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Subject: May 2010 update of Gainesville on-Site Human Health Risk Assessment
Attachments: Gainesville HHRA 10may2010 Text-Tables-Figures.pdf

Dear Scott:

On behalf of Beazer East, ARCADIS is sending the attached update of the on-Site Human Health Risk Assessment for the Gainesville Site ("Evaluation of Potential Theoretical On-Site Human Health Risks Associated with Soils and Sediments at the Koppers Inc. Wood-Treating Facility in Gainesville, Florida" May 2010). The attached report is an update of the August 2009 Human Health Risk Assessment (HHRA) and primarily reflects recent changes in land use at the Site. The key changes are:

- the updated HHRA assumes that the Site is currently vacant with hypothetical trespassers as the current hypothetical receptors with potential theoretical exposure to constituents on-Site;
- the updated HHRA assumes that in the future the Site may be developed for hypothetical recreational or commercial/industrial use and that the hypothetical receptors in those cases are hypothetical recreational users or hypothetical indoor or outdoor commercial/industrial workers;
- given that the Site is currently vacant and that exact nature of future development is not defined, the updated HHRA treats the Site as one hypothetical exposure area; and,
- US EPA theoretical default assumptions are used to evaluate the potential theoretical health risks for hypothetical future commercial/industrial workers.

Because the report with appendices is quite large, we have divided into two pieces. The first, attached to this email, is the text of the report with tables and figures. The second email, which I will send shortly, will have a file attached with the appendices and attachments. If you have problems receiving or opening either file, please contact me.

Also note that while we did not receive any comments from US EPA on the August 2009 HHRA, you did forward comments to us from FDEP. We are preparing a response letter that describes how those comments were addressed in the updated HHRA and will send that letter to you within the next week to ten days.

Best regards,

Paul Anderson

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Evaluation of Potential Theoretical On-Site Human Health Risks Associated with Soils and Sediments at the Koppers Inc. Wood-Treating Facility in Gainesville, Florida

May 2010

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Evaluation of Potential Theoretical On-Site Human Health Risks Associated with Soils and Sediments at the Koppers Inc. Wood-Treating Facility in Gainesville, Florida

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Appendix H Deterministic Potential Theoretical Risk Calculations

Acronyms

ADD	Average Daily Dose
ALM	Adult Lead Model
AT	Averaging Time
BaP-TE	Benzo(a)pyrene Toxic Equivalent
BBA	Boiler/Bathhouse Area
BW	Body Weight
DTSC/HERD	Department on Toxic Substances Control/ Human and Ecological Risk Division
CCA	Chromated Copper Arsenate
CF	Conversion Factor
cm^2	square centimeter
COPC	Constituent of Potential Concern
CSF	Cancer Slope Factor
d	day(s)
DD	Drainage Ditch
ED	Exposure Duration
ED01	estimated dose corresponding to a 1% increase in extra risk
EF	Exposure Frequency
EPC	Exposure Point Concentration

ET	Exposure Time
FDEP	Florida Department of Environmental Protection
FI	Fraction of daily exposure
GSD	Geometric Standard Deviation
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
hr	hour(s)
IR	Ingestion Rate
IRIS	Integrated Risk Information System
kg	kilogram
KI	Koppers, Inc.
LADD	Lifetime Average Daily Dose
LED01	95% lower confidence limit of the estimated dose corresponding to a 1% increase in extra risk
LOAEL	Lowest Observed Adverse Effect Level
MEE	Microexposure Event
m^3	cubic meter
mg	milligram

µg/dL	microgram per deciliter
NAS	National Academy of Sciences
NOAEL	No Observed Adverse Effect Level
NTP	National Toxicological Program
PA	Process Area
PAH	Polycyclic Aromatic Hydrocarbons
PBPK	Physiologically Based Pharmacokinetic
pcPAH	Potentially Carcinogenic Polycyclic Aromatic Hydrocarbons
PTELCR	Potential Theoretical Excess Lifetime Cancer Risk
PM10	Particulate Matter less than 10 microns
PRP	Potentially Responsible Party
RAF	Relative Absorption Factor
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RPM	Respirable Particulate Matter
RSD	Relative Standard Deviation
RSL	Regional Screening Level
SCTL	Soil Cleanup Target Level
SSA	Exposed Skin Surface Area
TCDD	2,3,7,8-Tetracholordibenzo-p-dioxin

TCDD-TEQ	2,3,7,8-Tetracholordibenzo-p-dioxin Toxic Equivalent(s)
TEF	Toxic Equivalent Factor
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
yr	year(s)

Executive Summary

This report presents on-Site human health risk assessment (HHRA) for the Former Koppers, Inc. (KI) wood-treating facility in Gainesville, Florida, assuming baseline (i.e., pre-remediation) conditions. The HHRA evaluates the potential theoretical non-cancer and cancer health risks associated with potential theoretical exposures of hypothetical receptors under current and potential theoretical future use conditions to constituents in on-Site soils and sediments. Results of the potential theoretical risk assessment will be used to design and evaluate potential Site remedies. The risk assessment contains both a conservative deterministic risk assessment used to estimate potential theoretical risk for all hypothetical on-Site receptors assuming a reasonable maximum exposure (RME) and an advanced probabilistic risk assessment used to refine and develop more realistic estimates of potential theoretical risk for those hypothetical on-Site receptors identified by the deterministic risk assessment as having the greatest potential theoretical risks. This HHRA was conducted consistent with United States Environmental Protection Agency (USEPA) human health risk assessment guidance that divides the risk assessment process into:

- Hazard Identification
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

The Hazard Identification step of the HHRA identifies the constituents of potential concern (COPCs) in each environmental medium to which hypothetical on-Site human receptors may theoretically be exposed. Environmental media at the Site addressed by this assessment include surface soil, subsurface soil, and sediment. COPCs were identified by reviewing historical operations at the Facility, reviewing data collected during several previous Site investigations, and comparing the maximum constituent concentrations to one-tenth of the lowest (i.e., most conservative), risk-based screening benchmarks developed by either the USEPA or the Florida Department of Environmental Protection (FDEP). Eighteen constituents (or classes of constituents) were identified as COPCs for the theoretical non-cancer risk assessment and four constituents (i.e., arsenic, benzo(a)pyrene toxic equivalents (BaP-TE), pentachlorophenol, and 2,3,7,8-tetracholordibenzo-p-dioxin toxic equivalents (TCDD-TEQ)) were identified as COPCs for the theoretical cancer risk assessment.

The Exposure Assessment step estimates the potential theoretical dose of each COPC for each potentially theoretically complete exposure pathway for each kind of hypothetical current and future on-Site human receptor included in the HHRA.

Potentially theoretically complete exposure pathways include incidental ingestion of soil (or sediment), dermal contact with soil (or sediment), and inhalation of soil derived dust. The following hypothetical receptors were identified based on theoretical behaviors and activities that are consistent with the current and hypothetical future use of the Site. The HHRA assumes the Site is currently inactive and that in the future it may potentially be developed either for commercial/industrial use or recreational use:

- Hypothetical Current and Future Trespassers;
- Hypothetical Future On-Site Indoor Workers;
- Hypothetical Future On-Site Outdoor Workers;
- Hypothetical Future Recreational Users;
- Hypothetical Future Construction Workers; and
- Hypothetical Future Utility Workers.

The potential theoretical dose (expressed as the Average Daily Dose (ADD) for non-cancer effects and as the Lifetime Average Daily Dose (LADD) for cancer effects) is a function of the Exposure Point Concentration (EPC) of a COPC in an environmental medium, selected receptor-specific theoretical parameters that describe the frequency and extent of a receptor's potential contact with a particular environmental medium, and selected COPC-specific parameters that describe a COPC's potential absorption. EPCs were estimated using a geostatistical bootstrapping approach to account for the spatial dependence of soil samples and the non-random nature of sampling at the Site. Hypothetical receptor-specific exposure parameters were developed based USEPA and FDEP sources, as well as the scientific literature. COPC-specific exposure parameters were obtained from USEPA sources and from peer-reviewed scientific literature.

At the time this HHRA was being conducted, the Site is inactive but future development plans for the Site, if any, were unknown. As a result, the HHRA treats the Site as a whole (i.e., the HHRA does not divide the Site into smaller parcels). Within the Site, hypothetical exposures and theoretical risks are separately estimated for potential theoretical exposures to surface soils, subsurface soils and drainage ditch (DD) sediments. The risk assessment procedures and assumptions described in this report are adaptive and can be used to develop revised estimates of potential theoretical future risks, once redevelopment plans for the Site become available.

Under current use conditions hypothetical trespassers are assumed to be potentially theoretically exposed to COPCs in surface soils (or sediments in the case of the Drainage Ditch). Under future use conditions hypothetical trespassers and hypothetical on-Site outdoor workers are assumed to potentially theoretically be

exposed to COPCs in surface soils (or sediments in the case of the Drainage Ditch). Hypothetical future indoor workers and hypothetical future recreational users are also assumed to be exposed to Site surface soil in the future. In addition, potential theoretical exposure to COPCs in subsurface soils is evaluated in the HHRA for hypothetical future utility and construction workers.

The Toxicity Assessment summarizes the dose-response characteristics of each COPC and identifies available Reference Doses (RfDs) and Cancer Slope Factors (CSFs) for COPCs. All cancer and non-cancer dose-response information presented in the toxicity assessment was obtained from USEPA sources. Substantial advances have been made in the understanding of the mechanisms of action and potential theoretical risks associated with exposure to 2,3,7,8-Tetracholordibenzo-p-dioxin Toxic Equivalents (TCDD-TEQ) since USEPA developed the CSF used in the theoretical deterministic risk assessment and then used in the theoretical probabilistic risk assessment presented in the Risk Characterization Section (Section 5) of this report. The new TCDD toxicity information was used to develop a distribution of CSFs for TCDD based upon the current scientific understandings of dioxin, and the new distribution was used in more refined runs of the probabilistic risk assessment. The results of the more refined runs are discussed in the Uncertainty Section (Section 6) of this report.

Risk Characterization combines the hypothetical exposures estimated in the Exposure Assessment with the theoretical dose-response values identified in the Toxicity Assessment to evaluate potential theoretical risks. Both potential theoretical non-cancer and potential theoretical cancer risks are evaluated. The risk characterization presented in this HHRA was conducted in two phases including both a theoretical deterministic risk assessment, to develop preliminary, conservative RME estimates of potential theoretical risk, and an advanced theoretical probabilistic assessment (Microexposure® Event (MEE) Modeling), to refine the theoretical preliminary risks for environmental media, potential receptors and Site-related constituents that have the greatest exceedance of risk benchmarks. The risk characterization is designed to provide both conservative RME evaluations and more realistic estimates of potential theoretical risks to hypothetical human receptors associated with potential theoretical exposure to on-Site soil and sediment. The results of each of these phases are described below.

For theoretical non-cancer risk, the deterministic risk assessment found that all hypothetical on-Site receptors have a total Hazard Index of less than 1. Accordingly, based upon the conservative hypothetical assumptions used in the deterministic risk

assessment, potential theoretical non-cancer health effects are not expected to occur as a result of potential theoretical exposure to COPCs in on-Site soils and on-Site sediments. Given that the conservative deterministic risk assessment predicts an absence of potential theoretical non-cancer risks, a more refined evaluation of potential theoretical non-cancer risks using the MEE model was not deemed necessary and was not conducted.

Using the conservative deterministic approach, potential theoretical excess lifetime cancer risks for hypothetical current and future trespassers, hypothetical future recreational users, hypothetical future construction workers and hypothetical future utility workers exposed to on-Site soils or sediments were within USEPA's allowable risk range (Figure ES-1). For hypothetical future on-Site indoor and outdoor workers, potentially theoretically exposed to COPCs in surface soils, the conservative deterministic risk assessment indicated potential theoretical excess lifetime cancer risk is above USEPA's allowable risk range of $1x10^{-6}$ to $1x10^{-4}$ (one in one million to one in ten thousand) (Figure ES-1). For hypothetical exposure to on-Site sediments, hypothetical on-Site workers had a potential theoretical excess lifetime cancer risk below USEPA's allowable risk range.

Under FDEP's more conservative risk management policy (a threshold excess lifetime cancer risk benchmark of $1x10^{-6}$), the potential theoretical excess lifetime cancer risk estimated for hypothetical future on-Site workers by the conservative deterministic risk assessment for COPCs in sediments in the Drainage Ditch (DD) is below FDEP's risk benchmark. Potential theoretical excess lifetime cancer risks estimated using the conservative deterministic risk assessment exceed FDEP's risk benchmark for all other hypothetical scenarios evaluated in the HHRA. As noted above, with the exception of the hypothetical future on-Site indoor and outdoor worker, potential theoretical risks associated with all the other scenarios were within USEPA's allowable risk range.

Based upon the results of the conservative deterministic risk assessment the hypothetical future on-Site indoor and outdoor workers were identified as the most highly potentially theoretically exposed receptors, and therefore the MEE analysis was run for the hypothetical future indoor and outdoor worker hypothetically exposed to all of the four potentially carcinogenic COPCs included in the conservative deterministic risk assessment (i.e., arsenic, BaP-TE, pentachlorophenol, and TCDD-TEQ) in on-Site surface soils. If the hypothetical future worker's potential theoretical risks meet USEPA's or FDEP's risk benchmark , potential theoretical risks associated with the hypothetical exposures of other receptors are also assumed to meet the risk limit for current and hypothetical future use.

The more realistic and refined potential theoretical cancer risks predicted by the MEE analysis are substantially lower than the conservative estimates of potential theoretical cancer risk developed by the deterministic risk assessment used in the first phase of risk characterization (Figure ES-2). This is consistent with the deterministic assessment's use, and combination, of multiple conservative assumptions leading to likely unrealistic estimates of potential theoretical risk.

The results of the MEE analysis indicate that all hypothetical future indoor and outdoor workers are predicted to have potential theoretical excess lifetime cancer risks within USEPA's allowable risk range (Figure ES-2) and, thus, do not have an unacceptable cancer risk under USEPA's risk management policy. However, the estimated potential theoretical risks still exceed FDEP's risk benchmark when deterministic estimates of potential theoretical toxicity are employed.

If a distribution of TCDD-TEQ slope factors is employed in the MEE analysis in place of USEPA's default point estimate, potential theoretical excess lifetime cancer risks for the typical (i.e., median) hypothetical future on-Site indoor worker fall below USEPA's allowable risk range and FDEP's risk benchmark. Similarly, the potential theoretical risk for the typical hypothetical future on-Site outdoor worker is about equal to the low end of USEPA's allowable risk range and to FDEP's risk limit. With the inclusion of a range of TCDD-TEQ slope factors in the MEE analysis, the 95% upper percentile of the distribution of potential theoretical risk for the hypothetical future indoor and outdoor workers remains above the FDEP risk benchmark. However, FDEP's risk management policy does not specify what percentile of the distribution of potential theoretical risk must meet FDEP's risk benchmark of $1x10^{-6}$ (one in one million). Absent information to the contrary, the HHRA assumes that the statutory language refers to the typical, or average, Floridian (as opposed to some theoretical statistically defined upper bound Floridian) having a potential theoretical excess lifetime cancer risk equal to or less than the risk benchmark. As described above, when a distribution of cancer slope factors is used for TCDD-TEQ, the potential theoretical excess lifetime risk for the typical, or average, hypothetical future worker is below or just about equal to the FDEP risk benchmark.

In summary, when a conservative deterministic risk assessment methodology is exclusively used to estimate potential theoretical risks, potential theoretical excess lifetime cancer risks for the hypothetical trespasser theoretically exposed to soils on the Site and sediments in the DD, as well as the hypothetical future on-Site indoor and outdoor workers theoretically exposed to soils on the Site and sediments in the DD, and for hypothetical future recreational users, hypothetical future utility workers, and

hypothetical future construction workers theoretically exposed to soils on the Site, are below or within USEPA's allowable risk range. Potential theoretical risks estimated using the conservative deterministic risk assessment methodology are less than FDEP's risk benchmark for future workers theoretically exposed to DD sediments, but are above FDEP's risk benchmark for the other scenarios. When estimates of potential theoretical risk are refined using the MEE analysis, potential theoretical excess lifetime cancer risk for the typical, or median, hypothetical future indoor and outdoor worker meets USEPA risk limits. In addition, the upper 95th percentiles of the distribution of potential theoretical excess lifetime cancer risk representative of the RME also meet USEPA's risk limits. These findings indicate that when the refined estimates of potential theoretical risk developed by the MEE analysis are used and compared to USEPA's allowable risk range, unacceptable potential theoretical risk does not exist under current or hypothetical future conditions.

1. Introduction

This report presents a risk assessment that estimates potential theoretical on-Site human health risks that may result from direct contact with Site-related constituents in on-Site soils and sediments at the Former Koppers Inc. (KI) wood-treating facility in Gainesville, Florida (the Site) assuming baseline (i.e., pre-remediation) conditions. Prior to January 2010, the Gainesville Site was owned and operated by KI; however, Beazer East, Inc. (Beazer) maintained responsibility for certain historical environmental matters including the completion of this risk assessment.[1] At the end of 2009, KI stopped operations on the Site and KI workers are no longer present on the Site. The overall approach of the risk assessment follows USEPA's standard four-step human health risk assessment paradigm (i.e., Hazard Identification, Exposure Assessment, Toxicity Assessment and Risk Characterization). The approach incorporates several phases including both a conservative assessment of potential theoretical risks using deterministic risk estimation methods to develop preliminary highly conservative estimates of potential theoretical risk and an advanced probabilistic method (Microexposure® Event (MEE) Modeling) to refine the preliminary conservative potential theoretical risks for environmental media, potential hypothetical receptors and Site-related constituents that have the largest exceedance of risk benchmarks. The risk characterization is designed to provide conservative and realistic estimates of current and future potential theoretical risks to hypothetical human receptors due to theoretical exposure to on-Site surface and subsurface soils and also to sediment in a drainage ditch (DD) located on the Site.

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[1] On December 29, 1988, Koppers Industries, Inc. purchased certain assets of Koppers Company, Inc., including the rights to the name "Koppers." As a result of the sale, Koppers Company, Inc. changed its name to Beazer Materials and Services, Inc. in January 1989 and then to Beazer East, Inc. on April 16, 1990. Koppers Industries, Inc. changed its name to Koppers Inc. in February 2003.

Beazer East, Inc. and Koppers Inc. are two separate entities with no common ownership. Koppers Inc. is a direct, wholly-owned subsidiary of a U.S. company. Beazer East, Inc. is an indirect, wholly-owned subsidiary of a German company. There are no common officers, directors or ownership interests between the two companies. They are totally separate and distinct corporate entities.

1.1 Site Description

The Site encompasses approximately 90 acres of land within the northern part of the city limits of Gainesville, Florida. It is zoned and, prior to recently ceasing operations, was the only parcel of land that operated as industrial in the area. The former Cabot Carbon property, located east of the Site, the marshy area to the north of the old Cabot Carbon facility, and the property to the east and south of the Site are zoned commercial. The land to the west and northwest of the Site is zoned single family and multiple family residential. Scattered small businesses and a few mobile homes are located to the north/northwest of the Site. Commercial facilities border the Site to the south and east along NW 23rd Avenue and north Main Street. To the northeast, the adjacent land is primarily undeveloped and heavily vegetated.

The Site is characterized by relatively flat terrain that slopes generally toward the north-northeast. Low swampy areas are prevalent in an undeveloped, heavily vegetated area to the northeast of the Site. A drainage ditch bisects the Site from southwest to northeast, carrying surface run-off toward Springstead Creek, located approximately 750 feet to the north.

The central and northeastern portions of the Site were primarily used for wood storage during most recent KI operations. The Site is serviced by a series of railroad sidings that enter the northeast corner. A railroad track forms the eastern boundary of the Site.

The former wood-treating facilities were located within the southeastern portion of the Site. This area includes the former processing buildings, former tank containment and cooling pond areas, former drip track areas. The central and northern portions of the Site have been cleared and graded and were recently used as storage areas by KI. These portions of the Site also contain railroad tracks, gravel access roads, and a wood debarking area.

The location of some historic operations coincides with the location of recent operations like the process area. The former North and South Lagoons were used to manage wastewater generated by the treatment process. Based on aerial photographs, it appears that the North Lagoon operated from 1956 until the 1970s, and the South Lagoon operated from 1943 (or earlier) through 1975 or 1976. Both lagoons have been closed, covered and graded and, during the most recent operations by KI, the areas were used for storage of utility poles.

While KI occupied the Site, shallow soil fill, including crushed limestone, was placed over much of the Site and continued surface maintenance was part of routine, site-related activities. This maintenance included the addition of soil fill and crushed limestone and surface grading as was necessary.

The HHRA assumes that in the future the Site will continue to be used as an industrial/commercial property or be redeveloped for recreational use. The Site is expected to remain zoned for industrial/commercial use and adjacent lands are expected to remain mixed residential and commercial. The Site will not be redeveloped for purely unrestricted residential use. In the event that the assumed future use of the Site were to change at some point in the future, or when more specific redevelopment plans become available, the risk assessment methodology developed in this on-Site HHRA can be used to estimate potential theoretical risks associated with those more specific redevelopment plans. At some point, commercial/industrial use that includes certain types of restricted residential uses could be considered appropriate with proper engineering controls and land use restrictions.

1.2 Overview of the Risk Assessment Approach

As presented above, the human health risk assessment presented herein incorporates several phases and decision points (as described in AMEC, 2008a). Multiple phases and decision points are employed to expedite the overall risk assessment process and to focus the more advanced probabilistic risk assessment methods (i.e., the MEE model) on the media, hypothetical receptors and constituents that may present the greatest potential theoretical statistical risks. The overall process can be viewed as having four key decision points at which either constituents, hypothetical receptors or media may be documented to meet risk benchmarks and not need to be evaluated further in the risk assessment. The first decision point arises during the Hazard Identification step of the risk assessment. After examining the detection frequency of constituents or comparing constituent concentrations to screening levels, some constituents were eliminated from the on-Site risk assessment.

For constituents remaining in the risk assessment after the Hazard Identification step, conservative point estimates of potential theoretical risk were developed using a deterministic risk assessment approach. The resulting conservative estimates of potential theoretical risk were compared to FDEP risk benchmarks (i.e., an excess lifetime cancer risk of one in one million and an allowable Hazard Quotient of 1.0) to identify constituents, receptors and exposure media that meet FDEP benchmarks and those that exceed the FDEP benchmarks. The comparison of the conservative point

estimates of potential theoretical risk to USEPA and FDEP risk benchmarks is the second key decision point in the overall risk assessment process.

For those combinations of constituents, receptors and exposure media whose conservative point estimates of potential theoretical risk have the greatest exceedances of USEPA and FDEP benchmarks, estimated potential theoretical risks may be refined using advance probabilistic risk assessment methods (i.e., MEE modeling). The MEE model was described in a white paper (AMEC, 2008a). That white paper was previously provided to USEPA, and is included in the risk assessment as Appendix E. Given that hypothetical future on-Site indoor and outdoor workers are assumed to have a greater potential theoretical for exposure to COPCs in on-Site soils than the other hypothetical on-Site receptors (i.e., hypothetical trespasser, hypothetical future recreational user, hypothetical future construction worker, hypothetical future utility worker), the risk assessment contained herein uses probabilistic analysis only to refine the potential theoretical risk of hypothetical future on-Site workers. If potential theoretical risks for the hypothetical future on-Site worker meet risk benchmarks, potential theoretical risks for the other, less exposed, hypothetical receptors are also assumed to meet these benchmarks. AMEC 2008b indicated that the probabilistic modeling could be conducted in two phases. The key difference between the phases being the use of point estimates for all theoretical toxicity values in the first phase and distributions in the second phase. The risk assessment presented herein uses only a single phase with probabilistic modeling. Consistent with AMEC 2008b, the MEE model develops distributions of potential theoretical risk using probabilistic distributions instead of conservative deterministic (point) estimates for key exposure assumptions. AMEC 2008b further described an initial phase of MEE modeling that uses point estimates for theoretical toxicity values and a second phase, if necessary, that uses theoretical distributions for toxicity factors. The initial runs of the MEE analysis presented herein uses point estimates for toxicity factors for all constituents. Based upon the absence of a theoretical cancer slope factor for TCDD in USEPA's Integrated Risk Information System (IRIS) and the availability of substantial new scientific information on potential theoretical carcinogenicity of dioxin (discussed in Appendix D), the uncertainty section (Section 6) presents the results of subsequent runs of the MEE analysis that use a distribution of theoretical cancer slope factors (CSFs) for 2,3,7,8-tetracholordibenzo-p-dioxin (TCDD) to estimate potential theoretical risk associated with potential theoretical exposure to 2,3,7,8-tetracholordibenzo-p-dioxin toxic equivalents (TCDD-TEQ).

1.3 Document Structure

Section 2 summarizes the Hazard Identification process, the key outcome of which is the selection of constituents of potential concern (COPCs). COPCs were selected by comparing the maximum concentration of all constituents with a detection frequency of greater than 5% to industrial soil screening benchmarks.

The Exposure Assessment (Section 3) describes the hypothetical receptors potentially theoretically assumed to be exposed to soils or sediments along with the equations and theoretical exposure parameters that will be used to estimate their potential theoretical exposures. DD sediments are differentiated from soils because of expected differences in theoretical contact frequency. Note that the conservative deterministic and the more realistic probabilistic MEE assessments both use the same fundamental exposure estimation equations but the former uses conservative point estimates for each theoretical exposure assumption while the latter uses a distribution for most parameters. An overview of the geostatistical spatial bootstrapping method used to derive exposure point concentrations (EPCs) for each COPC is also presented in Section 3, as is a general description of the application of COPC-specific relative absorption factors (RAFs).

The Toxicity Assessment section (Section 4) contains a brief discussion of the sources of theoretical reference doses (RfDs) and theoretical cancer slope factors (CSFs) for the conservative deterministic assessment and the initial runs of the MEE model. Section 4 also describes the basis of the distribution of toxicity values for TCDD-TEQ used to derive distributions of potential theoretical risk in subsequent runs of the MEE model (the results of which are presented in Section 6). A more extended description of the derivation of the distribution of theoretical TCDD cancer slope factors is provided in Appendix D.

Section 5 presents the Risk Characterization. The equations used to estimate potential theoretical risk are described first, followed by the results of the phased approach to characterizing potential theoretical risk at the Site. The first phase of risk characterization consists of developing conservative estimates of potential theoretical risk using a deterministic approach where each parameter in the equations that are used to estimate potential theoretical risk is represented by a single theoretical value. As described above, the second phase of the risk characterization of the HHRA presented in this report is an MEE analysis to refine potential theoretical excess lifetime cancer risks for the hypothetical receptors with the greatest potential theoretical risks.

Section 6 describes the analysis of uncertainty involved in the characterization of potential theoretical risk. Included in this section are the results of runs of the MEE model using a distribution of CSFs for TCDD.

Conclusions are presented in Section 7 and references are listed in Section 8.

2. Hazard Identification

The Hazard Identification step of the HHRA involves identifying the Site-related COPCs to be quantitatively evaluated in the risk assessment. This risk assessment refers to the COPCs as being "Site-related". However, use of "Site-related" does not mean that wood-treating operations conducted currently or historically on the Site are potentially solely responsible for observed concentrations. Most of the COPCs have a variety of sources that may have contributed to the presence of a constituent at a sampling location. Use of the term "Site-related" does not mean the Site is responsible for most, or even the majority, of a COPC at a particular location. This is especially relevant for arsenic, polycyclic aromatic hydrocarbons (PAH) and TCDD-TEQ, all of which occur naturally but, more importantly, have anthropogenic sources that are present in the vicinity of the Site.

As a result of several phases of environmental investigation conducted at the Site, certain constituents were identified in one or more of the environmental media to which hypothetical receptors may be exposed. Soils (at a variety of depths) and sediments at a variety of locations were sampled and analyzed for a variety of constituents. In order to focus the human health risk assessment on the Site-related constituents that have the greatest theoretical potential to pose a risk, a multi-step screening process was used to identify COPCs.

2.1 Site Soil Data

Soil samples were collected from the Site between 1984 and 2009. AMEC previously reviewed and discussed the historic data in the *Revised Data Summary Report* (AMEC, 2007). In that report, AMEC concluded that the historic dataset was not complete because: the samples representing surface soil conditions in some portions of the Site were limited in extent; not all samples were analyzed for all constituents; most of the historic data were collected from source areas while the remainder of the Site was infrequently sampled; constituent concentrations may have changed over time due to transport and degradation; and, dioxin congener data were limited to mostly field immunoassay screening tests.

In a letter to USEPA Region 4 dated October 31, 2006 (Beazer, 2006), Beazer agreed to use data collected from the Site post-1990. Upon further review of the dataset, several limitations were identified for the 1990 to 1995 data set. All data collected from the Site between 1990 and 1995 were missing detection limits for constituents not detected and could not be used in development of EPCs. Using only the detected

constituents from the 1990 to 1995 data would unnecessarily bias the dataset and result in EPCs that are biased high. Also, there are no surface soil samples, i.e., samples starting at a 0 depth, from the 1990 – 1995 dataset. Of the 59 soil samples collected between 1990 and 1995, 58 were collected from the 1 to 3 foot depth and one was collected from the 2 to 4 foot depth. All soil samples collected from 2006 were analyzed across a 0 to 2 foot depth, which is a better representation of surface soil exposure, and represented all areas of the Site; therefore, the more recent data better characterize the concentration of constituents in surface soil. Consequently, the risk assessment presented herein included all data collected from 1995 to present.

Twenty-one soil samples were collected from the Site in August 1995 from eighteen locations. Five samples were collected from a depth of 0 to 6 inches. One sample was collected from a depth of 0 to 1 foot. Five samples were collected from a depth of 2 feet. Two samples were collected from a depth of 2.5 feet. Three samples were collected from a depth of 3 feet. Two samples were collected from a depth of 3.5 feet. Two samples were collected from a depth of 5 feet. One sample was collected from a depth of 5.5 feet.

Three hundred and twenty-one soil samples were collected from the Site in November and December 2006 from ninety-five locations. Ninety-five samples and twelve duplicate samples were collected from a depth of 0 to 3 inches. Ninety-five samples and twelve duplicate samples were collected from a depth of 3 to 6 inches. Forty-seven samples and six duplicate samples were collected from a depth of 6 inches to 2 feet. Forty-seven samples and seven duplicate samples were collected from a depth of 2 to 6 feet.

Thirteen soil samples were collected from the Site in June and December 2009 from eight locations. Three samples and one duplicate sample were collected from a depth of 0 to 3 inches. Five samples and one duplicate sample were collected from a depth of 0 to 6 inches. Three samples were collected from a depth of 3 to 6 inches. Figure 2-1 shows the location of the 0 to 6 inch soil samples. Figure 2-2 shows the location of the 0 to 6 foot soil locations. A summary of the analytical results from the surface and subsurface soil samples that were evaluated in this HHRA is provided in Appendix A.

2.2 Site Sediment Data

Thirteen sediment samples were collected from nine locations from the Drainage Ditch (DD) that runs from the southwest corner of the Site to the northeast corner of the Site in December 2006. Nine surface samples, 0 to 6 inch depth, were collected, along

with two duplicate samples. Two deeper samples, 6 inch to 2 feet depth, were collected from two of the nine locations. Figure 2-3 shows the location of the sediment samples. A summary of the analytical results from the sediment samples is provided in Appendix A.

2.3 COPC Screening

Maximum concentrations for all constituents detected at least once in surface soil, subsurface soil, or sediment were compared to the lower of the Florida Soil Cleanup Target Levels (FL SCTLs) for direct exposure to Commercial/Industrial Worker (FDEP, 2005) and the USEPA Industrial Soil Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (USEPA, 2008a). Prior to conducting the screening the lower of the two screening values (i.e., the lower of SCTL or RSL) was divided by 10, as requested by FDEP. Table 2-1 shows the screening values used to evaluate the soil and sediment data. Industrial surface soil screening levels were consistently and conservatively applied to subsurface soils and sediments even though potential theoretical exposure to subsurface soils and sediments is expected to be much lower than potential theoretical exposure to soils. Soil screening levels are not really applicable to sediments.

Duplicate samples were averaged before the constituents were screened. To average the duplicates, the following rules were followed. If a constituent was detected in both the sample and the duplicate, the concentration was the arithmetic average at the sampling location. If a compound was detected in a sample but not detected in the duplicate, then the detected concentration was conservatively used to represent that sample. If a constituent was not detected in either the sample or the duplicate, the lower detection limit was used to represent that sample.

The TCDD-TEQ concentration was calculated for each soil and sediment sample prior to the comparison of dioxin and furan congener concentrations to screening values. Dioxin and furan congeners are conservatively assumed to have analogous modes of action in their carcinogenic toxicity (van den Berg et al., 2006). Toxic equivalent factors (TEFs) have been developed to relate the carcinogenic potency of all other congeners to the potency of TCDD (van den Berg et al., 2006). These TEFs were applied to concentrations of individual dioxin and furan congeners in each sample and the total TCDD-TEQ was calculated for each sample. If one of the congeners was not detected in any particular sample, half of the detection limit for that congener was used in the calculation of TCDD-TEQ for that sample. Table 2-2 presents the TCDD TEFs used in the TCDD-TEQ calculations. TEFs developed by van den Berg et al. (2006) were used in the HHRA because they represent the most recent evaluation of the

relative carcinogenic potency of the different 2,3,7,8-substituted dioxin and furan congeners. TEFs presented in FDEP (2005) are based upon a set of TEFs (van den Berg et al., 1998) that have been superseded by those presented in van den Berg et al. (2006).

Note, however that the direct application of the van den Berg TEFs to estimate potential theoretical exposure of hypothetical receptors to dioxin and furan congeners in soil is not appropriate and results in an overestimate of potential exposure and potential theoretical risk. Van den Berg et al. (2006) clearly state that the application of TEFs "is only intended for estimating exposure to dioxin-like chemicals from consumption of food products, breast milk, etc." (page 234) and then go on to state that direct use of the WHO TEFs to congeners present in "soil, sediment or fly ash would lead to the inaccurate assessment of the potential toxic potency of the matrix." Van den Berg et al. (2006) further state that application of the WHO TEFs "in abiotic environmental matrices has limited toxicological relevance and use for risk assessment unless the aspect of reduced bioavailability is taken into consideration" (page 235). USEPA recognizes that the degree of uptake varies between congeners and that uptake cannot simply be estimated by applying a theoretical 2,3,7,8-TCDD uptake factor to the TCDD-TEQ concentration in soil or the environment. USEPA's guidance for conducting risk assessments of combustion facilities (USEPA 2005a) has a unique uptake factor for each congener. The congener-specific uptake factors presented in USEPA (2005a) account for potential theoretical exposure from multiple sources and, thus, do not represent theoretical uptake differences associated solely with soil. Theoretical differences associated with only soil would likely be greater than those associated with all potential theoretical exposure pathways and routes. Even acknowledging the likelihood that theoretical uptake differences associated with only soil are underestimated by the theoretical uptake factors presented in USEPA (2005a), application of those theoretical uptake factors to account for differences in biovailability when estimating TCDD-TEQ in soil with a congener distribution pattern similar to that present in on-Site soils, results in a reduction of the TCDD-TEQ concentration of between two and three fold. This in turn would mean that the exposure point concentrations presented in this HHRA for TCDD-TEQ are at least two to three fold higher than appropriate, and that the potential theoretical risks associated with TCDD-TEQ in soil are overestimated by at least two to three fold, solely based on the failure of the accepted TCDD-TEF procedure to account for differences in theoretical bioavailability between congeners.

Similar to dioxin and furan congeners, potentially carcinogenic polycyclic aromatic hydrocarbons (pcPAHs) are also assumed by USEPA to have analogous modes of

action in their toxicity (USEPA, 1993). TEFs have been developed to relate the potency of all other pcPAHs to the potency of benzo(a)pyrene (BaP) (USEPA, 1993). These TEFs were applied to concentrations of pcPAHs in each sample and the total BaP toxic equivalent (BaP-TE) was calculated for each sample. If one of the pcPAHs was not detected in any particular sample, half of the detection limit for that pcPAH was used in the calculation of BaP-TE for that sample. Table 2-3 presents the pcPAH TEFs used in the BaP-TE calculations.

Four constituents lacked screening values in either the FL SCTL table or the RSL table. These included: 4-bromophenyl phenyl ether, 4-chlorophenyl phenyl ether, dimethyl phthalate, and methylcyclohexane. 4-Bromophenyl phenyl ether, 4-chlorophenyl phenyl ether, and dimethyl phthalate were only detected once. For all three constituents, the single detection occurred in the same sample, SS067BA, but all three were not detected in the accompanying duplicate sample, SS067BB. Methylcyclohexane was detected in six of the 190 samples included in the surface soil (0 to 6 inches) and ten of the 279 surface and surface and subsurface soil samples (0 to 6 feet). None of the four constituents have toxicity values listed in IRIS; therefore they were excluded from further analysis.

Bis(2-chloroethyl)ether was detected above the screening level of 0.05 mg/kg in only one of the 279 soil samples collected to represent the depth of zero to six feet. The one sample, SS054AA, had a duplicate sample, SS054AB, collected in which bis(2-chloroethyl)ether was not detected. Bis(2-chloroethyl)ether is also not considered a COPC because it was only detected once and was not detected in the duplicate sample. For all other constituents, if the maximum detected concentration exceeded its screening value, then the constituent in that medium was retained as a COPC.

Table 2-4 presents the COPC screening results for the 0 to 6 inch soil data. Table 2-5 presents the COPC screening results for the 0 to 6 foot soil data and Table 2-6 presents the COPC screening results for the sediment data. Table 2-7 compiles all of the COPCs by media.

