wild rice from Cass Lake/Pike Bay and fish and wild rice from reference lakes in Addendum Table 4-7 and illustrated in Addendum Figures 4-5 through 4-8. Hazard indices are shown for standard and tribal children. Cancer risks are shown for standard and tribal adults, for whom the evaluation includes childhood exposures. Cancer risks and noncancer hazards for residential exposure pathways (ingestion of soil, ingestion of house dust, dermal contact with soil, inhalation of outdoor dust, and ingestion of homegrown produce) are shown for minimum, median, and maximum residential exposure locations in Area A assuming post-IRM soil concentrations and gardens grown in soil mixed over a 1 ft depth.

Considering cancer risks for both standard and tribal residents and noncancer hazards for tribal children, the predominant exposure pathway is ingestion of fish, followed by ingestion of house dust (Addendum Figures 4-5, 4-6, and 4-8). Considering noncancer hazards for standard children, the predominant exposure pathway is ingestion of house dust, followed by ingestion of fish (Addendum Figure 4-7). Noncancer hazards for ingestion of site fish and background fish exceed 1 for tribal children (hazard indices equal to10) but not for standard children. Cancer risks for ingestion of site fish and background fish exceed $1x10^{-4}$ for tribal residents ($1x10^{-3}$ for site fish, $8x10^{-4}$ for background fish) but not for standard residents.

Section 4.6.1. *Revised Table 4-22 is attached.*

Section 4.6.1.1. On p. 4-152, the following item is added to the bottom of the bulleted list in paragraph two:

- Exclusion of specific soil results from the Area A evaluation.

On p. 4-152, paragraph three is revised as follows:

At EPA's request, four of the issues identified in Table 4-22 are discussed in more detail below: exclusion of subsurface soil data, use of discrete fish homogenate samples, inclusion of the California extended list of PAHs in the calculation of BaPE, and exclusion of specific soil results from the Area A evaluation.

On p. 4-153, the following new paragraphs are added after paragraph two (end of Section 4.6.1.1):

EPA expressed concern about eight soil samples collected in Area A that were excluded from the HHRA. Three samples were collected of stained material in a roadway (RW-CENTER, -EAST, and -WEST). People will not be exposed through direct contact on a chronic basis to roadway materials, so it would not be appropriate to apply the exposure assumptions of the HHRA to these samples. Based on field descriptions of the samples indicating that RW-CENTER had to be "chipped out with a shovel" while RW-EAST and RW-WEST were "semiconsolidated, but could be broken up by hand" (Fetter 2004, pers. comm.), it is unlikely that people would be exposed to these materials through inhalation of fugitive dust or that these materials could serve as a source of recontamination through windblown dust. The roadway materials could serve as a source of recontamination to nearby residential properties via leaching or erosion into surface runoff. However, these are considered to be minor potential pathway because these processes would substantially dilute the concentrations of COPCs in the roadway samples.

The TEQdf concentrations in the roadway samples range from 1.81×10^{-5} to1.64×10^{-3} mg/kg (EAST and WEST, respectively). The CENTER and EAST TEQ results were flagged JEMPC, indicating unreliable data quality. In comparison, the TEQdf EPCs for former operational areas range from 7.21×10^{-4} to 2.57×10^{-3} mg/kg (International Paper and BNSF, respectively). TEQdf concentrations in the roadway samples are within or below the EPC concentrations in the former operational areas. BaPE concentrations in the roadway samples are 0.0844, 0.0260, and 565 mg/kg (WEST, EAST, and CENTER, respectively). In comparison, the BaPE EPCs for former operational areas range from 0.617 to 2.11 mg/kg (International Paper and BNSF, respectively). The WEST and EAST roadway concentrations fall well below the EPC concentrations in the former operational areas, but the CENTER roadway concentration is much higher. Due to the consolidated nature of the CENTER roadway sample, it is not considered a significant potential source of BaPE to nearby residential locations through surface runoff.

A sample of the topsoil (station ID "topsoil" from event "2004 RA") that was used to fill selected locations on the driveway of the Allen property in 2004 was excluded from the HHRA due to lack of information regarding the areal extent of coverage related to the sample. Instead, the topsoil concentrations used to represent the 17 properties that participated in the IRM were applied to the Allen property. Concentrations of TEQdf and BaPE in the excluded sample (2.45×10^{-7} and 0.0056 mg/kg, respectively) are lower than the topsoil concentrations used in the HHRA ($9.94x10^{-7}$ and 0.0096 mg/kg, respectively), so this was a health-protective decision.

Sample RES-16, which was collected in 2001, was excluded because the property was resampled in 2003 and is represented in the HHRA by samples RES-16A and RES-16B. Concentrations of TEQdf are $4.85x10^{-4}$, $2.87x10^{-4}$, and $4.82x10^{-5}$ mg/kg for RES-16, RES-16A, and RES-16B, respectively. RES-16 was analyzed for carcinogenic PAHs while RES-16A and RES-16B were not. The concentration of BaPE in RES-16 is 0.14 mg/kg. The total RME cancer risk for a tribal adult resident with a garden associated with sample RES-16, using assumptions consistent with the HHRA, is $5x10^{-5}$. In comparison, the total RME cancer risks reported in the HHRA for RES-16A and RES-16B are $5x10^{-5}$ and $8x10^{-6}$, respectively. The cancer risk associated with the excluded sample is consistent with the risks reported in the HHRA. Exclusion of the sample did not affect risk estimates.

Sample D20-21 on CFP property was excluded from the EPC calculation because it is covered by a geotextile membrane and four inches of gravel. Because the CFP data set had only seven samples, the maximum concentration of 0.0012 mg/kg (E11-13) was used. The concentration of TEQdf in D20-21 is 0.0016 mg/kg, which would have been the maximum concentration in the data set if it had been included. If the EPC for TEQdf on the CFP property were increased to 0.0016 mg/kg, the cancer risk for the worker scenario would be $4x10^{-5}$ rather than $3x10^{-5}$ as reported in the HHRA.

Section 4.6.1.2. *On p. 4-154, the first paragraph is revised as follows:*

Six of the issues identified in Table 4-22 warrant additional discussion, provided below. These issues include the use of sampled areas to represent unsampled areas, use of default soil ingestion rates, exclusion of dermal contact with indoor dust, exclusion of fish eggs from the evaluation of fish consumption, a comparison of CTE and RME risk results to illustrate the magnitude of variability and uncertainty in the exposure estimates, and a detailed discussion of uncertainties related to the evaluation of homegrown produce.

On p. 4-154, the following new paragraphs are added at the bottom of the page:

To evaluate the potential impact of the dust contact pathway on total risk results, cancer risks for tribal adults were calculated assuming dermal contact for a combined soil/dust scenario for 350 days per year under the current scenario (post-IRM, no garden). The soil adherence factor was adjusted to account for different dermal loading rates between soil and house dust. The soil adherence factors used in the HHRA were assumed to occur 83 days per year for adults and 150 days per year for children, consistent with the soil exposure frequencies assumed in the HHRA. Dust adherence factors for children were based on the weighted soil adherence factors for “indoor children” in Exhibit 3-3 of USEPA’s (2004i) dermal exposure guidance: 0.01 and 0.06 mg/cm^2 for the CTE and RME cases, respectively. These values were assumed to occur for the days of the year not spent outdoors (200 days). The weighted annual average adherence factors including both soil and dust for children were 0.02 and 0.12 mg/cm^2 for the CTE and RME cases, respectively, which are 60 percent of the original soil-only adherence factors (0.04 and 0.2 mg/cm^2, respectively). Because indoor adherence data are not available for adults, the weighted annual average adherence factors including both soil and dust for adults were assumed also be to 60 percent of the soil-only adherence factors, or 0.006 and 0.04 mg/cm^2 for the CTE and RME cases, respectively. Cancer risks including dermal contact with house dust at most locations were 7 percent higher than those excluding dermal contact with house dust (range 2–12 percent). At the maximum risk location (RES-16A), the total cancer risk including dermal contact with house dust was $4x10^{-5}$, which is the same as the result reported without dermal contact with indoor dust (Appendix D4). This evaluation indicates that while dermal contact with indoor dust probably is a significant exposure pathway, including it in the evaluation is unlikely to alter decision making at the Site. Data supporting the exposure assumptions for contact with indoor dust are lacking, which imparts a higher level of uncertainty than for dermal contact with outdoor soil.

Consumption of fish eggs is a reported practice in the local community. Applicable fish egg and fish liver ingestion rates, however, were not found in the literature. They are expected to be lower than finfish consumption rates. A recent effort on the part of the Leech Lake Division of Resource Management, the Tribal Food Safety Initiative, recommends limiting consumption of fish eggs and livers to ceremonial use only (Persell 2008). While it is unclear how closely these guidelines are followed, it is expected that fish egg consumption is limited to small amounts and only during the spring spawning season, which would potentially constitute a small bolus dosing situation.