Surface soil COPCs include arsenic, pcPAHs expressed as BaP-TE, pentachlorophenol, and dioxin and furan congeners expressed as TCDD-TEQ. In addition to these constituents, antimony, chromium, lead, mercury, 2-methylnaphthalene, and naphthalene are also COPCs in surface soil. Because maximum concentrations were used for screening COPCs, subsurface soil has the same set of COPCs as the surface soils, plus copper, mercury, acenaphthene, anthracene, carbazole, fluoranthene, fluorine, phenanthrene, and pyrene.

Sediment COPCs include arsenic, pcPAHs expressed as BaP-TE, pentachlorophenol, and dioxin and furan congeners expressed as TCDD-TEQ, as well as chromium, lead, and mercury. Table 2-7 lists the COPCs by media.

3. Exposure Assessment

The risk assessment process requires the identification of hypothetical exposure scenarios to assess the theoretical potential for adverse health effects from on-Site COPCs. While these hypothetical scenarios represent hypothetical people and activities, they reflect the physical description of the Site, as well as the hypothetical activities that may occur on the Site. Both current and future potential theoretical exposures are evaluated.

The exposure assessment involves estimating the potential theoretical Average Daily Dose (ADD) for assessing potentially theoretical non-carcinogenic risks and the potential theoretical Lifetime Average Daily Dose (LADD) for estimating potential theoretical excess lifetime cancer risk of each COPC for each hypothetical human receptor from all hypothetically complete exposure pathways. This potential theoretical dose of a COPC, when combined with that COPC's theoretical dose-response value (or values) identified in the Toxicity Assessment, is used to estimate potential theoretical health risks.

A hypothetical receptor's dose depends on:

- the COPC's concentration in various environmental media (e.g., soil, sediment);
- assumed biological characteristics and behaviors of a hypothetical receptor (e.g., body weight, theoretical ingestion rates of soil and sediment, theoretical skin surface area, theoretical frequency and duration of contact with each environmental medium, etc.); and
- COPC-specific theoretical parameters that influence COPC absorption.

If a COPC is absent from a medium or it is physically impossible for a hypothetical receptor to contact a medium, then the hypothetical exposure pathway is considered incomplete (USEPA, 1989), and there is no exposure to the hypothetical receptor. Only potentially theoretically complete exposure pathways are evaluated in this risk assessment.

3.1 Hypothetical Receptors and Potential Exposure Pathways

Based on current and hypothetical future conditions at the Site, six hypothetical receptors have been identified for the deterministic risk assessment: hypothetical

current and future trespassers, hypothetical future on-Site indoor workers, hypothetical future outdoor workers; hypothetical future recreational users; hypothetical future utility workers; and hypothetical future construction workers.

Now that the Site is inactive and no longer an operating wood treating facility, most of the exposure areas presented in the earlier on-Site risk assessment (AMEC 2009) are no longer relevant. The risk assessment presented in this report assumes that under current conditions, hypothetical trespassers may theoretically access all portions of the Site with equal frequency. However, hypothetical exposure to surface soils was estimated separately from hypothetical exposure to sediments. Current hypothetical trespassers were assumed to not be exposed to subsurface soils because such soils are not currently exposed.

Given that future development plans remain uncertain, subdivision of the Site into smaller areas is also uncertain, therefore, to evaluate hypothetical future potential theoretical risks, the Site was treated as one exposure area. Hypothetical future on-Site indoor and outdoor workers, as well as a hypothetical trespasser, were assumed to theoretically contact surface soils on all portions of the Site with equal frequency. Similarly, hypothetical future construction and utility workers were assumed to theoretically contact subsurface soils on the entire Site with equal frequency. Hypothetical future on-Site workers were also assumed to theoretically contact sediments in the Drainage Ditch.

In a letter dated August 8, 2008 entitled *Re: Preliminary Comments from the City of Gainesville and Alachua County Environmental Protection Department on Koppers Site Soils Risk Assessment* there was concern of homeless trespassers frequenting the Site. The Plant Manager stated on September 9, 2008 that there are no homeless individuals living on Site. Site employees did not see homeless people on the Site routinely and the Plant Manager, who has been Plant Manager at the Gainesville facility for 20 years up December 2009 when KI ceased active wood treating operations on the Site, could only recall one incident with a homeless person on the Site. Based upon the information provided by the Plant Manager, there is no evidence of hypothetical exposure of homeless trespassers to environmental media on the Site and, consequently, hypothetical homeless trespassers are not evaluated quantitatively in the HHRA.

3.1.1 Hypothetical Teenage Trespassers

Although the Site is surrounded by a fence to prevent unauthorized access to the property, the HHRA conservatively assumes there is some theoretical potential for unauthorized hypothetical individuals (i.e., hypothetical trespassers) to gain access to the property. The HHRA assumes that any hypothetical trespassers who theoretically come onto the Site are most likely to be adolescents. Young children are unlikely to be allowed to roam freely about without parental supervision and adults are not likely to participate regularly in such an activity. Hypothetical trespassers are assumed to be teenagers aged 7-17 (with corresponding theoretical exposure duration of ten years) with the potential to theoretically trespass on all areas of the Site. Potentially complete exposure pathways include theoretical incidental ingestion, theoretical dermal contact, and theoretical inhalation of surface soil containing COPCs as well as potential theoretical ingestion of and dermal contact with sediments containing COPCs.

3.1.2 Hypothetical Future On-Site Indoor and Outdoor Workers

The HHRA assumes that hypothetical future on-Site workers may be able to theoretically contact soils from the entire Site. Hypothetical complete exposure pathways include theoretical incidental ingestion, theoretical dermal contact, and theoretical inhalation of surface soil containing COPCs as well as potential theoretical ingestion of and dermal contact with sediments containing COPCs.

3.1.3 Hypothetical Future Recreational Users

Hypothetical future recreational users may theoretically be exposed to soil on the Site while walking or playing on the Site. The HHRA assumed that theoretically all age groups of people would be likely to recreate on the Site; 1 to 7 year old young children; 7 to 17 year old older children, and; 17 to 31 year old adults. Hypothetical recreational users may be theoretically exposed to COPCs in surface soil. Hypothetically complete exposure pathways include theoretical incidental ingestion, theoretical dermal contact, and theoretical inhalation of surface soil containing COPCs.

3.1.4 Hypothetical Future Utility Workers

Hypothetical future utility workers may theoretically be exposed to soil on the Site while maintaining underground utility lines. In this event, soil excavation may occur, and hypothetical future utility workers may theoretically be exposed to COPCs in subsurface soil (0-6 foot depth interval). Hypothetically complete exposure pathways

include theoretical incidental ingestion, theoretical dermal contact, and theoretical inhalation of subsurface soil containing COPCs.

3.1.5 Hypothetical Future Construction Workers

Hypothetical future construction workers are assumed to theoretically be exposed to COPCs in subsurface soil (0-6 foot depth interval) while engaged in digging or other hypothetical construction activities at the Site. Hypothetically complete exposure pathways include theoretical incidental ingestion, theoretical dermal contact, and theoretical inhalation of subsurface soil containing COPCs.

3.2 Theoretical Average Daily Doses

This section describes the equations used to estimate potential theoretical average daily doses used to estimate theoretical non-carcinogenic and carcinogenic effects.

3.2.1 Theoretical Non-Carcinogenic Effects

The theoretical Average Daily Dose (ADD) is an estimate of a hypothetical receptor's potential theoretical daily intake of a COPC from oral, dermal and inhalation exposure to COPCs assumed to cause potential theoretical non-carcinogenic effects. "Average Daily Dose" is a term-of-art used in risk assessment and does not represent a true average because the assumptions used to derive it do not represent "averages." According to USEPA (1989), the theoretical ADD should be calculated by averaging over the period of time for which the hypothetical receptor is assumed to be exposed (i.e., theoretical averaging time equals theoretical exposure duration when estimating potential theoretical non-carcinogenic risk). The theoretical ADD for each COPC via each hypothetical route of exposure is compared to the RfD for that COPC to estimate the potential theoretical hazard quotient associated with hypothetical exposure to that COPC via that route of exposure. If the theoretical exposure duration is less than 10% of a person's lifetime, the theoretical ADD represents a subchronic exposure while if it is greater than 10% it is assumed to represent a chronic exposure.

3.2.2 Theoretical Carcinogenic Effects

For constituents assumed to be associated with potential theoretical carcinogenic effects, the Lifetime Average Daily Dose (LADD) is an estimate of potential theoretical daily intake over the course of a lifetime. In accordance with USEPA (1989), the theoretical LADD is estimated by averaging the estimated theoretical exposure over

the hypothetical receptor's entire lifetime (assumed to be 70 years). The theoretical LADD for each COPC via each hypothetical route of exposure is combined with the theoretical cancer slope factor for that COPC in order to estimate the potential theoretical excess lifetime cancer risk assumed to be associated with exposure to that COPC via that route of exposure.

3.2.3 Average Daily Dose Formulas

The formulas for estimating a hypothetical receptor's potential theoretical average daily dose are presented in the following sections.

Theoretical ingestion of soil or sediment

$$\text{ADD (or LADD)} = \frac{EPC \times IR_s \times RAF \times FI \times EF \times ED \times CF}{BW \times AT}$$

where:

ADD	=	Average daily dose (potential subchronic or chronic exposure) (mg/kg-day)
LADD	=	Lifetime average daily dose (potential carcinogenic exposure) (mg/kg-day)
EPC	=	Exposure point concentration (mg/kg)
IR_s	=	Ingestion rate (mg/day)
RAF	=	Oral-soil/sediment relative absorption factor (dimensionless)
FI	=	Fraction of daily exposure from the Site (dimensionless)
EF	=	Exposure frequency (d/yr)
ED	=	Exposure duration (yr)
CF	=	Units conversion factor (10^{-6} kg/mg)
BW	=	Body weight (kg)
AT	=	Averaging time (equal to: EDD x 365 d/yr for ADD; 25,550 for LADD) (day)

Theoretical dermal contact with soil or sediment

$$\text{ADD (or LADD)} = \frac{EPC \times SSA \times AF \times RAF \times FI \times EF \times ED \times CF}{BW \times AT}$$

where:

ADD = Average daily dose (potential subchronic or chronic exposure) (mg/kg-day)
LADD = Lifetime average daily dose (potential carcinogenic exposure) (mg/kg-day)
EPC = Exposure point concentration (mg/kg)
SSA = Exposed skin surface area (cm^2)
AF = Soil/sediment adherence factor (mg/cm^2)
RAF = Dermal-soil/sediment relative absorption factor (dimensionless)
FI = Fraction of daily exposure from the Site (dimensionless)
EF = Exposure frequency (d/yr)
ED = Exposure duration (yr)
CF = Units conversion factor (10^{-6} kg/mg)
BW = Body weight (kg)
AT = Averaging time (equal to: EDD x 365 d/yr for ADD; 25,550 for LADD) (d)

Theoretical inhalation of Dust

$$ADD(orLADD) = \frac{EPC \times IR \times RPM \times RAF \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:
ADD = Average daily dose (potential subchronic or chronic exposure) (mg/kg-day)
LADD = Lifetime average daily dose (potential carcinogenic exposure) (mg/kg-day)
EPC = Exposure point concentration (mg/kg)
IR = Inhalation rate (m^3/hr)
RAF = Inhalation-soil/sediment relative absorption factor (dimensionless)
ET = Exposure time (hr/d)
EF = Exposure frequency (d/yr)
ED = Exposure duration (yr)
CF = Units conversion factor (10^{-6} kg/mg)
RPM = Respirable particulate concentration in air (mg/m^3)
BW = Body weight (kg)
AT = Averaging time (equal to: EDD x 365 d/yr for ADD; 25,550 for LADD) (d)

3.2.4 MEE Model Average Daily Dose Formulas

Appendix E provides detail concerning the theoretical ADD and LADD calculations performed by the MEE model. The same basic equations used in the theoretical

deterministic risk calculations described above are also used for the MEE analysis. However, as described in Appendix E, they are iterated thousands of times to simulate a hypothetical receptor's potential theoretical day to day exposure and develop a more refined estimate of potential theoretical exposure and risk.

3.3 Methodology for Estimating Exposure Point Concentrations

EPCs were estimated using all analytical data collected from field investigations conducted from 1995 through present. Many of the data were collected during the 2006 comprehensive Site-wide soil and sediment sampling event (AMEC, 2007). A few additional samples from the northern portion of the Site were collected in 2009 and are also included in the HHRA (AMEC, 2010). The post-1995 dataset used in this risk assessment encompasses the entire Site, including all known and suspected source areas.

3.3.1 EPCs for Soils

Because hypothetical receptors have the theoretical potential to be exposed to soil from differing depth intervals, EPCs were developed for both surface soil (0-6 in. below ground surface (bgs)) and subsurface soil (0-6 ft bgs). During the 2006 sampling event, samples were collected from multiple depth intervals. For example, at many locations in 2006, samples were collected from 0-3 in. bgs, 3-6 in. bgs, 6 in.-2 ft bgs, and 2-6 ft bgs. When multiple samples were collected at various depths at the same soil sample location, an arithmetic average concentration was calculated to represent the surface soil (0-6 in. bgs) concentration and subsurface soil (0-6 ft bgs) concentration for each COPC at each sampling location. Figure 2-1 shows all sample locations used in the calculation of surface soil EPCs. Figure 2-2 shows all sample locations used in the calculation of subsurface soil EPCs. Concentration data are not available for all COPCs at all sampling locations.

Once arithmetic averages were estimated for each sample point, EPCs in surface and subsurface soil were estimated using spatially-weighted averages to account for the varying densities of sampling locations on different parts of the Site.

Spatially-weighted averages for each exposure area (see Section 3.1) were calculated using a common geostatistical approach, Thiessen polygons. Geostatistical methods have been researched, used, and endorsed by USEPA for approximately the past two decades. The usefulness of geostatistical tools to help overcome variation in sampling distribution is described in several USEPA documents published over the past twenty

years (Breckenridge et al, 1991; USEPA, 2001a). USEPA began research into geostatistical methods around 1985, and has developed its own geostatistical software tools including GEO-PACK and GEO-EAS, which became available in 1990 and 1991, respectively (USEPA, 1990; USEPA, 1991). Perhaps most notably, risk assessment guidance published by USEPA includes use of geostatistical methods to improve data analysis and to help determine the EPC.

The Thiessen polygon technique was selected as the most appropriate spatial tool because it captures the representativeness of the sampling locations across the evaluated area without any biases that may be introduced by more complex interpolative geospatial tools such as Kriging or splining.

The Thiessen polygon geostatistical approach involves using software (for example, ArcGIS) to draw polygons so that each polygon contains one sample point, and all unsampled points in a polygon are closer to that polygon's sample point than to any other polygon's sample point. All soil within a polygon is then assumed to have the same concentration as that polygon's sample point. A spatially weighted average concentration is calculated by considering the fraction of the total exposure area that each individual polygon represents. This spatially weighted average concentration represents a central tendency estimate of the exposure point concentration in the exposure area.

Not all COPCs were analyzed in every sample; therefore, Thiessen polygons were drawn for each COPC. Figures 3-1 through 3-8 show the Thiessen polygons used to calculate EPCs for 0 to 6 inches soil data for the various COPCs included in the risk assessment. Figures 3-9 through 3-17 show the Thiessen polygons used to calculate EPCs for 0 to 6 foot soil data for the various COPCs included in the risk assessment.

A bootstrapping procedure was used to develop a 95% upper confidence limit (UCL) point estimate of the spatially weighted average for each soil depth interval evaluated at the Site. The use of bootstrapping techniques to represent confidence intervals is well-established. USEPA has supported several technical papers describing the use of bootstrapping techniques as a robust means to estimate the upper confidence limit of mean concentrations in environmental datasets (Singh et al., 1997; USEPA, 2002).

Bootstrap sampling (with replacement2) was performed on the dataset to generate a "sample" of concentrations from the dataset, with the size of the sample equal to the number of data points in the dataset (i.e., equal to the number of polygons in an exposure area). The procedure selects the specified number of samples, estimates a spatially-weighted mean of the data points in that sample, stores that spatially-weighted mean of that sample, and then repeats the process until the specified number of means has been calculated. A total of 5000 bootstrap samples were extracted from the dataset, resulting in a distribution of 5000 mean concentrations for each soil depth evaluated in this HHRA. Percentiles of the distribution of sample means were computed, and the 95th percentile of the cumulative distribution of sample means was identified for each soil depth evaluated in this HHRA.

The process of generating 5000 sample means and identifying the 95th percentile of the distribution of sample means was repeated a total of four times and the mean values from these replicates were used as the inputs for each percentile for each COPC in each exposure media (i.e., 0 to 6 inch soil, 0 to 6 foot soil, and sediment) at the Site. The relative standard deviation (RSD) values across the replicates represent the stability of the bootstrap runs. Although a larger number of replicates could be used, the calculated RSD values were typically less than 1% for any given percentile suggesting that four replicates were sufficient to demonstrate the stability of the results of the bootstrap runs. The mean of the 95th percentiles from the four distributions of sample means for each soil depth interval was estimated and selected as the EPC for

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[2] Sampling with replacement refers to the iterative practice of randomly selecting a value from the expanded dataset, storing that value for future use, and "replacing" that value back into the expanded dataset so that the expanded dataset retains the same number of data points. Alternatively, sampling without replacement would entail randomly selecting a value from the expanded dataset, storing that value for future use, and randomly selecting another value from the expanded dataset, which then has one less data point available for selection after each successive iteration. Sampling with replacement more closely approximates the concentration a hypothetical receptor visiting a site may be exposed to. A hypothetical receptor contacting a site over an extended period of time may contact the same location multiple times over months or years. This is equivalent to sampling with replacement where the same point can be selected over and over again. Sampling without replacement would be equivalent to a location not being available for contact once a hypothetical receptor contacted it the first time.

that soil depth interval. Appendix B presents the results of the bootstrapping methodology for all COPCs in 0 to 6 inch soil and 0 to 6 foot soil intervals. The distribution of means for each depth interval was used in the MEE model and was treated as a variability parameter in the day loop of the MEE model. Table 3-1 summarizes the 95th UCLs for the deterministic risk assessment that was generated using the bootstrap approach for each of the evaluated EPCs in soils.

3.3.2 EPCs for Sediments

Nine 0 to 6 inch sediment samples and two 6 inch to 2 foot samples were collected from the Drainage Ditch (DD). The nine surface sediment samples were used to develop EPCs for sediment because hypothetical receptors are not expected to theoretically contact sediments deeper than 6 inches. EPCs for sediments were developed using the same spatially-weighted approach (i.e., bootstrapping of spatially-weighted concentration data developed using Thiessen polygons) employed for soils, except that the area represented by a particular sediment sample corresponds to a specific length of the DD because the risk assessment assumes the ditch has a similar width across the entire Site. Figure 2-3 shows all sample locations used in the calculation of sediment EPCs. Figure 3-18 shows the length of the DD assigned to each sample used to calculate EPCs for the various COPCs included in the risk assessment and Table 3-1 summarizes the 95% UCL for each sediment COPC.

3.4 Theoretical Exposure Parameters

In this section theoretical exposure parameters for the five types of hypothetical on-Site receptors included in the HHRA are presented. As described above, all hypothetical receptors (hypothetical trespassers, hypothetical future on-Site indoor and outdoor workers, hypothetical future recreational users, hypothetical future construction workers, and hypothetical future utility workers) are included in the conservative deterministic risk assessment. Only hypothetical future on-Site indoor and outdoor deterministic risk assessment, were included in the MEE model. workers, the hypothetical receptor with the largest potential theoretical exposure based upon the results of the conservative Point estimates for theoretical exposure assumptions used in the deterministic assessment are developed and discussed below for all hypothetical receptors. Distributions of theoretical parameters are developed only for hypothetical future on-Site indoor and outdoor workers. For each theoretical exposure parameter described below, the theoretical distribution used in the MEE model is presented first, followed by the theoretical point estimates used in the conservative deterministic assessment. Tables 3-2, 3-3, 3-4, 3-5, and 3-6 summarize the theoretical exposure

parameters used in the deterministic risk assessment for the hypothetical trespasser, hypothetical future on-Site indoor and outdoor worker, hypothetical future recreational user, hypothetical future utility worker and hypothetical future construction worker, respectively. Figures 3-18 through 3-27 present summaries of the distributions used for theoretical exposure parameters in the MEE model.

For all of the theoretical exposure parameters for the hypothetical future on-Site indoor and outdoor worker, the deterministic values were based upon the distributions developed for the MEE model. The 90th or 95th percentiles of the distributions were typically used. For the most part, theoretical USEPA default worker assumptions were used to estimate hypothetical future on-Site indoor and outdoor worker exposures. Details regarding the development of the MEE model theoretical distributions and the deterministic values are presented below.

3.4.1 Theoretical Soil/Sediment Ingestion Rate

The *Exposure Factors Handbook* (USEPA, 1997) provides theoretical adult incidental soil ingestion rates, ranging from 0.5 to 100 mg/day, based primarily on a 1990 study conducted by Calabrese et al. (1990). EPA (1997) recommends 50 mg/day as a central tendency for commercial/industrial workers. No RME or upper percentile estimate is provided stating, “considering the uncertainties in the central estimate, a recommendation for an upper percentile value would be inappropriate”. FDEP cites the same study and uses 100 mg/day as an upper bound estimate of theoretical soil ingestion rates for adults.

A more recent study of adults has been conducted by the same investigators (Stanek et al., 1997). This study introduced a number of improvements over the 1990 study including: (1) a larger number of subjects and days of participation; (2) improved study design that considered seven consecutive days of fecal sampling; (3) improved selection of soil tracers; (4) a broader range of soil ingestion validation; and (5) enhanced capacity for additional assessments including particle size of the soil ingested. The result was more reliable daily estimates of soil ingestion and a greater capacity for more reliable long-term modeling estimates. However, the 1997 study has one identified complication. Of the ten adults participating in the study, one had an unusually high soil ingestion estimate (2 grams) for the first day of the study week. The high estimate resulted in an inflated upper percentile estimate of the overall ingestion rates. Dr. Calabrese (a co-author of the Stanek et al. paper) reported that the subject had four times higher freeze-dried fecal weight on the first day than on any other day of the study, suggesting that the subject’s excretion on that first day reflected a multi-day

accumulation, instead of just one day, as assumed in the calculations. This fact confirms that the 95th percentile value from this study, which is biased by the result for this one subject, is not only uncertain, but substantially overestimated. Due to the aberrant result from this one participant, Dr. Calabrese (2003) has recommended a more plausible estimate of high-end theoretical soil ingestion by adults is 50 mg/day, which is between the 75th percentile (34 mg/day) and 90th percentile (200 mg/day) reported in Table 9 of the 1997 study.

Based on this information, a distribution of theoretical soil ingestion rates was developed using a pert_alt distribution (also known as a beta pert) with a minimum of 0.5 mg/day, mode of 10 mg/day and maximum of 200 mg/day. The minimum value represents the low end of the range provided in the Exposure Factors Handbook (USEPA, 1997). The mode and maximum yield a 95th percentile of approximately 100 mg/day. This distribution was used to represent interindividual variability in short-term average soil ingestion rates among hypothetical future on-Site outdoor workers for the MEE model. A tabular and graphic summary of the theoretical incidental soil/sediment ingestion rate distribution is presented in Figure 3-19. The theoretical incidental soil/sediment ingestion rate distribution was treated as a variability parameter in the day loop of the MEE model.

Hypothetical teenage trespassers are assumed to theoretically inadvertently ingest soil at a rate of 100 mg/day. For the deterministic risk assessment, hypothetical future on-Site outdoor workers are assumed to have a theoretical incidental soil ingestion rate of 100 mg/day, the 95th percentile of the distribution used in the MEE model and equal to the high theoretical soil ingestion rate recommended by USEPA, and equal to twice of the theoretical soil ingestion rate used by FDEP in calculating SCTLs. Hypothetical future on-Site indoor workers are assumed to have a theoretical incidental soil ingestion rate half that of the hypothetical outdoor worker, or 50 mg/day. Hypothetical future recreational users are assumed to have theoretical age-specific soil ingestion rates. Young and older children are assumed to have a theoretical soil ingestion rate of 100 mg/day, while adults are assumed to have a theoretical soil ingestion rate of 50 mg/day, which is the mean recommended value from USEPA (1997).

USEPA included a potential theoretical soil ingestion rate of 330 mg/day for hypothetical future construction workers in its recently published Supplemental Soil Screening Guidance (2001b). This theoretical soil ingestion rate is intended for high intensity soil exposures, such as digging and working directly with subsurface utilities. Such intense excavation activities may potentially theoretically occur during the short-term hypothetical future utility worker exposures, but are not likely to occur during the

entire assumed hypothetical future construction worker exposure duration of six months. This risk assessment assumes that hypothetical future construction workers may experience high-intensity soil exposures for ten days (assumed to represent the number of days that active earth movement would take place when constructing a building) and that a theoretical lower soil ingestion rate (100 mg/day, which still is two-fold higher than USEPA's recommended theoretical soil ingestion rate for workers) occurs during the remainder of the hypothetical future construction worker exposure duration (120 days). For the hypothetical future construction worker exposure scenario, a weighted average potential theoretical soil ingestion rate of 118 mg/day was derived assuming ten days of exposure at 330 mg/day and 120 days of exposure at 100 mg/day. The hypothetical future construction worker is assumed to have a theoretical soil ingestion rate of 118 mg/day and the hypothetical future utility worker is assumed to have a theoretical soil ingestion rate of 330 mg/day (Tables 3-5 and 3-6, respectively).

3.4.2 Theoretical Exposure Frequency

The distribution of theoretical exposure frequency in the MEE model is based on a triangular distribution, setting 250 days as the most likely value, 240 days as the minimum and 260 days as the maximum. The most likely value represents a 5-day workweek for 52 weeks minus 10 holidays. The minimum value represents a 5-day workweek for 52 weeks minus 10 holidays and 10 days of vacation, and the maximum value represents a 5-day work week for 52 weeks with no holiday or vacation time. A tabular and graphic summary of the theoretical exposure frequency distribution is presented in Figure 3-20. The theoretical exposure frequency distribution was treated as a variability parameter in the variability loop of the MEE model.

Hypothetical Trespassers

Because the Site is fenced and access to the Site is restricted, hypothetical trespassers are conservatively assumed to potentially theoretically contact surface soils once a month. Hypothetical trespassers also are conservatively assumed to contact sediments in the DD once a month.

Hypothetical Future on-Site Indoor and Outdoor Workers

For the deterministic risk assessment, hypothetical future on-Site workers are assumed to have a theoretical exposure frequency of 250 days per year, equal to the default exposure assumptions used by USEPA for industrial/commercial workers and equal to the mode of the distribution used in the MEE model. Historically, the DD was

contacted very infrequently by KI workers; therefore, hypothetical future on-Site indoor and outdoor workers are conservatively assumed to have a theoretical exposure frequency of 1 day per year to sediments in the DD, which would account for the annual cutting of vegetation and clearing of the ditch.

Hypothetical Future Recreational Users

Hypothetical future recreational users are assumed to have a theoretical exposure frequency of 150 days per year, which assumes they are on the Site 3 days per week for 50 weeks per year, which would be a conservative estimate of the theoretical visitation frequency of someone leaving near the Site and using the Site for the majority of their recreational activities.

Hypothetical Future Utility and Construction Workers

The hypothetical future construction worker is assumed to theoretically contact subsurface soil five days per week for two weeks of a construction project that is assumed to take 6 months (26 weeks) to complete (Table 3-5). A hypothetical future utility worker may theoretically contact subsurface soil five days a year. This corresponds to a subsurface utility line repair that lasts a week (five days, Table 3-6). These are highly conservative estimates based on historic site information for these types of site activities.

3.4.3 Theoretical Exposure Duration

The distribution for theoretical exposure duration was based on the default EPA commercial/industrial worker. The percentiles of the job tenures were used as the theoretical exposure duration distribution. The distribution was used for all hypothetical future on-Site indoor and outdoor workers and is based on 1987 Bureau of Labor Statistics. The 95th percentile job tenure was equal to 25 years which represents a theoretical high-end exposure duration (FDEP, 2005). A tabular and graphic summary of the theoretical exposure duration distribution is presented in Figure 3-21. The theoretical exposure duration distribution was treated as a variability parameter in the variability loop of the MEE model.

For the deterministic HHRA, hypothetical trespassers are assumed to have a theoretical exposure duration of ten years. The hypothetical future on-Site outdoor and indoor workers are assumed to have a theoretical exposure duration of 25 years, which is the default theoretical exposure duration used by USEPA for industrial workers (USEPA, 1997). The hypothetical future recreational young child, older child, and adult

is assumed to have a theoretical exposure duration of 6 years, 10 years, and 14 years, respectively for potential theoretical non-cancer risk estimates. For the potential theoretical cancer risk estimate, all age groups are combined for a total theoretical exposure duration of 30 years. Hypothetical future utility workers are assumed to be potentially theoretically exposed to COPCs in on-Site soils for 25 years, conservatively corresponding to the same hypothetical future utility workers being engaged in utility repair work every year for each of the 25 years. Hypothetical future construction workers are assumed to have a theoretical exposure duration of 130 days for one year, corresponding to potential theoretical exposure that may be associated with a construction project lasting approximately six months (Table 3-5).

3.4.4 Theoretical Body Weight

The theoretical body weight MEE distribution was developed for adult males and females and based on average body weights at different quantiles reported in the Exposure Factors Handbook [Tables 7-4 and 7-5 of USEPA (1997)], for “all races” and age category “18-74” years. The theoretical distribution was “smoothed” by using these values as inputs to a cumulative function. A tabular and graphic summary of the theoretical body weight distribution is presented in Figure 3-22. The theoretical body weight distribution was treated as a variability parameter in the variability loop of the MEE model.

For the deterministic risk assessment, hypothetical teenage trespassers are assumed to have a theoretical body weight of 45 kg, the mean for males and females for 7 to 17 year olds reported in the Exposure Factors Handbook (USEPA, 1997). The hypothetical future on-Site outdoor and indoor workers are assumed to have a theoretical body weight of 71.5 kg, the average of male and female adult bodyweights. Hypothetical future recreational users are assumed to have age specific body weights using the mean for males and females. For the 1 to 7 year old young child, the theoretical body weight is assumed to be 16.6 kg. For the 7 to 17 year old, the mean theoretical body weight is 45 kg. The adult hypothetical future recreational user assumes a theoretical body weight of 71.5 kg. Hypothetical future utility workers and hypothetical future construction workers are assumed to have a theoretical body weight of 71.5 kg, the mean for male and females of this age group.

3.4.5 Theoretical Exposed Skin Surface Area

An estimate of the potentially theoretically exposed skin surface area (SSA) is required to estimate potential theoretical exposure via the dermal exposure pathway. SSA

varies with body weight represented by the following equation (FDEP, 2005): Total body surface area (cm2) = body weight (kg) 0.6821 * 1025. Theoretical SSA also varies depending on what portion of a hypothetical future on-Site indoor and outdoor worker's total body surface area is exposed. The HHRA assumes that theoretically the face, forearms and hands are exposed; FDEP (2005) provides the percentage surface area for a number of body parts in relation to total body surface area. The percentages for hands and forearms are 4.98% and 6.46%, respectively. A percentage for the face is not provided; however, the percentage for the head is 6.64%. USEPA (2004) assumes that the surface area for the face is 1/3 of head surface area. Based on this, the theoretical percentage for face is assumed to be 2.21%. Thus, the three theoretically exposed body parts represent 13.65% of the total body surface area. A tabular and graphic summary of the theoretical SSA distribution is presented in Figure 3-23 for hypothetical future on-Site indoor and outdoor workers. The theoretical exposed skin surface area distribution was treated as a variability parameter in the day loop of the MEE model.

For the deterministic risk assessment, hypothetical trespassers are assumed to theoretically have 5,048 cm2 skin exposed to soil (corresponding to the face, forearms, hands, lower legs, and feet) (USEPA, 1997). The hypothetical future on-Site outdoor and indoor workers are assumed to theoretically have 2,373 cm2 of potentially theoretically exposed skin on their face, hands, and forearms (USEPA, 1997). The hypothetical future recreational user young child is assumed to theoretically have 2,328 cm2 of skin exposed, while the older child is assumed to theoretically have 5,048 cm2 and the adult is assumed to theoretically have 6,073 cm2 of skin exposed, which corresponds to the face, forearms, hands, lower legs, and feet exposed to Site soil. The hypothetical future utility worker and the hypothetical future construction worker are assumed to theoretically have 2,478 cm2 skin (corresponding to face, forearms, and hands) (USEPA, 1997) exposed to soil.

3.4.6 Theoretical Soil/Sediment Adherence Factor

The same distribution for theoretical dermal adherence factors was used for hypothetical future on-Site indoor and outdoor workers. As noted above, the face, forearms and hands of hypothetical future on-Site indoor and outdoor workers are assumed to be potentially theoretically exposed. The theoretical distribution for the forearms is defined as beta general with a minimum of 0.0021 mg/cm^2, maximum of 0.36983 mg/cm^2, • 1 of 0.40624 and • 2 of 2.0055, truncated at 0 mg/cm^2. The theoretical distribution for the face is defined as logistic with an • of 0.027197, and • of 0.018828, truncated at 0 mg/cm^2. For the hands, the theoretical distribution is also

defined as logistic with an • of 0.178786 and a • of 0.074457, truncated at 0 mg/cm^2. The input values for the theoretical distribution are from the *Exposure Factors Handbook* (USEPA, 1997) for all hypothetical adult exposure scenarios in soil.

The theoretical dermal adherence factors are weighted based on exposed skin surface area. For hypothetical future on-Site indoor and outdoor workers, the theoretical weighting factors are 0.36, 0.49 and 0.15 for the hands, forearms and face, respectively. Dermal adherence distributions were derived by applying the theoretical weighting factors to their respective body part distributions and then summing across those weighted distributions. A tabular and graphic summary of the theoretical soil/sediment adherence factor distribution is presented in Figure 3-24 for hypothetical future on-Site indoor and outdoor workers. Theoretical soil/sediment adherence factor distributions were treated as an uncertainty parameter in the uncertainty loop of the MEE model.

For the deterministic risk assessment, hypothetical trespassers are assumed to have a theoretical surface area weighted soil adherence factor of 0.145 mg/cm^2 (USEPA, 1997). Hypothetical future on-Site outdoor and indoor workers are assumed to have a theoretical surface area weighted soil adherence factor of 0.206 mg/cm^2 (USEPA, 1997). Hypothetical future recreational users are assumed to have theoretical age-specific surface area weighted soil adherence factors of 0.153 mg/cm^2, 0.145 mg/cm^2, and 0.015 mg/cm^2 (USEPA, 1997) for the young child, older child, and adult, respectively. The theoretical soil adherence factor for the hypothetical future utility worker is assumed to be 0.24 mg/cm^2 (USEPA, 1997) and the theoretical soil adherence factor for the hypothetical future construction worker is assumed to be 0.14 mg/cm^2 (USEPA, 1997).

3.4.7 Theoretical Inhalation Rate

The distribution for theoretical inhalation rates is based on a triangular distribution, setting 1.44 m^3/hour as the most likely value, 0.96 m^3/hour as the minimum value and 2.46 m^3/hour as the maximum value. These values were derived from Lin et al. (1993), the data source also used as the basis of inhalation rates recommended in the *Exposure Factors Handbook* (USEPA, 1997). Linn et al. (1993) reported mean inhalation rates for construction workers under four activity conditions – sitting/standing, walking, carrying, and performing their trade. The most likely value (1.44 m^3/hour) represents the median value across all activity conditions; the minimum value (0.96 m^3/hour) represents the minimum rate across all categories; and the maximum value (2.46 m^3/hour) represents the maximum rate across all activity

conditions. A tabular and graphic summary of the theoretical inhalation rate distribution is presented in Figure 3-25. The theoretical inhalation rate distribution was treated as a variability parameter in the day loop of the MEE model.

For the deterministic risk assessment, hypothetical trespassers are assumed to have a theoretical inhalation rate of 1.6 m^3/hour (USEPA, 1997). All hypothetical future on-Site outdoor and indoor workers are assumed to have a theoretical inhalation rate of 2.18 m^3/hour, which is the 95th percentile from the MEE distribution (Linn at al, 1993). Hypothetical future recreational users are assumed to have a theoretical inhalation rate of 1.2 m^3/hour for young children and 1.6 m^3/hour for both older children and adults (USEAP, 1997). Hypothetical future utility workers and hypothetical future construction workers are assumed to have a theoretical inhalation rate of 2.5 m^3/hour (USEPA, 1997).

3.4.8 Theoretical Exposure Time for Theoretical Inhalation Exposures

Theoretical exposure time was set to 8 hours based on a professional judgment for a standard work day. Therefore the theoretical exposure time for inhalation exposures was not treated as a variability parameter in the day loop of the MEE model.

For the deterministic risk assessment hypothetical trespassers are assumed to theoretically have exposure to dust for 8 hours a day. Hypothetical trespassers are not expected to inhale sediments. Hypothetical future on-Site outdoor and indoor workers are assumed to be potentially theoretically exposed to fugitive dust for a standard 8 hour work day. Hypothetical on-Site workers are not assumed to inhale sediments. Hypothetical future recreational users are assumed to theoretically have an exposure to dust for 2 hours a day. The hypothetical future utility worker and hypothetical future construction worker are assumed to theoretically be exposed to fugitive dust for 8 hours a day.

3.4.9 Theoretical Fraction of Intake from the Site

The amount of a hypothetical receptor's daily exposure to soil and sediment is likely to vary and will depend upon what fraction of the day a hypothetical receptor may spend on-Site. To be conservative, hypothetical trespassers theoretically exposed to on-Site soils and sediments are assumed to get all of their potential theoretical ingestion and dermal exposures for the day from On-Site soil or sediment. Similarly, hypothetical future on-Site outdoor and indoor workers as well as hypothetical future utility workers and hypothetical future construction workers were assumed to have a theoretical FI of

1. The hypothetical future recreational user is assumed to theoretically be on the Site for only 2 hours per day and only get a quarter of their daily soil exposure from the Site, therefore their theoretical FI was assumed to be 0.25 (2 of the 8 hours per day).

These same theoretical FI values were used in the MEE model when estimating potential theoretical oral and dermal exposures.

3.4.10 Theoretical Averaging Time

For the deterministic risk assessment, the hypothetical trespasser, hypothetical future recreational user, hypothetical future utility worker, and hypothetical future construction worker were also assumed to have a theoretical life expectancy of 70 years when estimating the averaging time for assessment of potential theoretical carcinogenic effects.

When estimating potential theoretical excess lifetime cancer risks using either the MEE model or the deterministic risk assessment, hypothetical future on-Site outdoor and indoor workers were assumed to have a theoretical averaging time of 25,550 days, equal to 365 days per year times an assumed 70 year lifetime. Note that the current average life expectancy is closer to 80 years. Using 70 years as a theoretical lifetime results in a slight over-estimate of potential theoretical cancer risk.

For assessment of potential theoretical non-carcinogenic effects, the theoretical averaging time for the hypothetical future on-Site outdoor and indoor worker deterministic risk assessment is assumed to be 9,125 days, equal to the assumed theoretical exposure duration of 25 years times 365 days per year. The teenage trespasser is assumed to have a theoretical averaging time of 10 years. The hypothetical future recreational young child, older child, and adult are assumed to have a theoretical averaging time of 6 years, 10 years, and 14 years. The hypothetical future utility worker is assumed to have a theoretical averaging time of 25 years and the hypothetical future construction worker is assumed to have a theoretical averaging time of one year.

3.4.11 Theoretical Respirable Particulate Concentration

Site-specific respirable particulate matter (RPM) data were not available. In the absence of site-specific data, the distribution of RPM values (as PM10) measured at two air monitoring stations in Gainesville: Site_ID #23, located in the residential area at NW 53rd Avenue & NW 43rd Street; and, Site_ID #1003, located in the

urban/commercial area at 721 NW Sixth Street (http://www.epa.gov/aqspubl1/annual_summary.html) were used. Data from these stations represent annual values derived from hourly measurements. The quantiles (average, min., max., 10^{th}%, 25^{th}%, 50^{th}%, 75^{th}%, 90^{th}%, 95^{th}%, and 99^{th}%) were averaged across the datasets for each station and additional quantiles (e.g., 97.5^{th}%) were calculated using linear interpolation. Although the environmental setting differs between these two locations, the quantiles are similar. The mean concentrations for station #23 and #1003 are 0.0195 and 0.022 mg/m^3, respectively. Because the mean for the urban location is slightly greater, the urban distribution was used in the MEE model. A tabular and graphic summary of the theoretical respirable particulate concentration distribution is presented in Figure 3-26. The theoretical RPM distribution was treated as a variability parameter in the day loop of the MEE model.

For the deterministic risk assessment, the urban dataset discussed above was also used. The RPM concentration was 0.0394 mg/m^3, which represents the 95th percentile of the urban RPM from the distribution.

3.4.12 Theoretical Relative Absorption Factors

Theoretical Relative Absorption Factors (RAFs) are included in the estimation of potential theoretical dose to account for differences in COPC absorption efficiency when comparing the experimental conditions experienced by a test animal in a laboratory to the natural conditions experienced by a human at a site (USEPA, 1989). For example, the study that served as the basis for the development of an RfD or CSF may have administered the constituent to the laboratory animal in a matrix very different from the environmental media to which humans are exposed at a site. Physiological differences between laboratory animals and humans must also be accounted for as these may influence the uptake of a constituent from an exposure matrix or medium. Therefore, it is not always appropriate to directly apply a theoretical dose-response value from a laboratory study to the potential theoretical dose estimated at a site for a particular receptor. In many cases, a correction factor in the estimation of potential theoretical risk is needed to account for differences between theoretical absorption in the dose-response study and theoretical absorption that may occur upon human exposure to a constituent at a site. Without such a correction potential theoretical human health risk could be over- or under-estimated. RAFs are necessary to estimate oral, dermal, and inhalation exposure doses from any of the environmental media to which humans can theoretically be exposed at a site (soil or sediment).

The RAF is the ratio between the estimated human absorption factor for the specific medium and route of exposure, and the known or estimated absorption factor for the laboratory study from which the dose-response value was derived.

$$RAF = \frac{Fraction\ absorbed\ in\ humans\ in\ environmental\ exposure}{Fraction\ absorbed\ in\ the\ dose-response\ study}$$

The use of an RAF allows the risk assessor to make appropriate adjustments if the efficiency of absorption between environmental exposure and experimental exposure is known or expected to differ because of physiological effects and/or matrix or vehicle effects.

RAFs can be less than one or greater than one, depending on the COPC and potential theoretical routes of exposure at a site. If the RfD or CSF is based on an administered dose, then the theoretical RAF is calculated as the ratio of the estimated absorption for the site-specific medium and route of potential theoretical exposure, to the known or estimated absorption for the laboratory study from which the RfD or CSF was derived (e.g., if the two are the same, then the RAF is 1.0). If the RfD or CSF is based on an absorbed or metabolized dose, then the known or estimated absorption or metabolism in humans is used for the RAF. In the absence of detailed toxicological information on a constituent of interest, a default value of 1.0 is used. The extent of theoretical absorption or metabolism may depend on the medium and route of exposure.

In addition, within the chronic risk characterization analysis many constituents are assessed separately for their potential theoretical carcinogenic risk and their potential theoretical non-carcinogenic risk. If the experimental studies from which the theoretical cancer slope factor and the theoretical reference dose are derived are known or estimated to have the same absorption efficiency, then the theoretical RAFs used to estimate potential theoretical carcinogenic and non-carcinogenic doses are identical for a given route/medium situation. If, however, the theoretical absorption efficiencies differ, then there are two sets of RAFs, one for use with the theoretical cancer slope factor and one for use with the theoretical reference dose.

ARCADIS has summarized the route of exposure and the experimental matrix (diet, drinking water, corn oil gavage, etc.) used in the experimental study from which the relevant dose-response value was derived for many constituents. In addition, ARCADIS has reviewed scientific literature on the absorption and bioavailability of many constituents for the relevant routes of exposure and matrices. Based on these data, ARCADIS has summarized appropriately derived theoretical RAFs for many

constituents. These theoretical RAFs are presented in Appendix C and Appendix G and are used to estimate potential theoretical exposures and risks.

For the MEE, the available peer-reviewed scientific publications on the oral and dermal relative absorption of BaP-TE, arsenic, pentachlorophenol, and TCDD-TEQ from soil were reviewed and an overall distribution of the expected theoretical relative bioavailability of each constituent was generated. A full discussion of these theoretical distributions and supporting data were provided to USEPA in "Relative Absorption Factors (RAFs) for Oral and Dermal Absorption of Compounds in Soil Cabot Carbon/Koppers Site Gainesville, Florida" (AMEC, 2008c) and is included in Appendix G. A tabular and graphic summary of the theoretical RAF distributions for arsenic, BaP, pentachlorophenol, and TCDD is presented in Figure 3-27. A summary of the theoretical RAF distributions used in the MEE model is provided below. Theoretical RAF distributions were treated as an uncertainty parameter in the uncertainty loop of the MEE model.

Theoretical Oral Exposure

- Arsenic: A normal distribution was generated using the mean (0.163) and standard deviation (0.065) for the wood-treating site in Gainesville reported in Roberts *et al*. (2002). The deterministic RAF for arsenic was the 90th% of the MEE distribution (0.2465).

- BaP-TE: A normal distribution was generated using a mean (0.31) and standard deviation (0.166) based on bioavailability data reported in six different studies evaluated in AMEC (2008c). The deterministic RAF for BaP-TE was the 90th% of the MEE distribution (0.5286).

- Pentachlorophenol: A distribution of mean values was generated by combining distributions generated from the mean (and standard deviations) of bioavailability of pentachlorophenol from six soil types reported by Pu et al (2003). Lognormal distributions were used to generate initial distributions of the bioavailability factors for the individual soil types, which were then combined to calculate the distribution used in the MEE model. The deterministic RAF for pentachlorophenol was the 90th% of the MEE distribution (0.8992).

- TCDD-TEQ: A distribution of mean values was generated using a bootstrap of eight estimates of the mean bioavailability of TCDD from soil evaluated in

AMEC (2008c). A bootstrap method was used (in lieu of the method used to generate the pentachlorophenol distributions) since only the mean values were reported from these studies. The deterministic RAF for TCDD-TEQ was the 90th% of the MEE distribution (0.5).

Theoretical Dermal Exposure

- Arsenic: A normal distribution was generated using a mean of 0.009 and standard deviation of 0.001. As discussed in AMEC (2008c), the mean and standard deviation were calculated from the dermal absorption using three dose levels reported in Wester et al. (1993), prorated to a typical work day. The deterministic RAF for arsenic was the 90th% of the MEE distribution (0.01)

- BaP-TE: A normal distribution was generated using a mean of 0.02 and standard deviation of 0.01. Data for this distribution are based on Wester et al. (1990) and Yang et al. (1989). The distribution is truncated at 0.01 and 1. The deterministic RAF for BaP-TE was the 90th% of the MEE distribution (0.034).

- Pentachlorophenol: A normal distribution was generated using a mean of 0.032 and a standard deviation of 0.01. The sources of these data are Wester et al. (1993) and Qiao et al. (1997). The distribution is truncated at 0.01 and 1. The deterministic RAF for pentachlorophenol was the 90th% of the MEE distribution (0.045).

- TCDD-TEQ: An exponential distribution was generated using a mean of 0.03 and a risk shift of 0.01, based on nine estimates of bioavailability of TCDD from soil. This was based on three studies [Poiger and Schlatter (1980), Shu et al. (1988) and Roy et al. (1990)] evaluated in AMEC (2008c). The deterministic RAF for TCDD-TEQ was the 90th% of the MEE distribution (0.079).

Theoretical Inhalation Exposure

A review of the literature showed no suitable references for RAFs for arsenic, BaP-TE or pentachlorophenol. Therefore, the RAF was assumed to be 1 for these constituents in both the deterministic HHRA and MEE model.

- TCDD-TEQ: A fixed value of 55% was used for the deterministic HHRA and the MEE model, based on Nessel et al (1990).

4. Toxicity Assessment

The Toxicity Assessment step involves quantifying the relationship between the magnitude of potential theoretical exposure to COPCs via a particular exposure pathway and the likelihood of a theoretical adverse health effect. Adverse health effects are characterized by USEPA as carcinogenic or non-carcinogenic. Non-carcinogenic effects are further divided into subchronic (for potential theoretical exposures lasting less that 10% of a lifetime) and chronic (for potential theoretical exposures lasting more than 10% of a lifetime). Theoretical dose-response relationships are defined by USEPA for oral and inhalation routes of exposure. The results of the Toxicity Assessment, when combined with the potential theoretical dose estimated in the Exposure Assessment, are used to estimate potential theoretical health risks.

Theoretical toxicity values are developed by USEPA, state regulatory agencies and other entities after a comprehensive scientific review of all available toxicological literature and dose-response information for a constituent. The theoretical toxicity values used in the preliminary deterministic conservative risk assessment and the initial runs of the MEE analysis for all COPCs (with the exception of lead) are obtained from the following sources, in order of priority:

- USEPA's Integrated Risk Information System (IRIS) (USEPA, 2008b);
- USEPA Region 6 Human Health Medium-Specific Screening Levels, 2008 (USEPA, 2008a); and
- HEAST values as cited in the USEPA Region 6 Human Health Medium-Specific Screening Levels, 2008 (USEPA, 2008a).

As described below, a second series of runs of the MEE analysis presented in the Uncertainty Assessment (Section 6) uses a distribution of theoretical cancer slope factors to estimate the potential theoretical excess lifetime cancer risks associated with potential theoretical exposure of hypothetical future on-Site workers to dioxins and furans. The scientific basis for the distribution of theoretical slope factors is presented in Appendix D. In addition, when evaluating the potential theoretical effects associated with potential theoretical exposure to lead, USEPA does not use RfDs and CSFs but has, instead, developed a biokinetic model (described below).

4.1 Theoretical Toxicity Values for the Deterministic Risk Assessment

The theoretical subchronic toxicity values used to evaluate potential theoretical risks to the hypothetical future construction workers are presented in Table 4-1. The theoretical chronic toxicity values used to evaluate potential theoretical risks to hypothetical trespassers, hypothetical future on-Site workers, hypothetical future recreational users, and hypothetical future utility workers are presented in Tables 4-2 and 4-3 for evaluation of potential theoretical non-carcinogenic and potential theoretical carcinogenic effects, respectively, associated with potential theoretical exposure to COPCs.

4.1.1 Theoretical Lead Exposure

The theoretical potential for adverse effects from exposure to lead was evaluated for all receptors based on current guidance for evaluating theoretical lead exposures (USEPA, 2001c). The evaluation of theoretical lead exposures in soil and sediment to hypothetical trespassers, hypothetical future on-Site outdoor and indoor workers, hypothetical future utility workers, and hypothetical future construction workers at the Site was evaluated using the Adult Lead Model (ALM) (USEPA, 1999, 2001c). As a matter of default the ALM considers adult women's exposure to lead in soil. Although the hypothetical trespasser is assumed to be between the ages of 7 and 17, and is not an adult, the IEUBK Model for Lead in Children is not appropriate as it models potential theoretical lead exposures of children ages 0 to 7 years old. Therefore, the ALM was judged to be more appropriate for the hypothetical teenage trespasser and is used by this risk assessment to evaluate potential theoretical lead exposures of hypothetical teenage trespassers as well as other hypothetical receptors included in this risk assessment.

The ALM predicts the theoretical blood levels of lead that would likely occur in a pregnant woman and in her fetus from non-residential exposure to lead-containing soil and dust (e.g., a commercial scenario). The ALM incorporates population-based background blood lead levels as a starting concentration and predicts theoretical blood levels that may result after additional theoretical exposure to lead-containing soil occurs. The model also incorporates measures to control for the effects of population variability in background blood lead levels (i.e., geometric standard deviation (GSD) of background blood lead levels).

The ALM uses a simplified representation of lead biokinetics to predict quasi-steady state theoretical blood lead concentrations among hypothetical adults who have relatively steady patterns of potential theoretical site exposures. The ALM predicts a range of theoretical fetal blood lead concentrations and associated probabilities that the stated theoretical fetal blood lead concentrations will exceed the threshold fetal blood level. The model assumes theoretical fetal blood lead concentrations are proportionate, with some variability, to the theoretical maternal blood lead concentrations in the model. The theoretical adult blood lead concentration is estimated as the sum of typical baseline blood lead concentrations (µg/dL) (representing measured average concentrations from population surveys (ranging from 1.5 to 1.7 µg/dL) and predicted theoretical blood lead concentrations in hypothetical women receptors of child-bearing age potentially exposed to lead at a site. In the evaluation conducted for this risk assessment, the most conservative assumptions about background blood concentrations and standard deviations were used.

The model assumes adequate theoretical exposure exists to result in a steady-state blood lead concentration (USEPA, 2001c) and assumes that theoretical exposure continues regularly and for an indefinite period of time. Hypothetical trespasser exposures which occur infrequently and for short durations are not consistent with this assumption likely leading to an overestimate of potential theoretical blood lead levels in hypothetical trespassers. The averaging time for the model defaults to 365 days per year assuming that potential theoretical exposure occurs on a year-round basis.

From the estimate of theoretical blood lead levels in women theoretically exposed to lead at the Site, the theoretical fetal blood lead level is estimated as an upper end (95th percentile). The ALM was developed to evaluate non-residential exposures to the fetus of a worker who develops a theoretical body burden as a result of non-residential exposure to lead. This theoretical body burden is available to theoretically transfer to the fetus for several years after exposure ends. Given that the fetus is considered by USEPA the most sensitive receptor to lead, theoretical exposures to a fetus are considered conservative estimates of theoretical exposures for male or female adult workers. The results from the ALM are discussed in Section 5.1.1.

In evaluating the potential theoretical risks associated with potential theoretical exposure to lead, an initial screening evaluation was conducted. That evaluation used the highest lead EPC estimated for either the 0 to 6 inch soil or the 0 to 6 foot soil to represent the potential concentration of lead in soil. If potential theoretical exposure to lead in soils from the highest EPC is not associated with a theoretical adverse effect, then potential theoretical exposure to lead in soils from other depth intervals with lower

lead concentrations will also not be associated with a potential theoretical risk, precluding the need to run the ALM for every on-Site exposure scenario. For potential theoretical exposure to lead in sediments, the lead EPC for sediments was used. For most parameters, default ALM assumptions were used, with the exception of the theoretical exposure frequency, which was changed to be consistent with maximum assumed Site-specific exposures. The maximum theoretical soil exposure frequency used was 250 days per year and the maximum theoretical sediment exposure frequency used was 12 days per year.

4.1.2 Non-Carcinogenic Dose-Response

Constituents with known or potential theoretical noncarcinogenic effects are assumed to have a dose below which no adverse effect occurs, or conversely, above which an effect may be seen. This dose is called the threshold dose. In laboratory experiments, this dose is known as the No Observed Adverse Effect Level (NOAEL). The lowest dose at which an adverse effect is seen is called the Lowest Observed Adverse Effect Level (LOAEL). By applying uncertainty factors to the NOAEL or the LOAEL, the USEPA has developed Reference Doses (RfDs) to evaluate potential chronic exposures to constituents that are assumed to be associated with potential theoretical noncarcinogenic effects (USEPA, 2008b).

The uncertainty factors account for uncertainties associated with the theoretical dose-response value, such as the effect of using an animal study to derive a theoretical human dose-response value, extrapolating from a LOAEL to NOAEL, and evaluating sensitive subpopulations. For constituents that are assumed to cause potential theoretical noncarcinogenic effects, the RfD provides reasonable certainty that if the estimated potential theoretical exposure dose is below the RfD, then no potential theoretical noncarcinogenic health effects are expected to occur even if daily exposure were to occur for a lifetime. RfDs are expressed in terms of milligrams of constituent per kilogram of body weight per day (mg/kg-day).

Theoretical oral, dermal, and inhalation routes of exposure were evaluated in this risk assessment. Because theoretical dermal toxicity values are not generally available, theoretical oral dose-response information is used to estimate the potential theoretical risk associated with both potential theoretical oral and dermal exposures.

4.1.3 Carcinogenic Dose-Response

The underlying assumption used by USEPA for regulatory risk assessment for constituents with known or assumed potential theoretical carcinogenic effects is that no threshold dose exists. In other words, USEPA conservatively assumes that a finite level of potential theoretical risk is associated with any dose above zero however infinitesimal. To assess potential theoretical carcinogenic health effects, theoretical cancer slope factors (CSFs) were used to assess theoretical oral, dermal, and inhalation exposures. CSFs are upper-bound estimates of the carcinogenic potency of chemicals that are used to estimate the potential theoretical incremental risk of developing cancer, corresponding to a theoretical lifetime of exposure at the levels estimated in the exposure assessment. In standard risk assessment procedures, theoretical estimates of carcinogenic potency reflect the conservative assumption that no threshold exists for carcinogenic effects, i.e., that any exposure to a carcinogenic chemical will contribute a theoretical incremental amount to an individual's overall risk of developing cancer. The CSF values recommended by the U.S. EPA are conservative upper-bound estimates of potential theoretical risk. As a result, the "true" cancer risk is unlikely to exceed the potential theoretical estimated risk calculated using the CSF, and may be as low as zero (USEPA, 1986).

Theoretical cancer toxicity values that are used in the risk assessment likely vary in the type of data used to calculate the CSFs, and the strength of the evidence supporting the values. Chemicals for which adequate human data are available are categorized as "known human carcinogens", while other values with varying levels of supporting data may be classified as "likely human carcinogens," "suggestive of human carcinogenicity," "not likely to be carcinogenic," or, perhaps data may be inadequate to make a determination of carcinogenicity. The USEPA has developed computerized models that extrapolate observed responses at high doses used in animal studies to predicted theoretical responses in humans at the low doses encountered in environmental situations. The models developed by the USEPA assume no threshold and usually use animal, and sometimes human, data to develop an estimate of the theoretical carcinogenic potency of a constituent. This numerical estimate is referred to by the USEPA as the CSF. The computerized models used by USEPA assume that carcinogenic dose-response is linear at low doses. CSFs are expressed in terms of $(mg/kg\text{-}day)^{-1}$.

4.2 Theoretical Toxicity Values for the Probabilistic Risk Assessment

The MEE analysis is used to refine potential theoretical excess lifetime cancer risks for four COPCs (arsenic, BaP-TE, pentachlorophenol and TCDD-TEQ). The CSFs used in the initial runs of the MEE analysis to estimate potential theoretical risks are the same as those used in the deterministic risk assessment and are presented in Table 4-3. A second series of runs of the MEE analysis (the results of which are presented in the Uncertainty Assessment (Section 6)) uses a distribution of CSFs to estimate the potential theoretical excess lifetime cancer risk associated with TCDD-TEQ because an overwhelming amount of new scientific data are available and are not reflected in the theoretical point estimate TCDD CSF. The derivation and scientific basis of the theoretical TCDD-TEQ CSF distribution is described briefly below and is discussed in detail in Appendix D. The CSF distribution was treated as a variability parameter in the variability loop of the MEE model. Because the distribution is based on data from one study and one type of model, the range arises because of potential variability in response among the different animals. Had the HHRA included a range of CSFs arising from a series of studies, or using a range of dose response models, that would be treated as uncertainty in the MEE model.

CSFs for TCDD available from regulatory agencies and the published literature were reviewed for inclusion in the second series of runs of the MEE analysis. USEPA's published CSF of 150,000 (mg/kg-day)-1 available from HEAST (1997) was not used because it is based upon an outdated assessment (USEPA, 1984), and as such the data, methods, and policies used in the assessment are now obsolete. This CSF has never been verified for inclusion in USEPA's Integrated Risk Information System (IRIS). Specific limitations of the HEAST CSF for TCDD include: (1) the CSF relied upon conclusions originally reported in Kociba et al. (1978), which have since been updated to reflect more recent pathology guidelines (PWG, 1990); (2) the CSF does not reflect more recent cancer bioassays conducted for TCDD; (3) the CSF relies upon dose-response data that were assessed in terms of administered dose, which is not considered to be a suitable dose measure for persistent chemicals such as TCDD; (4) the CSF relies upon an allometric scaling factor of 2/3 to scale doses from rats to humans, rather than a scaling factor of 3/4 as is current agency policy (USEPA, 1992); and (5) the CSF relies upon a low-dose extrapolation method (linearized multistage model) that is not consistent with current agency guidelines for carcinogen risk assessment (USEPA, 2005).

In 2003, a draft USEPA reassessment of the CSF for TCDD was released for review by the National Academy of Sciences (NAS). NAS was tasked to assess whether

USEPA's risk estimates for dioxin-like chemicals were scientifically robust and whether there is a clear delineation of all substantial uncertainties and variability. NAS released its critical review of USEPA's draft reassessment in 2006. USEPA's draft CSF value of 1,000,000 (mg/kg-day)-1 was not used based upon the critical review it received from the NAS. Key criticisms and recommendations from NAS for USEPA's assessment include: (1) the linear extrapolation to low doses reflects agency policy, and does not reflect the state of the science for TCDD; (2) USEPA should use a variety of different theoretical dose-response models rather than just the multistage model with linear extrapolation (3) USEPA should use probabilistic methods to address uncertainty in the theoretical cancer potency; (4) USEPA should use the most current data in its risk estimates, in particular, the NTP (2006) cancer bioassay; and (5) the assessment should consider multiple dose measures, and CSFs based upon body burden should address species differences in body fat composition. In response to these comments, a revised reassessment is being prepared by USEPA, and it is estimated to become available for public review and comment in 2012.

A CSF estimate was recently published by Maruyama and Aoki (2006). This assessment relied upon the dose-response data for liver tumors in female rats from the recent NTP bioassay (2006). Dose was assessed in terms of tissue burden using physiologically based pharmacokinetic (PBPK) models in rats (Andersen et al., 1993) and humans (Maruyama et al., 2002, 2003). The data set, treatment of dose, and use of several dose response models in this assessment make it consistent with the NAS recommendations listed above. In deriving the CSF, several theoretical dose-response models were fit by the authors to the dose-response data set, with the Weibull model providing the best overall fit (p=0.999). The Weibull model was used to estimate the theoretical dose corresponding to a 1% increase in extra risk (ED01) and its 95% lower confidence limit (LED01), which were then used to derive linear estimates of theoretical cancer potency with a most likely estimate for the CSF of 1,600 (mg/kg-day)-1 and an upper bound estimate of 3,000 (mg/kg-day)-1. Since USEPA's revised assessment will not be vetted though public peer review until an estimated date of to 2012, the assessment of Maruyama and Aoki (2006) was used in subsequent runs of the MEE analysis as an interim CSF that is reflective of the best available science. Although the upper bound CSF value of Maruyama and Aoki is lower than the HEAST value of 150,000 (mg/kg-day)-1, it is likely to overestimate the potential theoretical risks to human health for the following reasons: (1) an inherent assumption of the assessment is that the rat liver tumor response when assessed on a tissue burden basis is predictive of theoretical response in a human tissue; (2) the CSFs listed above reflect the more conservative of two estimates of rat liver dose considered by the authors; and (3) the CSF does not take into consideration the theoretical mode of action and NAS

recommendation that supports consideration of a nonlinear dose-response relationship.

Based on the NTP bioassay data and Maruyama and Aoki (2006), a pert distribution[3] using the 5th percentile value of 200 (assuming symmetry about the MLE fit of the Weibull model), the median value of 1600 (based upon the MLE fit of the Weibull model) and the 95th percentile value of 3000 (based upon the 95% lower confidence limit for the Weibull model) was generated for the oral CSF for TCDD. By expressing the CSF for TCDD as a distribution, this risk assessment is consistent with USEPA's Guidelines for Carcinogen Risk Assessment (USEPA, 2005b), which states that "…assessments should provide central estimates of potential risk in conjunction with lower and upper bounds..." The oral CSF distribution was also used to assess potential theoretical dermal and inhalation exposures.

[3] The pert distribution is an alternative to a triangular distribution. It uses a smoother curve shape that places less emphasis on the upper extremes. This particular application replaces the min and max values typically used for the triangular distributions with the 5th and 95th percentiles.

5. Risk Characterization

Risk Characterization combines the results of the Exposure Assessment and the Toxicity Assessment to provide a quantitative estimate of the theoretical potential for carcinogenic and non-carcinogenic human health effects due to theoretical chronic and/or subchronic exposure. A deterministic risk assessment was used to develop initial conservative estimates of potential theoretical cancer and non-cancer risks for all potential theoretical receptors hypothetically exposed to all COPCs. The initial conservative estimates of potential theoretical risk were then compared to risk benchmarks to determine whether potential theoretical risks associated with any hypothetical receptors and environmental media exceeded those benchmarks and needed to be refined using the MEE analysis. Based upon that comparison, the MEE analysis was used to refine potential theoretical excess lifetime cancer risks (PTELCRs) associated with potential theoretical exposure of hypothetical future on-Site outdoor and indoor workers to arsenic, BaP-TE, pentachlorophenol and TCDD-TEQ in surface soils.

5.1 Deterministic Risk Assessment

This section presents the results of the deterministic risk assessment. Potential theoretical non-cancer risks are presented first, including potential theoretical risks associated with lead, followed by potential theoretical excess lifetime cancer risks.

5.1.1 Potential Theoretical Risks from Lead

As discussed in Section 4.1.1, potential lead exposures to all on-Site receptors were evaluated using USEPA's Adult Lead Model. A maternal/fetal blood lead level of 10 µg/dL in greater than 5 percent of a hypothetically exposed population represents the threshold for an unacceptable level of potential adverse neurological effects (USEPA, 1999). If the predicted theoretical blood lead concentration from potential theoretical exposure to on-Site soil, or potential theoretical exposure to on-Site sediment, is less than 10 µg/dL in at least 95 percent of the potentially theoretically exposed population, then potential theoretical exposure to lead in on-Site soils results in estimated potential theoretical risks that are acceptable to USEPA. Using the highest EPC estimated from either the 0 to 6 inch soil or the 0 to 6 foot soil (equal to 68.7 mg/kg estimated for the 0 to 6 inch soil), predicted 95th percentile theoretical blood lead levels in hypothetical future on-Site outdoor and indoor workers, hypothetical teenage trespassers, hypothetical future utility workers, and hypothetical future construction workers are less than the threshold of 10 µg/dL (Table 5-1). Because the lead EPC for 0 to 6 foot soil is

smaller than 68.7 mg/kg, theoretical blood lead levels would be predicted to be less than the threshold of 10 µg/dL in hypothetical future utility and construction workers potentially theoretically exposed to lead in deeper soil as well. Similarly, potential theoretical exposure to lead in on-Site sediments results in predicted 95th percentile theoretical blood lead levels in hypothetical future on-Site outdoor and indoor workers and hypothetical trespassers that are less than the threshold of 10 µg/dL (Table 5-2). Combined, these results indicate that potential theoretical exposure of hypothetical on-Site receptors to lead in on-Site soils and sediments does not pose an unacceptable risk.

5.1.2 Potential Theoretical Non-Cancer Risks

Potential theoretical non-cancer health risks associated with potential theoretical exposure to a COPC are estimated by calculating the Hazard Quotient (HQ), which is the ratio between the theoretical Average Daily Dose of a COPC estimated in the exposure assessment and that COPC's reference dose identified in the toxicity assessment. The HQ is estimated using the equation shown below.

$$HQ = \frac{ADD}{RfD}$$

where:

HQ = Hazard quotient (unitless);

ADD = Average daily dose (mg/kg-day), this can be either for a chronic or subchronic exposure duration; and,

RfD = Reference dose (mg/kg-day).

If the HQ for a given constituent and potential pathway does not exceed one, then the RfD has not been exceeded, and no theoretical adverse non-cancer health effects are expected to occur as a result of potential theoretical exposure to that constituent via that pathway. The HQs for each constituent are summed to yield the Hazard Index (HI) for that pathway. A total HI for each hypothetical receptor is then calculated by summing the pathway-specific HIs. If the total HI does not exceed one, then no potential theoretical adverse non-cancer health effects are expected to occur as a result of that receptor's potential theoretical exposure to those constituents in the exposure media evaluated. If the total HI exceeds 1.0, then endpoint specific HIs can be estimated for that receptor. If all endpoint specific HIs are less than 1.0, then no potential theoretical adverse non-cancer health effects are expected to occur as a result of that hypothetical receptor's potential theoretical exposure to those constituents in the exposure media evaluated.

Total HIs for all hypothetical receptors are summarized in Table 5-3. Tables 5-4 through 5-6 provide a more detailed presentation of HQs and HIs. Table 5-4 provides a summary of HQs (for each COPC and theoretical exposure pathway combination) and HIs (for each COPC and each theoretical exposure pathway, as well as all theoretical pathways combined) for hypothetical trespassers, hypothetical future on-Site outdoor and indoor workers, and hypothetical future recreational users. Table 5-5 provides a similar summary for hypothetical trespassers and hypothetical future on-Site workers exposed to DD sediments. Table 5-6 summarizes HQs and HIs for the hypothetical future utility and construction workers. Appendix H presents the potential theoretical risk calculations for the deterministic assessment. All hypothetical receptors have a total HI of less than 1, regardless whether potentially theoretically exposed to surface soils, subsurface soils, or sediments. Accordingly, based upon the conservative assumptions used in the deterministic risk assessment presented herein, potential theoretical non-cancer health effects are not expected to occur as a result of potential theoretical exposure to COPCs in on-Site soils and on-Site sediments. Given that the conservative deterministic risk assessment predicts an absence of potential theoretical non-cancer risks, a more refined evaluation of potential theoretical non-cancer risks using the MEE model is not necessary and was not conducted.

5.1.3 Potential Theoretical Excess Lifetime Cancer Risks

Potential theoretical excess lifetime cancer risks (PTELCRs) associated with potential theoretical exposure to COPCs in on-Site soils and sediments were estimated by combining the theoretical Lifetime Average Daily Dose for a COPC estimated in the exposure assessment and the cancer slope factor identified in the toxicity assessment. The PTELCR is estimated using the equations shown below.

$$PTELCR = 1 - e^{-CSF \times LADD}$$

where:

PTELCR = Potential Theoretical Excess Lifetime Cancer Risk (unitless);
LADD = Lifetime Average Daily Dose (mg/kg-day); and,
CSF = Cancer Slope Factor ((mg/kg-day)$^{-1}$).

This is the general form of the equation, and may be used in all cases to estimate potential theoretical risk, regardless of the magnitude of the potential theoretical estimated risk. In particular, this equation should be used when the product of the theoretical dose and potency slope is greater than 0.01. This practice prevents estimation of potential theoretical risks that are greater than one.

The exponential equation can be simplified to a linear equation, which closely approximates the results of the exponential equation when the product of the theoretical dose and potency slope is less than 0.01. The simplified linear form of the equation is expressed as:

$$PTELCR = LADD \times CSF$$

where:

PTELCR = Potential Theoretical Excess Lifetime Cancer Risk (unitless);
LADD = Lifetime Average Daily Dose (mg/kg-day); and,
CSF = Cancer Slope Factor ((mg/kg-day)$^{-1}$).

PTELCRs were estimated for each pathway for each COPC assumed to be associated with potential theoretical carcinogenic effects. The PTELCRs for each COPC were summed to yield a pathway-specific PTELCR, and then a total PTELCR for each hypothetical receptor was estimated by summing the pathway-specific PTELCRs. The estimated PTELCRs associated with COPCs are an indication of the potential theoretical cancer risk a hypothetical receptor may theoretically experience over and above their background cancer risk from all sources over the duration of a lifetime. The background cancer incidence in the US is approximately 3.5 in 10 (based on cancer prevalence data from the National Cancer Institute [NCI, 2007] and population statistics from the United States Census Bureau [Census Bureau, 2007]). Given this background incidence of cancer in the US, the increase in overall cancer risk associated with a PTELCR of 1 X 10^{-6} corresponds to an individual having a theoretical increase from 0.350000 to 0.350001 in their chance of getting cancer over a lifetime. Similarly, the increase in overall cancer risk associated with a PTELCR of 1 X 10^{-4} corresponds to an individual having a theoretical increase from 0.3500 to 0.3501 in their chance of getting cancer over a lifetime. Both of these potential theoretical increases are so small as to be immeasurable and are one reason why USEPA considers increases this small to be acceptable. Note as well, that because of the numerous conservative theoretical exposure and toxicity assumptions used in the deterministic risk assessment, PTELCRs represent substantial theoretical overestimates and any actual cancer risks, if present at all, are substantially lower.

At virtually all CERCLA sites, if the PTELCR for a particular hypothetical receptor falls within or is below USEPA's allowable risk range of 1 X 10^{-6} to 1 X 10^{-4} (one in one million to one in ten thousand), then potential theoretical risks associated with potential theoretical exposures to COPCs at a site are assumed to be acceptable. However, even though the Gainesville Site is being evaluated under the oversight of USEPA,

FDEP evaluates estimated potential theoretical excess lifetime cancer risks by comparison to a risk benchmark of 1 X 10^{-6} (one in one million). Thus, it is possible that the risk assessment may develop estimated PTELCRs for one or more hypothetical receptors that fall within USEPA's allowable risk range (i.e., between 1 X 10^{-6} and 1 X 10^{-4}) but exceed FDEP's bright-line risk benchmark. In such an instance, the potential theoretical exposures would be judged to meet USEPA's benchmark but may be judged to exceed FDEP's benchmark. Given the presence of dual risk management benchmarks at the Gainesville Site, acceptability of potential theoretical excess lifetime cancer risks are discussed in relation to both USEPA's risk range and FDEP's risk benchmark.

Total PTELCRs for all hypothetical receptors for both current and future use estimated by the deterministic risk assessment are summarized in Table 5-3. Tables 5-4 through 5-6 provide a more detailed presentation of PTELCRs estimated by the deterministic risk assessment. Table 5-4 provides a summary of PTELCRs (for each COPC, for each theoretical exposure pathway, as well as all theoretical pathways and COPCs combined) for hypothetical trespassers, hypothetical future on-Site workers, and hypothetical future recreational users. Table 5-5 provides a summary for DD sediments for the hypothetical trespasser and hypothetical future on-Site worker. Table 5-6 summarizes PTELCRs for the hypothetical future utility and construction workers. Appendix H presents the potential theoretical risk calculations for the deterministic assessment.

Potential theoretical excess lifetime cancer risks estimated by the deterministic risk assessment are presented below for each hypothetical receptor. For all hypothetical receptors, potential theoretical exposures associated with potential theoretical incidental ingestion of soil containing COPCs pose the highest potential theoretical risk followed by potential theoretical dermal exposure to COPCs in soil. Potential theoretical inhalation exposures pose the lowest potential theoretical risks.

5.1.3.1 Hypothetical Trespasser Deterministic Estimates

The total PTELCR for the hypothetical trespasser is estimated to be 2 x 10^{-5} (Tables 5-3 and 5-4) based upon the conservative deterministic risk assessment. This total PTELCR falls within USEPA's allowable risk range, but is above FDEP's risk benchmark. Only the PTELCR associated with TCDD-TEQ exceeds FDEP's risk benchmark of 1x10^{-6}. PTELCRs associated with arsenic, BaP-TE and pentachlorophenol are below FDEP's risk benchmark.