Some chemicals are more highly concentrated in fish eggs than in fillet tissue, though this is dependent on both the fish species and the chemical in question. As discussed in Section 4.3.2.1, fish egg data were collected from Cass Lake and Pike Bay in 2004. The ratios of mean concentrations of TEQp (WHO98 ND1/2) in eggs to mean concentrations in fillet tissue were 3 for all species combined and 2 for whitefish alone. The ratios of mean concentrations for TEQdf (WHO98 ND1/2) were also 3 for all species combined and 2 for whitefish alone. Assuming limited and seasonal consumption of fish eggs in the diet, it appears that the inclusion of fish eggs would have little impact on the risks associated with fish consumption.

On p. 4-156, paragraph three is revised and a new bullet is added to the list as follows:

The following five uncertainties associated with quantifying risks from consuming produce grown in a home garden are discussed in this section:

- Potential for people to be exposed through ingestion of aboveground produce contaminated through deposition of fugitive dust

On p. 4-156, the following new paragraph is added below the bulleted list:

As discussed in section 4.3.3.3, the literature suggests that plant uptake of COPCs in residential soil and dust is limited and primarily confined to soil-to-root transfer.

Aboveground produce is typically assumed to be contaminated by three possible mechanisms: direct deposition of particles, vapor transfer, and root uptake of COPCs from soil followed by transfer to the aboveground portions of the plant (USEPA 2005). Because the soil COPCs at the Site are not volatile, vapor transfer is not a viable mechanism. Edible portions of some aboveground produce such as peas, corn, and melons are protected by a hearty covering and are only affected by root uptake. It is possible that some additional contamination of above-ground *exposed* produce may occur as a result of wind-blown dust or soil deposition. The extent to which this may influence ingestion exposure is dependent on environmental conditions, soil type, and the physiochemical characteristics of the COPCs (Beck et al. 1996). It is possible to calculate the COPC concentration in aboveground vegetation due to deposition of COPCs onto plant surfaces (see Appendix B, Table B-2-7, USEPA 2005h). Without the benefit of air dispersion modeling data, however, significant uncertainty exists regarding the actual absorption of COPCs into vegetation as a result of dustfall and soil deposition. Nevertheless, based on our literature review, we anticipate this to be a very small fraction of plant uptake of COPCs. Direct ingestion of dust is considered with conservative parameters in the soil/dust ingestion pathway in this HHRA and it is not anticipated that the additional ingestion of dust on unwashed produce would significantly alter the risk calculation.

Section 4.6.1.3. *On p. 4-160, the word "two" is deleted and replaced with "three"in the first sentence of paragraph four.*

On p. 4-160, the following new paragraph is inserted after paragraph five:

The 2005 revisions of the TEF values may result in as much as a 25 percent decrease in the total TEQ in several data sets depending on the matrix and the exposure sources (Bhavsar et al. 2008; Witsieppe et al. 2007) and our risk estimates may be overestimated to a similar degree.

Section 4.6.2.5. *On p. 4-164, the first sentence of paragraph three is revised as follows:*

Decreasing the dermal absorption factor for all chemicals by a factor of 10, chosen based on professional judgment as an estimate of the general degree of conservatism for dermal absorption factors, reduces risk estimates for the dermal absorption pathway to 0.1 times the original risk estimate for this pathway (Table D5-1).

Section 5—Ecological Risk Assessment

Section 5. *On p. 5-1 in the first paragraph, USEPA (1997c) is replaced with USEPA (1997a).*

Section 5.1.1.1. *In Table 5-1, the following is deleted from the third column of the table:*

Iron

Section 5.1.1.2. *On p. 5-6, footnote 29 is revised as follows:*

EPA required International Paper to retain lead as a COPEC in Area A and Area B soils due to the preponderance of soil sample concentrations exceeding the screening level and the potential for direct toxicity due to elevated concentrations. Lead in soils was not significantly greater in Area A or Area B soils than in reference area soils.

On p. 5-8, the third sentence in paragraph 2 is revised as follows:

EPA has required that International Paper include lead as a COPEC in Area A and Area B soils due to the preponderance of sample concentrations exceeding the screening level and the potential for direct toxicity due to elevated concentrations.

Section 5.1.1.3. *Table 5-4 is revised to include screening of TEQdfp (ND=1//2DL fish) with the screening value for TEQs. The revised table is attached.*

Section 5.1.1.3. *On p. 5-10, the following words are deleted from the third sentence of the section:*

…dioxins, total polychlorinated furans, the sum of dioxins and furans….

Section 5.1.1.3. *On p. 5-11, the following words are deleted:*

Dioxin and furan concentrations also exceeded screening levels in background sediment at four stations…

The deleted words are replaced with the following:

One or more dioxin and furan congener was detected in sediment from all reference stations…

Section 5.1.1.3. *On p. 5-11, the following text from the first full paragraph is deleted:*

Screening values are not available for any of these. The expression of dioxins and furans as totals was used in Table 5-4 because it captures concentrations of all congeners, without applying TEFs, which are not relevant to the toxicology of these compounds in invertebrates.

The deleted text is replaced with the following:

The dioxin screening value used in Table 5-4 was derived by the CCME using TEFs for fish. Therefore, the meaning of the exceedances listed in Table 5-4 in terms of toxicity to benthic invertebrates is not clear.

Section 5.1.1.4. *On p. 5-15, in the second paragraph, the first four sentences are revised follows:*

In the forested wetland, concentrations of dissolved aluminum, iron, lead and zinc all exceeded screening levels for the dissolved form of these metals. Total aluminum, barium, lead, manganese and zinc exceeded criteria for total concentrations of these metals. Total concentrations for aluminum, iron, and lead were similar to their dissolved concentrations. Of the four water samples collected in the forested wetland, one sample exceeded the dissolved and total screening levels for lead and zinc, two samples exceeded one or both of the aluminum and iron screening levels, and all four samples exceeded the barium and manganese screening levels, which are only available for total barium and manganese.

Section 5.1.3.4. *On p. 5-19, the following text is inserted between the second and third paragraphs of this section:*

Also observed on the site visit on July 2005 was evidence that Fox Creek is inhabited by beavers and muskrats. The outlet of Fox Creek to Pike Bay is blocked by a beaver dam complex. In general, the presence of actively maintained beaver dams in Minnesota streams alters stream hydrology, fish and plant community structure, nutrient cycling in sediments and water, energy flux processes and rates, and the structure of habitats for birds and mammals.

Section 5.1.7. *After the first paragraph of this section, the following text is inserted:*

There is an ongoing investigation of NAPL in the upland and wetland areas at the Cass Lake City Dump. The results of this investigation are preliminary and could therefore not be used to address the groundwater-surface water pathway for this ERA. As a result, the ERA does not address possible risks associated with potential releases of NAPL to habitats at the Site, and conclusions may be reviewed and updated as appropriate based on the findings of the NAPL investigation.

Section 5.2.4*. On p. 5-33, ASTM (1998) is replaced with ASTM (2004).*

Section 5.2.5.1. *On p. 5-33, the fifth sentence in the first paragraph of this section is revised as follows:*

Hazard quotients based on no-effects TRVs are a point of reference for interpretation of exposures; hazard quotients based on lowest effects TRVs, the toxicity endpoint represented by the TRVs, and qualitative observations of the ecological condition of the Site and uncertainties in the exposure and toxicity assessments are also considered.

Section 5.3. *On p. 5-36, the second and third sentences in the third bullet are revised as follows:*

Sections 7.2.7 and 7.3.7 of that document describe how representative species were selected as receptors from among those species that are likely to occur on the Site. Generally, a selected receptor's home range is assumed to be smaller than or equal to the size of the Site and the diet is assumed to be closely linked to the primary contaminated media.

Section 5.3.3.1. *On p. 5-45 in the fourth paragraph, (1994b) is replaced with (USEPA 1994b).*

Section 5.3.3.1, *p. 5-46, the following paragraph is inserted between the second and third full paragraphs on this page:*

An analysis of the uncertainty associated with exposure calculations using sucker data for piscivorous receptors foraging in the Channel and Pike Bay was conducted. If the general methodology for this risk assessment would dictate that the 95 percent UCL be used to estimate the RME for a given COPEC, the maximum concentration of the COPEC was used instead in the uncertainty analysis, to provide an upper bound exposure estimate. The results of this uncertainty analysis are discussed in Section 5.5.