The total PTELCR for the hypothetical trespasser potentially theoretically exposed to COPCs in DD sediments is estimated to be 4×10^{-6} (Tables 5-3 and 5-5) based upon the conservative deterministic risk assessment. This total PTELCR falls in the lower end of USEPA's allowable risk range but is above FDEP's risk benchmark. Only the PTELCR associated with TCDD-TEQ slightly exceeds FDEP's risk benchmark of 1×10^{-6}. PTELCRs associated with arsenic, BaP-TE and pentachlorophenol are below FDEP's risk benchmark.

5.1.3.2 Hypothetical Future On-Site Indoor and Outdoor Worker Deterministic Estimates

The total PTELCR for the hypothetical future on-Site indoor worker is estimated to be 3×10^{-4} (Tables 5-3 and 5-4) based upon the conservative deterministic risk assessment. This PTELCR exceeds both the USEPA allowable risk range and FDEP's risk benchmark. PTELCRs associated with all COPCs exceed FDEP's risk benchmark but only the PTELCR associated with TCDD-TEQ exceeds USEPA's risk range. The total PTELCR for the hypothetical future on-Site outdoor worker is estimated to be 5×10^{-4} (Tables 5-3 and 5-4) based upon the conservative deterministic risk assessment. This PTELCR exceeds both the USEPA allowable risk range and FDEP's risk benchmark. PTELCRs associated with all COPCs exceed FDEP's risk benchmark but only the PTELCR associated with TCDD-TEQ exceeds USEPA's risk range.

The total PTELCR for hypothetical future on-Site indoor and outdoor workers potentially theoretically exposed to COPCs in DD sediments is estimated to be 5×10^{-7} (Tables 5-3 and 5-5) based upon the conservative deterministic risk assessment. This PTELCR is below USEPA's risk range and FDEP's risk benchmark indicating COPCs in on-Site sediments do not pose an unacceptable theoretical risk to hypothetical future on-Site indoor and outdoor workers.

5.1.3.3 Hypothetical Future Recreational User Deterministic Estimates

The total PTELCR for the hypothetical future recreational user potentially theoretically exposed to COPCs in surface soils is estimated to be 9×10^{-5} (Tables 5-3 and 5-4) based upon the conservative deterministic risk assessment. This total PTELCR falls within USEPA's allowable risk range, but is above FDEP's risk limit. The PTELCRs associated with arsenic, Bap-TE, and TCDD-TEQ exceed FDEP's risk limit of 1×10^{-6}. PTELCRs associated with pentachlorophenol are below or equal to FDEP's risk limit. PTELCRs associated with all COPCs fall within, or below, USEPA's allowable risk range.

5.1.3.4 Hypothetical Future Construction Worker Deterministic Estimates

The total PTELCR for the hypothetical future construction worker potentially theoretically exposed to COPCs in subsurface soils is estimated to be 1 x 10^{-5} (Tables 5-3 and 5-6) based upon the conservative deterministic risk assessment. This total PTELCR falls within USEPA's allowable risk range, but is above FDEP's risk limit. Only the PTELCR associated with TCDD-TEQ exceeds FDEP's risk limit of 1x10^{-6}. PTELCRs associated with arsenic, BaP-TE and pentachlorophenol are below or equal to FDEP's risk limit. PTELCRs associated with all COPCs fall within, or below, USEPA's allowable risk range.

5.1.3.5 Hypothetical Future Utility Worker Deterministic Estimates

Using the deterministic calculations, the total PTELCR for the hypothetical future utility worker potentially theoretically exposed to COPCs in subsurface soils is estimated to be 2 x 10^{-5} (Tables 5-3 and 5-6) based upon the conservative deterministic risk assessment. This total PTELCR falls within USEPA's allowable risk range, but is above FDEP's risk limit. The PTELCRs associated with BaP-TE and TCDD-TEQ exceed FDEP's risk limit of 1x10^{-6}. PTELCRs associated with arsenic and pentachlorophenol are below FDEP's risk limit. PTELCRs associated with all COPCs fall within, or below, USEPA's allowable risk range.

5.1.3.6 Summary of Deterministic Estimates

In summary, based upon the conservative assumptions used in the deterministic risk assessment presented herein, potential theoretical non-cancer health effects are not expected to occur for any of the receptors as a result of potential theoretical exposure to COPCs in on-Site soils and on-Site sediments.

Potential theoretical excess lifetime cancer risks for hypothetical trespassers and hypothetical future recreational users, as well as hypothetical future construction and utility workers, were within USEPA's allowable risk range for potential theoretical exposure to Site soil and sediments. Additionally the deterministic risk assessment found that potential theoretical risks for hypothetical future on-Site indoor and outdoor workers potentially theoretically exposed to COPCs in DD sediments were also within USEPA's allowable risk range. The deterministic risk assessment estimated that hypothetical future on-Site indoor and outdoor workers potentially theoretically exposed to COPCs in surface soils have potential theoretical excess lifetime cancer risks above USEPA's allowable risk range. These results suggest that under baseline conditions,

only hypothetical future workers potentially theoretically exposed to surface soils have a potential theoretical excess lifetime cancer risk that exceeds USEPA's risk management benchmark. The surface soil TCDD-TEQ EPC also exceeds the lower end of USEPA's range of current TCDD-TEQ cleanup levels for commercial/industrial sites. Thus, the conservative deterministic risk assessment results and USEPA's range of TCDD-TEQ cleanup levels reach consistent conclusions about the acceptability of potential theoretical risk associated with on-Site soils.

Potential theoretical excess lifetime cancer risks associated with hypothetical trespasser and hypothetical future on-Site indoor and outdoor worker potential theoretical exposure to COPCs in DD sediments meet FDEP's risk limit. The potential theoretical excess lifetime cancer risks estimated by the conservative deterministic risk assessment for all hypothetical receptors potentially theoretically exposed to on-Site soils exceed FDEP's risk limit (in contrast to falling within or below USEPA's allowable risk range with the exception of hypothetical future on-Site indoor and outdoor workers).

5.2 Refined Risk Estimates Using Probabilistic Assessment

Based upon the results of the conservative deterministic risk assessment, hypothetical future on-Site indoor and outdoor workers were identified as the theoretically most highly exposed receptors, and, therefore, the MEE analysis was run for the hypothetical future on-Site indoor and outdoor worker potentially theoretically exposed to the four potentially carcinogenic COPCs (i.e., arsenic, BaP-TE, pentachlorophenol, and TCDD-TEQ) in on-Site surface soil. Potential theoretical risks to hypothetical future workers were refined because these potential theoretical risks are greater than potential theoretical risks for the other hypothetical receptors evaluated in this HHRA.

If the refined and more realistic potential theoretical risks for the hypothetical future on-Site indoor and outdoor worker (developed by the MEE analysis) are predicted to fall within acceptable levels, either as a baseline condition or as a consequence of some future remedial action, then more realistic potential theoretical risks for the other hypothetical receptors with lower potential theoretical exposures will also fall within or below risk limits. A concomitant reduction in potential theoretical risks will occur for other hypothetical receptors because the use of distributions instead of point estimates (e.g., the COPC concentration would be a distribution, not a single upper bound concentration; a distribution would be used for theoretical exposure frequency so a hypothetical trespasser would be assumed to be on the Site from 1-12 days a year instead of 12, etc.) will also result in more realistic and lower estimates of potential

theoretical exposure and risk than estimated by the conservative deterministic risk assessment.

A detailed description of the MEE model, including an example calculation, was provided to USEPA previously (AMEC, 2008a). That description is reproduced in Appendix E of this risk assessment and, thus, a detailed description of the MEE model is not repeated in the main body of this document. However, an overview of the MEE model and description of the different general kinds of estimates of potential theoretical risk developed by the MEE analysis is presented below to enable readers to better understand and appreciate the results of the MEE analysis.

The MEE model consists of a series of three nested loops that are iterated numerous times to predict the day-to-day potential theoretical estimated risk of many hypothetical receptors and to then estimate how much of the variation in potential theoretical risk be can be ascribed to variability between hypothetical receptors versus uncertainty about theoretical exposure and toxicity factors that determine potential theoretical risk. The three nested loops are the uncertainty loop, the variability loop and the day loop. The user defines the number of uncertainty loops and variability loops in a model run. For the MEE analysis presented in this risk assessment, 200 uncertainty loops and 1000 variability loops were run. In other words, potential theoretical risks for 1000 hypothetical on-Site workers were estimated 200 times (the equivalent of estimating the potential theoretical risk for 200,000 hypothetical future on-Site workers). The number of day loops is equal to the number of days a hypothetical receptor is potentially theoretically exposed to on-Site soils. The number of days varies from one hypothetical receptor to the next and is set by the MEE model when it selects a theoretical exposure duration (ED) and theoretical exposure frequency (EF) for a hypothetical receptor.

Once the uncertainty parameters (i.e., the theoretical relative absorption factors and the theoretical dermal adherence factors) and the variability parameters (theoretical exposure duration, theoretical exposure frequency, theoretical body weight, theoretical skin surface area and cancer slope factor, if applicable) are set for a single hypothetical receptor (i.e., a hypothetical future on-Site indoor and outdoor worker), the MEE model estimates the total potential theoretical excess lifetime cancer risk for that single hypothetical receptor. Total potential theoretical lifetime cancer risk is estimated by summing the daily potential theoretical risk for every day that the hypothetical receptor is assumed to be theoretically exposed (i.e., by summing the results of all of the day loop iterations). The number of day loop iterations can vary greatly between hypothetical future workers. The potential theoretical risk for a hypothetical future

worker may consist of the summation of as few as 250 day loop iterations (for a hypothetical future worker with a theoretical exposure duration of 1 year and a theoretical exposure frequency of 250 days per year) to more than 6,250 (for a hypothetical future worker with a theoretical exposure duration of 25 years and a theoretical exposure frequency of more than 250 days per year). Regardless the number of day loops required to estimate the total potential theoretical excess lifetime risk for a hypothetical future worker, a single estimate of potential theoretical excess lifetime cancer risk is output by the MEE model for each hypothetical future worker. This single estimate of potential theoretical risk could be shown as a single point on the figures summarizing the results of the MEE models runs (Table 5-7 summarizes the MEE model results). However, because the MEE analysis in the risk assessment estimates the potential theoretical excess lifetime cancer risk for 1000 hypothetical future workers for each iteration of the uncertainly loop, 1000 points would need be shown on the figures for each single iteration of an uncertainly loop. These 1000 results are instead shown as a single line on the figures. The 1000 results are plotted (by percentile) from lowest to highest estimated total potential theoretical excess lifetime risk (Figures 5-1 and 5-2).

If the results from all 200 uncertainly loop iterations were shown on each figure, then each figure would have 200 lines (with each line representing the distribution of the potential theoretical lifetime risk of the 1000 hypothetical future workers included in one iteration of the uncertainty loop). Because presenting 200 lines on a single figure would result in a figure that is not readable, each figure in this risk assessment presents three lines. The middle line (shown in red) corresponds to the 50th percentile (median) line of the uncertainty iteration. The bottom dashed line (shown in blue) corresponds to the 5th percentile of the uncertainty iteration. The top dashed line (shown in green) corresponds to the 95th percentile of the uncertainty iteration (Figures 5-1 and 5-2).

The figures also present the potential theoretical excess lifetime cancer risk estimated by the conservative deterministic risk assessment. This point estimate of potential theoretical risk is plotted at the 100th percentile (on the right-hand y-axis) for convenience. The deterministic potential theoretical risks are not estimated as a percentile of a distribution of potential theoretical risk, rather they are point estimates.

5.2.1 Median and Upper 95th Percentile MEE Potential Theoretical Cancer Risks

MEE analysis results for a typical hypothetical future worker (e.g. the potential theoretical excess lifetime cancer risk for the 50th percentile (median) of the variability

distribution at the 50th percentile uncertainty distribution) are summarized in Tables 5-7 through 5-10. The tables also present the 5th and 95th percentiles of the variability distribution as well as the deterministic PTELCRs for each on-Site exposure area. The PTELCRs are reported to two significant digits to better demonstrate trends in the results. As described above, the middle (red) lines on Figures 5-1 and 5-2 also show these results.

All COPCs Combined

The median PTELCRs are within or below USEPA's allowable risk range, but are above FDEP's risk limit (Table 5-7, Figures 5-1 and 5-2). The lower bound (5th percentile) PTELCR fell within USEPA's allowable risk range but was slightly above FDEP's risk limit for the hypothetical future indoor and outdoor worker (Table 5-7, Figures 5-1 and 5-2). The upper bound (95th percentile of variability) PTELCRs are also within USEPA' allowable risk range; however, upper bound PTELCRs exceed FDEP's risk limit for both the hypothetical future indoor and outdoor worker (Table 5-7, Figures 5-1 and 5-2). Review of Tables 5-8 through 5-10 shows that the total PTELCRs are driven by the theoretical incidental soil ingestion pathway. Potential theoretical risks associated with theoretical dermal contact with soil and theoretical inhalation of dust derived from soil are about 40-fold and 30-fold lower, respectively, than potential theoretical risks associated with incidental ingestion of soil for the hypothetical future outdoor worker and about 20-fold and 10-fold lower, respectively, than potential theoretical risks associated with theoretical incidental ingestion of soil for the hypothetical future indoor worker.

TCDD-TEQ

The median PTELCR associated with potential theoretical exposure to TCDD-TEQ is in the lower half of USEPA's allowable risk range for both hypothetical future on-Site indoor and outdoor workers but is above FDEP's risk limit (Table 5-7). The upper bound (95th percentile of variability) PTELCRs are also within USEPA's allowable risk range but exceed FDEP's risk limit. As discussed in the uncertainty section, the upper bound PTELCRs are below FDEP's risk limit and USEPA's allowable risk range when a distribution of TCDD CSFs that is more representative of the current state of knowledge about TCDD's potential carcinogenicity is employed.

BaP-TE

The median PTELCR associated with potential theoretical exposure to BaP-TE is below USEPA's allowable risk range and are also below FDEP's risk limit for both

hypothetical future on-Site indoor and outdoor workers (Table 5-7). All lower bound (5th percentile) PTELCRs are far below both USEPA's allowable risk range and FDEP's risk limit for both hypothetical future on-Site indoor and outdoor workers (Table 5-7). All upper bound (95th percentile of variability) PTELCRs are also within or below USEPA's allowable risk range; however, the upper bound PTELCR exceeds FDEP's risk limit by about 30% for the hypothetical future on-Site indoor worker and by about 2.5-fold for the hypothetical future on-Site outdoor worker (Table 5-7). Review of Tables 5-8 through 5-10 shows that the BaP-TE PTELCRs are driven by the theoretical incidental soil ingestion pathway, followed by potential theoretical dermal contact with soil or inhalation of dust.

Arsenic

The median PTELCR associated with potential theoretical exposure to arsenic is below USEPA's allowable risk range and are also below FDEP's risk limit for both hypothetical future on-Site indoor and outdoor workers (Table 5-7). All lower bound (5th percentile) PTELCRs are below both USEPA's allowable risk range and FDEP's risk limit for both hypothetical future on-Site indoor and outdoor workers (Table 5-7). All upper bound (95th percentile of variability) PTELCRs are also within or below USEPA's allowable risk range; however, the upper bound PTELCR exceeds FDEP's risk limit by about 3-fold for the hypothetical future on-Site indoor worker and by about 5-fold for the hypothetical future on-Site outdoor worker (Table 5-7). Review of Tables 5-8 through 5-10 shows that the arsenic PTELCRs are driven roughly equally by the theoretical incidental soil ingestion and theoretical inhalation of dust pathways, followed by the potential theoretical dermal contact pathway for which potential theoretical risks are more than 10-fold lower.

Pentachlorophenol

The median variability PTELCRs associated with potential theoretical exposure to pentachlorophenol, as well as the lower and upper bound PTELCRs, are below USEPA's allowable risk range and are also below FDEP's risk limit (Table 5-7).

5.2.2 Lower and Upper Uncertainty Bounds for PTELCRs Developed by the MEE Analysis

The MEE model also estimates lower (5th percentile) and upper (95th) percentile bound PTELCRs to provide an estimate of the uncertainty associated with the median (50th percentile) MEE results. The 5th percentile and 95th percentile uncertainty bounds are shown on Figures 5-1 and 5-2. The lower and upper bound PTELCRs at a given percentile of the distribution are generally within a factor of 2 to 4 of each other

suggesting that the uncertainty associated with a PTELCR at a particular percentile is small. Given that the range in uncertainty about the 50th percentile PTELCRs is relatively small, presentation and discussion of the MEE analysis results focuses on the 50th percentile (median) of the uncertainty iterations.

5.2.3 Summary of PTELCRs Estimated by the MEE Analysis

All potential theoretical risks estimated by the MEE model, even the upper uncertainty bounds of the upper percentile variability theoretical risks, are lower than the potential theoretical deterministic risks substantiating the highly conservative nature of the deterministic point estimate PTELCRs (Figures 5-1 and 5-2, Table 5-7). This finding is expected. When multiple independent conservative theoretical exposure and toxicity assumptions are combined, the estimated potential theoretical risk is more conservative than any one of the individual theoretical assumptions.

For the typical hypothetical future on-Site indoor and outdoor workers, the total PTELCRs developed by the MEE analysis are within the lower half of USEPA's allowable risk range, but are above FDEP's risk limit (Table 5-7, Figures 5-1 and 5-2). Total PTELCRs in the upper percentiles of the distribution are also within USEPA's allowable risk range, but above the FDEP risk limit. Note that the MEE analysis used conservative theoretical point estimate assumptions (not theoretical distributions) for some parameters that determine potential theoretical risk (e.g., all of a hypothetical future on-Site indoor or outdoor worker's theoretical daily exposure to soil was assumed to come from the Site; the upper 95th percentile of the distribution of possible CSFs for arsenic, BaP-TE, TCDD and pentachlorophenol was used). As a result, the upper percentiles of potential theoretical risk are far more likely to represent over- rather than underestimates of potential theoretical risk. In such instances, USEPA (2001a) recommends that the lower end of the RME percentile range (i.e., below the 95th percentile rather than above the 95th percentile) be used. This range of estimates falls within EPA's allowable risk range.

Potential theoretical incidental soil ingestion exposures are associated with the largest potential theoretical excess lifetime risks, followed by potential theoretical dermal exposures and then potential theoretical inhalation exposures. The largest PTELCRs were associated with potential theoretical exposures to TCDD TEQ, followed by potential theoretical exposure to BaP-TE, arsenic, and pentachlorophenol (Table 5-7). As discussed in the Uncertainty Assessment (Section 6), when a distribution of TCDD CSFs is employed, rather than USEPA's point estimate CSF for TCDD, PTELCRs associated with TCDD-TEQ decline from making the greatest to making the smallest

contribution of all COPCs to overall potential theoretical cancer risk. When an alternate CSF is used for TCDD-TEQ, the total PTELCR for a typical (median) hypothetical future on-Site indoor worker drops to below USEPA's allowable risk range and is below FDEP's benchmark and is essentially equal to FDEP's benchmark and the bottom of USEPA's allowable risk range for typical (median) hypothetical future on-Site outdoor workers (see discussion in Uncertainty Section, Section 6.0).

As described above, PTELCRs developed by the MEE analysis are expected to be lower than those estimated using the conservative deterministic point estimate approach for any receptor included in the MEE analysis, not just for the hypothetical future on-Site indoor and outdoor workers included in the MEE analysis. Median MEE PTELCRs for hypothetical future on-Site indoor and outdoor workers are approximately 70 times lower, than the conservative deterministic point estimate PTELCRs (Table 5-7). Upper bound MEE PTELCRs are about 10 times lower than the conservative deterministic point estimate PTELCRs (Table 5-7). The MEE analysis only included quantitative PTELCRs for hypothetical future on-Site indoor and outdoor workers because they were the most exposed hypothetical receptor. If potential theoretical risks to a hypothetical future on-Site indoor or outdoor worker are allowable under baseline conditions, or are reduced to an allowable level following implementation of a remedy, similar reductions in potential theoretical excess lifetime cancer risks would be expected for the other hypothetical receptors included in the conservative point estimate risk assessment but not included in the MEE analysis (e.g., hypothetical trespassers, hypothetical future recreational users, hypothetical future construction workers, and hypothetical future utility workers). Such reductions are expected to decrease the potential theoretical risks for these hypothetical receptors to allowable levels.

6. Uncertainty Assessment

In each of the four steps of the HHRA process, assumptions were made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk assessment process, but the assumptions that are made are conservative in that they are meant to be more protective in order to ensure that health risks are not underestimated. In fact, the use of such conservative assumptions at every stage of the risk assessment process almost certainly has the effect of overestimating potential theoretical health risks to the human population.

The assumptions that introduce the greatest amount of uncertainty in this risk assessment are discussed in this section. For the deterministic HHRA, they are discussed in general terms, because, for most of the assumptions, there is not enough information to assign a numerical value that can be factored into the estimation of potential theoretical risk. In contrast, the MEE risk evaluation captures both the variability in the assumptions, as well as the uncertainty.

6.1 Hazard Identification

Constituents of potential concern (COPCs) at the Site were identified using a conservative screening process resulting in a high degree of confidence that no constituents that may contribute significantly to total potential theoretical risks would be eliminated from the risk assessment and to ensure the risk assessment focused on those constituents that could potentially pose a theoretical risk. The screening process used conservative (i.e., maximum) concentrations that were compared to screening values that represent conservative overestimates of theoretical exposures that may theoretically occur at the Site. Potential theoretical estimated exposures are likely to be less frequent than assumed in the screening values to which maximum concentrations were compared for the purpose of selecting COPCs. As a result, some COPCs were selected that are highly unlikely to pose an unacceptable risk to hypothetical receptors. Nevertheless, all COPCs identified during this process were quantitatively evaluated in the risk assessment, ensuring that the potential theoretical risks are not underestimated.

6.2 Toxicity Assessment

The Toxicity Assessment step of a HHRA always involves uncertainty because the ability of a risk assessor to characterize the theoretical dose-response characteristics of a COPC is entirely dependent on that constituent having been previously subjected to rigorous toxicological or epidemiological study by the scientific community. A valid study requires that a suitable number of test organisms were exposed to a constituent, over a suitable range of doses to account for theoretical exposures in natural settings, and that a suitable number of toxicological end-points were examined in the organisms to ensure that the theoretical health effects associated with each dose were well-characterized. Uncertainty arises however, because most laboratory toxicological studies tend to involve the administration of high doses of a single constituent over a short time frame to a non-human organism, whereas humans in natural settings tend to theoretically be exposed to low doses of constituent mixtures over a long time frame. Epidemiological studies require a clear identification and understanding of all potential confounding factors that could lead to erroneous conclusions being drawn about the theoretical relationship between a constituent and the effects it elicits in an organism, and often these studies are in occupational settings where the theoretical doses are much higher than what would occur in non-occupational settings.

The dose-response characteristics of a constituent are most defensible for use in a risk assessment when sufficient toxicological or epidemiological dose-response information exists for USEPA to derive an RfD or CSF. USEPA derives point-estimate RfDs and CSFs by applying conservative assumptions and uncertainty factors to available toxicological or epidemiological dose-response information, in order to account for the limitations of toxicological research outlined above, namely animal-to-human extrapolation, and high-to-low dose extrapolation. A USEPA-derived COPC-specific RfD and/or CSF was used for each of the COPCs in the deterministic risk assessment and the initial runs of the MEE analysis. Accordingly, little chance exists that potential theoretical risks were underestimated in the risk assessment. It is much more likely that potential theoretical risks are overestimated for most COPCs, potentially substantially. Certainly the use of point estimate CSFs (equal to the 95th% upper confidence limit) in the MEE analysis leads to an overestimate of PTELCRs by the MEE analysis for these constituents.

As described in above in Section 4.2 a second series of runs of the MEE model was conducted that uses a distribution of CSFs to estimate the potential theoretical excess lifetime cancer risk associated with TCDD-TEQ because an overwhelming amount of new scientific data are available and are not reflected in the point estimate US EPA's

TCDD CSF. The derivation and scientific basis of the TCDD CSF distribution is discussed in detail in Appendix D. The CSF distribution was treated as a variability parameter in the variability loop of the MEE model. The distribution is based on data from one study and one type of model. The range arises because of potential variability in response among the different animals. Had the HHRA included a range of CSFs arising from a series of studies, or using a range of dose response models, that would be included in the MEE model as uncertainty.

The results of the second series of MEE model runs are summarized in Table 6-1. For perspective, a summary of the results of the MEE analysis assuming USEPA's fixed CSF are also presented in Table 6-1. When the distribution of TCDD CSFs is employed, PTELCRs associated with exposure to TCDD-TEQ decrease by about 1,000-fold. Based upon the results of the MEE analysis with a fixed TCDD CSF, potential theoretical excess lifetime cancer risks for the typical (i.e., median of the variability distribution) hypothetical future on-Site indoor or outdoor worker were already within USEPA's allowable risk range but above FDEP's risk limit. When the TCDD CSF distribution is employed, the upper bound potential theoretical excess lifetime cancer risks (95^{th} percentile of the variability distribution) associated with TCDD-TEQ decrease and are below USEPA's allowable risk range and FDEP's risk benchmark for the hypothetical future on-Site indoor and outdoor worker. Additionally, the potential theoretical excess lifetime cancer risk from all COPCs decreases such that the potential theoretical risk for a typical (i.e., median of the variability distribution) hypothetical future on-Site indoor worker falls below USEPA's allowable risk range and FDEP's risk benchmark and is essentially equal to the lower end of USEPA's allowable risk range and FDEP's risk benchmark for the hypothetical future on-Site outdoor worker. The upper bound potential theoretical excess lifetime cancer risk (95^{th} percentile of the variability distribution) associated with all COPCs falls within EPA's allowable risk for both hypothetical future on-Site indoor or outdoor workers but is above FDEP's risk benchmark.

The second MEE analysis is less likely to have significantly overstated the potential theoretical risks associated with TCDD-TEQ because a CSF distribution was used, which was derived from more recent toxicological and pharmacokintetic studies, but even those CSFs are more likely than not to overstate potential theoretical risks. As stated in Section 4.2, although the upper bound CSF value of Maruyama and Aoki is lower than the HEAST value of 150,000 $(mg/kg\text{-}day)^{-1}$, it is likely to overestimate the potential theoretical risks to human health for the following reasons: (1) an inherent theoretical assumption of the assessment is that the rat liver tumor response when assessed on a tissue burden basis is predictive of response in a human tissue; (2) the

CSFs listed above reflect the more conservative of two theoretical estimates of rat liver dose considered by the authors; and (3) the CSF does not take into consideration the theoretical mode of action and NAS recommendation that supports consideration of a nonlinear dose-response relationship.

Note as well that Table 6-1 also summarizes the PTELCRs developed by the deterministic risk assessment using USEPA's fixed CSF of 150,000 $(mg/kg\text{-}day)^{-1}$ compared with the PTELCRs calculated using the 95% upper bound CSF of 3,000 $(mg/kg\text{-}day)^{-1}$ from the Maruyama and Aoki study. When the CSF from the Maruyama and Aoki study is used, PTELCRs associated with potential theoretical exposure to TCDD-TEQ decrease and fall within USEPA's allowable risk range but remain above FDEP's risk benchmark.

Taken together, the multiple layers of conservatism in the Toxicity Assessment provide confidence that the dose-response information used in the risk assessment is much more likely to have overestimated than underestimated potential theoretical risks.

6.3 Exposure Assessment

The Exposure Assessment step of a HHRA always involves uncertainty because it requires the risk assessor to make theoretical estimations and assumptions relating to the theoretical extent of COPCs available for human contact (that is, the exposure point concentrations) and the biological and behavioral characteristics of hypothetical human receptors. For some of the theoretical exposure parameters describing the biological and behavioral characteristics of hypothetical human receptors, conservative parameter values were selected, generally from information in guidance recommended by USEPA.

EPCs were developed using methodologies carefully selected to be representative of conditions at the Site. For example, spatially-weighted average concentrations were developed for constituents in soil and sediment because this approach provides an unbiased representation of concentrations that could be encountered. Nevertheless, as mentioned above, the EPCs used in this HHRA for TCDD-TEQ are substantial overestimates because of how the TCDD-TEQ concentration in soil was estimated. The process followed was consistent with how TCDD-TEQ is typically calculated but as clearly stated in Van den Berg et al. (2006), the relevance of that process to the risk assessment of dioxins and furans in soils is questionable. It likely overestimates the bioavailable fraction of TCDD-TEQ in soil. Van den Berg et al. (2006) clearly state that the application of TEFs "is only intended for estimating exposure to dioxin-like

chemicals from consumption of food products, breast milk, etc." (page 234). Van den Berg et al. (2006) further state that application of the WHO TEFs "in abiotic environmental matrices has limited toxicological relevance and use for risk assessment unless the aspect of reduced bioavailability is taken into consideration" (page 235). USEPA's guidance for conducting risk assessments of combustion facilities (USEPA 2005a) has a unique dietary uptake factor for each congener into various biota. The congener-specific uptake factors presented in USEPA (2005a) account for potential theoretical exposure from multiple sources and, thus, do not represent uptake differences associated solely with soil. Differences associated with only soil would likely be greater than those associated with all potential theoretical exposure pathways and routes. Even acknowledging the likelihood that uptake differences associated with only soil are underestimated by the uptake factors presented in USEPA (2005a), application of those uptake factors when estimating TCDD-TEQ in soil with congener distribution patterns similar to those present in on-Site soils, results in a reduction of the TCDD-TEQ concentration of between two and three fold. This in turn would mean that the exposure point concentrations presented in this HHRA for TCDD-TEQ are at least two to three fold higher than appropriate, and that the potential theoretical risks associated with TCDD-TEQ in soil are at least two to three fold higher than appropriate as well.

Oral and dermal RAFs appropriate for estimating potential theoretical non-cancer risks were derived for many constituents using constituent-specific published absorption information (presented in Appendix C). FDEP applies a default theoretical relative bioavailability factor of 1 to all constituents, except arsenic and lead. When estimating potential theoretical risk associated with the theoretical dermal route of exposure, FDEP applies a theoretical gastro-intestinal absorption factor as well as a theoretical dermal absorption factor. In order to evaluate the possible uncertainty associated with using FDEP's theoretical default absorption factors, potential theoretical non-cancer risks were also estimated using these theoretical default assumptions. These alternative estimates result in lower potential theoretical non-cancer risks for some COPCs and slightly higher potential theoretical non-cancer risks for other COPCs. None of the alternative potential theoretical risk estimates were more than 25% higher than the potential theoretical non-cancer risk estimates based upon ARCADIS RAFs and presented in this risk assessment. Given that potential theoretical non-cancer risk estimates developed in this risk assessment using ARCADIS RAFs are more than 10 times lower than a Hazard Index of 1.0, a 25% increase will not cause estimated potential theoretical non-cancer risks to increase above a Hazard Index of 1.0. Therefore, the conclusion of this risk assessment, that no unacceptable potential

theoretical non-cancer risks are present at the Site, would not change if FDEP theoretical absorption values were used.

Altogether, the multiple layers of conservatism in the Exposure Assessment provide confidence that assumptions made in this step of the deterministic risk assessment process very likely resulted in potential theoretical risks that were overestimated rather than underestimated. The MEE provides a more realistic estimate of potential theoretical risks, principally because less uncertainty is present in the theoretical exposure assumptions, and this uncertainty can be quantified using the two-dimensional model approach (i.e., separating uncertainty from variability).

Recent evidence of the conservative nature of the theoretical exposure assumptions used in risk assessments is provided by the work of Dr. David Garabrant at the University of Michigan. Dr. Garabrant found that elevated concentrations of TCDD-TEQ in soil in and near Midland Michigan could not be correlated to any increase in blood plasma levels in residents living in the study area. (Garabrant et al. 2008, 2009). Dr. Garabrant's results, along with those of other researchers studying potential theoretical exposure to dioxin in West Virginia soils led California's Department of Toxic Substances Control Human and Ecological Risk Division (CA DTSC/HERD, 2009) to increase its dioxin residential soil clean-up level by 10-fold to account for the measured actual uptake of dioxin in soils being substantially lower than the theoretical exposures estimated using typical risk assessment methods and assumptions. When a similar ten-fold reduction is applied to the deterministic risk assessment results reported herein, PTELCRs for hypothetical future workers associated with TCDD-TEQ decrease to be within USEPA's allowable risk range. (Note that the MEE model was not run using the 10-fold reduction because the theoretical exposure assumption distributions employed in the MEE model may account for some of the overestimate of theoretical exposure that the CA DTSC/HERD was trying to address by changing its residential clean-up goal derived using default deterministic risk assessment assumptions.) When the 10-fold adjustment to account for decreased theoretical exposure is combined with the fixed TCDD CSF from the Maruyama and Aoki study, the deterministic risk assessment PTELCRs associated with potential theoretical exposure to TCDD-TEQ decrease to below USEPA's allowable risk range and FDEP's risk benchmark.

These comparisons indicate that, at least for TCDD-TEQ, incorporation of recent scientific advances regarding theoretical toxicity assessment and exposure assessment in the main body of this HHRA would have substantially decreased

estimated potential theoretical risks, likely to levels that fall below both USEPA's risk range and FDEP risk benchmark.

6.3.1 Evaluation of Alternative Future Uses

A key uncertainty that affects estimates of potential theoretical risk is the assumed future use of the Site. The Site is currently inactive and the nature of future redevelopment is unknown at this time. The estimates of potential theoretical risk presented in the HHRA assume that the hypothetical future use could be either commercial/industrial or recreational, though the details of the hypothetical future development are unknown at the time this HHRA report is being written. A critical aspect of the MEE model developed for the Site (as well as the deterministic risk assessment presented in this HHRA report) is that it also allows for evaluation of future on-Site conditions that differ from the hypothetical future conditions assumed by the on-Site risk assessment (e.g., that the entire Site can be treated as a single exposure area). As long as those alternative future conditions can be characterized (e.g., the hypothetical receptors expected to be on the Site in the future identified; the distribution of concentrations of COPCs in on-Site soil predicted, etc.), potential theoretical risks associated with those conditions can be estimated using the MEE model (and/or the deterministic risk assessment presented herein). Developing estimates of the potential theoretical risk associated with alternative future conditions does not require changing the equations used in the MEE model or the deterministic risk assessment; rather, the theoretical inputs are changed such that the MEE model and deterministic risk assessment will estimate potential theoretical risk for any potential future use of the Site.

Some examples of changes in assumed future conditions that the MEE model and deterministic risk assessment can account for are presented below.

- Evaluation of multiple future use scenarios. The MEE model can be run several times to estimate the potential theoretical risks associated with as many different potential future uses as necessary. Such scenarios can include potential theoretical future risks associated with entirely different land uses than have historically been present at the Site.

- Addition of new hypothetical receptors. If future use of the Site changes and hypothetical receptors different than those evaluated in the HHRA are assumed to be present, the potential theoretical risks associated with different hypothetical receptors can be modeled by inputting alternative theoretical

distributions appropriate for their exposure assumptions. If more than one type of hypothetical receptor is assumed to be present under future conditions (or several potential future conditions need to be evaluated), the MEE model (and deterministic risk assessment) can accommodate that as well.

- Revised theoretical exposure assumptions. If the MEE model is updated to include new hypothetical receptors, relevant theoretical exposure assumptions can be updated as well (e.g., lower theoretical exposure intensity if the Site were developed for retail purposes where the hypothetical workers are inside and not exposed to soil for the same duration as the hypothetical future on-Site indoor or outdoor worker evaluated in the HHRA).

- Changed COPC concentrations. If portions of the Site were to be covered, thereby changing the COPC concentrations to which hypothetical receptors may potentially theoretically be exposed, alternative distributions of on-Site soil concentrations can be developed and input into the MEE model and a revised distribution of potential theoretical risk can be estimated for all appropriate hypothetical future receptors. Similarly, if new COPC concentration data were to become available, the existing distributions of on-Site soil concentrations could be updated and revised distributions of potential theoretical risk developed.

- Updated toxicity assumptions. As new information about the potential theoretical toxicity and theoretical bioavailability of COPCs becomes available, toxicity assumptions used in the existing MEE model may be revised. The MEE model can be rerun using the revised toxicity assumptions, if needed.

6.4 Risk Characterization

The potential theoretical risk of adverse human health effects depends on estimated levels of exposure and on dose-response relationships. Once potential theoretical exposure to, and potential theoretical risk from, each of the selected constituents is estimated, the total potential theoretical risk posed by potential theoretical exposure to COPCs is determined by combining the potential theoretical health risk contributed by each constituent across the different potential theoretical exposure pathways. Where COPCs do not interact, do not affect the same target organ or do not have the same mechanism of action, summing the potential theoretical risks for multiple COPCs results in an overestimate of potential theoretical risk posed by the Site. However, in

order not to understate potential theoretical risk, it was initially assumed that the effects of different constituents may be combined.

The conservative nature of the risk characterization from the deterministic HHRA is obvious when compared to the MEE potential theoretical risk estimates. For example, Figure 5-1 shows that the potential theoretical deterministic risks across all COPCs and exposure pathways for the hypothetical future on-Site outdoor worker are approximately one order of magnitude greater than the comparable potential theoretical risk (95th%) estimated from the MEE analysis. The potential theoretical deterministic risks were also outside of the upper 95th% risk bounds estimated using the MEE model, further supporting the conservative nature of the deterministic HHRA.