Section 5.3.6.2. *On p. 5-52, the following text is inserted as a new paragraph following the first full, non-bulleted paragraph:*

Uncertainties associated with the assumption that *Corbicula* and mussels represent invertebrates used by most aquatic wildlife receptors were analyzed as follows. To determine the COPECs for which this assumption generated less conservative exposure estimates, the concentrations of all aquatic COPECs in *Corbicula* were compared statistically with those in *Lumbriculus* tissue, and those COPECs that were significantly different between tissue types were identified. The magnitude of the difference was determined by calculating the ratio of the *Corbicula* and mussel CT to the *Lumbriculus* CT. Subsequent uncertainty analysis was only required if there was potential for the alternative assumptions to result in a hazard quotient greater than 1. The uncertainty analysis was therefore applied to exposure models in which the COPEC concentration in the tissue used to represent invertebrate prey for the receptor was significantly lower than in the other tissue type, or for which the concentrations in the two types of invertebrate tissue differed by more than a factor of 10.

COPEC concentrations in *Corbicula* and mussel tissue COPEC concentrations were compared to concentrations in *Lumbriculus* using a nonparametric test (Mann Whitney 2-tailed U test, $p < 0.05$). The mean concentrations for the *Corbicula* and mussel tissue data set were significantly higher than for *Lumbriculus* for all analytes except for lead and zinc in Fox Creek, and antimony, dioxins/furans (TEQdfp based on avian TEFs at ND = ½ DL), LPAH and HPAH in the Channel (Addendum Table 5-1). Therefore, because the *Corbicula* and mussels data set was used to represent invertebrates in the diet of raccoon, mink, and kingfisher (i.e., all aquatic omnivorous receptors except mallard), the use of *Corbicula* and mussels to represent the invertebrate tissue was conservative for these receptors for all analytes other than those listed above. Uncertainty analyses were conducted for these COPECs for all receptors whose diet was assumed to include *Corbicula* and mussels, if the hazard quotient was greater than 0.1. In these cases, exposure models were re-run using *Lumbriculus* data.

For mallard, the model was re-run using *Corbicula* and mussel data in place of *Lumbriculus* data for COPECs with concentrations in *Corbicula* and mussels significantly greater than those in *Lumbriculus*, and when the hazard quotient was greater than 0.1. In addition, the average DDE concentrations were more than a factor of 10 higher in *Corbicula* and mussels than *Lumbriculus*, so this analyte was also re-run for mallard using *Corbicula* and mussels data, even though the differences between the two tissue types were not significant. The results of this uncertainty analysis are discussed in Section 5.5.

Section 5.3.7.2. *On p. 5-53, the following text is inserted between the first and second sentence of the first paragraph:*

As described in Section 5.1.5, a subset of species that could occur on the Site has been selected as receptors for the purposes of the ERA. Receptors are intended to represent the species or communities most likely to come into contact with contaminated media (USEPA

1992a). Species that have a high potential for exposure to hazardous substances and that conservatively represent species in the same or similar feeding guild are used as receptors. Therefore, exposure assumptions, including details of the composition of the diet, body weights, and ingestion rates of food and water are derived from general assumptions about biology of each species. Details of receptor diets are intended to provide representation of the foods of the receptor while on the Site, to better characterize how foraging at the Site itself could result in exposures. Moreover, the suite of receptors addressed by the ERA provides a spectrum of feeding guilds (e.g., the use of muskrat, raccoon, and mink provides a range from herbivory through omnivory to piscivory for the purposes of representing a range of possible exposures to mammals). Receptors are thus intended to be a generalized conceptual model for the purposes of understanding potential exposures to major taxa within generalized feeding guilds, and not to reflect specific knowledge or speculation about the details of actual wildlife behaviors at the Site. More information about the biology of each receptor is provided in Appendix E3.

Section 5.3.2. *On p. 5-40, the following text is inserted at the end of the first sentence on the page:*

Lengths and areas were then calculated using the automated calculation functions inherent to ESRI's ArcGIS software package from these digitized vector data sets (i.e., polylines and polygons) after being trimmed to the appropriate portions of Area A and/or Area B

Section 5.3.7.2. *On p. 5-53, at the end of the final bullet, and as part of the bullet, the following statement is added:*

Methods for calculating exposure areas are described in the introductory text to Section 5.3.2, at the bottom of p. 5-39.

Section 5.3.7.2. *On p. 5-55, the first paragraph, which begins on p. 5-54, is revised to include the following at the end of the paragraph:*

As described in Section 5.3.2, the polylines for the total lengths of Fox Creek, Pike Bay, and the Channel were used to generate Figure 5-7. The length of the polyline for Fox Creek was used as the exposure area for evaluating heron exposure in Fox Creek, and the total lengths of the Fox Creek, Pike Bay, and Channel polylines were summed to obtain the overall aquatic area of exposure for heron.

Section 5.3.7.2. *On p. 5-55, the first full paragraph is revised to include the following as the second sentence:*

This is the arithmetic mean of adult heron body weight values taken from multiple studies and summarized by USEPA (1993b), rounded to 2 significant figures.

Section 5.3.7.2. *On p. 5-55, the second full paragraph is revised to include the following as the second sentence:*

This is the arithmetic mean of adult kingfisher body weight values taken from multiple studies and summarized by USEPA (1993b), rounded to 2 significant figures.

Section 5.3.7.2. *On p. 5-55, the third full paragraph is revised to include the following as the last sentence:*

As described in Section 5.3.2, the length of the polyline of Pike Bay shoreline was used to define the exposure unit for evaluating kingfisher exposure in Pike Bay, and the length of the polyline of the total length of the Channel was used to define the exposure unit for evaluating kingfisher exposure in the Channel.

Section 5.3.7.2. *On p. 5-55, the final paragraph is revised to include the following as the second sentence:*

This is the arithmetic mean of adult robin body weight values reported by Wheelright (1986), rounded to 2 significant figures.

Section 5.3.7.2. *On p. 5-55 in the second paragraph and on p. 5-58 in the first paragraph, (USEPA 1993a) is replaced with (USEPA 1993b).*

Section 5.3.7.2. *`On p. 5-56, the second paragraph (consisting of a single sentence, beginning "All non-residential portions of Area A…") is revised to include the following at the end:*

As described in Section 5.3.2, the area calculated from the polygon for the terrestrial habitat of Area A was used to define the exposure unit for robin in Area A, the area calculated from the polygon for the terrestrial habitat of Area B was used to define the exposure unit for robin in Area B, and the area of the two polygons were summed to calculate the overall terrestrial exposure area (Table 5-22). For COPECs for which exposure was evaluated only in the City Dump, the polygon area of the City Dump was used to estimate the area of exposure for robin (Table 5-22).

Section 5.3.7.2. *On p. 5-56, the fourth paragraph is revised to include the following at the end of this paragraph:*

As described in Section 5.3.2, the polygons for the total area of Fox Creek including its floodplain, the total area of the Pike Bay shoreline to the edge of vegetative cover, and the total area of the Channel and its floodplain were used to describe exposure areas for mallard (Figure 5-10). The area of the polygon for Fox Creek including its floodplain was used as the exposure area for evaluating mallard exposure in Fox Creek, the area of the polygon of the Pike Bay shoreline to the edge of vegetative cover was used for evaluating mallard exposure in Pike Bay, and the areas of the Fox Creek, Pike Bay, and Channel polygons were summed to obtain the combined aquatic area to estimate exposures of mallard.

Section 5.3.7.2. *On p. 5-57, the first full paragraph is revised to include the following, after the third sentence:*

The polygons for the total area of Fox Creek including its floodplain, the total area of the Pike Bay shoreline to the edge of vegetative cover, and the polygon for the area of the Channel and its floodplain are depicted on Figure 5-10. The area of the polygon for Fox Creek including its floodplain was used to describe the exposure unit for evaluating raccoon exposure in Fox Creek, the area of the polygon of the Pike Bay shoreline to the edge of vegetative cover was used for evaluating raccoon exposure in Pike Bay, and the total areas of the Fox Creek, Pike Bay, and Channel polygons were summed to obtain the overall aquatic area of to estimate exposure for raccoons using the entire site.

Section 5.3.7.2. *On p. 5-57, the last paragraph is revised to include the following at the end:*

As described in Section 5.3.2, the polygons for the total area of Fox Creek including its floodplain, the total area of the Pike Bay shoreline to the edge of vegetative cover, and the total area of the Channel and its floodplain are depicted on Figure 5-10. The area of the polygon for Fox Creek including its floodplain was used to represent the exposure area for evaluating muskrat exposure in Fox Creek, the area of the polygon of the Pike Bay shoreline to the edge of vegetative cover was used for to represent the area of muskrat exposure in Pike Bay, and the total areas of the Fox Creek, Pike Bay, and Channel polygons were summed to obtain the overall area of exposure for muskrat.

Section 5.3.7.2. *On p. 5-58, the second paragraph is revised to include the following at the end of this paragraph:*

As described in Section 5.3.2, the polylines for the total lengths of Fox Creek, Pike Bay, and the Channel were used to generate Figure 5-7. The length of the polyline for Fox Creek was used to describe the exposure unit for evaluating mink exposure in Fox Creek, the length of the polyline for Pike Bay was used to describe the exposure unit for evaluating mink exposure in Pike Bay, the length of the polyline for the Channel was used to describe the exposure unit for evaluating mink exposure in the Channel, and the total lengths of the Fox Creek, Pike Bay, and Channel polylines were summed to obtain the overall aquatic habitat potentially used by mink at the site.

Section 5.3.7.2. *On p. 5-58, the fourth paragraph is revised to include the following at the end of this paragraph:*

As described in Section 5.3.2, the area calculated from the polygon for the terrestrial habitat of Area A was used to describe the exposure unit for meadow vole in Area A, the area calculated from the polygon for the terrestrial habitat of Area B was used to describe the exposure unit for meadow vole in Area B, and the area of the two polygons were summed to calculate the overall meadow vole terrestrial exposure area (Table 5-22). For COPECs for which exposure was evaluated only in the City Dump, the polygon area of the City Dump was used to estimate the area of exposure for meadow vole.

Section 5.3.7.2. *On p. 5-59, the first full paragraph on this page is revised to include the following at the end of this paragraph:*

As described in Section 5.3.2, the area calculated from the polygon for the terrestrial habitat of Area A was used to describe the exposure unit for shrew in Area A, the area calculated from the polygon for the terrestrial habitat of Area B was used to describe the exposure unit for shrew in Area B, and the area of the two polygons were summed to calculate the overall shrew terrestrial exposure area (Table 5-22). For COPECs for which exposure was evaluated only in the City Dump, the area of the polygon around the City Dump was used to estimate the area of exposure for shrew.

Section 5.3.7.2. *Figures 5-7, 5-8, 5-9, and 5-10 are revised to clarify which areas are considered habitats for each of the receptors. Revised figures with these numbers are attached, and replace the former figures with these numbers.*

Section 5.4.2. *On p. 5-61, the following is added to the end of the fourth sentence in the first paragraph of this section:*

…of the significance of responses in bioassays, but allowed it for evaluating the causes of effects observed in bioassays.

Section 5.4.2. *On p. 5-61, the following text is inserted at the end of the sixth sentence in the last paragraph on the page:*

Although the RAWP specified that amphipod growth would be evaluated in bioassays, the test was not performed. Uncertainties associated with this data gap are discussed in Section 5.5.2.

Section 5.4.2.2*, Pages 5-62 and 5-63. This section references Tables 5-30 and 5-31. In addition to reporting the mean and standard deviation, the standard error—which provides a snapshot of variability with respect to the mean—should be listed. Revised tables are attached and replace the former tables with those numbers.*

Section 5.4.3. *In Table 5-33, the NOAEC for cadmium is revised from 4 to 32 mg/kg dw. The "Endpoint" designation for Pentachlorophenol is revised from "Growth EC50"to "Growth EC20". In Table 5-34, the NOAEC for DDT/DDE/DDT is revised from 0.122 mg/kg to 1.22 mg/kg. The endpoint designation for this chemical is "Survival".*

Section 5.4.3. *On p. 5-63, the following text is added between the second and third sentences in the paragraph that follows the bullets:*

Only the following TRVs changed as a result of replacement:

- The pentachlorophenol LOAEC for plants (Table 5-33)
- The copper NOAEC for aquatic invertebrates (Table 5-35)
- The cadmium NOAEC for fish (Table 5-36)
- The cadmium NOAEC for mammals (Table 5-37)
- The pentachlorophenol TRVs for mammals (Table 5-38)
- The cadmium and copper TRVs for birds (Table 5-38)
- The addition of a LOAEL for mercury for birds (Table 5-38).

Some of these replacements resulted in lower (more conservative) TRVs; those that changed to higher values were pentachlorophenol in plants, the copper NOAEC for invertebrates, and the cadmium NOAEC for fish and cadmium TRVs for mammals. The reason for the changes in the pentachlorophenol values and for the cadmium TRV for mammals was that syntheses of reliable toxicity data for these chemicals were produced by EPA in 2005, under their Eco-SSL program. The toxicity data used by this program are widely vetted in the scientific community, and of the appropriate quality for risk assessment. The reason for change in the copper NOAEC for invertebrates was because the source document provided more than one NOAEC, with the difference resulting from different concentrations of copper in sediments to which test organisms were exposed. The new NOAEC is 30.4 mg/kg ww; the original NOAEC was 29.2 mg/kg ww. The concentration in sediments that resulted in the critical tissue residue value in the current draft was closer to those in sediments from the Site. Finally, the cadmium NOAEC for fish was changed because the lower value (0.54 mg/kg ww) was for a trout species, which were not among the tissues analyzed at the Site. The higher value (0.69 mg/kg ww) is an NOAEC for dace, which might better represent species for which chemical data are available for the Site, as discussed in Appendix E2. These differences were minor in most cases in which higher TRVs replaced TRVs from earlier publications.

Section 5.4.3.2. *On p. 5-67, after the second full paragraph, the following paragraph is inserted:*

Several CTRs for aquatic species were taken from a document listing available CTRs for several chemicals (Jarvinen and Ankley 1999), which is also available as an online database. For any given chemical, results of numerous toxicological studies are available. To select a CTR from among the available values, the following qualities were prioritized: the CTRs were for whole body, freshwater species, following chronic exposures to concentrations of chemicals in sediment, food, or water that were similar to concentrations known to occur in media from the Site. As a result, the CTRs may not be the lowest among data provided by Jarvinen and Ankley (1999). This approach was used to maximize the realism of the values used.

Section 5.4.3.2. *Tables 5-35 and 5-36 are replaced with tables that provide a more complete list of references. The revised tables are attached.*

Section 5.4.3.3. *On p. 5-67, the following text is added at the end of the first paragraph in this section:*

More information on the details of the original studies used to define TRVs is provided in Appendix E2.

Section 5.4.3.3. *On p. 5-68, before the first complete sentence on this page, the following is inserted:*

The use of these specific uncertainty factors to convert for acute to chronic and from LOAEL to NOAEL values is generally supported by several studies reviewed by Chapman et al. (1998).

Section 5.5.1.1. *On p. 5-71, the third bullet in the series of four bullets is revised as follows:*

COPECs in soils are no more or less bioavailable to plants at the Site than they are to test organisms in toxicity tests.

Section 5.5.1.2. *At the bottom of p. 5-74, the following text is deleted:*

The derived value is also at the low end of the range of NOAEC values for soil invertebrates identified by USEPA (2007a), which also improves confidence in the TRV. Therefore,…

The deleted text is replaced with the following:

The derived value is about 3.3 times lower than the lowest LC_{50} values for soil invertebrates identified by USEPA (2007a), although the only data found in their analysis was for a cricket species, which does not inhabit the soil, but is more closely associated with the litter layer. USEPA's (2007a) summary shows that in soils with organic carbon content of about 1 to 2 percent, the LC_{50} for crickets is around 4.1 to 4.3 mg/kg dw. The three stations with the highest total DDX concentrations in soils were in the City Dump, where soil organic matter ranges from 1.2 to 3.5 percent. The highest concentration of total DDX was 0.156 mg/kg. This is 26 times lower than the LC_{50} for crickets identified by USEPA (2007a). There remains uncertainty due to a lack of information on the toxicity of total DDX on soil infaunal invertebrates, but…

Section 5.5.1.2. *On p. 5-75, in the last paragraph, the following text is deleted:*

high bioavailability of chemicals relative to bioavailability in the field (Robertson and Alexander 1998), or

Section 5.5.1.2. *On p. 5-76, after the end of the first partial sentence, the following is inserted:*

Bioavailability of COPECs in soils from the Site relative to bioavailability in soils used for toxicity testing is uncertain.

Section 5.5.1.4. *On p. 5-84, in the second full paragraph 2, the following sentence is deleted:*

Exposures of robins to zinc in Area B may exceed the NOAEL, but are not expected to exceed the LOAEL, even at the RME.

The deleted sentence is replaced with:

Exposures of robins to zinc in Area B may exceed the NOAEL, but do not exceed the LOAEL, even at the RME.

On p. 5-84 in the third paragraph, USEPA (2005) is replaced with USEPA (2005a).

Section 5.5.2.1. *On p. 5-86, the following text is inserted after the third bullet, as the beginning of the subsequent paragraph:*

Growth of amphipods was not evaluated.

Section 5.5.2.1. *On p. 5-93, the following is added as the last bullet in the series:*

- Absence of results of a site-specific amphipods growth test.