6.5 MEE Model – Number of Uncertainty Iterations

A total of 200 Uncertainty Loops and 1,000 Variability Loops were used for the MEE analyses performed for the hypothetical future on-Site workers. The number of Uncertainty Loops was based upon the observed smoothing of the uncertainty bounds across the range of potential theoretical total cancer risks across all four evaluated COPCs. The impact of using the alternate numbers of uncertainty iterations (100, 300, 400, 500 and 1,000) on the estimated potential theoretical excess lifetime cancer risk (across all four COPCs and all potential theoretical exposure pathways)[4] was evaluated as part of this uncertainty assessment. Three cases were evaluated - median, 95th% and average potential theoretical risks – using the alternate number of uncertainty loop iterations. The stability of the estimated potential theoretical risks was calculated two ways:

- As the Relative Standard Deviation (RSD) across all six (200 plus five alternate) loop counts
- As the percent difference (%D) between the 200 iteration loop potential theoretical risks and the average across all six loop counts

[4] The CSFs for pentachlorophenol and B(a)P were based on the 3/4-scaling factor; the Dioxin-TEQ CSF was based on Maruyama and Aoki (2006).

Both stability metrics are shown on Table 6-2 with the estimated potential theoretical risks. The latter are reported to two significant digits to display the range of results. Review of this table shows that the RSD values ranged from 0.9 to 4.7%, which are within the 5 to 10% error that is anticipated using probabilistic modeling. The %D values ranged from -7.3 to -2.3%, which are also within the 5 to 10% error that is anticipated using probabilistic modeling. Based on these results, the 200 Uncertainty Loops and 1,000 Variability Loops used for the MEE modeling would adequately represent the potential theoretical risks for the hypothetical future on-Site workers.

7. Summary of Potential Theoretical Risks and Conclusions

For potential theoretical non-cancer risk, the deterministic risk assessment found that all hypothetical current and hypothetical future receptors have a total Hazard Index of less than 1. Accordingly, based upon the conservative assumptions used in the deterministic risk assessment, potential theoretical non-cancer health effects are not expected to occur as a result of potential theoretical exposure to COPCs in on-Site soils and on-Site sediments. Given that the conservative deterministic risk assessment predicts an absence of potential theoretical non-cancer risks, a more refined evaluation of potential theoretical non-cancer risks using the MEE model was not necessary and was not conducted.

The conservative deterministic risk assessment found that potential theoretical excess lifetime cancer risks associated with potential theoretical exposure to COPCs in on-Site soils and sediments for hypothetical trespassers and hypothetical future recreational users, as well as hypothetical future construction and utility workers, were within USEPA's allowable risk range of $1x10^{-6}$ to $1x10^{-4}$ (one in one million to one in ten thousand), and, thus, do not have an unacceptable potential theoretical cancer risk according to USEPA's risk management policy. Additionally the deterministic risk assessment found that potential theoretical risks for hypothetical future on-Site indoor and outdoor workers exposed to COPCs in DD sediments were also within USEPA's allowable risk range and, thus, do not have an unacceptable potential theoretical cancer risk. The deterministic risk assessment estimated that hypothetical future on-Site indoor and outdoor workers potentially theoretically exposed to COPCs in surface soils have potential theoretical excess lifetime cancer risks above USEPA's allowable risk range. These results suggest that under baseline conditions, only hypothetical future workers potentially theoretically exposed to surface soils have a potential theoretical excess lifetime cancer risk that exceeds USEPA's risk management benchmark.

Potential theoretical excess lifetime cancer risks associated with a hypothetical trespasser's and hypothetical future on-Site indoor and outdoor worker's potential theoretical exposure to COPCs in DD sediments meet FDEP's risk benchmark. The potential theoretical excess lifetime cancer risks estimated by the conservative deterministic risk assessment for all other current and future hypothetical receptors exposed to on-Site soils exceed FDEP's risk benchmark (in contrast to falling within or below USEPA's allowable risk range with the exception of hypothetical future on-Site indoor and outdoor workers).

Based upon the results of the conservative deterministic risk assessment, the MEE analysis was run for hypothetical future on-Site indoor and outdoor workers potentially theoretically exposed to the four potentially carcinogenic COPCs (i.e., arsenic, BaP-TE, pentachlorophenol, and TCDD-TEQ) in surface soils.

The more realistic and refined potential theoretical cancer risks predicted by the MEE analysis are substantially lower than the conservative theoretical point estimates developed by the deterministic risk assessment (Figures 5-1 and 5-2). This is consistent with the deterministic assessment's use and combination of multiple theoretical conservative assumptions leading to potentially unrealistic estimates of risk.

For the typical (i.e., median) and upper bound (i.e., 95th percentile of variability) hypothetical future on-Site indoor and outdoor worker, PTELCRs developed by the MEE analysis are within USEPA's allowable risk range but exceed FDEP's risk benchmark.

Given that refinement of potential theoretical excess lifetime cancer risk using the MEE analysis reduced potential theoretical risks for the hypothetical future on-Site indoor and outdoor workers to allowable levels assuming USEPA's allowable risk range, a similar reduction in potential theoretical risk would result for the other hypothetical receptors not included in the MEE analysis,. Thus, when potential theoretical excess lifetime cancer risk for hypothetical future on-Site indoor and outdoor workers meets risk limits, other less exposed hypothetical receptors (i.e, hypothetical trespassers, hypothetical future recreational users, hypothetical future construction/utility workers) would also be expected to meet risk benchmarks.

A useful aspect of the risk assessment methodology presented in the HHRA is that it also allows for evaluation of future on-Site conditions that differ from the hypothetical future conditions assumed by the on-Site risk assessment presented herein. The risk assessment methodology is designed to be an adaptive risk assessment tool. If the future use is assumed to be different from the hypothetical conditions and hypothetical receptors evaluated in this HHRA, then assumptions representative of those alternative conditions can be employed in the risk assessment methodology used by the HHRA presented herein (either or both the conservative deterministic risk assessment and the more refined and realistic MEE model) to evaluate potential theoretical risks associated with the alternative conditions.

In summary, when a conservative deterministic risk assessment methodology is exclusively used to estimate potential theoretical risks, potential theoretical excess

lifetime cancer risks for the hypothetical trespasser, hypothetical future recreational users, and for hypothetical future utility and hypothetical future construction workers, are within or below USEPA's allowable risk range. Potential theoretical excess lifetime cancer risks for hypothetical future on-Site indoor and outdoor workers exceed USEPA's allowable risk range. Potential theoretical excess lifetime cancer risks are driven by potential theoretical exposure to TCDD, followed by BaP-TE and arsenic. Potential theoretical exposure to pentachlorophenol makes a small contribution to total potential theoretical excess lifetime cancer risk. Potential theoretical risks estimated using the conservative deterministic risk assessment methodology exceed FDEP's risk benchmark for most hypothetical receptors, though not the hypothetical trespasser in the DD sediments. When estimates of potential theoretical risk are refined using the MEE analysis but using USEPA's existing point estimate cancer slope factors, potential theoretical excess lifetime cancer risks for the typical, or median, hypothetical future on-Site indoor and outdoor worker are within USEPA's allowable risk range but exceed FDEP's risk benchmark. If a distribution of TCDD-TEQ slope factors is employed in the MEE analysis, potential theoretical excess lifetime cancer risks for the typical (i.e., median) hypothetical future on-Site indoor worker fall below USEPA's allowable risk range and FDEP's risk limit and potential theoretical risk for the typical hypothetical future on-Site outdoor worker are about equal to the low end of USEPA's allowable risk range and to FDEP's risk benchmark.

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Tables

TABLE 2-1
SOIL/SEDIMENT SCREENING VALUES
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Constituents Detected in Soil or Sediment	FL SCTLs Direct Exposure Commercial / Industrial (mg/kg)	EPA Regional Screening Levels Industrial Soil (mg/kg)	Lower of FL SCTLs and EPA RSLs		Lowest Screening Value Divided by 10
				Value (mg/kg)	Source	
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	[a]	[a]	NA		NA
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	[a]	[a]	NA		NA
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	[a]	[a]	NA		NA
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	[a]	[a]	NA		NA
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	[a]	[a]	NA		NA
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	[a]	[a]	NA		NA
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	[a]	[a]	NA		NA
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	[a]	[a]	NA		NA
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	[a]	[a]	NA		NA
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	[a]	[a]	NA		NA
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	[a]	[a]	NA		NA
95-50-1	1,2-Dichlorobenzene	5000	10000	5000	FL SCTL	500
106-46-7	1,4-Dichlorobenzene	9.9	13	9.9	FL SCTL	0.99
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	[a]	[a]	NA		NA
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	[a]	[a]	NA		NA
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	[a]	[a]	NA		NA
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.00003	0.000018	0.000018	EPA RSL	0.0000018
95-95-4	2,4,5-Trichlorophenol	130000	62000	62000	EPA RSL	6200
95-95-4	2,4,5-Trichlorophenol	130000	62000	62000	EPA RSL	6200
105-67-9	2,4-Dimethylphenol	18000	12000	12000	EPA RSL	1200
121-14-2	2,4-Dinitrotoluene	4.3	1200	4.3	FL SCTL	0.43
91-57-6	2-Methylnaphthalene	2100	4100	2100	FL SCTL	210
88-74-4	2-Nitroaniline	130	82[b]	130	FL SCTL	13
99-09-2	3-Nitroaniline	130	82	82	EPA RSL	8.2
534-52-1	4,6-Dinitro-2-methylphenol	180	62	62	EPA RSL	6.2
101-55-3	4-Bromophenyl phenyl ether	NA	NA	NA		NA
59-50-7	4-Chloro-3-methylphenol	8000	NA	8000	FL SCTL	800
7005-72-3	4-Chlorophenyl phenyl ether	NA	NA	NA		NA
106-44-5	4-Methylphenol (m/p-cresol)	3400	3100	3100	EPA RSL	310
83-32-9	Acenaphthene	20000	33000	20000	FL SCTL	2000
208-96-8	Acenaphthylene	20000	NA	20000	FL SCTL	2000
67-64-1	Acetone	68000	610000	68000	FL SCTL	6800
120-12-7	Anthracene	300000	170000	170000	EPA RSL	17000
7440-36-0	Antimony	370	410	370	FL SCTL	37
7440-38-2	Arsenic	12	1.6	1.6	EPA RSL	0.16
7440-39-3	Barium	130000	190000	130000	FL SCTL	13000
71-43-2	Benzene	1.7	5.6	1.7	FL SCTL	0.17
56-55-3	Benzo(a)anthracene	[c]	[c]	NA		NA
50-32-8	Benzo(a)pyrene	0.7	0.21	0.21	EPA RSL	0.021
205-99-2	Benzo(b)fluoranthene	[c]	[c]	NA		NA
191-24-2	Benzo(g,h,i)perylene	52000	NA	52000	FL SCTL	5200
207-08-9	Benzo(k)fluoranthene	[c]	[c]	NA		NA
85-68-7	Benzyl butyl phthalate	380000	910	910	EPA RSL	91
92-52-4	Biphenyl	34000	51000	34000	FL SCTL	3400
111-44-4	Bis(2-chloroethyl)ether	0.5	0.9	0.5	FL SCTL	0.05
117-81-7	Bis(2-ethylhexyl)phthalate	390	120	120	EPA RSL	12
7440-43-9	Cadmium	1700	810	810	EPA RSL	81
86-74-8	Carbazole	240	NA	240	FL SCTL	24
67-66-3	Chloroform	0.6	1.5	0.6	FL SCTL	0.06
7440-47-3	Chromium	470	1400	470	FL SCTL	47
218-01-9	Chrysene	[c]	[c]	NA		NA
7440-50-8	Copper	89000	41000	41000	EPA RSL	4100
110-82-7	Cyclohexane	NA	30000	30000	EPA RSL	3000
53-70-3	Dibenzo(a,h)anthracene	[c]	[c]	NA		NA
132-64-9	Dibenzofuran	6300	NA	6300	FL SCTL	630
75-09-2	Dichloromethane	26	54	26	FL SCTL	2.6
84-66-2	Diethyl phthalate	[d]	490000	490000	EPA RSL	49000
131-11-3	Dimethyl phthalate	[d]	NA	NA		NA
84-74-2	Di-n-butyl-phthalate	170000	62000	62000	EPA RSL	6200
117-84-0	Di-n-octyl-phthalate	39000	NA	39000	FL SCTL	3900
100-41-4	Ethylbenzene	9200	29	29	EPA RSL	2.9

TABLE 2-1
SOIL/SEDIMENT SCREENING VALUES
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Constituents Detected in Soil or Sediment	FL SCTLs Direct Exposure Commercial / Industrial (mg/kg)	EPA Regional Screening Levels Industrial Soil (mg/kg)	Lower of FL SCTLs and EPA RSLs		Lowest Screening Value Divided by 10
				Value (mg/kg)	Source	
206-44-0	Fluoranthene	59000	22000	22000	EPA RSL	2200
86-73-7	Fluorene	33000	22000	22000	EPA RSL	2200
118-74-1	Hexachlorobenzene	1.2	1.1	1.1	EPA RSL	0.11
193-39-5	Indeno(1,2,3-cd)pyrene	(c)	(c)	NA		NA
98-82-8	Isopropylbenzene	1200	11000	1200	FL SCTL	120
7439-92-1	Lead	1400	800	800	EPA RSL	80
136777-61-2	m,p-Xylenes	700	19000	700	FL SCTL	70
7439-97-6	Mercury	17	28	17	FL SCTL	1.7
79-20-9	Methyl acetate	38000	1000000	38000	FL SCTL	3800
78-93-3	Methyl ethyl ketone	110000	190000	110000	FL SCTL	11000
108-10-1	Methyl isobutyl ketone	44000	52000	44000	FL SCTL	4400
108-88-3	Methylbenzene	60000	46000	46000	EPA RSL	4600
108-87-2	Methylcylohexane	NA	NA	NA	FL SCTL	NA
91-20-3	Naphthalene	300	20	20	EPA RSL	2
86-30-6	N-Nitrosodiphenylamine	730	350	350	EPA RSL	35
39001-02-0	Octachlorodibenzofuran	(a)	(a)	NA		NA
3268-87-9	Octachlorodibenzo-p-dioxin	(a)	(a)	NA		NA
95-47-6	o-Xylene	700	23000	700	FL SCTL	70
87-86-5	Pentachlorophenol	28	9	9	EPA RSL	0.9
85-01-8	Phenanthrene	36000	NA	36000	FL SCTL	3600
100-01-6	p-Nitroaniline	96	82	82	EPA RSL	8.2
129-00-0	Pyrene	45000	17000	17000	EPA RSL	1700
7782-49-2	Selenium	11000	5100	5100	EPA RSL	510
7440-22-4	Silver	8200	5100	5100	EPA RSL	510
100-42-5	Styrene	23000	38000	23000	FL SCTL	2300
127-18-4	Tetrachloroethylene	18	2.7	2.7	EPA RSL	0.27
7440-62-2	Vanadium	10000	7200	7200	EPA RSL	720

(a) Constituent included in TCDD-TEQ concentration, which is compared to the 2,3,7,8-tetrachlorodibenzo-p-dioxin screening value of 0.0000018 mg/kg.
(b) Used 3-nitroaniline as a surrogate.
(c) Constituent included in BaP-TE concentration, which is compared to the benzo(a)pyrene screening value of 0.021 mg/kg.
(d) FL SCTLs note " contaminant is not a health concern for this exposure scenario".

TABLE 2-2
TCDD TOXIC EQUIVALENT FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Compound	TEF
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01
Octachlorodibenzo-p-dioxin	0.0003
2,3,7,8-Tetrachlorodibenzofuran	0.1
1,2,3,7,8-Pentachlorodibenzofuran	0.03
2,3,4,7,8-Pentachlorodibenzofuran	0.3
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
Octachlorodibenzofuran	0.0003

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TABLE 2-3
BENZO(A)PYRENE TOXIC EQUIVALENT FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Compound	TEF
Benzo(a)pyrene	1
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(ah)anthracene	1
Indeno(123-cd)pyrene	0.1

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TABLE 2-4
CONSTITUENT OF POTENTIAL CONCERN SCREENING FOR 0 TO 6 INCH SOIL
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Constituent Name	CAS No	Units	Sample Type	Number Detected	Number Analyzed	Frequency of Detect	Minimum Detect & Qualifier	Maximum Detect & Qualifier	Minimum Reporting Limit	Maximum Reporting Limit	Sample ID with Maximum Conc.	Sample Date	Start Depth	End Depth	Screening Level (mg/kg)	Is Max > Screening Level? (yes/no)	Is Compound COPC? (yes/no)
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	mg/kg	SO	96	97	98.97%	1.753E-05	0.958 J	0.0000739	522000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	mg/kg	SO	97	97	100.00%	7.952E-05	9.1 J	0.046	3240000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	mg/kg	SO	94	97	96.91%	1.022E-06 J	0.0634	0.000143	45300	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	mg/kg	SO	90	97	92.78%	4.75E-07 J	0.0261	0.000279	15700	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	mg/kg	SO	94	97	96.91%	5.78E-07 J	0.0481	0.000388	24400	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	mg/kg	SO	91	97	93.81%	4.07E-07 J	0.0102 J	0.000219	10200	SS058AA	12/5/2006	0	0.25	NA	NA	Yes(1)
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	mg/kg	SO	96	97	98.97%	2.449E-06 J	0.169	0.000235	105000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	mg/kg	SO	73	97	75.26%	1.78E-07 J	0.00544	0.000282	4250	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	mg/kg	SO	96	97	98.97%	1.666E-06 J	0.0611	0.000224	49500	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	mg/kg	SO	86	97	88.66%	3.7E-08 J	0.00143	0.000092	1430	SS058AA	12/5/2006	0	0.25	NA	NA	Yes(1)
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	mg/kg	SO	91	97	93.81%	2.56E-07 J	0.00692	0.000131	6350	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2-Dichlorobenzene	95-50-1	mg/kg	SO	3	189	1.59%	0.00052 J	0.00066 J	0.000038	0.00019	SS039AA	12/7/2006	0	0.25	500	No	No
1,4-Dichlorobenzene	106-46-7	mg/kg	SO	2	189	1.06%	0.00051 J	0.00057 J	0.000038	0.00021	SS083AA	12/1/2006	0	0.25	0.99	No	No
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	mg/kg	SO	90	91	98.90%	4.79E-07 J	0.0247	0.019	21000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	mg/kg	SO	87	91	95.60%	1.51E-07 J	0.00393	0.028	3300	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	mg/kg	SO	62	97	63.92%	1.9E-07 JN	0.000266	0.000051	266	SS058AA	12/5/2006	0	0.25	NA	NA	Yes(1)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	mg/kg	SO	62	97	63.92%	1.08E-07 J	0.000491	0.0000408	291	SS104AA	6/11/2009	0	0.25	0.0000018	Yes	Yes(1)
2,4,5-Trichlorophenol	95-95-4	mg/kg	SO	2	190	1.05%	0.045 J	0.29 J	0.014	0.18	SS082BA	12/7/2006	0.25	0.5	6200	No	No
2,4-Dimethylphenol	105-67-9	mg/kg	SO	15	190	7.89%	0.022 J	0.087 J	0.02	0.25	SS073AA	11/30/2006	0	0.25	1200	No	No
2,4-Dinitrotoluene	121-14-2	mg/kg	SO	1	190	0.53%	0.082 J	0.082 J	0.01	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	0.43	No	No
2-Methylnaphthalene	91-57-6	mg/kg	SO	158	207	76.33%	0.0014 J	650	0.0016	21	TC	8/24/1995	0	1	210	Yes	Yes
2-Nitroaniline	88-74-4	mg/kg	SO	1	190	0.53%	0.03 J	0.03 J	0.023	0.29	SS067BA & Dup	11/30/2006	0.25	0.5	13	No	No
3-Nitroaniline	99-09-2	mg/kg	SO	1	190	0.53%	0.037 J	0.037 J	0.018	0.23	SS067BA & Dup	11/30/2006	0.25	0.5	8.2	No	No
4,6-Dinitro-2-methylphenol	534-52-1	mg/kg	SO	2	190	1.05%	0.028 J	0.06 J	0.0096	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	6.2	No	No
4-Bromophenyl phenyl ether	101-55-3	mg/kg	SO	1	190	0.53%	0.053 J	0.053 J	0.01	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	NA	NA	No
4-Chloro-3-methylphenol	59-50-7	mg/kg	SO	1	190	0.53%	0.034 J	0.034 J	0.017	0.22	SS067BA & Dup	11/30/2006	0.25	0.5	800	No	No
4-Chlorophenyl phenyl ether	7005-72-3	mg/kg	SO	1	190	0.53%	0.035 J	0.035 J	0.023	0.29	SS067BA & Dup	11/30/2006	0.25	0.5	NA	NA	No
4-Methylphenol (m/p-Cresol)	106-44-5	mg/kg	SO	4	190	2.11%	0.029 J	0.058 J	0.027	0.35	SS073AA	11/30/2006	0	0.25	310	No	No
Acenaphthene	83-32-9	mg/kg	SO	95	207	45.89%	0.00145 J	430	0.0028	16	NL	8/24/1995	0	0.5	2000	No	No
Acenaphthylene	208-96-8	mg/kg	SO	199	207	96.14%	0.0021 J	18	0.0027	78	SS058BA	12/5/2006	0.25	0.5	2000	No	No
Acetone	67-64-1	mg/kg	SO	54	189	28.57%	0.0033 J	0.66	0.00026	0.006	SS024BA	12/11/2006	0.25	0.5	6800	No	No
Anthracene	120-12-7	mg/kg	SO	206	207	99.52%	0.0011 J	4590	0.00064	3.4	TC	8/24/1995	0	1	17000	No	No
Antimony	7440-36-0	mg/kg	SO	113	190	59.47%	0.37 J	200	0.33	0.51	SS032AA	12/6/2006	0	0.25	37	Yes	Yes
Arsenic	7440-38-2	mg/kg	SO	191	195	97.95%	0.45	3600	0.4	20	SS095AA	12/6/2006	0	0.25	0.16	Yes	Yes
BaP-TE	BAPTE	mg/kg	SO	210	210	100.00%	0.0009948	138.1			SS058BA	12/5/2006	0.25	0.5	0.021	Yes	Yes
Barium	7440-39-3	mg/kg	SO	196	196	100.00%	1.6	180	0.35	0.54	SS011BA	12/5/2006	0.25	0.5	13000	No	No
Benzene	71-43-2	mg/kg	SO	1	189	0.53%	0.0029 J	0.0029 J	0.00004	0.00094	SS082BA	12/7/2006	0.25	0.5	0.17	No	No
Benzo(a)anthracene	56-55-3	mg/kg	SO	205	207	99.03%	0.0029 J	210	0.00052	2.8	TC	8/24/1995	0	1	NA	NA	Yes(2)
Benzo(a)pyrene	50-32-8	mg/kg	SO	205	207	99.03%	0.003 J	77	0.0012	6.2	DT	8/24/1995	0	0.5	0.021	Yes	Yes(2)
Benzo(b)fluoranthene	205-99-2	mg/kg	SO	205	207	99.03%	0.0058	260	0.00083	4.5	SS058BA	12/5/2006	0.25	0.5	NA	NA	Yes(2)
Benzo(g,h,i)perylene	191-24-2	mg/kg	SO	204	207	98.55%	0.0035 J	63	0.00068	72	SS058BA	12/5/2006	0.25	0.5	5200	No	No
Benzo(k)fluoranthene	207-08-9	mg/kg	SO	205	207	99.03%	0.0049	190	0.00068	3.7	SS058BA	12/5/2006	0.25	0.5	NA	NA	Yes(2)
Benzyl butyl phthalate	85-68-7	mg/kg	SO	11	190	5.79%	0.022 J	0.1025 J	0.019	0.24	SS067BA & Dup	11/30/2006	0.25	0.5	91	No	No
Biphenyl	92-52-4	mg/kg	SO	1	190	0.53%	3 J	3 J	0.16	2	SS082BA	12/7/2006	0.25	0.5	3400	No	No
Bis(2-chloroethyl)ether	111-44-4	mg/kg	SO	1	190	0.53%	1.3	1.3	0.016	0.2	SS054AA & Dup	12/1/2006	0	0.25	0.05	Yes	No
Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	SO	73	190	38.42%	0.02 J	0.78	0.017	0.22	SS051AA	12/4/2006	0	0.25	12	No	No
Cadmium	7440-43-9	mg/kg	SO	44	196	22.45%	0.167 J	1.9	0.28	0.43	SS040AA	12/1/2006	0	0.25	81	No	No
Carbazole	86-74-8	mg/kg	SO	175	196	89.29%	0.019 J	24	0.017	0.22	SS082BA	12/7/2006	0.25	0.5	24	No	No
Chloroform	67-66-3	mg/kg	SO	2	189	1.06%	0.00057 J	0.002 J	0.000048	0.00082	SS008AA	12/5/2006	0	0.25	0.06	No	No
Chromium	7440-47-3	mg/kg	SO	196	196	100.00%	1.7	3700	0.09	2.1	SS095AA	12/6/2006	0	0.25	47	Yes	Yes
Chrysene	218-01-9	mg/kg	SO	205	207	99.03%	0.0035 J	250	0.0005	2.7	TC	8/24/1995	0	1	NA	NA	Yes(2)
Copper	7440-50-8	mg/kg	SO	196	196	100.00%	0.87 J	2200	0.29	6.7	SS095AA	12/6/2006	0	0.25	4100	No	No
Cyclohexane	110-82-7	mg/kg	SO	2	189	1.06%	0.00063 J	0.00069 J	0.000054	0.00092	SS003BA	12/8/2006	0.25	0.5	3000	No	No
Dibenzo(a,h)anthracene	53-70-3	mg/kg	SO	204	207	98.55%	0.00091 J	26	0.00053	78	SS058BA	12/5/2006	0.25	0.5	NA	NA	Yes(2)
Dibenzofuran	132-64-9	mg/kg	SO	164	201	81.59%	0.0015 J	46	0.014	0.18	SS082BA	12/7/2006	0.25	0.5	630	No	No
Dichloromethane	75-09-2	mg/kg	SO	2	189	1.06%	0.0053 J	0.0085 J	0.00006	0.00094	SS020BA	12/12/2006	0.25	0.5	2.6	No	No
Diethyl phthalate	84-66-2	mg/kg	SO	1	190	0.53%	0.064 J	0.064 J	0.013	0.16	SS067BA & Dup	11/30/2006	0.25	0.5	49000	No	No
Dimethyl phthalate	131-11-3	mg/kg	SO	1	190	0.53%	0.036 J	0.036 J	0.01	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	NA	NA	No
di-n-Butyl-phthalate	84-74-2	mg/kg	SO	1	190	0.53%	0.19 J	0.19 J	0.063	0.81	SS067BA & Dup	11/30/2006	0.25	0.5	6200	No	No
di-n-Octyl-phthalate	117-84-0	mg/kg	SO	4	190	2.11%	0.02 J	0.18 J	0.016	0.2	SS042AA	12/1/2006	0	0.25	3900	No	No
Ethylbenzene	100-41-4	mg/kg	SO	1	189	0.53%	0.02 J	0.02 J	0.00003	0.0011	SS082BA	12/7/2006	0.25	0.5	2.9	No	No
Fluoranthene	206-44-0	mg/kg	SO	206	207	99.52%	0.0047	980	0.00062	3.3	TC	8/24/1995	0	1	2200	No	No
Fluorene	86-73-7	mg/kg	SO	144	207	69.57%	0.00062 J	450	0.0016	8.4	NL	8/24/1995	0	0.5	2200	No	No
Hexachlorobenzene	118-74-1	mg/kg	SO	1	190	0.53%	0.078 J	0.078 J	0.0085	0.11	SS067BA & Dup	11/30/2006	0.25	0.5	0.11	No	No
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	SO	204	207	98.55%	0.0038	110	0.00091	72	SS058BA	12/5/2006	0.25	0.5	NA	NA	Yes(2)
Lead	7439-92-1	mg/kg	SO	196	196	100.00%	1.85	2200	0.13	1.3	SS032AA	12/6/2006	0	0.25	80	Yes	Yes
m,p-Xylenes	136777-61-2	mg/kg	SO	1	189	0.53%	0.026 J	0.026 J	0.000074	0.0021	SS082BA	12/7/2006	0.25	0.5	70	No	No
Mercury	7439-97-6	mg/kg	SO	196	196	100.00%	0.016 J	26.1	0.0041	0.052	SS104AA	6/11/2009	0	0.25	1.7	Yes	Yes

TABLE 2-4
CONSTITUENT OF POTENTIAL CONCERN SCREENING FOR 0 TO 6 INCH SOIL
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Constituent Name	CAS No	Units	Sample Type	Number Detected	Number Analyzed	Frequency of Detect	Minimum Detect & Qualifier		Maximum Detect & Qualifier		Minimum Reporting Limit	Maximum Reporting Limit	Sample ID with Maximum Conc.	Sample Date	Start Depth	End Depth	Screening Level (mg/kg)	Is Max > Screening Level? (yes/no)	Is Compound COPC? (yes/no)
Methyl acetate	79-20-9	mg/kg	SO	1	189	0.53%	0.0021	J	0.0021	J	0.00011	0.00046	SS002AA & Dup	12/5/2006	0	0.25	3800	No	No
Methyl ethyl ketone	78-93-3	mg/kg	SO	6	189	3.17%	0.0019	J	0.022		0.00031	0.0027	SS082BA	12/7/2006	0.25	0.5	11000	No	No
Methylbenzene	108-88-3	mg/kg	SO	13	189	6.88%	0.00051	J	0.013	J	0.000031	0.0011	SS082BA	12/7/2006	0.25	0.5	4600	No	No
Methylcylohexane	108-87-2	mg/kg	SO	6	189	3.17%	0.000085	J	0.003	J	0.000052	0.0011	SS082BA	12/7/2006	0.25	0.5	NA	NA	No
Naphthalene	91-20-3	mg/kg	SO	174	207	84.06%	0.0027	J	250		0.00053	78	NL	8/24/1995	0	0.5	2	Yes	Yes
n-Nitrosodiphenylamine	86-30-6	mg/kg	SO	1	190	0.53%	0.086	J	0.086	J	0.012	0.15	SS067BA & Dup	11/30/2006	0.25	0.5	35	No	No
Octachlorodibenzofuran	39001-02-0	mg/kg	SO	96	97	98.97%	4.848E-05		5.58	J	0.000561	2460000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
Octachlorodibenzo-p-dioxin	3268-87-9	mg/kg	SO	97	97	100.00%	0.0007342		82.3	J	0.057	31000000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
o-Xylene	95-47-6	mg/kg	SO	1	189	0.53%	0.014	J	0.014	J	0.000029	0.00096	SS082BA	12/7/2006	0.25	0.5	70	No	No
Pentachlorophenol	87-86-5	mg/kg	SO	185	205	90.24%	0.003		630	J	0.00073	78	SS058BA	12/5/2006	0.25	0.5	0.9	Yes	Yes
Phenanthrene	85-01-8	mg/kg	SO	197	207	95.17%	0.0043	J	830		0.0035	19	NL	8/24/1995	0	0.5	3600	No	No
p-Nitroaniline	100-01-6	mg/kg	SO	3	190	1.58%	0.034	J	0.07	J	0.013	0.16	SS067BA & Dup	11/30/2006	0.25	0.5	8.2	No	No
Pyrene	129-00-0	mg/kg	SO	207	207	100.00%	0.00057	J	610		0.00054	2.9	TC	8/24/1995	0	1	1700	No	No
Selenium	7782-49-2	mg/kg	SO	13	196	6.63%	0.3		2.1		0.81	1.3	SS064AA	12/8/2006	0	0.25	510	No	No
Silver	7440-22-4	mg/kg	SO	7	196	3.57%	0.009		0.61		0.37	0.57	SS095AA	12/6/2006	0	0.25	510	No	No
Styrene (monomer)	100-42-5	mg/kg	SO	1	189	0.53%	0.0044	J	0.0044	J	0.000027	0.0011	SS082BA	12/7/2006	0.25	0.5	2300	No	No
TCDD-TEQ	TCDD-TEQ	mg/kg	SO	107	107	100.00%	2.4E-06		0.17				SS104AA	6/11/2009	0	0.25	0.0000018	Yes	Yes
Tetrachloroethylene	127-18-4	mg/kg	SO	1	189	0.53%	0.00071	J	0.00071	J	0.00004	0.00096	SS073AA	11/30/2006	0	0.25	0.27	No	No
Vanadium (fume or dust)	7440-62-2	mg/kg	SO	159	190	83.68%	0.97	J	34		0.87	1.3	SS062BA	12/8/2006	0.25	0.5	720	No	No

(1) Compound included as part of TCDD-TEQ.
(2) Compound included as part of BaP-TE.
SO - soil
J - concentration estimated.
NA - not applicable
1-Methylnaphthalene was detected, with the maximum above the screening level, in 3 samples collected in 2009. Since it was not analyzed for in any other samples, an appropriate exposure point concentration could not be calculated, therefore it was excluded from the screening.