Section 5.5.2.1. *On p. 5-96, after the end of the first full paragraph, the following is added as a paragraph:*

Absence of results of a site-specific growth test for amphipods—In assessment of risk to benthic invertebrate communities, it is generally preferable to develop and apply several lines of evidence, because of the number and variety of species and life stages that make up the benthic invertebrate community, and the ecological importance of the benthic invertebrate community as detrital processors, predators, and prey for other invertebrates, fish, amphibians, birds, and mammals. In this risk assessment, lines of evidence to address risks to the benthic invertebrate community (listed on p. 5-85) include site-specific insect growth and survival tests, and the site-specific amphipod survival test, but do not include results of an amphipod growth test. Results of an amphipod growth bioassay with site-specific sediment would have provided an additional line of evidence for evaluating growth effects on organisms exposed to Site sediments and thereby may have helped in the interpretation of the causes of the observed growth effect in *C. tentans*. For example, if growth in amphipods was predicted by nutritional quality of sediments as growth in *C. tentans* was, it would have supported the hypothesis that growth effects were the result of high TOC. Alternatively, if growth had been impaired in one but not the other test, then it would have suggested differing mechanisms.

However, it is not appropriate to speculate about what an amphipod growth test might have shown. According to national experts on sediment toxicity studies, amphipod growth (using *Hyalella azteca*) in sediment bioassays can be approximately as sensitive as *Chironomus* growth, but the ability to equate the two is significantly confounded in field-collected sediments contaminated with chemical mixtures (Ingersoll 2008, pers. comm.). Literature comparing insect and amphipod responses in controlled laboratory toxicity tests supports this assertion. In 10-day, water-only exposures, *Hyalella azteca* was more sensitive to metals, and *Chironomus tentans* was more sensitive to pesticides (Phipps et al. 1995). In a 28-day growth tests using water contaminated with imidicloprid (insecticide), the LOAEC for *C. tentans* was 3.57 µg/L, and for *H. azteca* was 8.72 µg/L (Stoughton et al. 2008). Given these types of differences in response, the complexity and variability of the site-specific sediment matrix, and of the chemical mixtures therein, make it inappropriate to speculate about whether one or the other organism would have greater sensitivity at the Site.

Generally, a 28-day exposure is required for a sufficient change in the biomass of healthy amphipods to be appropriate for statistical analysis (Ingersoll 2008, pers. comm.; Redmond 2008, pers. comm.). The performance of a 28-day amphipod growth test was never planned for this risk assessment, and the 10-day growth test, which was listed among analyses in the RAWP, would likely have allowed insufficient time to perceive the presence or absence of effects.

Section 5.5.2.1. *On p. 5-94, at the end of the first partial paragraph, the following statement is added:*

The absence of information on the growth of amphipods in site-specific sediments is also a source of uncertainty in understanding the significance and causes of the growth effect in *C. tentans*, and in understanding the overall risk to benthic invertebrate communities in Fox Creek.

Section 5.5.2.1. *On p. 5-98, between the first and second bullets on this page, the following is added as a new bullet:*

- Although growth may have been impaired in *C. tentans*, this was likely the result of the natural condition of the sediment. As such, the benthic community as a whole would be expected to respond by filling available niches in the sediment invertebrate community with other species and trophic guilds. Therefore, to the extent that invertebrate growth provides a conduit for the transfer of energy to higher trophic levels, reductions in growth of one species that is not well adapted to high-organic carbon sediments, does not signal a significant loss of food to higher trophic level organisms. This is supported by observations of the Site, which suggest a robust, highly functional wetland community in Fox Creek. However, the lack of information on amphipod growth in site-specific sediments is a relevant source of uncertainty.

Section 5.5.2.2. *On p. 5-99, the following is inserted as the third full paragraph on this page:*

The criterion for iron was derived before the standard methods for deriving AWQC were published. The basis of the criterion for iron is EPA's redbook (USEPA 1976), so interpretation of exceedances of iron is associated with some uncertainty. USEPA (1976) notes that laboratory exposures may result in greater toxicity than observed in natural environments. The lowest LC_{50} cited by EPA is 0.32 mg/L for several insect orders, but the pH, the form of the iron, and the species tested are not given. Based on two citations that indicate that fish fauna are normal at iron concentrations of 1 mg/L or less, the EPA recommends this value for its criterion. The toxicity of iron to algae, plants, amphibians and other members of aquatic communities are not explicitly considered by the AWQC.

Section 5.5.2.3. *On p. 5-101, in the third paragraph, the following text is deleted:*

None of the predicted concentrations exceed available CTRs.

The deleted text is replaced with the following:

None of the predicted concentrations except those for copper exceed available CTRs.

Section 5.5.2.3. *On p. 5-103, in the second paragraph, the following text is deleted:*

The only COPEC that exceeded the CTRs in measured or modeled fish tissue from the Site was copper. Although copper exceeded the CTR (an LOAEC of 1.71 mg/kg ww) listed in Table 5-53 in five fish samples, the CTR used was the lowest one available. Jarvinen and Ankley (1999) list CTRs for copper in fish whole bodies ranging from 7.4 to 34.3 mg/kg ww that have no effect on tested fish. None of the measured or modeled concentrations was equal to or greater than these concentrations. Moreover, concentrations…

The deleted text is replaced with:

The only COPEC that exceeded the CTRs in measured and modeled fish tissue from the Site was copper. Although copper exceeded the CTR (a LOAEC for growth in rainbow trout of

1.71 mg/kg ww) listed in Table 5-53 in five fish samples, and were predicted to exceed the CTR in Fox Creek samples, the meaning of this exceedance is unclear. Fish are generally thought to effectively regulate metals, such that concentrations in whole body samples may not reflect the biologically active fraction of the metal (USEPA 2007d). The ability of fish to regulate metals to various degrees would also account for the relatively wide range of CTR values (Jarvinen and Ankley 1999). In addition, concentrations…

Section 5.5.2.3. *On p. 5-104, the following is inserted between the fourth and fifth sentences of the second full paragraph:*

The uncertainties associated with the use of whole body CTRs for metals (USEPA 2007d) as a way of predicting toxic effects on fish, and the exceedance of the copper CTR in fish from reference areas suggest that the exceedance of copper in whole fish from the Site is not a reliable indicator of risk to fish. Moreover, while dissolved copper was below detection limits, total copper concentrations exceeded hardness-dependent WQC in both Site and reference area waters. Thus, both water and tissue concentrations of copper are elevated relative to their respective benchmarks in some of the samples from both the Site and reference areas. Risks to fish due to copper at the site cannot be concluded to exceed risks to fish from copper at reference areas.

Section 5.5.2.3. *On p. 5-104, the second sentence of the second full paragraph is deleted. The deleted sentence is replaced with:*

The available lines of evidence indicate that there are no risks to the survival and reproductive success of fish in Cass Lake, Pike Bay, Fox Creek, or the channel from exposure to COPECs. Uncertainties result from the absence of a CTR for molybdenum, and absence of data for molybdenum in water. For metals that exceed CTRs in tissue of site fish, or exceed WQC in water, exceedances are also observed in reference area tissue or water.

Section 5.5.2.5. *On p. 5-107, the following is deleted from the last paragraph:*

Because most of the aquatic receptors are piscivorous, there is also uncertainty associated with modeling concentrations of chemicals in fish tissue.

The deleted text is replaced with:

There is also uncertainty associated with modeling concentrations of chemicals in fish tissue.

Section 5.5.2.5. *On p. 5-107, the following text is inserted as new paragraphs following the first paragraph in the subsection titled "Semi-aquatic mammals: Uncertainties":*

Uncertainty in the exposure estimate for piscivorous mammals in the Channel and Pike Bay resulted from the use of whole body sucker data to represent fish consumed by piscivorous wildlife foraging in areas where no whole fish tissue data were available. To evaluate the uncertainty of this approach, exposure and risks were estimated using the maximum concentration of certain COPECs in sucker and compared to the estimates generated using the general methodology for this ERA.

For the majority of exposure models, data rules for this ERA (Section 2.2) already dictated the use of the maximum value in the whole-body sucker data set to represent the RME. For only a few COPECs (barium, lead, dioxins/furans, PCBs, and PAHs) the 95 percent UCL was used as the RME. For these COPECs, an uncertainty analysis was conducted for piscivorous mammals foraging in the Channel and Pike Bay by using the maximum value of the COPEC as the RME if the hazard quotient was greater than 0.1. The only piscivorous mammalian model with hazard quotients greater than 0.1 for the COPECs listed above was the dioxins/furans model for mink in the combined Aquatic Areas. The uncertainty analysis conducted for mink exposure to dioxins/furans in the combined Aquatic Areas using the maximum dioxin/furan concentration for whole-body white sucker in place of the 95% UCL for the RME resulted in an increase in the hazard quotient from 0.3 to 0.4. The estimated exposure remained lower than the mammalian NOAEL TRV for dioxins/furans using the maximum concentration available for whole-body sucker in this model.

Section 5.5.2.5. *On p. 5-108, the final sentence in the second bulleted paragraph is deleted. The following is inserted in its place:*

To further evaluate the difference in exposure estimates for TEQs based on predicted concentrations from those based on measured concentrations, measured TEQ concentrations in white sucker were substituted for predicted TEQ concentration in fish in the diets of piscivorous mammals (mink and raccoon) in Fox Creek. The maximum TEQ concentration measured in sucker was used as the RME to increase the conservatism of the analysis. For mink, this substitution resulted in an increase in the CT hazard quotient from less than 0.1 using predicted fish values to 0.1 using measured sucker data; and an increase in the RME hazard quotient from less than 0.1 using predicted fish values to 0.2 using measured sucker data. Both the CT and RME hazard quotients for raccoons remained at less than 0.1 after substituting the measured sucker data. In both cases, therefore, modeled exposure does not change the conclusions of the risk assessment.

Section 5.5.2.5. *On p. 5-109, the following text is added as a new paragraph at the end of the first partial paragraph on this page:*

Accumulation of PAHs in fish is complicated and varies by fish species, exposure media, exposure route and duration, the PAH compounds of interest, the concentration of humic matter in the aquatic environment, and the water temperature (Varanasi et al. 1989). Therefore, PAH concentrations in fish tissue in Fox Creek were not estimated from Fox Creek sediment data, but from measured concentrations in suckers from Cass Lake and Pike Bay. The absence of information on the PAH concentrations of fish tissue in Fox Creek is an uncertainty, but this uncertainty does not affect results and conclusions of the risk assessment. Sediment LPAH concentrations were somewhat higher in Fox Creek than in Pike Bay and Cass Lake (averages of 1.3 and 0.98 mg/kg dw, respectively), but for LPAH, the highest RME hazard quotients among piscivores was for raccoon, at less than 0.0002. Even if the assumed concentration of LPAH in fish were adjusted for the difference in sediment concentrations, the RME hazard quotient for raccoon would not approach 1. For HPAH, the arithmetic average concentrations in sediment of Cass Lake and Pike Bay (3.4 mg/kg dw) was just slightly lower than the arithmetic average for Fox Creek (3.8 mg/kg dw). The highest hazard quotient for piscivorous receptors was the RME for heron, at 0.08, with the highest RME for piscivorous mammals at 0.01 for mink. Adjusting concentrations in fish for the difference in sediment concentrations of HPAH between Fox Creek and the Pike Bay and Cass Lake sediments would not result in a hazard quotient greater than 1 for any piscivorous receptor.

Section 5.5.2.6. *On p. 5-111, the following text is inserted as a new paragraph following the first full paragraph:*

An uncertainty analysis was conducted for exposure calculations using site-specific sucker data for piscivorous birds foraging in the Channel and Pike Bay by substituting the maximum concentration of the COPEC as the RME where appropriate, using the approach for aquatic mammals described in Section 5.5.2.5. The only piscivorous bird model to which this uncertainty analysis applied (i.e., with hazard quotients greater than 0.1 for the COPECs that had previously used the 95% UCL as the RME) was the barium model for kingfisher in the Channel. The uncertainty analysis conducted for kingfisher exposure to barium in the Channel using the maximum barium concentration for whole-body white sucker did not change the hazard quotient of 2 that was originally calculated for barium.

Section 5.5.2.6. *On p. 5-111, the following is included at the end of the second full paragraph:*

To further evaluate differences in exposure estimates resulting from predicted vs. measured fish tissue TEQ concentrations, models were run for aquatic piscivorous birds in Fox Creek (heron) substituting TEQ concentrations for whole-body sucker for the predicted TEQ concentrations in fish. The maximum dioxin/furan value for sucker data was used as the RME to increase the conservatism of the analysis. The original hazard quotient, based on an exposure estimate using predicted fish tissue data was less than 0.1, and remained less than 0.1 when measured TEQ values were substituted in the exposure model. There was no difference in the risk to birds from dioxin/furan exposures resulting from the substitution of the predicted fish tissue concentrations with the higher measured dioxin/furan concentrations in fish tissue.

Section 5.5.2.6. *On p. 5-111, the following text is inserted as a new paragraph following the first full paragraph:*

An uncertainty analysis was conducted for raccoon, mink, kingfisher and mallard for COPECs with concentrations in the type of invertebrate tissue used to represent consumed invertebrates had significantly lower than concentrations of COPECs in the alternative invertebrate tissue data available. The antimony model for kingfisher in the Channel was the only model identified in which exposures to a receptor assumed to eat *Corbicula* and mussels were modeled using a lower concentration of a COPECs than the available alternative tissue (Addendum Table 5-1), and which had a hazard quotient greater than 0.1 (Table 5-64). The model was re-run using the EPCs for antimony in *Lumbriculus* instead of those for *Corbicula* and mussels; this substitution increased the hazard quotient of 0.1 to a hazard quotient of 0.2 for the CT, and increased the RME hazard quotient from 0.3 to 0.5. The estimated exposure therefore remained lower than the NOAEL avian TRV for antimony in this uncertainty analysis.

For mallard, all hazard quotients based on consumption of *Lumbriculus* were less than or equal to 0.1 (Table 5-65). However, DDE in both Fox Creek and the Channel was identified as having concentrations that were more than a factor of 10 higher in *Corbicula* and mussels than in *Lumbriculus* (even though the difference was not statistically significant). Therefore, DDE models for mallards in Fox Creek and the Channel were re-run, substituting the EPC from the *Corbicula* and mussel data set for the EPC from the *Lumbriculus* data. The resulting CT and RME hazard quotients for mallard in Fox Creek and the Channel remained less than 0.01.

Section 5.4.2.2. *For Tables 5-30, 5-31, and 5-32, the following is added to the column entry for "TOC" for the row "Laboratory Control":*

--[a]

[a] – The TOC in laboratory sediment was not measured, but is estimated by the lab to be approximately 4 percent.

REFERENCES CITED

Revised References

On p. 6-7, the reference for Ecological Specialists (2005) is revised as follows:
Ecological Specialists. 2005. Characterization of unionid communities and habitat in three areas near Cass Lake, Cass County, MN. Prepared for Integral Consulting Inc., Mercer Island, WA. Ecological Specialists, Inc., O'Fallon, MO.

On p. 6-10, the IWP reference is revised to include the year, as follows:
IWP. 2003. White House opts for broad science review of EPA dioxin risk study. Inside Washington Publishers. October 20.

On p. 6-15, the reference for OEHHA (2005) is revised to identify agency represented by the acronym:
OEHHA. 2005. Toxicity criteria database. http://www.oehha.ca.gov/risk/ChemicalDB/. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment.

On p. 6-17, the duplicate entry for Sample and Arenal (1999) is deleted.

On p. 6-19, the reference for St. Regis Paper Company (2007) stands as is; it is cited on p. 3-8.

On p. 6-20, Tetra Tech EM (2002) and Tetra Tech EM (2003) are removed from the list to eliminate the redundancy with Tetra Tech (2002) and Tetra Tech (2003) and citations in text are consistently phrased as Tetra Tech (2002) and Tetra Tech 2003), as appropriate.

On p. 6-26, the entry for USEPA (2004a) is deleted.

On p. 6-25, USEPA (2003c) is replaced with:
USEPA. 2003c. Ecological soil screening level for aluminum. Interim final. OSWER Directive 9285.7-60. U.S. Environmental Protection Agency, Washington, DC.

On p. 6-29, WHO (2002) is replaced with the following:
WHO. 2002. Safety evaluation of certain food additives and contaminants, polychlorinated dibenzodioxins, polychlorinated dibenzofurans, and coplanar polychlorinated biphenyls. WHO Food Additives Series 48 (2002). Available at:
http://www.inchem.org/documents/jecfa/jecmono/v48je20.htm

On p. 6-30, the duplicate entry for Wild and Jones (1992) is deleted.

Additional HHERA References

Barr. 2004c. Analytical data review/validation – 2001 fish tissue samples, St. Regis Paper Company Site, Cass Lake, Minnesota. Memorandum from Tom Mattison to Tim Drexler, U.S. EPA Region 5, April 5, 2004.

Barr. 2005c. final report, Unilateral Administrative Order Docket No. V-W-'04-C-771. St. Regis Paper Company Superfund Site, Cass Lake, Minnesota. Prepared for International Paper. Prepared by Barr Engineering Company, Minneapolis, MN.

Barr 2006b. Remedial action report, Unilateral Administrative Order Docket No. V-W-'05-C-833. St. Regis Paper Company Superfund Site, Cass Lake, Minnesota. Prepared for International Paper. Prepared by Barr Engineering Company, Minneapolis, MN.