TABLE 2-5
CONSTITUENT OF POTENTIAL CONCERN SCREENING FOR 0 TO 6 FOOT SOIL
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Constituent Name	CAS No	Units	Sample Type	Number Detected	Number Analyzed	Frequency of Detect	Minimum Detect & Qualifier	Maximum Detect & Qualifier	Minimum Reporting Limit	Maximum Reporting Limit	Sample ID with Maximum Conc.	Sample Date	Start Depth	End Depth	Screening Level (mg/kg)	Is Max > Screening Level? (yes/no)	Is Compound COPC? (yes/no)
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	mg/kg	SO	152	154	98.70%	0.000000898 J	0.958 J	0.0000739	522000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	mg/kg	SO	151	154	98.05%	0.000012833 J	9.1 J	0.00045	3240000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	mg/kg	SO	142	154	92.21%	0.000000179 J	0.0634	0.000143	45300	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	mg/kg	SO	136	154	88.31%	0.000000171 J	0.0261	0.000272	15700	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	mg/kg	SO	142	154	92.21%	0.000000143 J	0.0481	0.000306	24400	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	mg/kg	SO	130	154	84.42%	0.000000117 J	0.0102 J	0.00017	10200	SS058AA	12/5/2006	0	0.25	NA	NA	Yes(1)
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	mg/kg	SO	149	154	96.75%	0.000000385 J	0.169	0.000204	105000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	mg/kg	SO	87	154	56.49%	0.000000096 J	0.00544	0.000282	4250	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	mg/kg	SO	147	154	95.45%	0.000000242 J	0.0611	0.000224	49500	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	mg/kg	SO	120	154	77.92%	0.000000037 J	0.00143	0.000092	1430	SS058AA	12/5/2006	0	0.25	NA	NA	Yes(1)
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	mg/kg	SO	134	154	87.01%	0.000000134 J	0.00692	0.000131	6350	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
1,2-Dichlorobenzene	95-50-1	mg/kg	SO	3	276	1.09%	0.00052 J	0.00066 J	0.000038	0.00019	SS039AA	12/7/2006	0	0.25	500	No	No
1,4-Dichlorobenzene	106-46-7	mg/kg	SO	3	276	1.09%	0.00051 J	0.00072 J	0.000038	0.00021	SS094DA	12/11/2006	2	6	0.99	No	No
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	mg/kg	SO	129	143	90.21%	0.000000129 J	0.0247	0.017	21000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	mg/kg	SO	121	143	84.62%	0.000000135 J	0.00393	0.011	3300	SS104AA	6/11/2009	0	0.25	NA	NA	Yes(1)
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	mg/kg	SO	70	153	45.75%	0.000000019 JN	0.000266	0.000051	266	SS058AA	12/5/2006	0	0.25	NA	NA	Yes(1)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	mg/kg	SO	73	153	47.71%	0.000000108 J	0.000491	0.0000408	291	SS104AA	6/11/2009	0	0.25	0.0000018	Yes	Yes(1)
2,4,5-Trichlorophenol	95-95-4	mg/kg	SO	2	280	0.71%	0.045 J	0.29 J	0.014	0.18	SS082BA	12/7/2006	0.25	0.5	6200	No	No
2,4-Dimethylphenol	105-67-9	mg/kg	SO	18	279	6.45%	0.022 J	3.05 J	0.02	0.25	SS100DA & Dup	12/8/2006	2	6	1200	No	No
2,4-Dinitrotoluene	121-14-2	mg/kg	SO	1	279	0.36%	0.082 J	0.082 J	0.01	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	0.43	No	No
2-Methylnaphthalene	91-57-6	mg/kg	SO	212	305	69.51%	0.0014 J	10000	0.0016	81	TP10	8/22/1995	3.5	3.5	210	Yes	Yes
2-Nitroaniline	88-74-4	mg/kg	SO	1	279	0.36%	0.03 J	0.03 J	0.023	0.29	SS067BA & Dup	11/30/2006	0.25	0.5	13	No	No
3-Nitroaniline	99-09-2	mg/kg	SO	1	279	0.36%	0.037 J	0.037 J	0.018	0.23	SS067BA & Dup	11/30/2006	0.25	0.5	8.2	No	No
4,6-Dinitro-2-methylphenol	534-52-1	mg/kg	SO	2	279	0.72%	0.028 J	0.06 J	0.0096	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	6.2	No	No
4-Bromophenyl phenyl ether	101-55-3	mg/kg	SO	1	279	0.36%	0.053 J	0.053 J	0.01	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	NA	NA	No
4-Chloro-3-methylphenol	59-50-7	mg/kg	SO	1	279	0.36%	0.034 J	0.034 J	0.017	0.22	SS067BA & Dup	11/30/2006	0.25	0.5	800	No	No
4-Chlorophenyl phenyl ether	7005-72-3	mg/kg	SO	1	279	0.36%	0.035 J	0.035 J	0.023	0.29	SS067BA & Dup	11/30/2006	0.25	0.5	NA	NA	No
4-Methylphenol (m/p-Cresol)	106-44-5	mg/kg	SO	6	279	2.15%	0.029 J	3.8	0.027	0.35	SS101DA	12/11/2006	2	6	310	No	No
Acenaphthene	83-32-9	mg/kg	SO	148	307	48.21%	0.00057 J	9600	0.0028	150	TP10	8/22/1995	3.5	3.5	2000	Yes	Yes
Acenaphthylene	208-96-8	mg/kg	SO	278	311	89.39%	0.0021 J	150 J	0.0027	78	TP10	8/22/1995	3.5	3.5	2000	No	No
Acetone	67-64-1	mg/kg	SO	107	279	38.35%	0.003 J	0.66	0.00026	0.006	SS024BA	12/11/2006	0.25	0.5	6800	No	No
Anthracene	120-12-7	mg/kg	SO	299	311	96.14%	0.00074 J	23000	0.00063	3.4	TP4	8/21/1995	2	2	17000	Yes	Yes
Antimony	7440-36-0	mg/kg	SO	120	280	42.86%	0.37 J	200	0.32	3.5	SS032AA	12/6/2006	0	0.25	37	Yes	Yes
Arsenic	7440-38-2	mg/kg	SO	283	301	94.02%	0.44 J	8100	0.39	20	TP4_5	8/21/1995	5	5	0.16	Yes	Yes
BaP-TE	BAPTE	mg/kg	SO	313	313	100.00%	0.00098165	617.7			TP10	8/22/1995	3.5	3.5	0.021	Yes	Yes
Barium	7440-39-3	mg/kg	SO	287	287	100.00%	1.6	180	0.34	3.7	SS011BA	12/5/2006	0.25	0.5	13000	No	No
Benzene	71-43-2	mg/kg	SO	7	279	2.51%	0.00053 J	0.13	0.00004	0.00094	SS101DA	12/11/2006	2	6	0.17	No	No
Benzo(a)anthracene	56-55-3	mg/kg	SO	300	311	96.46%	0.00073 J	1200	0.00052	2.8	TP10	8/22/1995	3.5	3.5	NA	NA	Yes(2)
Benzo(a)pyrene	50-32-8	mg/kg	SO	298	312	95.51%	0.0028 J	400	0.0012	6.2	SS101DA	12/11/2006	2	6	0.021	Yes	Yes(2)
Benzo(b)fluoranthene	205-99-2	mg/kg	SO	304	312	97.44%	0.001 J	730	0.00083	4.5	TP10	8/22/1995	3.5	3.5	NA	NA	Yes(2)
Benzo(g,h,i)perylene	191-24-2	mg/kg	SO	299	312	95.83%	0.00099 J	130 J	0.00067	72	TP4	8/21/1995	2	2	5200	No	No
Benzo(k)fluoranthene	207-08-9	mg/kg	SO	303	312	97.12%	0.00078 J	250	0.00067	3.7	TP10	8/22/1995	3.5	3.5	NA	NA	Yes(2)
Benzyl butyl phthalate	85-68-7	mg/kg	SO	10	280	3.57%	0.022 J	0.1025 J	0.019	0.24	SS067BA & Dup	11/30/2006	0.25	0.5	91	No	No
Biphenyl	92-52-4	mg/kg	SO	10	279	3.58%	2.4	110	0.16	17	SS101CA	12/11/2006	0.5	2	3400	No	No
Biphenyl	92-52-4	mg/kg	SO	10	279	3.58%	2.4	110	0.16	17	SS101DA	12/11/2006	2	6	3400	No	No
Bis(2-chloroethyl)ether	111-44-4	mg/kg	SO	1	279	0.36%	1.3	1.3	0.016	0.2	SS054AA & Dup	12/1/2006	0	0.25	0.05	Yes	No
Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	SO	75	279	26.88%	0.02 J	0.78	0.017	0.22	SS051AA	12/4/2006	0	0.25	12	No	No
Cadmium	7440-43-9	mg/kg	SO	44	287	15.33%	0.167 J	1.9	0.28	3	SS040AA	12/1/2006	0	0.25	81	No	No
Carbazole	86-74-8	mg/kg	SO	195	279	69.89%	0.019 J	150	0.017	2	SS100DA & Dup	12/8/2006	2	6	24	Yes	Yes
Chloroform	67-66-3	mg/kg	SO	2	279	0.72%	0.00057 J	0.002 J	0.000048	0.00082	SS008AA	12/5/2006	0	0.25	0.06	No	No
Chromium	7440-47-3	mg/kg	SO	303	303	100.00%	0.95 J	14000	0.09	2.1	TP4	8/21/1995	5	5	47	Yes	Yes
Chrysene	218-01-9	mg/kg	SO	305	312	97.76%	0.00074 J	1200	0.0005	2.7	TP10	8/22/1995	3.5	3.5	NA	NA	Yes(2)
Copper	7440-50-8	mg/kg	SO	285	298	95.64%	0.33 J	5800	0.29	6.7	TP4	8/21/1995	5	5	4100	Yes	Yes
Cyclohexane	110-82-7	mg/kg	SO	4	280	1.43%	0.00063 J	0.0012 J	0.000054	0.00092	SS101DA	12/11/2006	2	6	3000	No	No
Dibenzo(a,h)anthracene	53-70-3	mg/kg	SO	291	312	93.27%	0.00057 J	29 J	0.00053	78	TP4	8/21/1995	2	2	NA	NA	Yes(2)
Dibenzofuran	132-64-9	mg/kg	SO	200	290	68.97%	0.0015 J	350	0.014	1.6	SS101CA	12/11/2006	0.5	2	630	No	No
Dichloromethane	75-09-2	mg/kg	SO	5	279	1.79%	0.0053 J	0.0085 J	0.00006	0.00094	SS020BA	12/12/2006	0.25	0.5	2.6	No	No
Diethyl phthalate	84-66-2	mg/kg	SO	1	279	0.36%	0.064 J	0.064 J	0.013	0.16	SS067BA & Dup	11/30/2006	0.25	0.5	49000	No	No
Dimethyl phthalate	131-11-3	mg/kg	SO	1	279	0.36%	0.036 J	0.036 J	0.01	0.13	SS067BA & Dup	11/30/2006	0.25	0.5	NA	NA	No
di-n-Butyl-phthalate	84-74-2	mg/kg	SO	1	279	0.36%	0.19 J	0.19 J	0.063	0.81	SS067BA & Dup	11/30/2006	0.25	0.5	6200	No	No
di-n-Octyl-phthalate	117-84-0	mg/kg	SO	4	279	1.43%	0.02 J	0.18 J	0.016	0.2	SS042AA	12/1/2006	0	0.25	3900	No	No
Ethylbenzene	100-41-4	mg/kg	SO	10	279	3.58%	0.000445	0.083 J	0.000023	0.0011	SS100CA	12/8/2006	0.5	2	2.9	No	No
Fluoranthene	206-44-0	mg/kg	SO	303	312	97.12%	0.0015 J	9800	0.00061	32	TP10	8/22/1995	3.5	3.5	2200	Yes	Yes
Fluorene	86-73-7	mg/kg	SO	198	308	64.29%	0.00062 J	13000	0.0016	81	TP10	8/22/1995	3.5	3.5	2200	Yes	Yes
Hexachlorobenzene	118-74-1	mg/kg	SO	1	279	0.36%	0.078 J	0.078 J	0.0085	0.11	SS067BA & Dup	11/30/2006	0.25	0.5	0.11	No	No
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	SO	299	312	95.83%	0.001 J	220	0.0009	72	SS101DA	12/11/2006	2	6	NA	NA	Yes(2)
Isopropylbenzene	98-82-8	mg/kg	SO	1	276	0.36%	0.00074 J	0.00074 J	0.00003	0.0012	SS095DA	12/6/2006	2	6	120	No	No
Lead	7439-92-1	mg/kg	SO	287	287	100.00%	0.88	2200	0.12	1.3	SS032AA	12/6/2006	0	0.25	80	Yes	Yes

TABLE 2-5
CONSTITUENT OF POTENTIAL CONCERN SCREENING FOR 0 TO 6 FOOT SOIL
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Constituent Name	CAS No	Units	Sample Type	Number Detected	Number Analyzed	Frequency of Detect	Minimum Detect & Qualifier	Maximum Detect & Qualifier	Minimum Reporting Limit	Maximum Reporting Limit	Sample ID with Maximum Conc.	Sample Date	Start Depth	End Depth	Screening Level (mg/kg)	Is Max > Screening Level? (yes/no)	Is Compound COPC? (yes/no)
m,p-Xylenes	136777-61-2	mg/kg	SO	9	279	3.23%	0.00105	0.21 J	0.000058	0.0021	SS100CA	12/8/2006	0.5	2	70	No	No
Mercury	7439-97-6	mg/kg	SO	287	287	100.00%	0.0046 J	26.1	0.0041	0.052	SS095AA	12/6/2006	0	0.25	1.7	Yes	Yes
Methyl acetate	79-20-9	mg/kg	SO	1	279	0.36%	0.0021 J	0.0021 J	0.00011	0.00046	SS002AA & Dup	12/5/2006	0	0.25	3800	No	No
Methyl ethyl ketone	78-93-3	mg/kg	SO	13	279	4.66%	0.0019 J	0.022	0.00031	0.0027	SS082BA	12/7/2006	0.25	0.5	11000	No	No
Methyl isobutyl ketone	108-10-1	mg/kg	SO	2	279	0.72%	0.02 J	0.022 J	0.0004	0.0018	SS101CA	12/11/2006	0.5	2	4400	No	No
Methylbenzene	108-88-3	mg/kg	SO	36	279	12.90%	0.00049 J	0.13 J	0.000024	0.0011	SS100DA & Dup	12/8/2006	2	6	4600	No	No
Methylcylohexane	108-87-2	mg/kg	SO	10	279	3.58%	0.000085 J	0.0088 J	0.000052	0.0011	SS101DA	12/11/2006	2	6	NA	NA	No
Naphthalene	91-20-3	mg/kg	SO	224	312	71.79%	0.0011 J	13000	0.00053	78	TP4, 'TP10	8/22/1995	2, 3.5	2, 3.5	2	Yes	Yes
n-Nitrosodiphenylamine	86-30-6	mg/kg	SO	1	279	0.36%	0.086 J	0.086 J	0.012	0.15	SS067BA & Dup	11/30/2006	0.25	0.5	35	No	No
Octachlorodibenzofuran	39001-02-0	mg/kg	SO	152	154	98.70%	0.000002716 J	5.58 J	0.000561	2460000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes[1]
Octachlorodibenzo-p-dioxin	3268-87-9	mg/kg	SO	153	154	99.35%	0.000043117 J	82.3 J	0.000939	31000000	SS104AA	6/11/2009	0	0.25	NA	NA	Yes[1]
o-Xylene	95-47-6	mg/kg	SO	10	279	3.58%	0.000695	0.13 J	0.000023	0.00096	SS100CA	12/8/2006	0.5	2	70	No	No
Pentachlorophenol	87-86-5	mg/kg	SO	258	308	83.77%	0.0011 J	630 J	0.00072	550	SS058BA	12/5/2006	0.25	0.5	0.9	Yes	Yes
Phenanthrene	85-01-8	mg/kg	SO	277	310	89.35%	0.0036 J	26000	0.0034	180	TP10	8/22/1995	3.5	3.5	3600	Yes	Yes
p-Nitroaniline	100-01-6	mg/kg	SO	3	279	1.08%	0.034 J	0.07 J	0.013	0.16	SS067BA & Dup	11/30/2006	0.25	0.5	8.2	No	No
Pyrene	129-00-0	mg/kg	SO	297	303	98.02%	0.00057 J	6300	0.00054	28	TP10	8/22/1995	3.5	3.5	1700	Yes	Yes
Selenium	7782-49-2	mg/kg	SO	14	287	4.88%	0.3	2.1	0.8	8.7	SS064AA	12/8/2006	0	0.25	510	No	No
Silver	7440-22-4	mg/kg	SO	7	286	2.45%	0.009	0.61	0.36	3.9	SS095AA	12/6/2006	0	0.25	510	No	No
Styrene (monomer)	100-42-5	mg/kg	SO	10	279	3.58%	0.00073 J	0.215 J	0.000027	0.0011	SS100DA & Dup	12/8/2006	2	6	2300	No	No
TCDD-TEQ	TCDD-TEQ	mg/kg	SO	165	165	100.00%	2.8E-07	0.17			SS104AA	6/11/2009	0	0.25	0.0000018	Yes	Yes
Tetrachloroethylene	127-18-4	mg/kg	SO	1	279	0.36%	0.00071 J	0.00071 J	0.00004	0.00096	SS073AA	11/30/2006	0	0.25	0.27	No	No
Vanadium (fume or dust)	7440-62-2	mg/kg	SO	229	280	81.79%	0.97 J	34	0.86	9.3	SS062BA	12/8/2006	0.25	0.5	720	No	No

(1) Compound included as part of TCDD-TEQ.
(2) Compound included as part of BaP-TE.
SO - soil
J - concentration estimated.
NA - not applicable
1-Methylnaphthalene was detected, with the maximum above the screening level, in 3 samples collected in 2009. Since it was not analyzed for in any other samples, an appropriate exposure point concentration could not be calculated, therefore it was excluded from the screening.

TABLE 2-6
CONSTITUENT OF POTENTIAL CONCERN SCREENING FOR SEDIMENT
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Constituent Name	CAS No	Units	Sample Type	Number Detected	Number Analyzed	Frequency of Detect	Minimum Detect & Qualifier	Maximum Detect & Qualifier	Minimum Reporting Limit	Maximum Reporting Limit	Sample ID with Maximum Conc.	Sample Date	Start Depth	End Depth	Screening Level (mg/kg)	Is Max > Screening Level? (yes/no)	Is Compound COPC? (yes/no)
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	mg/kg	SE	11	11	100.00%	0.000385429	0.029	0.000000104	0.029	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	mg/kg	SE	11	11	100.00%	0.002250305 J	0.191	0.00000181	0.191	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	mg/kg	SE	11	11	100.00%	2.32305E-05	0.00179	0.000000593	0.00179	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	mg/kg	SE	11	11	100.00%	1.16355E-05	0.000732	0.000000095	0.000732	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	mg/kg	SE	11	11	100.00%	0.000016458	0.00179	0.000000044	0.00179	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	mg/kg	SE	11	11	100.00%	8.4585E-06	0.00058	0.000000117	0.00058	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	mg/kg	SE	11	11	100.00%	6.35395E-05	0.00536	0.000000051	0.00536	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	mg/kg	SE	8	11	72.73%	7.535E-07 J	0.000174	0.000000063	0.000174	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	mg/kg	SE	11	11	100.00%	0.000039266	0.00306	0.000000048	0.00306	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	mg/kg	SE	11	11	100.00%	1.9685E-06 J	0.0000681	0.000000037	0.0000681	SD004BA	12/12/2006	0.5	2	0.000044	Yes	Yes(1)
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	mg/kg	SE	11	11	100.00%	5.8215E-06	0.000491	0.000000035	0.000491	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	mg/kg	SE	11	11	100.00%	0.000006875	0.00115	0.000000074	0.00115	SD004BA	12/12/2006	0.5	2	NA	NA	Yes(1)
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	mg/kg	SE	11	11	100.00%	1.9065E-06 J	0.000208	0.000000047	0.000208	SD004BA	12/12/2006	0.5	2	0.0000044	Yes	Yes(1)
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	mg/kg	SE	9	11	81.82%	9.225E-07 J	0.0000443	0.000000433	0.0000443	SD004BA	12/12/2006	0.5	2	0.000013	Yes	Yes(1)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	mg/kg	SE	11	11	100.00%	0.000000971 J	0.0000328	0.000000021	0.0000328	SD004BA	12/12/2006	0.5	2	0.0000018	Yes	Yes(1)
Acenaphthylene	208-96-8	mg/kg	SE	9	11	81.82%	0.11	1.6	0.029	0.63	SD004BA	12/12/2006	0.5	2	2000	No	No
Acetone	67-64-1	mg/kg	SE	11	11	100.00%	0.0034 J	0.14 J	0.0027	0.0073	SD003AA	12/12/2006	0	0.5	6800	No	No
Anthracene	120-12-7	mg/kg	SE	11	11	100.00%	0.17	2.4	0.0067	0.15	SD005AA	12/12/2006	0	0.5	17000	No	No
Antimony	7440-36-0	mg/kg	SE	10	11	90.91%	0.43 J	8.6 J	0.34	0.8	SD003AA	12/12/2006	0	0.5	37	No	No
Arsenic	7440-38-2	mg/kg	SE	11	11	100.00%	1.9	390	0.41	0.96	SD005AA	12/12/2006	0	0.5	0.16	Yes	Yes
BaP-TE	50-32-8	mg/kg	SE	11	11	100.00%	0.54833	18.682			SD002AA	12/12/2006	0	0.5	0.021	Yes	Yes
Barium	7440-39-3	mg/kg	SE	11	11	100.00%	6.5	86	0.36	0.84	SD004BA	12/12/2006	0.5	2	13000	No	No
Benzo(a)anthracene	56-55-3	mg/kg	SE	11	11	100.00%	0.18	7.7	0.0055	0.12	SD002AA	12/12/2006	0	0.5	0.21	Yes	Yes(2)
Benzo(a)pyrene	50-32-8	mg/kg	SE	11	11	100.00%	0.32	12	0.012	0.27	SD002AA	12/12/2006	0	0.5	0.021	Yes	Yes(2)
Benzo(b)fluoranthene	205-99-2	mg/kg	SE	11	11	100.00%	0.62	17	0.0088	0.2	SD002AA	12/12/2006	0	0.5	0.21	Yes	Yes(2)
Benzo(g,h,i)perylene	191-24-2	mg/kg	SE	11	11	100.00%	0.36	11	0.0071	0.16	SD002AA	12/12/2006	0	0.5	5200	No	No
Benzo(k)fluoranthene	207-08-9	mg/kg	SE	11	11	100.00%	0.3	10	0.0071	0.16	SD002AA	12/12/2006	0	0.5	2.1	Yes	Yes(2)
Benzyl butyl phthalate	85-68-7	mg/kg	SE	4	11	36.36%	0.057 J	0.57 J	0.019	0.43	SD002AA	12/12/2006	0	0.5	91	No	No
Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	SE	8	11	72.73%	0.05 J	2.8 J	0.017	0.39	SD003AA	12/12/2006	0	0.5	12	No	No
Cadmium	7440-43-9	mg/kg	SE	7	11	63.64%	0.35 J	3.1	0.29	0.68	SD003AA	12/12/2006	0	0.5	81	No	No
Carbazole	86-74-8	mg/kg	SE	11	11	100.00%	0.048 J	1.1	0.017	0.39	SD002AA	12/12/2006	0	0.5	24	No	No
Chromium	7440-47-3	mg/kg	SE	11	11	100.00%	9.15	710	0.09	0.22	SD004BA	12/12/2006	0.5	2	47	Yes	Yes
Chrysene	218-01-9	mg/kg	SE	11	11	100.00%	0.33	12	0.0053	0.12	SD002AA	12/12/2006	0	0.5	21	No	Yes(2)
Copper	7440-50-8	mg/kg	SE	11	11	100.00%	14	320	0.3	0.7	SD004BA	12/12/2006	0.5	2	4100	No	No
Dibenzo(a,h)anthracene	53-70-3	mg/kg	SE	11	11	100.00%	0.11	3.1	0.0056	0.13	SD002AA	12/12/2006	0	0.5	0.021	Yes	Yes(2)
Dibenzofuran	132-64-9	mg/kg	SE	9	11	81.82%	0.016 J	0.28 , J	0.014	0.31	SD005AA, SD004BA	12/12/2006	0, 0.5	0.5, 2	630	No	No
di-n-Butyl-phthalate	84-74-2	mg/kg	SE	1	11	9.09%	0.57	0.57	0.064	1.5	SD002AA	12/12/2006	0	0.5	6200	No	No
Fluoranthene	206-44-0	mg/kg	SE	11	11	100.00%	0.35	17	0.0065	0.15	SD002AA	12/12/2006	0	0.5	2200	No	No
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	SE	11	11	100.00%	0.35	10	0.0095	0.21	SD002AA	12/12/2006	0	0.5	0.21	Yes	Yes(2)
Lead	7439-92-1	mg/kg	SE	11	11	100.00%	6.5	450	0.13	0.3	SD004BA	12/12/2006	0.5	2	80	Yes	Yes
Mercury	7439-97-6	mg/kg	SE	11	11	100.00%	0.029	2 J	0.0044	0.033	SD004BA	12/12/2006	0.5	2	1.7	Yes	Yes
Methyl ethyl ketone	78-93-3	mg/kg	SE	1	11	9.09%	0.011 J	0.011 J	0.0012	0.0033	SD003AA	12/12/2006	0	0.5	11000	No	No
Methylbenzene	108-88-3	mg/kg	SE	5	11	45.45%	0.000875 J	0.0035 J	0.00044	0.0013	SD002AA, SD003AA	12/12/2006	0, 0	0.5, 0.5	4600	No	No
Octachlorodibenzofuran	39001-02-0	mg/kg	SE	11	11	100.00%	0.001903545	0.108	0.000000207	0.108	SD004BA	12/12/2006	0.5	2	0.0044	Yes	Yes(1)
Octachlorodibenzo-p-dioxin	3268-87-9	mg/kg	SE	11	11	100.00%	0.024539524 J	1.58	0.000000389	1.58	SD004BA	12/12/2006	0.5	2	0.0061	Yes	Yes(1)
Pentachlorophenol	87-86-5	mg/kg	SE	11	11	100.00%	0.11 J	1.8 J	0.0077	0.17	SD004BA	12/12/2006	0.5	2	0.9	Yes	Yes
Phenanthrene	85-01-8	mg/kg	SE	11	11	100.00%	0.11	6.3	0.036	0.79	SD002AA	12/12/2006	0	0.5	3600	No	No
Pyrene	129-00-0	mg/kg	SE	11	11	100.00%	0.41	16	0.0057	0.13	SD002AA	12/12/2006	0	0.5	1700	No	No
Selenium	7782-49-2	mg/kg	SE	3	11	27.27%	1.5	3.1	0.85	2	SD003AA	12/12/2006	0	0.5	510	No	No
TCDD-TEQ	TCDD-TEQ	mg/kg	SE	11	11	100.00%	5.67369E-05	0.004601573			SD004BA	12/12/2006	0.5	2	0.0000018	Yes	Yes
Vanadium (fume or dust)	7440-62-2	mg/kg	SE	11	11	100.00%	1.3 J	28	0.91	2.1	SD003AA	12/12/2006	0	0.5	720	No	No

(1) Compound included as part of TCDD-TEQ.
(2) Compound included as part of BaP-TE.
SE - sediment
J - concentration estimated.
NA - not applicable

TABLE 2-7
CONSTITUENTS OF POTENTIAL CONCERN BY MEDIA
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Compound	COPC for 0 to 6 Inch Soil	COPC for 0 to 6 Foot Soil	COPC for Sediment
91-57-6	2-Methylnaphthalene	X	X	
83-32-9	Acenaphthene		X	
120-12-7	Anthracene		X	
7440-36-0	Antimony	X	X	
7440-38-2	Arsenic	X	X	X
50-32-8	BAP-TE	X	X	X
86-74-8	Carbazole		X	
7440-47-3	Chromium	X	X	X
7440-50-8	Copper		X	
206-44-0	Fluoranthene		X	
86-73-7	Fluorene		X	
7439-92-1	Lead	X	X	X
7439-97-6	Mercury	X	X	X
91-20-3	Naphthalene	X	X	
87-86-5	Pentachlorophenol	X	X	X
85-01-8	Phenanthrene		X	
129-00-0	Pyrene		X	
1746-01-6	TCDD-TEQ	X	X	X

TABLE 3-1
EXPOSURE POINT CONCENTRATIONS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Constituent	Entire Site 0 to 6 Inch Soil (mg/kg)	Entire Site 0 to 6 Foot Soil (mg/kg)	Drainage Ditch 0 to 6 Inch Sediment (mg/kg)
91-57-6	2-Methylnaphthalene	1.87E+01	1.77E+02	NA
83-32-9	Acenaphthene	NA	1.71E+02	NA
120-12-7	Anthracene	NA	3.85E+02	NA
7440-36-0	Antimony	7.36E+00	5.52E+00	NA
7440-38-2	Arsenic	1.38E+02	1.51E+02	2.09E+02
50-32-8	BAP-TE	1.08E+01	2.04E+01	1.10E+01
86-74-8	Carbazole	NA	3.13E+00	NA
7440-47-3	Chromium	1.91E+02	2.38E+02	3.79E+02
7440-50-8	Copper	NA	1.20E+02	NA
206-44-0	Fluoranthene	NA	1.90E+02	NA
86-73-7	Fluorene	NA	2.23E+02	NA
7439-92-1	Lead	6.87E+01	6.43E+01	2.26E+02
7439-97-6	Mercury	1.39E+00	1.33E+00	8.55E-01
91-20-3	Naphthalene	5.55E+00	2.46E+02	NA
87-86-5	Pentachlorophenol	1.24E+01	1.30E+01	1.09E+00
85-01-8	Phenanthrene	NA	4.57E+02	NA
129-00-0	Pyrene	NA	1.27E+02	NA
1746-01-6	TCDD-TEQ	9.20E-03	9.07E-03	1.40E-03

NA - Not a COPC in that media.

TABLE 3-2
THEORETICAL EXPOSURE PARAMETERS FOR THE HYPOTHETICAL CURRENT AND FUTURE TEENAGE TRESPASSER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

PARAMETER DEFINITION	UNITS	HYPOTHETICAL TRESPASSER	RATIONALE/ REFERENCE	HYPOTHETICAL TRESPASSER IN THE DRAINAGE DITCH	RATIONALE/ REFERENCE
GENERAL INFO:					
Age	years	7-17		7-17	
Body Weight	kg	45	EPA (1997)	45	EPA (1997)
Averaging Time - Noncarcinogenic	days	3,650	10 years exposure	3,650	10 years exposure
Averaging Time - Carcinogenic	days	25,550	70 years lifetime	25,550	70 years lifetime
Fraction of Exposure from Site	unitless	1	All soil exposure assumed to come from site.	1	All soil exposure assumed to come from site.
INGESTION OF SOIL/SEDIMENT:					
Conversion Factor	kg/mg	1E-06		1E-06	
Ingestion Rate	mg/day	100	EPA (1997)	100	EPA (1997)
Exposure Frequency	days/year	12	One time per month	12	One time per month
Exposure Duration	years	10		10	
DERMAL ABSORPTION OF SOIL/SEDIMENT:					
Conversion Factor	kg/mg	1E-06		1E-06	
Soil to Skin Adherence Factor	mg/cm^2	0.145	EPA (1997). Body-part specific age-adjusted values for children playing in wet soil and children playing in dry soil.	0.145	EPA (1997). Body-part specific age-adjusted values for children playing in wet soil and children playing in dry soil.
Skin Surface Area Available for Contact	cm^2/day	5,048	EPA (1997). Mean of 50th percentile values for hands, forearms, lower legs, feet, and face for males and females representing age range	5,048	EPA (1997). Mean of 50th percentile values for hands, forearms, lower legs, feet, and face for males and females representing age range
Exposure Frequency	days/year	12	One time per month	12	One time per month
Exposure Duration	years	10		10	
INHALATION OF FUGITIVE DUST AND VAPORS:					
Respirable Particulate Concentration	mg/m^3	0.0394	95th percentile of urban RPM from nearby station (city identified sources)	NA	
Inhalation Rate	$m^3/hour$	1.6	EPA (1997)	NA	
Exposure Frequency	days/year	12	One time per month	NA	
Exposure Duration	years	10		NA	
Exposure Time	hours/day	8		NA	

References:

EPA (1997). Exposure Factors Handbook. Volumes I - III. EPA/600/P-95/002. August.
FL Division of Air Resources Management (2005). Florida Air Monitoring Report. Division of Air Resource Mangement of the Department Environmental Protection. 2005.

TABLE 3-3
THEORETICAL EXPOSURE PARAMETERS FOR THE HYPOTHETICAL FUTURE ON-SITE WORKER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

PARAMETER DEFINITION	UNITS	HYPOTHETICAL ON-SITE INDOOR WORKER	RATIONALE/ REFERENCE	HYPOTHETICAL ON-SITE OUTDOOR WORKER	RATIONALE/ REFERENCE	HYPOTHETICAL ON-SITE WORKER IN THE DRAINAGE DITCH	RATIONALE/ REFERENCE
GENERAL INFO:							
Age	years	18-65		18-65		18-65	
Body Weight	kg	71.5	EPA (1997). Mean of men and woman age 18<75.	71.5	EPA (1997). Mean of men and woman age 18<75.	71.5	EPA (1997). Mean of men and woman age 18<75.
Averaging Time - Noncarcinogenic	days	9,125	25 years of work.	9,125	25 years of work.	9,125	25 years of work.
Averaging Time - Carcinogenic	days	25,550	70 years lifetime.	25,550	70 years lifetime.	25,550	70 years lifetime.
Fraction of Exposure from Site	unitless	1	All soil exposure assumed to come from site.	1	All soil exposure assumed to come from site.	1	All soil exposure assumed to come from site.
INGESTION OF SOIL/SEDIMENT:							
Conversion Factor	kg/mg	1E-06		1E-06		1E-06	
Ingestion Rate	mg/day	50	EPA (1997).	100	EPA (1997).	100	EPA (1997).
Exposure Frequency	days/year	250	5 days/week, 50 weeks/year, accounting for ten holidays per year.	250	5 days/week, 50 weeks/year, accounting for ten holidays per year.	1	Professional judgement.
Exposure Duration	years	25	95th percentile of worker job tenures. EPA (1993).	25	95th percentile of worker job tenures. EPA (1993).	25	95th percentile of worker job tenures. EPA (1993).
DERMAL ABSORPTION OF SOIL/SEDIMENT:							
Conversion Factor	kg/mg	1E-06		1E-06		1E-06	
Soil to Skin Adherence Factor	mg/cm^2	0.206	EPA (2001a). Area-weighted mean of values for forearms, hands, and face of Utility Workers and Construction Workers.	0.206	EPA (2001a). Area-weighted mean of values for forearms, hands, and face of Utility Workers and Construction Workers.	0.206	EPA (2001a). Area-weighted mean of values for forearms, hands, and face of Utility Workers and Construction Workers.
Skin Surface Area Available for Contact	cm^2/day	2,373	Approximate area of forearms, hands, and face. (EPA 1997).	2,373	Approximate area of forearms, hands, and face. (EPA 1997).	2,373	Approximate area of forearms, hands, and face. (EPA 1997).
Exposure Frequency	days/year	250	5 days/week, 50 weeks/year, accounting for ten holidays per year.	250	5 days/week, 50 weeks/year, accounting for ten holidays per year.	1	Professional judgement.
Exposure Duration	years	25	95th percentile of worker job tenures. EPA (1993).	25	95th percentile of worker job tenures. EPA (1993).	25	95th percentile of worker job tenures. EPA (1993).
INHALATION OF FUGITIVE DUST AND VAPORS:							
Respirable Particulate Concentration	mg/m^3	0.0394	95th percentile of urban RPM from nearby station (city identified sources).	0.0394	95th percentile of urban RPM from nearby station (city identified sources).	NA	
Inhalation Rate	m^3/hour	2.18	95th percentile of all activities. Linn et al. (1993).	2.18	95th percentile of all activities. Linn et al. (1993).	NA	
Exposure Frequency	days/year	250	5 days/week, 50 weeks/year, accounting for ten holidays per year.	250	5 days/week, 50 weeks/year, accounting for ten holidays per year.	NA	
Exposure Duration	years	25	95th percentile of worker job tenures. EPA (1993).	25	95th percentile of worker job tenures. EPA (1993).	NA	
Exposure Time	hours/day	8	Standard work day.	8	Standard work day.	NA	

References:

EPA (1997). Exposure Factors Handbook. Volumes I - III. EPA/600/P-95/002. August.

EPA (2001a). Risk Assessment Guidance for Superfund: Volume III - Part A, Process for Conducting Probabilistic Risk Assessment. EPA 540-R-02-002, OSWER 9285.7-45. December. Office of Emergency and Remedial Response.

FL Division of Air Resources Management (2005). Florida Air Monitoring Report. Division of Air Resource Mangement of the Department Environmental Protection. 2005.

Linn et al (1993). Activity Patterns in Ozone-Exposed Construction Workers. J. Occ. Med. Tox. 2(1): 1-14.

TABLE 3-4
THEORETICAL EXPOSURE PARAMETERS FOR THE HYPOTHETICAL FUTURE RECREATIONAL USER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

PARAMETER DEFINITION	UNITS	HYPOTHETICAL YOUNG CHILD RECREATIONAL USER	RATIONALE/ REFERENCE	HYPOTHETICAL OLDER CHILD RECREATIONAL USER	RATIONALE/ REFERENCE	HYPOTHETICAL ADULT RECREATIONAL USER	RATIONALE/ REFERENCE
GENERAL INFO:							
Age	years	1-7		7-17		17-31	
Bodyweight	kg	16.6	EPA (1997)	45	EPA (1997)	71.5	EPA (1997)
Averaging Time - Noncarcinogenic	days	2,190	6 years exposure	3,650	10 years exposure	5,110	14 years exposure
Averaging Time - Carcinogenic	days	25,550	70 years lifetime	25,550	70 years lifetime	25,550	70 years lifetime
Fraction of exposure from Site	unitless	0.25	2 hours per 8 hour day	0.25	2 hours per 8 hour day	0.25	2 hours per 8 hour day
INGESTION OF SOIL/SEDIMENT:							
Conversion Factor	kg/mg	1E-06		1E-06		1E-06	
Ingestion Rate	mg/day	100	EPA (1997)	100	EPA (1997)	50	EPA (1997)
Exposure Frequency	days/years	150	3 days/wk, excluding 2 weeks of vacation away from the area	150	3 days/wk, excluding 2 weeks of vacation away from the area	150	3 days/wk, excluding 2 weeks of vacation away from the area
Exposure Duration	years	6		10		14	
DERMAL ABSORPTION OF SOIL/SEDIMENT:							
Conversion Factor	kg/mg	1E-06		1E-06		1E-06	
Soil to Skin Adherence Factor	mg/cm2	0.153	EPA (1997). Body-part specific age-adjusted values for children playing in wet soil and children playing in dry soil.	0.145	EPA (1997). Body-part specific age-adjusted values for children playing in wet soil and children playing in dry soil.	0.015	EPA (1997). Body-part specific values for adult soccer players.
Skin Surface Area Available for Contact	cm2/day	2,328	EPA (1997). Mean of 50th percentile values for hands, forearms, lower legs, feet, and face for males and females represent age range	5,048	EPA (1997). Mean of 50th percentile values for hands, forearms, lower legs, feet, and face for males and females represent age range	6,073	EPA (1997). Mean of 50th percentile values for hands, forearms, lower legs, feet, and face for males and females represent age range
Exposure Frequency	days/years	150	3 days/wk, excluding 2 weeks of vacation away from the area	150	3 days/wk, excluding 2 weeks of vacation away from the area	150	3 days/wk, excluding 2 weeks of vacation away from the area
Exposure Duration	years	6		10		14	
INHALATION OF FUGITIVE DUST AND VAPORS:							
Respirable Particulate Concentration	mg/m3	0.0394	95th percentile of urban RPM from nearby station (city identified sources)	0.0394	95th percentile of urban RPM from nearby station (city identified sources)	0.0394	95th percentile of urban RPM from nearby station (city identified sources)
Inhalation Rate	m3/hour	1.2	EPA (1997)	1.6	EPA (1997)	1.6	EPA (1997)
Exposure Frequency	days/year	150	3 days/wk, excluding 2 weeks of vacation away from the area	150	3 days/wk, excluding 2 weeks of vacation away from the area	150	3 days/wk, excluding 2 weeks of vacation away from the area
Exposure Duration	years	6		10		14	
Exposure Time	hours/day	2	Professonal judgement.	2	Professonal judgement.	2	Professonal judgement.

References:

EPA (1997). Exposure Factors Handbook. Volumes I - III. EPA/600/P-95/002. August.
FL Division of Air Resources Management (2005). Florida Air Monitoring Report. Division of Air Resource Mangement of the Department Environmental Protection. 2005.
Linn et al (1993). Activity Patterns in Ozone-Exposed Construction Workers. J. Occ. Med. Tox. 2(1): 1-14.

TABLE 3-5
THEORETICAL EXPOSURE PARAMETERS FOR THE HYPOTHETICAL FUTURE CONSTRUCTION WORKER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

PARAMETER DEFINITION	UNITS	HYPOTHETICAL CONSTRUCTION WORKER	RATIONALE/ REFERENCE
GENERAL INFO:			
Age	years	18-65	
Bodyweight	kg	71.5	EPA (1997) - mean of men and women age 18<75
Averaging Time - Noncarcinogenic	days	182	26 weeks
Averaging Time - Carcinogenic	days	25,550	70 years lifetime
Fraction of exposure from Site	unitless	1	All soil exposure assumed to come from site.
INGESTION OF SOIL:			
Conversion Factor	kg/mg	1E-06	
Ingestion Rate	mg/day	118	Ten days of exposure at 330 mg/day (EPA, 2001b) and 120 days of exposure at 100 mg/day
Exposure Frequency	days/years	130	5 days/week, 26 weeks/year
Exposure Duration	years	1	Professional judgement
DERMAL ABSORPTION OF SOIL:			
Conversion Factor	kg/mg	1E-06	
Soil to Skin Adherence Factor	mg/cm^2	0.14	EPA (2001a). Body-part specific value for Construction Workers
Skin Surface Area Available for Contact	cm^2/day	2,478	Approximate area of forearms, hands, and face (EPA 1997)
Exposure Frequency	days/years	130	5 days/week, 26 weeks/year
Exposure Duration	years	1	Professional judgement
INHALATION OF FUGITIVE DUST AND VAPORS:			
Respirable Particulate Concentration	mg/m^3	0.0394	95th percentile of urban RPM from nearby station (city identified sources)
Inhalation Rate	$m^3/hour$	2.5	EPA (1997)
Exposure Frequency	days/year	130	5 days/week, 26 weeks/year
Exposure Duration	years	1	Professional judgement
Exposure Time	hours/day	8	Standard work day.