Hattemer-Frey, H.A., and C.C. Travis. 1991. Benzo-a-pyrene: Environmental partitioning and human exposure. *Toxicol. Ind. Health* 7(3):141-157. (cited on p. 4-149)

Krablin, R. 1989. Letter of October 13, 1989 to Jonathan Z. Cannon concerning soil ingestion rates. Denver, CO: Arco Coal Co. As cited in USEPA 1997. (cited on p. 4-61)

Lacey, R., M.C. Watzin, and A.W. McIntosh. 1999. Sediment organic matter content as a confounding factor in toxicity tests with *Chironomus tentans*. *Environ. Toxicol. Chem*. 18(2):231-236. (cited on p. 5-63)

Long, E.R., C.G. Ingersoll, and D.D. MacDonald. 2006. Calculation and uses of mean sediment quality guideline quotients: A critical review. *Environ. Sci. Technol.* 40(6):1726-1736. (cited on p. 5-88)

Minnesota Department of Employment and Economic Development. 2002. Data retrieved from Minnesota Workforce Data Center website (http://data.mnwfc.org/lmi/es/). (cited on p. 4-2)

USEPA. 1999c. Contract Laboratory Program national functional guidelines for organic data review. 540-R-99-008. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. (cited on p. 2-2)

USEPA. 2002i. USEPA Contract Laboratory Program national functional guidelines for inorganic data review. 540-R-01-008. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. (cited on p. 2-2)

USEPA. 1992d. Calculating the concentration term. Publication 9285.7-081. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. May. (cited on p. 2-4)

Barr. 2006b. Remedial action report, Unilateral Administrative Order, Docket No. V-W-'05-C-833, Residential Dust Reduction, St. Regis Paper Company Superfund Site, Cass Lake, Minnesota. Prepared by Barr Engineering Company, Minneapolis, MN, for International Paper Company, Memphis, TN. (cited on p. 4-36)

MPCA. 2004. Guidance manual for assessing the quality of Minnesota surface waters for the determination of impairment 305(b) report and 303(d) list. Minnesota Pollution Control Agency, St. Paul, MN. (cited on p. 5-13)

USEPA. 1992d. Calculating the concentration term. Publication 9285.7-081. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. May. (cited on p. 4-35)

USEPA. 1991c. Role of the baseline risk assessment in Superfund remedy selection decisions. OSWER Directive 9355.0-30. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. April 22. (cited on p. 4-134)

Van Wijnen, J.H., P. Clausing, B. Brunekreef. 1990. Estimated soil ingestion by children. Environ. Res. 51:147-162. As cited in: USEPA 1994a. (cited on p. 4-60)

Addendum References (cited herein)

Bhavsar, S.P., E.J. Reiner, A. Hayton, R. Fletcher, and K. Macpherson. 2008. Converting toxic equivalents (TEQ) of dioxins and dioxin-like compounds in fish from one toxic equivalency factor (TEF) scheme to another. *Environment International* Epub ahead of print

Biesinger, K.E. and L.E. Anderson. 1982. Chronic effects of inorganic and organic mercury on *Daphnia magna*: toxicity, accumulation, and loss. *Arch. Environ. Contam. Toxicol.* 11(6):769–774.

Borgmann, U. and W.P. Norwood. 1997. Toxicity and accumulation of zinc and copper in *Hyalella azteca* exposed to metal-spiked sediments. *Can. J. Fish. Aquat. Sci.* 54:1046–1054.

Chapman, P.M., A. Fairbrother, and D. Brown. 1998. A critical evaluation of safety (uncertainty) factors for ecological risk assessment. *Environ. Toxicol. Chem.* 17(1):99–108.

Duff, R.M. and J.C. Kissel. 1996. Effect of soil loading on dermal absorption efficiency from contaminated soils. *J. Toxicol. Environ. Health* 48:93–106.

Emond, C., L.S. Birnbaum, and M.J. DeVito. 2006. Use of a physiologically based pharmacokinetic model for rats to study the influence of body fat mass and induction of CYP1A2 on the pharmacokinetics of TCDD. *Environ. Health Perspect.* 114:1394–1400.

Emond, C., J.E. Michalek, L.S. Birnbaum, and M.J. DeVito. 2005. Comparison of the use of a physiologically based pharmacokinetic model and a classical pharmacokinetic model for dioxin exposure assessments. *Environ. Health Perspect.* 113:1666–1668.

Fetter, D. 2004. Personal communication (email from Dan Fetter, Barr Engineering Company, to Rick Rothman et al. dated July 19, 2004, 3:30 p.m., regarding Cass Lake-Samples Collected).

Freeman, G.B., M.V. Ruby, R.A. Schoof, M.V. Ruby, A.O. Davis, J.A. Dill, et al. 1995. Bioavailability of arsenic in soil and house dust impacted by smelter activities following oral administration in cynomolgus monkeys. *Fundam. Appl. Toxicol.* 28(2):215–222.

Ingersoll, C.G. 2008. Personal communication (conversation with J. Sampson, Integral Consulting Inc. Mercer Island WA, on March 26, 2008 regarding the relative sensitivity of amphipods and chironomids in 10-day toxicity tests.). U.S. Geological Survey, Columbia, MO.

Ingersoll, C.G., F.J. Dwyer, and May T.W. 1990. Toxicity of inorganic and organic selenium to *Daphnia magna* (Cladocera) and *Chironomus riparius* (Diptera). *Environ. Toxicol. Chem.* 9:1171–1181.

Kissel, J.C., K.Y. Richter, and R.A. Fenske. 1996. Factors affecting soil adherence to skin in hand-press trials. *Bull. Environ. Contam. Toxicol.* 56:722–728.

Marr, J.C.A., J. Lipton, D. Cacela, J.A. Hansen, H.L. Bergman, J.S. Meyer, et al. 1996. Relationship between copper exposure duration, tissue copper concentration, and rainbow trout growth. *Aquat. Toxicol.* 36:17–30.

Persell, J. 2008. Tribal food safety initiative: a triblal effort to inform food consumption decisions. http://www.lldrm.org/assets/foodhistory2.ppt. Accessed on May 23, 2008. Leech Lake Division of Resource Management, Cass Lake, MN.

Phipps, G.L., V.R. Mattson, and G.T. Ankley. 1995. Relative sensitivity of three freshwater benthic macroinvertebrates to ten contaminants. *Arch. Environ. Contam. Toxicol.* 28(3):281–286.

Rasmussen, P.E. 2004. Can metal concentrations in indoor dust be predicted from soil geochemistry? *Can. J. Anal. Sci. Spectros.* 49:166–174.

Redmond, M. 2008. Personal communication (telephone conversation with J. Sampson, Integral Consulting, Inc., Mercer Island, WA, on April 14, 2008 on the history of sediment toxicity testing at the St. Regis Site in Cass Lake, MN). Northwestern Aquatic Sciences, Newport, OR.

Stoughton, S.J., K. Liber, J. Culp, and A. Cessna. 2008. Acute and chronic toxicity of Imidacloprid to the aquatic invertebrates *Chironomus tentans* and *Hyalella azteca* under constant- and pulse-exposure conditions. *Arch. Environ. Contam. Toxicol.* 54(4):662–673.

USEPA. 1976. Quality criteria for water. PB-263 943. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1992d. Test methods for evaluating solid waste, physical/chemical methods (SW-846), Chapter 1 – Quality Control. U.S. Environmental Protection Agency, Washington, DC. Available online at http://www.epa.gov/sw-846/main.htm.

USEPA. 2003l. World Trade Center indoor environment assessment: Selecting contaminants of potential concern and setting health-based benchmarks. Prepared by the Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Task Force Working Group. Available at: http://www.epa.gov/wtc/copc_benchmark.pdf.

USEPA. 2004l. Information sheet 1. Dioxin: Summary of the dioxin reassessment science. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

USEPA. 2004m. Information sheet 2. Dioxin: Scientific highlights from the NAS review draft of EPA's dioxin reassessment. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

USEPA. 2005g. National functional guidelines for chlorinated dioxin/furan data review. EPA-540-R-05-001. Office of Superfund Remediation and Technology Innovation. U.S. Environmental Protection Agency, Washington, DC.

USEPA. 2005h. Human health risk assessment protocol. U.S. Environmental Protection Agency Region 6. Office of Solid Waste. Multimedia Planning and Permitting Division. Center for Combustion Science and Engineering, Washington DC.

USEPA. 2007c. Dermal exposure assessment: A summary of EPA approaches. EPA 600/R-07/040F. U.S. Environmental Protection Agency, National Center for Environmental Assessment Office of Research and Development, Washington, DC.

USEPA. 2007b. Framework for metals risk assessment. EPA 120/R-07/001. U.S. Environmental Protection Agency, Washington, DC.

USEPA. 2007e. ProUCL Version 4.00.02 User Guide. EPA/600/R-07/038. Prepared by Lockheed Martin Environmental Services, Las Vegas, NV. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

Varanasi, U., J.E. Stein, and M. Nishimoto. 1989. Biotransformation and Discposition of Polycyclic Aromatic Hydrocarbons (PAH) in fish. In: *Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment*.pp. 93–148.