References:

EPA (1989). Risk Assessment Guidance for Superfund (RAGS). Volume I, Human Health Evaluation Manual (Part A). EPA/540/1-89/002. December.
EPA (1997). Exposure Factors Handbook. Volumes I - III. EPA/600/P-95/002. August.
FL Division of Air Resources Management (2005). Florida Air Monitoring Report. Division of Air Resource Mangement of the Department Environmental Protection. 2005.

TABLE 3-6
THEORETICAL EXPOSURE PARAMETERS FOR THE HYPOTHETICAL FUTURE UTILITY WORKER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

PARAMETER DEFINITION	UNITS	HYPOTHETICAL UTILITY WORKER	RATIONALE/ REFERENCE
GENERAL INFO:			
Age	years	18-65	
Bodyweight	kg	71.5	EPA (1997) - mean of men and women age 18<75
Averaging Time - Noncarcinogenic	days	9,125	25 years of work
Averaging Time - Carcinogenic	days	25,550	70 years lifetime
Fraction of exposure from Site	unitless	1	All soil exposure assumed to come from site.
INGESTION OF SOIL:			
Conversion Factor	kg/mg	1E-06	
Ingestion Rate	mg/day	330	EPA (2001)
Exposure Frequency	days/years	5	Utility repair assumed to require five days
Exposure Duration	years	25	EPA (1989)
DERMAL ABSORPTION OF SOIL:			
Conversion Factor	kg/mg	1E-06	
Soil to Skin Adherence Factor	mg/cm^2	0.24	EPA (2001a). Body-part specific value for Utility Workers
Skin Surface Area Available for Contact	cm^2/day	2,478	Approximate area of forearms, hands, and face (EPA 1997)
Exposure Frequency	days/years	5	Utility repair assumed to require five days
Exposure Duration	years	25	EPA (1989)
INHALATION OF FUGITIVE DUST AND VAPORS:			
Respirable Particulate Concentration	mg/m^3	0.0394	95th percentile of urban RPM from nearby station (city identified sources)
Inhalation Rate	m^3/hour	2.5	EPA (1997)
Exposure Frequency	days/year	5	Utility repair assumed to require five days
Exposure Duration	years	25	EPA (1989)
Exposure Time	hours/day	8	Standard work day.

References:

EPA (1989). Risk Assessment Guidance for Superfund (RAGS). Volume I, Human Health Evaluation Manual (Part A). EPA/540/1-89/002. December.
EPA (1997). Exposure Factors Handbook. Volumes I - III. EPA/600/P-95/002. August.
FL Division of Air Resources Management (2005). Florida Air Monitoring Report. Division of Air Resource Mangement of the Department Environmental Protection. 2005.

TABLE 4-1
SUBCHRONIC TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Constituent	Subchronic Oral RfD (mg/kg-day)	RfD Source	Test Species	Study Type & Length	Critical Effect	Confidence Level	Uncertainty Factor	Modifying Factor	Subchronic Inhalation RfD (mg/kg-day)	Subchronic Inhalation RfC (mg/m^3)	RfC Source	Test Species	Study Type & Length	Target Organ/ Critical Effect	Confidence Level	Uncertainty Factor	Modifying Factor
7440-36-0	Antimony	4.00E-04	IRIS (Chronic value)	rat	chronic oral bioassay	longevity, blood glucose, and cholesterol	low	1000	1	NA	NA							
7440-38-2	Arsenic	3.00E-04	IRIS (Chronic value)	human	chronic oral exposure	Hyperpigmentation, keratosis, vascular complications	Medium	3	1	NA	NA							
16065-83-1	Chromium III	1.50E+00	IRIS (Chronic value)	rat	chronic feeding study	none observed	low	100	10	NA	NA							
7440-50-8	Copper	3.70E-02	HEAST as cited in USEPA 2007 (chronic value)															
7439-92-1	Lead	NA								NA	NA							
7439-97-6	Mercury	NA								8.57E-05	3.00E-04	IRIS (Chronic val	Human	occupational inhalation studies	Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction	medium	30	1
83-32-9	Acenaphthene	6.00E-01	IRIS	mouse	oral subchronic study	Hepatotoxicity	low	300	1	6.00E-01	2.10E+00	IRIS route-extrapolation as cited in USEPA 2007	mice	oral subchronic study	Hepatotoxicity	low	300	1
120-12-7	Anthracene	3.00E+00	IRIS	mouse	subchronic toxicity	none observed	low	300	1	3.00E+00	1.05E+01	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic toxicity	none observed	low	300	1
50-32-8	Benzo(a)pyrene	3.00E-01	IRIS (pyrene used as a surrogate)	mouse	subchronic oral bio	Kidney effects (renal tubular pa	low	3,000	1	3.00E-01	1.05E+00	IRIS (pyrene used as a surrogate)	mice	subchronic oral I	Kidney effects (rer	low	3,000	1
86-74-8	Carbazole	NA								NA	NA							
206-44-0	Fluoranthene	4.00E-01	IRIS	mouse	subchronic study	Nephropathy, increased liver weights, hematological alterations, and clinical effects	low	300	1	4.00E-01	1.40E+00	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic study	Nephropathy, increased liver weights, hematological alterations, and clinical effects	low	300	1
86-73-7	Fluorene	4.00E-01	IRIS	mouse	subchronic study	Decreased RBC, packed cell volume and hemoglobin	low	3,000	1	4.00E-01	1.40E+00	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic study	Decreased RBC, packed cell volume and hemoglobin	low	3,000	1
91-57-6	2-Methylnaphthalene	4.00E-03	IRIS (Chronic value)	mouse	81 week dietary study	Pulmonary alveolar proteinosis	low	1,000	1	NA	NA							
91-20-3	Naphthalene	2.00E-01	IRIS	rat	subchronic oral study	decreased mean terminal body weight in males	low	300	1	8.57E-04	3.00E-03	IRIS (Chronic val	mouse	chronic inhalation study	Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively	medium	3000	1
87-86-5	Pentachlorophenol	3.00E-02	IRIS (Chronic value)	rat	oral chronic study	liver and kidney pathology	medium	100	1	NA	NA							
85-01-8	Phenanthrene	3.00E-01	IRIS (pyrene used as a surrogate)	mouse	subchronic oral bio	Kidney effects (renal tubular pa	low	3.00E+03	1.00E+00	3.00E-01	1.05E+00	IRIS (pyrene used as a surrogate)	mice	subchronic oral I	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3,000	1
119-00-0	Pyrene	3.00E-01	IRIS	mouse	subchronic oral bioassay	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3,000	1	3.00E-01	1.05E+00	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic oral bioassay	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3,000	1
1746-01-6	2,3,7,8-TCDD	NA								NA	NA							

TABLE 4-1
SUBCHRONIC TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		Absorption Factors for Evaluating Subchronic Exposures					
		Soil Ingestion		Soil Dermal Absorption		Inhalation	
CAS #	Constituent	RAF (fraction)	Source	RAF (fraction)	Source	RAF (fraction)	Source
7440-36-0	Antimony	1.00E+00	AMEC, Appendix C	7.00E-03	AMEC, Appendix C	NA	
7440-38-2	Arsenic	2.47E-01	90th percentile, AMEC 2008c	1.00E-02	90th percentile, AMEC 2008c	1.00E+00	Assumed
16065-83-1	Chromium III	1.00E+00	AMEC, Appendix C	9.00E-02	AMEC, Appendix C	NA	
7440-50-8	Copper	1.00E+00	Assumed	1.00E+00	Assumed	NA	
7439-92-1	Lead	NA		NA		NA	
7439-97-6	Mercury	NA		NA		1.00E+00	AMEC, Appendix C
83-32-9	Acenaphthene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
120-12-7	Anthracene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
50-32-8	Benzo(a)pyrene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
86-74-8	Carbazole	1.00E+00	Assumed	1.00E+00	Assumed	1.00E+00	Assumed
206-44-0	Fluoranthene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
86-73-7	Fluorene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
91-57-6	2-Methylnaphthalene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
91-20-3	Naphthalene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
87-86-5	Pentachlorophenol	8.99E-01	90th percentile, Figure 5J	4.50E-02	90th percentile, Figure 5J	1.00E+00	Assumed
85-01-8	Phenanthrene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
119-00-0	Pyrene	7.80E-01	90th percentile, AMEC 2008c	1.70E-01	90th percentile, AMEC 2008c	1.00E+00	Assumed
1746-01-6	2,3,7,8-TCDD	NA		NA		NA	

TABLE 4-2
CHRONIC TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Constituent	Chronic Oral RfD (mg/kg/day)	RfD Source	Test Species	Study Type & Length	Critical Effect	Confidence Level	Uncertainty Factor	Modifying Factor	Chronic Inhalation RfD (mg/kg/day)	Chronic Inhalation RfC (mg/m^3)	RfC Source	Test Species	Study Type & Length	Target Organ/ Critical Effect	Confidence Level	Uncertainty Factor	Modifying Factor
7440-36-0	Antimony	4.00E-04	IRIS	rat	chronic oral bioassay	longevity, blood glucose, and cholesterol	low	1,000	1	NA	NA							
7440-38-2	Arsenic	3.00E-04	IRIS	human	chronic oral exposure	Hyperpigmentation, keratosis, possible vascular complications	Medium	3	1	NA	NA							
16065-83-1	Chromium III	1.50E+00	IRIS	rat	chronic feeding study	none observed	low	100	10	NA	NA							
7440-50-8	Copper	3.70E-02	HEAST as cited in USEPA 2007							NA	NA							
7439-92-1	Lead	NA								NA	NA							
7439-97-6	Mercury	NA								8.57E-05	3.00E-04	IRIS	Human	occupational inhalation studies	Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction	medium	30	1
83-32-9	Acenaphthene	6.00E-02	IRIS	mouse	oral subchronic study	Hepatotoxicity	low	3,000	1	6.00E-02	2.10E-01	IRIS route-extrapolation as cited in USEPA 2007	mice	oral subchronic study	Hepatotoxicity	low	3,000	1
120-12-7	Anthracene	3.00E-01	IRIS	mouse	subchronic toxicity	none observed	low	3,000	1	3.00E-01	1.05E+00	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic toxicity	none observed	low	3,000	1
50-32-8	Benzo(a)pyrene	3.00E-02	IRIS (pyrene used as a surrogate)	mouse	subchronic oral bioassay	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3000	1	3.00E-02	1.05E-01	IRIS (pyrene used as a surrogate)	mice	subchronic oral bioassay	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3000	1
86-74-8	Carbazole	NA								NA	NA							
206-44-0	Fluoranthene	4.00E-02	IRIS	mouse	subchronic study	Nephropathy, increased liver weights, hematological alterations, and clinical effects	low	3,000	1	4.00E-02	1.40E-01	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic stu	Nephropathy, increased liver weights, hematological alterations, and clinical effects	low	3,000	1
86-73-7	Fluorene	4.00E-02	IRIS	mouse	subchronic study	Decreased RBC, packed cell volume and hemoglobin	low	3,000	1	4.00E-02	1.40E-01	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic stu	Decreased RBC, packed cell volume and hemoglobin	low	3,000	1
91-57-6	2-Methylnaphthalene	4.00E-03	IRIS	mouse	81 week dietary study	Pulmonary alveolar proteinosis	low	1,000	1	NA	NA							
91-20-3	Naphthalene	2.00E-02	IRIS	rat	subchronic oral study	decreased mean terminal body weight in males	low	3,000	1	8.57E-04	3.00E-03	IRIS	mouse	chronic inhalation study	Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively	medium	3000	1

TABLE 4-2
CHRONIC TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

CAS #	Constituent	Chronic Oral RfD (mg/kg/day)	RfD Source	Test Species	Study Type & Length	Critical Effect	Confidence Level	Uncertainty Factor	Modifying Factor	Chronic Inhalation RfD (mg/kg/day)	Chronic Inhalation RfC (mg/m^3)	RfC Source	Test Species	Study Type & Length	Target Organ/ Critical Effect	Confidence Level	Uncertainty Factor	Modifying Factor
87-86-5	Pentachlorophenol	3.00E-02	IRIS	rat	oral chronic study	liver and kidney pathology	medium	100	1	NA	NA							
85-01-8	Phenanthrene	3.00E-02	IRIS (pyrene used as a surrogate)	mouse	subchronic oral bio	Kidney effects (ren	low	3.00E+03	1.00E+00	3.00E-02	1.05E-01	IRIS (pyrene used as a surrogate)	mice	subchronic oral	Kidney effects (r	low	3,000	1
119-00-0	Pyrene	3.00E-02	IRIS	mouse	subchronic oral bioassay	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3,000	1	3.00E-02	1.05E-01	IRIS route-extrapolation as cited in USEPA 2007	mice	subchronic oral bioassay	Kidney effects (renal tubular pathology, decreased kidney weights)	low	3,000	1
1746-01-6	2,3,7,8-TCDD	NA								NA	NA							

TABLE 4-2
CHRONIC TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		Absorption Factors for Evaluating Chronic Exposures					
		Soil Ingestion		Soil Dermal Absorption		Inhalation	
CAS #	**Constituent**	**RAF** (fraction)	**Source**	**RAF** (fraction)	**Source**	**RAF** (fraction)	**Source**
7440-36-0	Antimony	1.00E+00	AMEC, Appendix C	7.00E-03	AMEC, Appendix C	NA	
7440-38-2	Arsenic	2.47E-01	90th percentile, AMEC 2008	1.00E-02	90th percentile, AMEC 2008	1.00E+00	Assumed
16065-83-1	Chromium III	1.00E+00	AMEC, Appendix C	9.00E-02	AMEC, Appendix C	NA	
7440-50-8	Copper	1.00E+00	Assumed	1.00E+00	Assumed	NA	
7439-92-1	Lead	NA		NA		NA	
7439-97-6	Mercury	NA		NA		1.00E+00	AMEC, Appendix C
83-32-9	Acenaphthene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
120-12-7	Anthracene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
50-32-8	Benzo(a)pyrene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
86-74-8	Carbazole	1.00E+00	Assumed	1.00E+00	Assumed	1.00E+00	Assumed
206-44-0	Fluoranthene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
86-73-7	Fluorene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
91-57-6	2-Methylnaphthalene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
91-20-3	Naphthalene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed

TABLE 4-2
CHRONIC TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		Absorption Factors for Evaluating Chronic Exposures					
		Soil Ingestion		Soil Dermal Absorption		Inhalation	
CAS #	**Constituent**	**RAF** (fraction)	**Source**	**RAF** (fraction)	**Source**	**RAF** (fraction)	**Source**
87-86-5	Pentachlorophenol	8.99E-01	90th percentile, Figure 5J	4.50E-02	90th percentile, Figure 5J	1.00E+00	Assumed
85-01-8	Phenanthrene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
119-00-0	Pyrene	7.80E-01	90th percentile, AMEC 2008	1.70E-01	90th percentile, AMEC 2008	1.00E+00	Assumed
1746-01-6	2,3,7,8-TCDD	NA		NA		NA	

TABLE 4-3
CANCER TOXICITY VALUES AND RELATIVE ABSORPTION FACTORS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

													Absorption Factors for Evaluating Carcinogenicity					
CAS #	**Constituent**	**Oral Slope Factor** $(mg/kg/day)^{-1}$	**Source**	**Test Species**	**Route**	**Tumor Type**	**Inhalation Slope Factor** $(mg/kg/day)^{-1}$	**Inhalation Unit Risk** $(\mu g/m^3)^{-1}$	**Source**	**Test Species**	**Study Type & Length**	**Tumor Type**	**Soil Ingestion RAF (fraction)**	**Source**	**Soil Dermal Absorption RAF (fraction)**	**Source**	**Inhalation RAF (fraction)**	**Source**
7440-36-0	Antimony	NA					NA	NA					NA		NA		NA	
7440-38-2	Arsenic	1.50E+00	IRIS	human	Oral, Drinking water	skin cancer	1.5E+01	4.30E-03	IRIS	human, male	inhalation, occupational exposure	lung cancer	2.47E-01	90th percentile, AMEC 2008	1.00E-02	90th percentile, AMEC 2008	1.00E+00	Assumed
16065-83-1	Chromium III	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
7440-50-8	Copper	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
7439-92-1	Lead	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
7439-97-6	Mercury	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
83-32-9	Acenaphthene	NA					NA	NA					NA		NA		NA	
120-12-7	Anthracene	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
50-32-8	Benzo(a)pyrene	7.30E+00	IRIS	CFW mice, sex unknown; SWR/J Swill mice; Sprague-Dawley rats, males and females	oral, diet	Forestomach, squamous cell papillomas and carcinomas; forestomach, larynx and esophagus, papillomas and carcinomas (combined)	3.10E+00	NA	NCEA				5.29E-01	90th percentile, AMEC 2008	3.40E-02	90th percentile, AMEC 2008	1.00E+00	Assumed
86-74-8	Carbazole	2.0E-02	HEAST as cited in USEPA 2007				2.0E-02	NA	HEAST route-extrapolation as cited in USEPA 2007				1.00E+00	Assumed	1.00E+00	Assumed	1.00E+00	Assumed
206-44-0	Fluoranthene	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
86-73-7	Fluorene	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
91-57-6	2-Methylnaphthalene	NA					NA	NA					NA		NA		NA	
91-20-3	Naphthalene	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
87-86-5	Pentachlorophenol	1.20E-01	IRIS	mice	diet	hepatocellular adenoma/carcinoma, pheochromocytoma, hemangioma	1.20E-01	4.20E+02	IRIS - route extrapolation				8.99E-01	90th percentile, Figure 5J	4.50E-02	90th percentile, Figure 5J	1.00E+00	Assumed
85-01-8	Phenanthrene	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
119-00-0	Pyrene	NA	IRIS				NA	NA	IRIS				NA		NA		NA	
1746-01-6	2,3,7,8-TCDD	1.5E+05	HEAST as cited in USEPA 2007			repiratory system tumors, liver tumors	1.5E+05	NA	HEAST as cited in USEPA 2007	rat	720 days, diet	respiratory system and liver tumors	5.00E-01	90th percentile, AMEC 2008	7.90E-02	90th percentile, AMEC 2008	5.50E-01	AMEC, Appendix C

TABLE 5-1
ADULT LEAD MODEL FOR MAXIMUM SOIL EXPOSURE POINT CONCENTRATION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PbB Equation[1] 1*	PbB Equation[1] 2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario: Using Equation 1 GSDi = Hom	Using Equation 1 GSDi = Het	Using Equation 2 GSDi = Hom	Using Equation 2 GSDi = Het
PbS	X	X	Soil lead concentration	ug/g or ppm	68.7	68.7	68.7	68.7
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.1	2.3	2.1	2.3
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.7	1.5	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	250	250	250	250
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**			**ug/dL**	**1.6**	**1.8**	**1.6**	**1.8**
$PbB_{fetal,\ 0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**4.9**	**6.4**	**4.9**	**6.4**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**			**%**	**0.5%**	**1.5%**	**0.5%**	**1.5%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

PbB_{adult} =	$(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$
$PbB_{fetal,\ 0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

PbB_{adult} =	$PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$
$PbB_{fetal,\ 0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

TABLE 5-2
ADULT LEAD MODEL FOR SEDIMENT EXPOSURE POINT CONCENTRATION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PbB Equation[1] 1*	PbB Equation[1] 2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario			
					Using Equation 1		Using Equation 2	
					GSDi = Hom	GSDi = Het	GSDi = Hom	GSDi = Het
PbS	X	X	Soil lead concentration	ug/g or ppm	226	226	226	226
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.1	2.3	2.1	2.3
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.7	1.5	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	12	12	12	12
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**			**ug/dL**	**1.5**	**1.7**	**1.5**	**1.7**
$PbB_{fetal,\ 0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**4.6**	**6.1**	**4.6**	**6.1**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**			**%**	**0.4%**	**1.3%**	**0.4%**	**1.3%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

PbB_{adult} =	$(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$
$PbB_{fetal,\ 0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

PbB_{adult} =	$PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$
$PbB_{fetal,\ 0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

TABLE 5-3
SUMMARY OF ESTIMATED POTENTIAL THEORETICAL NON-CANCER RISKS AND POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS - DETERMINISTIC RISK ASSESSMENT
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

	Current Use and Hypothetical Future Use		
Receptor/Area	**Potential Theoretical Subchronic Non-Cancer Risk**	**Potential Theoretical Chronic Non-Cancer Risk (HQ)**	**Potential Theoretical Excess Lifetime Cancer Risk**
Hypothetical Current and Future On-Site Trespasser	NA	0.01	2E-05
Hypothetical Current and Future On-Site Trespasser in Drainage Ditch	NA	0.02	4E-06
Hypothetical Future On-Site Outdoor Worker	NA	0.2	5E-04
Hypothetical Future On-Site Indoor Worker	NA	0.09	3E-04
Hypothetical Future On-Site Worker in Drainage Ditch	NA	0.0008	5E-07
Hypothetical Future On-Site Utility Worker	NA	0.02	2E-05
Hypothetical Future On-Site Construction Worker	0.3	NA	1E-05
Hypothetical Future On-Site Recreational User, Young Child	0.1	NA	
Hypothetical Future On-Site Recreational User, Older Child	NA	0.04	9E-05
Hypothetical Future On-Site Recreational User, Adult	NA	0.01	

NA = not applicable

TABLE 5-4
SUMMARY OF ESTIMATED POTENTIAL THEORETICAL NON-CANCER RISKS AND POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS - DETERMINISTIC RISK ASSESSMENT - SURFACE SOIL
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

	Potential Theoretical Non-Cancer Risks (HI)				Potential Theoretical Excess Lifetime Cancer Risk			
Hypothetical Current and Future On-Site Trespasser	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	1E-03	7E-05	NA	1E-03	NA	NA	NA	NA
Arsenic	8E-03	2E-03	NA	1E-02	5E-07	2E-07	1E-07	8E-07
Chromium	9E-06	6E-06	NA	2E-05	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	6E-06	6E-06	NA	NA	NA	NA
BaP-TE	2E-05	3E-05	1E-07	5E-05	4E-07	2E-07	2E-09	6E-07
2-Methylnaphthalene	3E-04	4E-04	NA	7E-04	NA	NA	NA	NA
Naphthalene	2E-05	3E-05	2E-06	4E-05	NA	NA	NA	NA
Pentachlorophenol	3E-05	1E-05	NA	4E-05	1E-08	5E-09	8E-11	2E-08
TCDD-TEQ	NA	NA	NA	NA	7E-06	8E-06	4E-08	2E-05
TOTAL	1E-02	3E-03	9E-06	1E-02	8E-06	9E-06	2E-07	2E-05

	Potential Theoretical Non-Cancer Risks (HI)				Potential Theoretical Excess Lifetime Cancer Risk			
Hypothetical Future On-Site Outdoor Worker	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	2E-02	6E-04	NA	2E-02	NA	NA	NA	NA
Arsenic	1E-01	2E-02	NA	1E-01	2E-05	3E-06	5E-06	3E-05
Chromium	1E-04	5E-05	NA	2E-04	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	1E-04	1E-04	NA	NA	NA	NA
BaP-TE	3E-04	3E-04	2E-06	6E-04	1E-05	4E-06	8E-08	2E-05
2-Methylnaphthalene	3E-03	4E-03	NA	7E-03	NA	NA	NA	NA
Naphthalene	2E-04	2E-04	4E-05	5E-04	NA	NA	NA	NA
Pentachlorophenol	4E-04	9E-05	NA	4E-04	5E-07	1E-07	4E-09	6E-07
TCDD-TEQ	NA	NA	NA	NA	2E-04	2E-04	2E-06	4E-04
TOTAL	1E-01	3E-02	2E-04	2E-01	3E-04	2E-04	7E-06	5E-04

	Potential Theoretical Non-Cancer Risks (HI)				Potential Theoretical Excess Lifetime Cancer Risk			
Hypothetical Future On-Site Indoor Worker	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	9E-03	6E-04	NA	9E-03	NA	NA	NA	NA
Arsenic	5E-02	2E-02	NA	8E-02	9E-06	3E-06	5E-06	2E-05
Chromium	6E-05	5E-05	NA	1E-04	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	1E-04	1E-04	NA	NA	NA	NA
BaP-TE	1E-04	3E-04	2E-06	4E-04	7E-06	4E-06	8E-08	1E-05
2-Methylnaphthalene	2E-03	4E-03	NA	5E-03	NA	NA	NA	NA
Naphthalene	1E-04	2E-04	4E-05	4E-04	NA	NA	NA	NA
Pentachlorophenol	2E-04	9E-05	NA	3E-04	2E-07	1E-07	3E-09	3E-07
TCDD-TEQ	NA	NA	NA	NA	1E-04	2E-04	2E-06	3E-04
TOTAL	6E-02	3E-02	2E-04	9E-02	1E-04	2E-04	7E-06	3E-04

	Potential Theoretical Subchronic Non-Cancer Risks (HI) - Young child				Potential Theoretical Chronic Non-Cancer Risks (HI) - Older child			
Hypothetical Future Recreational User	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	1E-02	3E-04	NA	1E-02	4E-03	2E-04	NA	4E-03
Arsenic	7E-02	1E-02	NA	8E-02	3E-02	8E-03	NA	3E-02
Chromium	8E-05	3E-05	NA	1E-04	3E-05	2E-05	NA	5E-05
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	4E-05	4E-05	NA	NA	2E-05	2E-05
BaP-TE	2E-05	1E-05	8E-08	3E-05	6E-05	1E-04	4E-07	2E-04
2-Methylnaphthalene	2E-03	2E-03	NA	4E-03	8E-04	1E-03	NA	2E-03
Naphthalene	1E-05	1E-05	2E-05	4E-05	5E-05	8E-05	7E-06	1E-04
Pentachlorophenol	2E-04	4E-05	NA	3E-04	9E-05	3E-05	NA	1E-04
TCDD-TEQ	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	8E-02	1E-02	5E-05	1E-01	3E-02	9E-03	3E-05	4E-02

	Potential Theoretical Chronic Non-Cancer Risks (HI) - Adult				Potential Theoretical Excess Lifetime Cancer Risk			
Hypothetical Future Recreational User cont.	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	1E-03	2E-05	NA	1E-03	NA	NA	NA	NA
Arsenic	8E-03	6E-04	NA	9E-03	3E-06	8E-07	8E-07	5E-06
Chromium	9E-06	1E-06	NA	1E-05	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	1E-05	1E-05	NA	NA	NA	NA
BaP-TE	2E-05	8E-06	3E-07	3E-05	3E-06	1E-06	1E-08	4E-06
2-Methylnaphthalene	3E-04	1E-04	NA	4E-04	NA	NA	NA	NA
Naphthalene	2E-05	6E-06	5E-06	3E-05	NA	NA	NA	NA
Pentachlorophenol	3E-05	2E-06	NA	3E-05	9E-08	2E-08	6E-10	1E-07
TCDD-TEQ	NA	NA	NA	NA	5E-05	4E-05	3E-07	9E-05
TOTAL	1E-02	7E-04	2E-05	1E-02	5E-05	4E-05	1E-06	9E-05

TABLE 5-5
SUMMARY OF ESTIMATED POTENTIAL THEORETICAL NON-CANCER RISKS AND POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS - DETERMINISTIC RISK ASSESSMENT - DRAINAGE DITCH
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

	Potential Theoretical Non-Cancer Risks (HI)			Potential Theoretical Excess Lifetime Cancer Risk		
Hypothetical Current and Future On-Site Trespasser	**Soil Ingestion**	**Soil Dermal**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**All Pathways**
Arsenic	1E-02	4E-03	2E-02	8E-07	2E-07	1E-06
Chromium	2E-05	1E-05	3E-05	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA
BaP-TE	2E-05	3E-05	5E-05	4E-07	2E-07	7E-07
Pentachlorophenol	2E-06	9E-07	3E-06	1E-09	4E-10	2E-09
TCDD-TEQ	NA	NA	NA	1E-06	1E-06	2E-06
TOTAL	1E-02	4E-03	2E-02	2E-06	2E-06	4E-06

	Potential Theoretical Non-Cancer Risks (HI)			Potential Theoretical Excess Lifetime Cancer Risk		
Hypothetical Future On-Site Worker	**Soil Ingestion**	**Soil Dermal**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**All Pathways**
Arsenic	7E-04	1E-04	8E-04	1E-07	2E-08	1E-07
Chromium	1E-06	4E-07	1E-06	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA
BaP-TE	1E-06	1E-06	2E-06	6E-08	2E-08	8E-08
Pentachlorophenol	1E-07	3E-08	2E-07	2E-10	4E-11	2E-10
TCDD-TEQ	NA	NA	NA	1E-07	1E-07	3E-07
TOTAL	7E-04	1E-04	8E-04	3E-07	1E-07	5E-07

TABLE 5-6
SUMMARY OF ESTIMATED POTENTIAL THEORETICAL NON-CANCER RISKS AND POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS - DETERMINISTIC RISK ASSESSMENT - SUBSURFACE SOIL
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

	Potential Theoretical Non-Cancer Risks (HI)				Potential Theoretical Excess Lifetime Cancer Risk			
Hypothetical Future Construction Worker	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	2E-02	3E-04	NA	2E-02	NA	NA	NA	NA
Arsenic	1E-01	2E-02	NA	2E-01	5E-07	6E-08	1E-07	7E-07
Chromium	2E-04	5E-05	NA	2E-04	NA	NA	NA	NA
Copper	4E-03	1E-02	NA	2E-02	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	1E-04	1E-04	NA	NA	NA	NA
Acenaphthene	3E-04	2E-04	2E-06	4E-04	NA	NA	NA	NA
Anthracene	1E-04	8E-05	1E-06	2E-04	NA	NA	NA	NA
BaP-TE	6E-05	4E-05	5E-07	1E-04	7E-07	1E-07	4E-09	8E-07
Carbazole	NA	NA	NA	NA	5E-10	2E-09	4E-12	2E-09
Fluoranthene	4E-04	3E-04	4E-06	7E-04	NA	NA	NA	NA
Fluorene	5E-04	3E-04	4E-06	8E-04	NA	NA	NA	NA
2-Methylnaphthalene	4E-02	3E-02	NA	7E-02	NA	NA	NA	NA
Naphthalene	1E-03	7E-04	2E-03	4E-03	NA	NA	NA	NA
Pentachlorophenol	5E-04	7E-05	NA	5E-04	1E-08	2E-09	9E-11	1E-08
Phenanthrene	1E-03	9E-04	1E-05	2E-03	NA	NA	NA	NA
Pyrene	4E-04	2E-04	3E-06	6E-04	NA	NA	NA	NA
TCDD-TEQ	NA	NA	NA	NA	6E-06	3E-06	4E-08	8E-06
TOTAL	2E-01	6E-02	2E-03	3E-01	7E-06	3E-06	2E-07	1E-05

	Potential Theoretical Non-Cancer Risks (HI)				Potential Theoretical Excess Lifetime Cancer Risk			
Hypothetical Future Utility Worker	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**	**Soil Ingestion**	**Soil Dermal**	**Soil Inhalation**	**All Pathways**
Antimony	9E-04	1E-05	NA	9E-04	NA	NA	NA	NA
Arsenic	8E-03	6E-04	NA	8E-03	1E-06	9E-08	1E-07	1E-06
Chromium	1E-05	2E-06	NA	1E-05	NA	NA	NA	NA
Copper	2E-04	4E-04	NA	6E-04	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	2E-06	2E-06	NA	NA	NA	NA
Acenaphthene	1E-04	6E-05	4E-07	2E-04	NA	NA	NA	NA
Anthracene	6E-05	2E-05	2E-07	9E-05	NA	NA	NA	NA
BaP-TE	3E-05	1E-05	1E-07	5E-05	2E-06	2E-07	3E-09	2E-06
Carbazole	NA	NA	NA	NA	1E-09	3E-09	3E-12	4E-09
Fluoranthene	2E-04	9E-05	7E-07	3E-04	NA	NA	NA	NA
Fluorene	3E-04	1E-04	8E-07	4E-04	NA	NA	NA	NA
2-Methylnaphthalene	2E-03	9E-04	NA	3E-03	NA	NA	NA	NA
Naphthalene	6E-04	2E-04	4E-05	9E-04	NA	NA	NA	NA
Pentachlorophenol	2E-05	2E-06	NA	3E-05	3E-08	3E-09	8E-11	3E-08
Phenanthrene	8E-04	3E-04	2E-06	1E-03	NA	NA	NA	NA
Pyrene	2E-04	8E-05	6E-07	3E-04	NA	NA	NA	NA
TCDD-TEQ	NA	NA	NA	NA	2E-05	4E-06	4E-08	2E-05
TOTAL	1E-02	3E-03	5E-05	2E-02	2E-05	5E-06	2E-07	2E-05

TABLE 5-7
SUMMARY OF MEE AND DETERMINISTIC POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS (ALL PATHWAYS)
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		MEE Results						Deterministic Risk	
		Hypothetical Future On-Site Indoor Worker			Hypothetical Future On-Site Outdoor Worker			Indoor	Outdoor
	COPC:	Arsenic							
	Variability:	5%	50%	95%	5%	50%	95%		
Uncertainty	*5%*	1.1E-07	3.3E-07	**2.1E-06**	1.46E-07	4.63E-07	**3.0E-06**	**2.E-05**	**3.E-05**
Uncertainty	*50%*	1.6E-07	5.3E-07	**3.3E-06**	2.44E-07	7.97E-07	**5.2E-06**		
Uncertainty	*95%*	2.1E-07	7.0E-07	**4.6E-06**	3.49E-07	**1.14E-06**	**7.5E-06**		
	COPC:	BaP-TE							
	Variability:	5%	50%	95%	5%	50%	95%		
Uncertainty	*5%*	1.9E-08	6.5E-08	4.0E-07	3.47E-08	1.06E-07	7.2E-07	**1.E-05**	**2.E-05**
Uncertainty	*50%*	6.9E-08	2.2E-07	**1.4E-06**	1.40E-07	4.48E-07	**2.8E-06**		
Uncertainty	*95%*	1.3E-07	4.3E-07	**2.7E-06**	2.50E-07	8.25E-07	**5.2E-06**		
	COPC:	Pentachlorophenol							
	Variability:	5%	50%	95%	5%	50%	95%		
Uncertainty	*5%*	1.1E-09	3.8E-09	2.4E-08	1.95E-09	6.35E-09	4.2E-08	3.E-07	6.E-07
Uncertainty	*50%*	1.8E-09	6.0E-09	3.8E-08	3.68E-09	1.20E-08	7.8E-08		
Uncertainty	*95%*	2.5E-09	8.2E-09	5.3E-08	5.07E-09	1.63E-08	1.1E-07		
	COPC:	TCDD-TEQ							
	Variability:	5%	50%	95%	5%	50%	95%		
Uncertainty	*5%*	8.8E-07	**2.9E-06**	**1.8E-05**	**1.69E-06**	**5.48E-06**	**3.6E-05**	***3.E-04***	***4.E-04***
Uncertainty	*50%*	**1.2E-06**	**4.1E-06**	**2.7E-05**	**2.34E-06**	**7.59E-06**	**5.0E-05**		
Uncertainty	*95%*	**1.8E-06**	**5.6E-06**	**3.7E-05**	**3.09E-06**	**1.02E-05**	**6.7E-05**		
	COPC:	All COPCs							
	Variability:	5%	50%	95%	5%	50%	95%		
Uncertainty	*5%*	**1.1E-06**	**3.6E-06**	**2.2E-05**	**2.00E-06**	**6.60E-06**	**4.4E-05**	***3.E-04***	***5.E-04***
Uncertainty	*50%*	**1.5E-06**	**4.9E-06**	**3.2E-05**	**2.70E-06**	**9.00E-06**	**5.8E-05**		
Uncertainty	*95%*	**2.0E-06**	**6.4E-06**	**4.2E-05**	**3.50E-06**	**1.10E-05**	**7.6E-05**		

Note:
PELCRs shown in bold are greater than FDEP's risk limit, and those shown in bold italics exceed USEPA's allowable risk range.

TABLE 5-8
SUMMARY OF MEE AND DETERMINISTIC POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS (ORAL PATHWAYS)
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		MEE Results						Deterministic Risk	
		Hypothetical Future On-Site Indoor Worker			Hypothetical Future On-Site Outdoor Worker			Indoor	Outdoor
COPC:		Arsenic							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	3.0E-08	9.3E-08	5.6E-07	6.56E-08	2.10E-07	**1.4E-06**	**9.E-06**	**2.E-05**
	50%	8.3E-08	2.8E-07	**1.8E-06**	1.69E-07	5.50E-07	**3.6E-06**		
	95%	1.4E-07	4.5E-07	**2.9E-06**	2.70E-07	8.98E-07	**5.9E-06**		
COPC:		BaP-TE							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	1.8E-08	5.8E-08	3.7E-07	3.20E-08	9.98E-08	6.8E-07	**7.E-06**	**1.E-05**
	50%	6.4E-08	2.0E-07	**1.3E-06**	1.37E-07	4.34E-07	**2.8E-06**		
	95%	1.3E-07	4.2E-07	**2.6E-06**	2.43E-07	8.09E-07	**5.1E-06**		
COPC:		Pentachlorophenol							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	1.0E-09	3.4E-09	2.2E-08	1.88E-09	6.22E-09	4.0E-08	2.E-07	5.E-07
	50%	1.7E-09	5.7E-09	3.7E-08	3.60E-09	1.16E-08	7.5E-08		
	95%	2.4E-09	7.8E-09	5.1E-08	4.96E-09	1.61E-08	1.1E-07		
COPC:		TCDD-TEQ							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	8.3E-07	**2.7E-06**	**1.7E-05**	**1.62E-06**	**5.13E-06**	**3.5E-05**	***1.E-04***	***2.E-04***
	50%	**1.1E-06**	**3.8E-06**	**2.4E-05**	**2.25E-06**	**7.41E-06**	**4.7E-05**		
	95%	**1.6E-06**	**5.2E-06**	**3.3E-05**	**2.94E-06**	**9.82E-06**	**6.3E-05**		
COPC:		All COPCs							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	9.5E-07	**3.1E-06**	**1.9E-05**	**1.88E-06**	**6.03E-06**	**4.1E-05**	***1.E-04***	***3.E-04***
	50%	**1.3E-06**	**4.3E-06**	**2.8E-05**	**2.59E-06**	**8.41E-06**	**5.4E-05**		
	95%	**1.7E-06**	**5.7E-06**	**3.6E-05**	**3.29E-06**	**1.08E-05**	**7.1E-05**		

Note:
PELCRs shown in bold are greater than FDEP's risk limit, and those shown in bold italics exceed USEPA's allowable risk range.