Wittsiepe, J., P. Fürst, and M.E. Will. 2007. The 2005 World Health Organization re-evaluation of TEFs for dioxins and dioxin-like compounds--what are the consequences for German human background levels? *Int. J. Hyg. Environ. Health.* 210(3-4):335–339.

APPENDIX A

On p. A-4, the last paragraph is revised as follows:

All other data treatment rules described in Section 2 also apply. Notably, nondetected values whose detection limits exceeded the highest detected concentration in the reference data sets ("biasing nondetects") were excluded. Biasing nondetects were determined independently for Study Area and reference data sets. ~~This evaluation occurred~~ In addition, the identification of biasing nondetects in the Site dataset was performed in a slightly different manner for the comparison of Site and background concentrations ~~comparison~~ than for other uses in the risk assessment ~~the overall dataset~~. In the ~~overall~~ analysis of biasing nondetects for other uses in the risk assessment, only those censored data whose detection limits exceeded the *site-wide* maximum detected value were excluded. However, for this background analysis, biasing nondetects in the Site data set were determined based on chemical/area combination. This rule affected only the arsenic data set for Pike Bay/Channel area sediment samples. The highest sediment arsenic concentration in Pike Bay/Channel area samples was a value of 6.89 mg/kg from the Channel area. Six Channel samples were reported as nondetects with detection limits higher than 6.89 mg/kg (detection limits ranging from 10.2 to 14.9 mg/kg). These six samples were excluded from the background comparisons.

Revised Tables A-3, A-4, and A-5 are attached. These tables, which were presented separately in the September 2007 HHERA, have been combined into a single table to improve readability.

APPENDIX B

On p. B-4, the third full paragraph is revised as follows:

All other data treatment rules described in Section 2 also apply. Notably, nondetected values whose detection limits exceeded the highest detection concentration ("biasing nondetects") were excluded. Biasing nondetects were determined independently for Study Area and reference data sets. ~~This evaluation occurred~~ In addition, the identification of biasing nondetects in the Site data set was performed in a slightly different manner for the comparison of Site and background concentrations ~~comparison~~ than for other uses in the risk assessment ~~the overall dataset~~. In the ~~overall~~ analysis of biasing nondetects for other uses in the risk assessment, only those censored data whose detection limits exceeded the *site-wide* maximum detected value were excluded. However, for this background analysis, biasing nondetects in the Site data set were determined based on chemical/area combination.

Revised Tables B-5, B-6, B-7, and B-8 are attached. These tables, which were presented separately in the September 2007 HHERA, have been combined into a single table to improve readability.

APPENDIX C TABLES

As discussed above under Table 2-7 and Section 2.2.4.2, EPA's February 8, 2008, comments directed International Paper to use the average results of TEQdf and TEQp replicate analyses for samples CL-WH-14 and CL-S-29. Statistical calculations and supporting tables and figures were revised in response to this directive, as follows:

- Revised Table C-1 is attached, with changes indicated by shading.
- Revised Tables C-9, C-10, and C-11 are attached. These tables, which were presented separately in the September 2007 HHERA, have been combined into a single table to improve readability. Changes to the statistical results presented in these tables are indicated by shading.
- Revised Figures C-6b, C-6e, C-7b, C-7e, C-8e, and C-9e are attached.

APPENDIX D

Portions of Appendix D are revised and are provided on CD.

Appendix D-2 includes the following revisions:

- Additional documentation of data sets, station IDs, and ProUCL output is included.
- Data sets and statistical EPC calculations for background fish are added.
- The EPC for trench vapors is changed to reflect a deeper trench for the utility worker. The depth increase caused the trench volume to increase. The depth increase should have caused the ACH to decrease but, because the original ACH was calculated based on a 10.8-ft trench, the ACH actually decreased from the originally reported value. The net effect was to decrease vapor concentrations in the trench.
- The EPC for TEQdf for site fish increased because the value for sample CL-WH-14R is revised.

Appendix D-4 includes the following revisions:

- A roadmap of the spreadsheet system is included.
- A matrix of risk result tables is included.
- The spreadsheets are delivered without security protection to eliminate unwieldy pathnames in cell references.
- New Sum A Past (All) pages are added to residential receptors. These pages include all properties, not just properties that participated in the IRM, and they include homegrown produce grown in pre-IRM soil concentrations.
- Future residential risks are calculated for the minimum, median, and maximum concentration locations on City property.
- A new page called "Special Houses" is added to the EPC spreadsheet to document residential locations with special considerations and where they are discussed in the text.
- A value is added for the subchronic dermal RfD for manganese.
- All numerical values are deleted from Table D4-4l, Exposure Location RES-40-(0-4) (file name App_D4-8 to D4-13_Stnd_Adult_AltSF.xls, worksheet Sum - A - CR - Future) to eliminate a #DIV/0! message. A note is included stating that this location was not evaluated separately and is the same as RES-02.
- The subchronic RfC and source columns are removed from the Parameter_Risk file because this parameter is not used.
- EPA expressed concern about inconsistent spreadsheet entries of "--" and "0.00E+00". The "--" entry occurs for chemicals without an applicable toxicity value. The "0.00E+00" entry occurs for chemicals that were not selected as COPCs for a given exposure unit. The spreadsheet reprogramming necessary to convert the "0.00E+00" entry to a "--" entry would have introduced a significant potential for error and was not attempted.
- EPA expressed concern about a future A+B scenario that linked to a current Area B page. This link was intentional. The A+B scenario in question modeled a future scenario in which the city dump area was not open to recreation, which is evaluated on the current Area B page. An A+B scenario in which the city dump area is open to recreation, which links to the future Area B page, is evaluated on a different A+B page.
- EPA expressed concern about an apparent inconsistency between the text and spreadsheets, in which the text states that homegrown produce is not grown in unamended soil but the spreadsheets used the pre-IRM concentration to evaluate produce grown at the Allen-C property. When estimating produce concentrations for the Allen-C sample result, as well as any residence that did not participate in

the IRM, it was necessary to use the pre-IRM soil concentration, because no changes in soil concentrations have occurred on these properties.

APPENDIX E

Appendix E2, Section 2.5. *On p. E2-11, the following text is inserted as the second bullet on this page:*

Marr et al. (1996) exposed rainbow trout fry to 0.9, 1.1, 2.2, 4.6 and 9.0 mg/L copper in water for 60 days, and observed statistically significant differences in growth of fry after about 20 days. Fish exposed to higher concentrations of copper accumulated more whole-body copper than fish exposed to lower concentrations. After 40 days, there was no effect on body weight of fish exposed to 1.1 mg/L copper, and the whole-body copper concentration was 4.24 mg/kg dw. There was no effect on growth at this exposure level through 60days, so this value was taken as the NOAEC. Also after 40 days, the body weight of fish exposed to 2.2 mg/L was reduced relative to controls. Their whole-body copper concentrations at this time were 4.19 mg/kg dw, and this value was taken as the LOAEC. Assuming 72.5 percent moisture, the NOAEC and LOAEC values were 1.17 and 1.71 mg/kg ww, respectively. These values were applied to the risk assessment for fish.

Appendix E2, Section 3.4. *On p. E2-35, the following text is deleted:*

Terrestrial plants were adversely affected when grown in PCP solution at 0.3 mg/L (root growth) and soil invertebrates were adversely affected at 1 to 5 g/m^2 soil (reduction in soil biota populations) (Eisler 1989). PCP may be phytotoxic at soil concentrations as low as 3 mg/kg (Efroymson et al. 1997b) and may be toxic to soil biota at soil concentrations as low as 30 mg/kg (Efroymson et al. 1997a). Hulzebos et al. (1993) tested the toxicity of PCP on lettuce seedlings. Lettuce seedlings were exposed to PCP for 14 days in two loamy soils (one with 12 percent clay, the other with 24 percent clay), and in solutions for up to 21 days. Hulzebos et al. (1993) only provide EC50 values, that is, concentrations which affect 50 percent of exposed specimens. Soils with higher clay content were less toxic, even with the same concentration of PCP. The EC50 for 12 percent clay was 3.2 mg/kg and the EC50 for 24 percent clay was 8 mg/kg. Because the clay content for soils at the site is generally less than 4 percent, the lower (i.e., more conservative) EC50 of 3.2 mg/kg was selected to represent a LOAEC for plants.

In place of this deleted text, the following text is inserted:

USEPA (2005e) derived an EcoSSL for PCP after critical review of the only four papers (out of 43 identified) that met the acceptability criteria for their EcoSSL database. They derived an EcoSSL from three EC20 values for growth of plants exposed to pentachlorophenol in soils with very low organic matter (0.1 percent): their plant EcoSSL for this chemical is 5.0 mg/kg dw.

Appendix E6, Section 7.1.2. *On p. E6-17, at the end of the fifth main bullet (regarding the proportion of all organic matter in fish food), the following is deleted:*

(2004)

In place of the deleted text, the following is added:

(Barr 2005).