TABLE 5-9
SUMMARY OF MEE AND DETERMINISTIC POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS (DERMAL PATHWAYS)
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		MEE Results						Deterministic Risk	
		Hypothetical Future On-Site Indoor Worker			Hypothetical Future On-Site Outdoor Worker			Indoor	Outdoor
COPC:		Arsenic							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	2.4E-10	7.7E-10	5.0E-09	2.13E-10	6.64E-10	4.2E-09	**3.E-06**	**3.E-06**
	50%	2.5E-09	7.9E-09	5.1E-08	2.59E-09	8.11E-09	5.1E-08		
	95%	7.4E-09	2.4E-08	1.6E-07	9.89E-09	2.92E-08	1.9E-07		
COPC:		BaP-TE							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	2.2E-10	7.4E-10	4.6E-09	2.11E-10	6.59E-10	4.2E-09	**4.E-06**	**4.E-06**
	50%	2.4E-09	7.5E-09	4.8E-08	2.39E-09	7.41E-09	4.7E-08		
	95%	7.2E-09	2.3E-08	1.5E-07	1.09E-08	3.38E-08	2.1E-07		
COPC:		Pentachlorophenol							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	5.1E-12	1.6E-11	9.9E-11	2.79E-12	8.54E-12	5.4E-11	1.E-07	1.E-07
	50%	4.2E-11	1.3E-10	8.5E-10	4.56E-11	1.37E-10	8.9E-10		
	95%	1.3E-10	4.3E-10	2.6E-09	1.63E-10	5.18E-10	3.5E-09		
COPC:		TCDD-TEQ							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	4.8E-09	1.6E-08	9.4E-08	5.50E-09	1.71E-08	1.1E-07	**2.E-04**	**2.E-04**
	50%	5.0E-08	1.5E-07	**1.0E-06**	5.05E-08	1.55E-07	**1.0E-06**		
	95%	3.4E-07	**1.1E-06**	**6.7E-06**	2.83E-07	8.77E-07	**5.2E-06**		
COPC:		All COPCs							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	5.4E-09	1.7E-08	1.0E-07	6.15E-09	1.87E-08	1.2E-07	**2.E-04**	**2.E-04**
	50%	5.4E-08	1.7E-07	**1.2E-06**	5.72E-08	1.76E-07	**1.2E-06**		
	95%	3.5E-07	**1.1E-06**	**6.9E-06**	3.05E-07	9.82E-07	**5.6E-06**		

Note:
PELCRs shown in bold are greater than FDEP's risk limit, and those shown in bold italics exceed USEPA's allowable risk range.

TABLE 5-10
SUMMARY OF MEE AND DETERMINISTIC POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISKS (INHALATION PATHWAYS)
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

		MEE Results						Deterministic Risk	
		Hypothetical Future On-Site Indoor Worker			Hypothetical Future On-Site Outdoor Worker			Indoor	Outdoor
COPC:		Arsenic							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	7.0E-08	2.2E-07	**1.4E-06**	6.99E-08	2.19E-07	**1.4E-06**	**5.E-06**	**5.E-06**
	50%	7.3E-08	2.4E-07	**1.5E-06**	7.29E-08	2.36E-07	**1.5E-06**		
	95%	7.6E-08	2.6E-07	**1.7E-06**	7.68E-08	2.54E-07	**1.7E-06**		
COPC:		BaP-TE							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	1.2E-09	3.7E-09	2.3E-08	1.18E-09	3.70E-09	2.4E-08	8.E-08	8.E-08
	50%	1.2E-09	4.0E-09	2.6E-08	1.24E-09	3.99E-09	2.6E-08		
	95%	1.3E-09	4.3E-09	2.9E-08	1.29E-09	4.30E-09	2.8E-08		
COPC:		Pentachlorophenol							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	3.6E-11	1.1E-10	7.1E-10	3.60E-11	1.13E-10	7.2E-10	3.E-09	4.E-09
	50%	3.8E-11	1.2E-10	8.0E-10	3.76E-11	1.22E-10	8.0E-10		
	95%	3.9E-11	1.3E-10	8.8E-10	3.94E-11	1.32E-10	8.7E-10		
COPC:		TCDD-TEQ							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	2.2E-08	6.9E-08	4.3E-07	2.16E-08	6.79E-08	4.3E-07	**2.E-06**	**2.E-06**
	50%	2.3E-08	7.4E-08	4.8E-07	2.26E-08	7.31E-08	4.8E-07		
	95%	2.3E-08	7.9E-08	5.3E-07	2.36E-08	7.87E-08	5.2E-07		
COPC:		All COPCs							
Variability:		5%	50%	95%	5%	50%	95%		
Uncertainty	***5%***	9.3E-08	2.9E-07	**1.8E-06**	9.29E-08	2.91E-07	**1.9E-06**	**7.E-06**	**7.E-06**
	50%	9.7E-08	3.2E-07	**2.0E-06**	9.67E-08	3.14E-07	**2.1E-06**		
	95%	1.0E-07	3.4E-07	**2.3E-06**	1.02E-07	3.37E-07	**2.2E-06**		

Note:
PELCRs shown in bold are greater than FDEP's risk limit, and those shown in bold italics exceed USEPA's allowable risk range.

TABLE 6-1
EVALUATION OF THE EFFECT OF VARYING TCDD CSF AND EXPOSURE ASSUMPTIONS ON ESTIMATED POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISK OF A HYPOTHETICAL FUTURE ON-SITE WORKER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

	Alternative TCDD CSF	
	Deterministic	**MEE**
	Potential Theoretical Excess Lifetime Cancer Risk from TCDD-TEQ Only	
Hypothetical Future On-Site Indoor Worker	**6E-06**	4.0E-08 (7.1E-09, 2.9E-07)
Hypothetical Future On-Site Outdoor Worker	**8E-06**	7.6E-08 (1.3E-08, 5.7E-07)
	Potential Theoretical Excess Lifetime Cancer Risk from all COPCs	
Hypothetical Future On-Site Indoor Worker	**3E-05**	7.8E-07 (2.4E-07, **5.1E-06**)
Hypothetical Future On-Site Outdoor Worker	**5E-05**	**1.3E-06 (4.0E-07, 8.4E-06)**

Note:
PELCRs shown in bold are greater than FDEP's risk limit, and those shown in bold italics exceed USEPA's allowable risk range.
Median PELCR with the 5th% and 95% variability range shown below, at the median uncertainty.

ARCADIS

Figures

FIGURE ES-1
SUMMARY OF DETERMINISTIC RISK ASSESSMENT RESULTS
POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISK
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

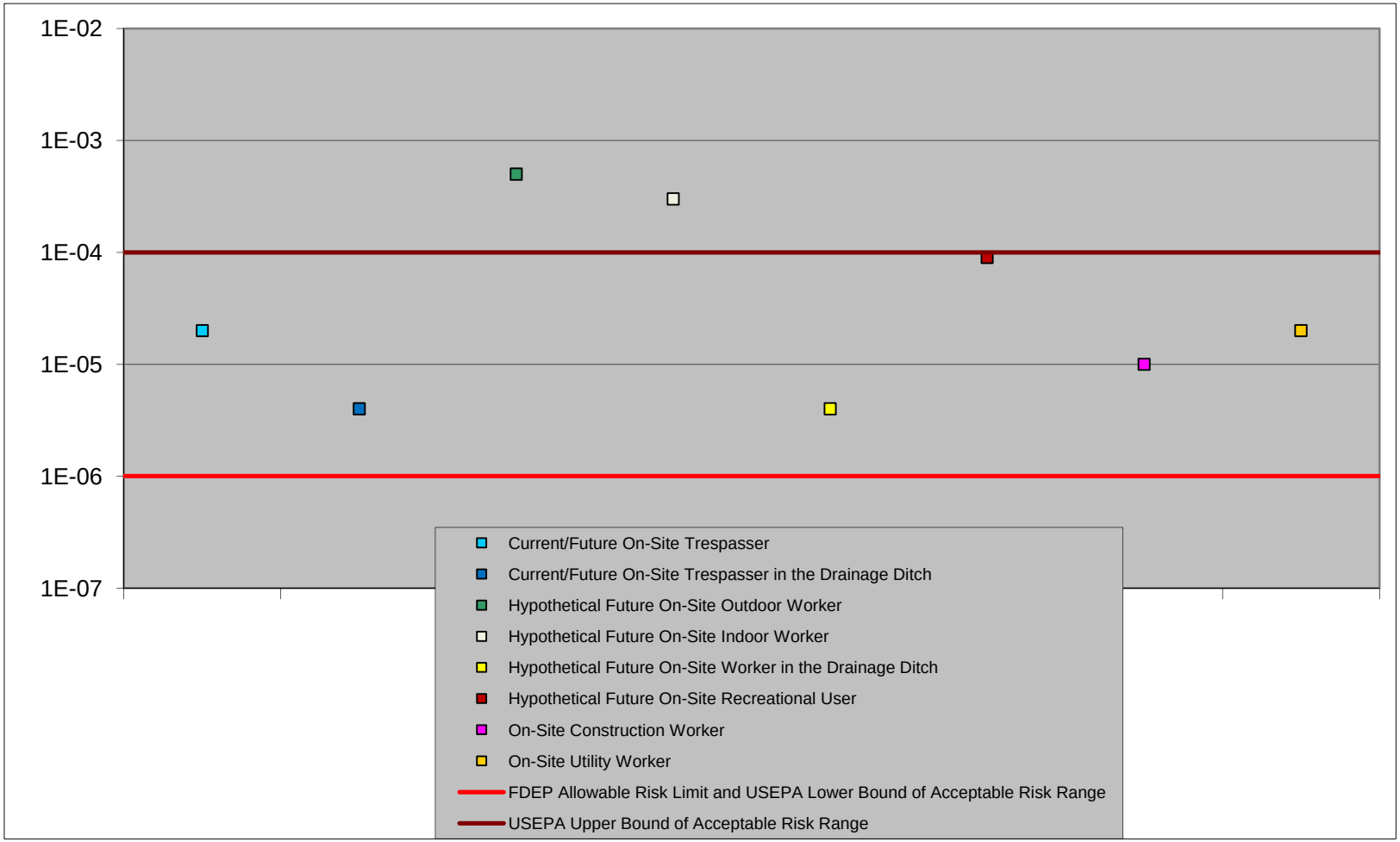
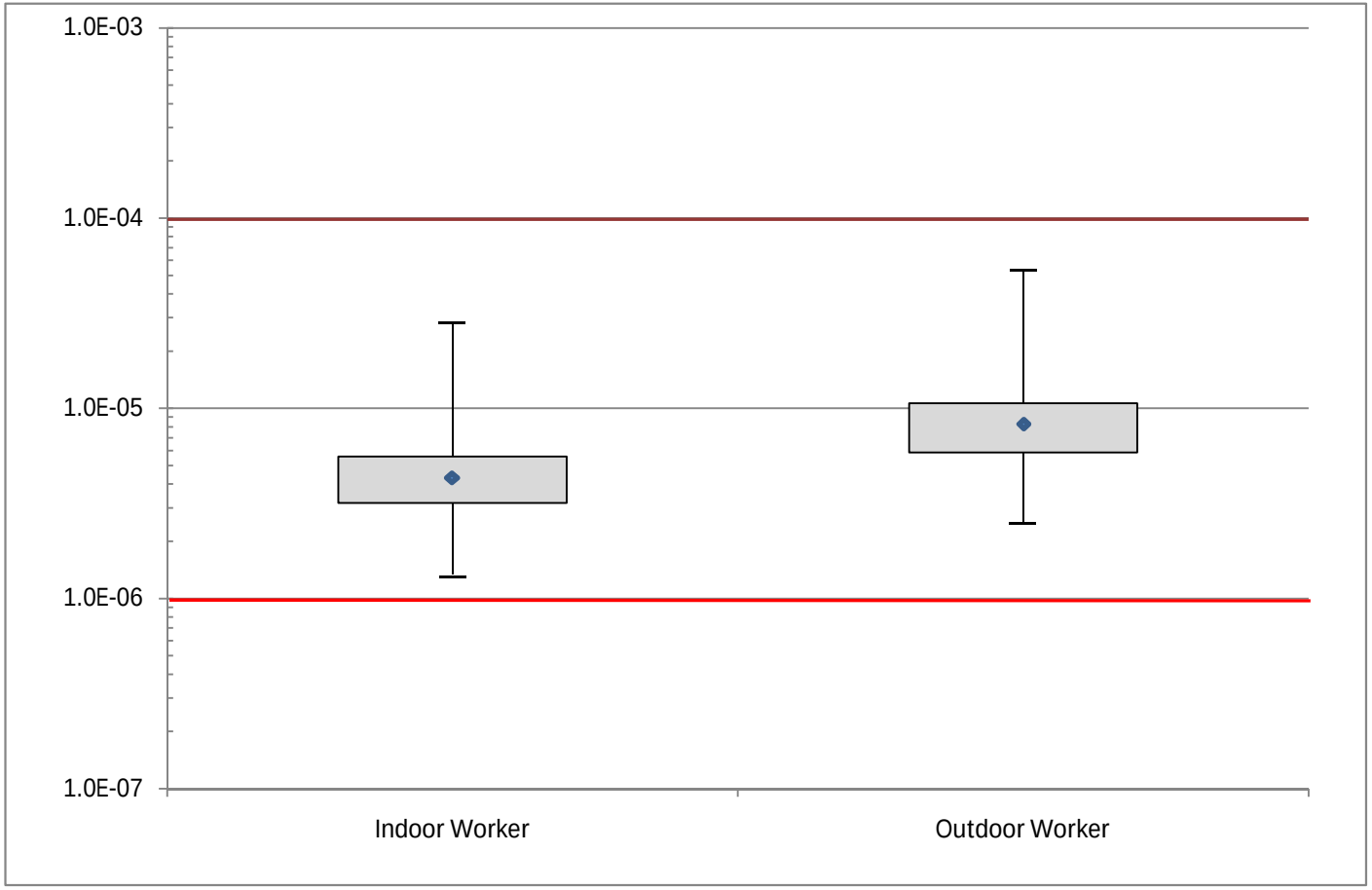
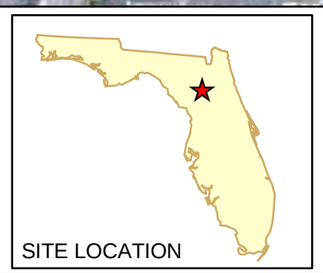


FIGURE ES-2
SUMMARY OF MEE MODEL RESULTS
POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISK FOR ALL COPCS AND ALL EXPOSURE PATHWAYS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA



Note: The error bars represent the variability range from 5th% to 95th% at median uncertainty.

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

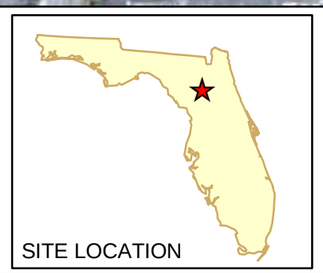
SOIL SAMPLE LOCATIONS 0 TO 6 INCH

ARCADIS

FIGURE 2-1

CITY: SYR DIV/GROUP: IM/AIT DB: J.RAPP LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\SoilSampleLocations_0to6in.mxd - 5/10/2010 @ 9:53:05 AM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

SOIL SAMPLE LOCATIONS 0 TO 6 FOOT

ARCADIS

FIGURE 2-2

CITY: SYR DIV/GROUP: IM/AIT DB: J.RAPP LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\SoilSampleLocations_0to6ft.mxd - 5/10/2010 @ 9:59:30 AM

DRAFT

LEGEND:

- SEDIMENT SAMPLE LOCATION
- DRAINAGE DITCH
- SITE BOUNDARY

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

DRAINAGE DITCH SAMPLE LOCATIONS

ARCADIS

FIGURE
2-3

CITY: SYR DIV/GROUP: IM/AIT DB: J.RAPP LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\DrainageDitchSampleLocations.mxd - 3/22/2010 @ 4:20:16 PM

DRAFT

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR 2-METHYLNAPTHALENE

ARCADIS

FIGURE 3-1

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
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DRAFT

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR BAP-TE

ARCADIS

FIGURE 3-2

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\BAP-TE_Thiessens.mxd - 3/5/2010 @ 11:31:22 AM

DRAFT

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR ANTIMONY

ARCADIS

FIGURE 3-3

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
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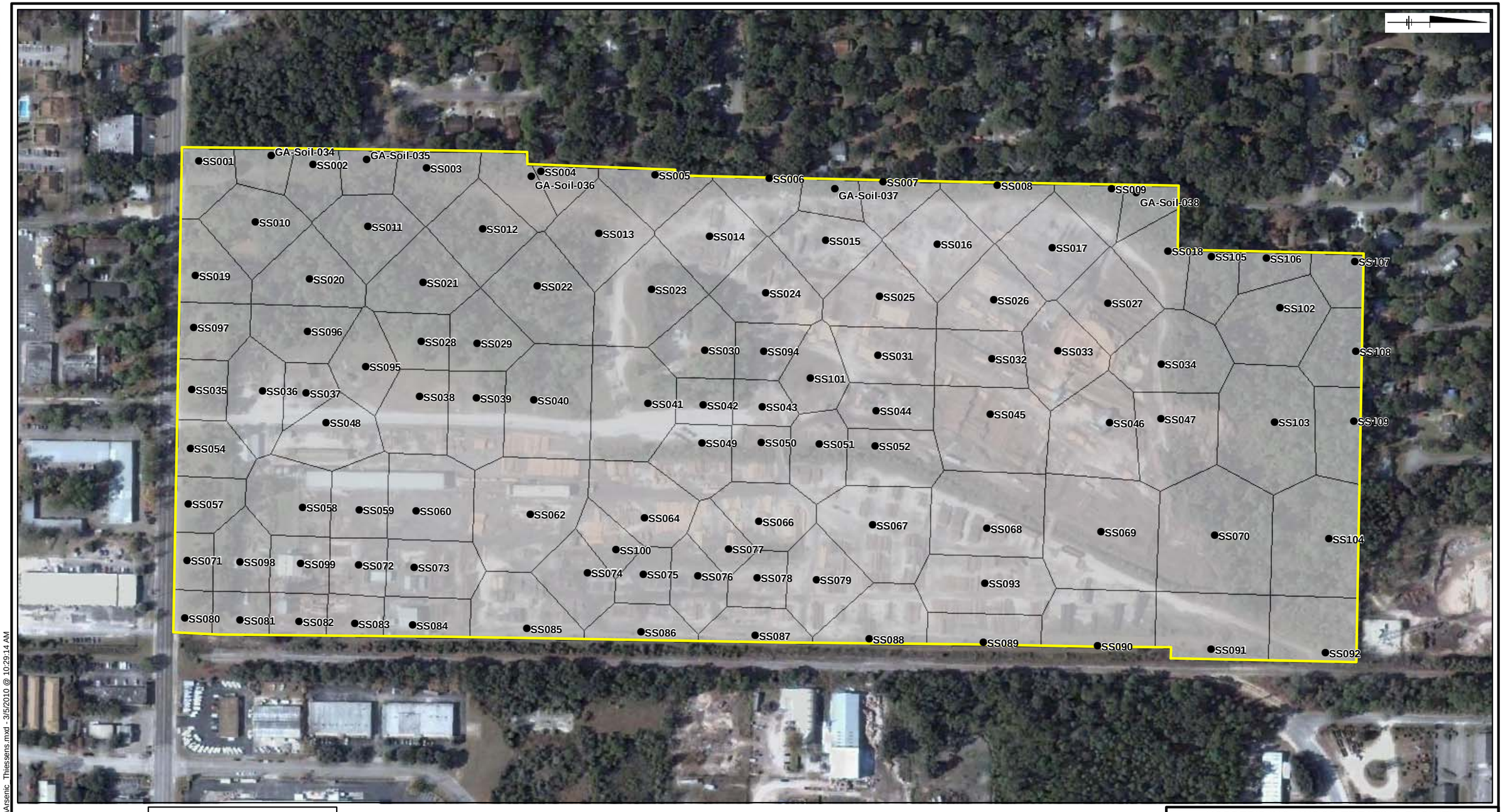
DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA
EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR ARSENIC

ARCADIS

FIGURE 3-4

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Arsenic_Thiessens.mxd - 3/5/2010 @ 10:29:14 AM

DRAFT

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR LEAD AND MERCURY

ARCADIS

FIGURE 3-5

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
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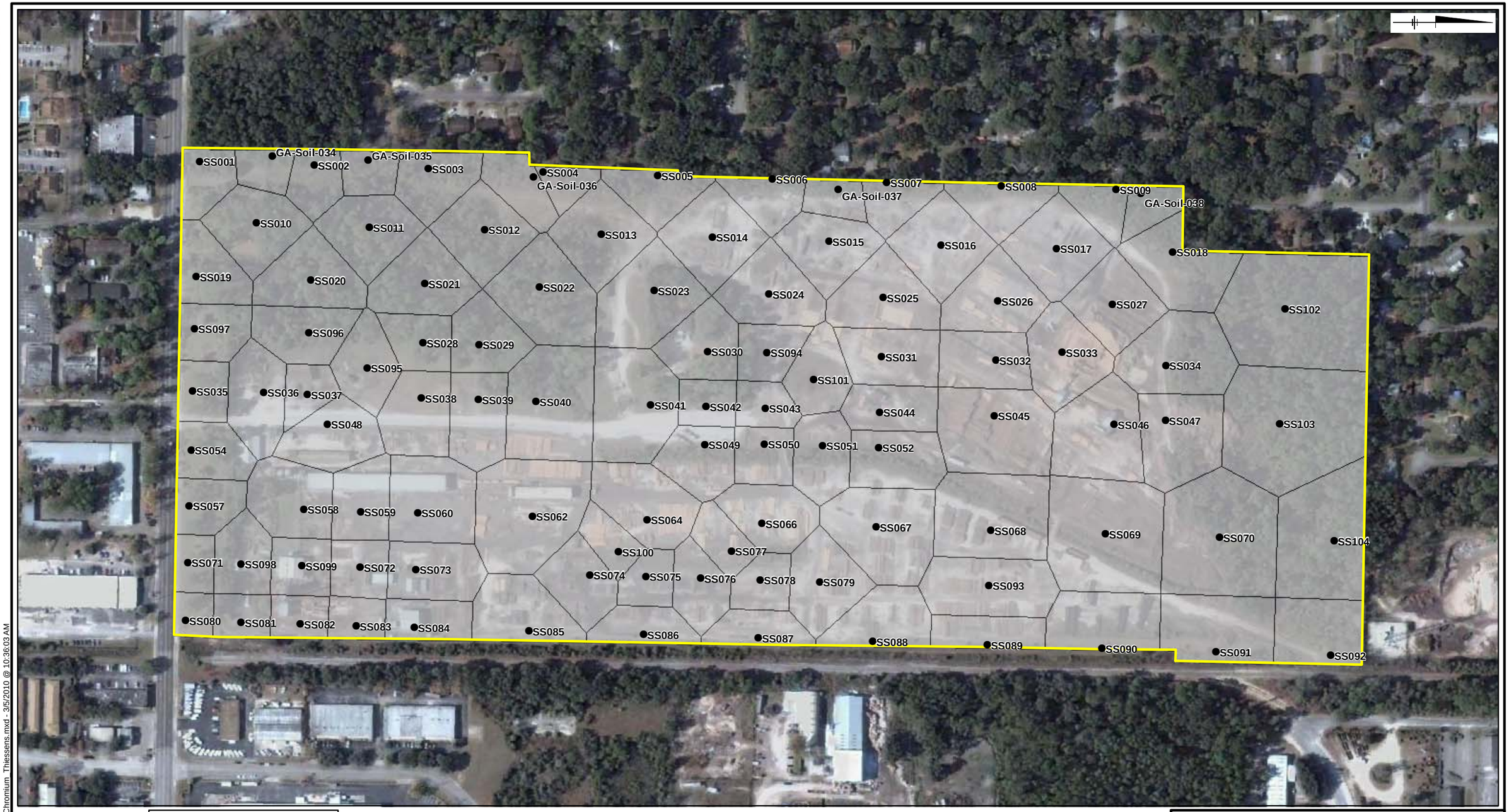
DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR CHROMIUM

ARCADIS

FIGURE 3-6

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Chromium_Thiessens.mxd - 3/5/2010 @ 10:36:03 AM

DRAFT

SITE LOCATION

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

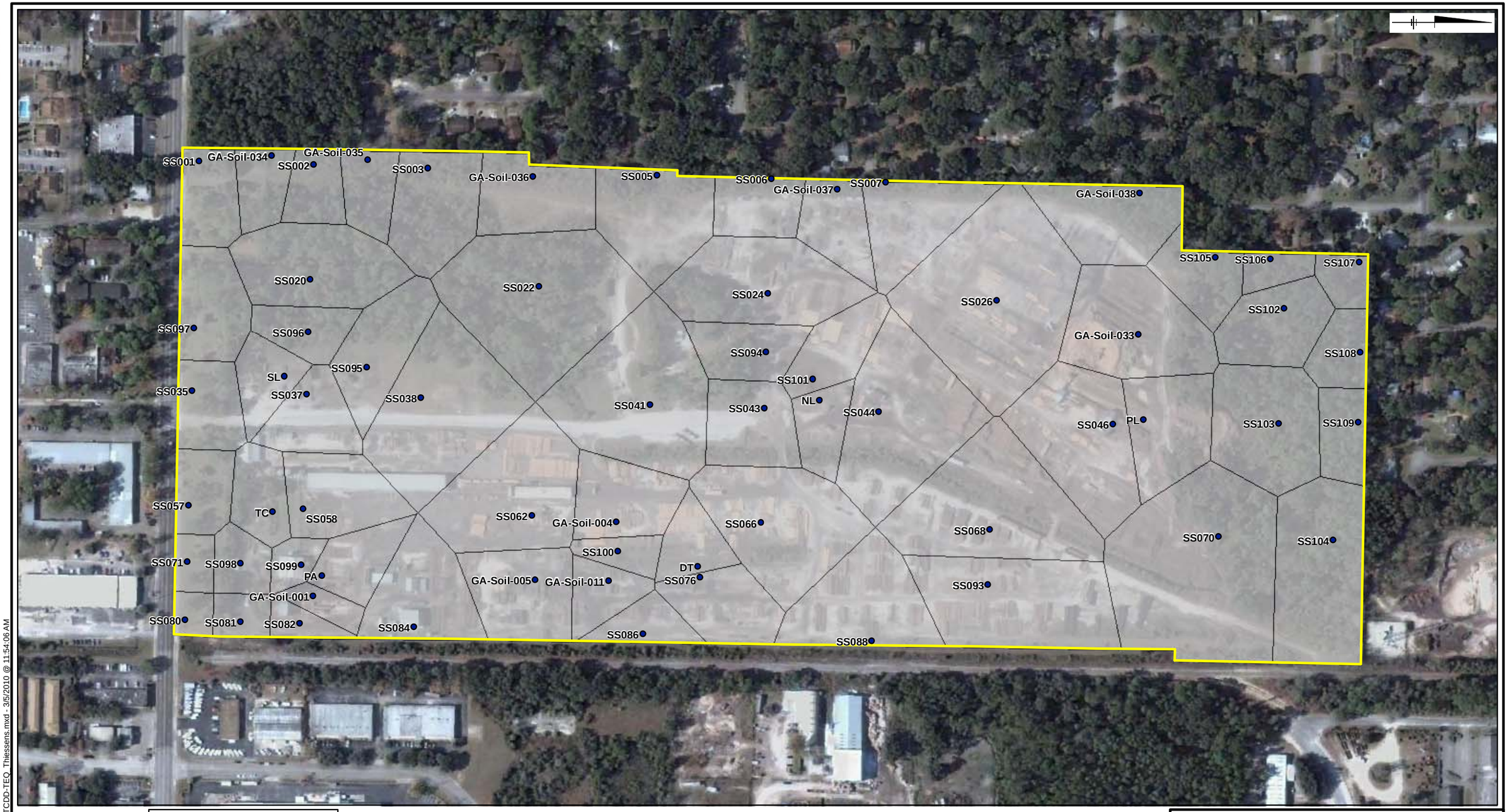
THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR NAPTHALENE AND PENTACHLOROPHENOL

ARCADIS

FIGURE 3-7

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Napthalene-Pentachlor_Thiessens.mxd - 3/5/2010 @ 11:52:30 AM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

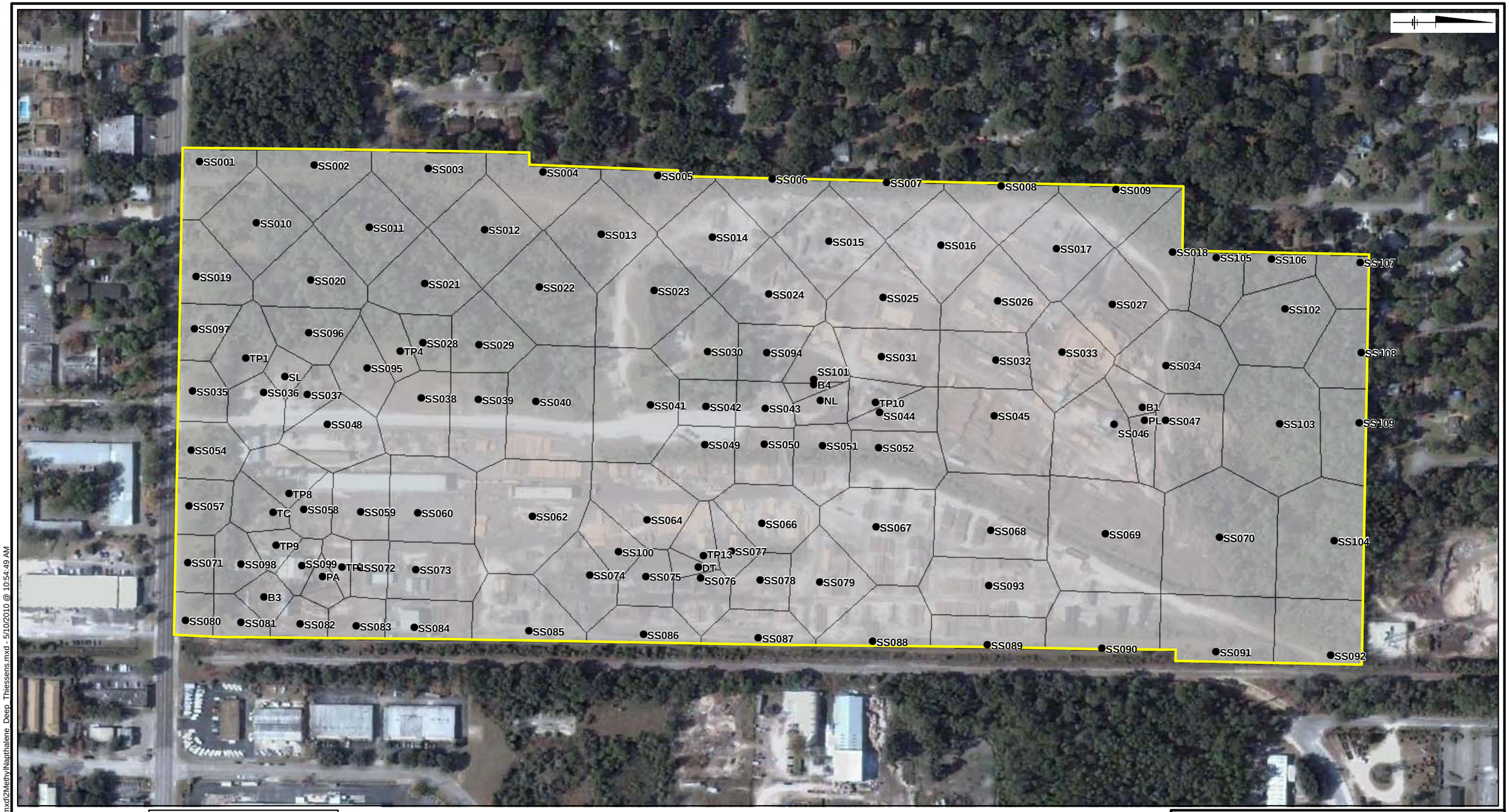
THIESSEN POLYGONS FOR 0-6 INCH SOIL SAMPLE FOR TCDD-DEQ

ARCADIS

FIGURE 3-8

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\TCDD-TEQ_Thiessens.mxd - 3/5/2010 @ 11:54:06 AM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

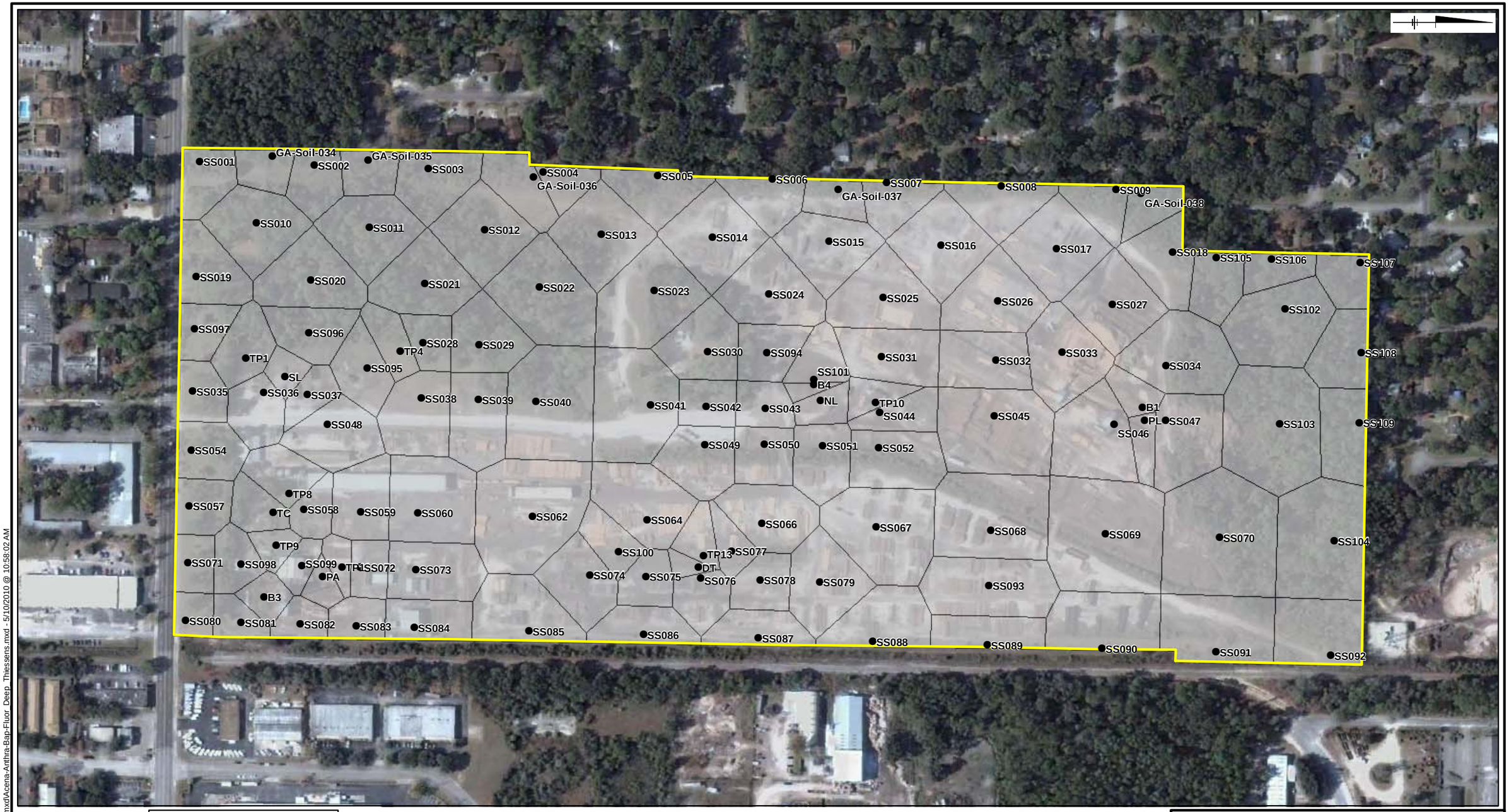
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR 2-METHYLNAPTHALENE

ARCADIS

FIGURE 3-9

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\2MethylNapthalene_Deep_Thiessens.mxd - 5/10/2010 @ 10:54:49 AM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR ACENAPHTHENE, ANTHRACENE, BAP-TE, FLUORANTHENE AND FLUORENE

ARCADIS

FIGURE
3-10

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\Acena-Anthra-Bap-Fluor_Deep_Thiessens.mxd - 5/10/2010 @ 10:58:02 AM

DRAFT

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

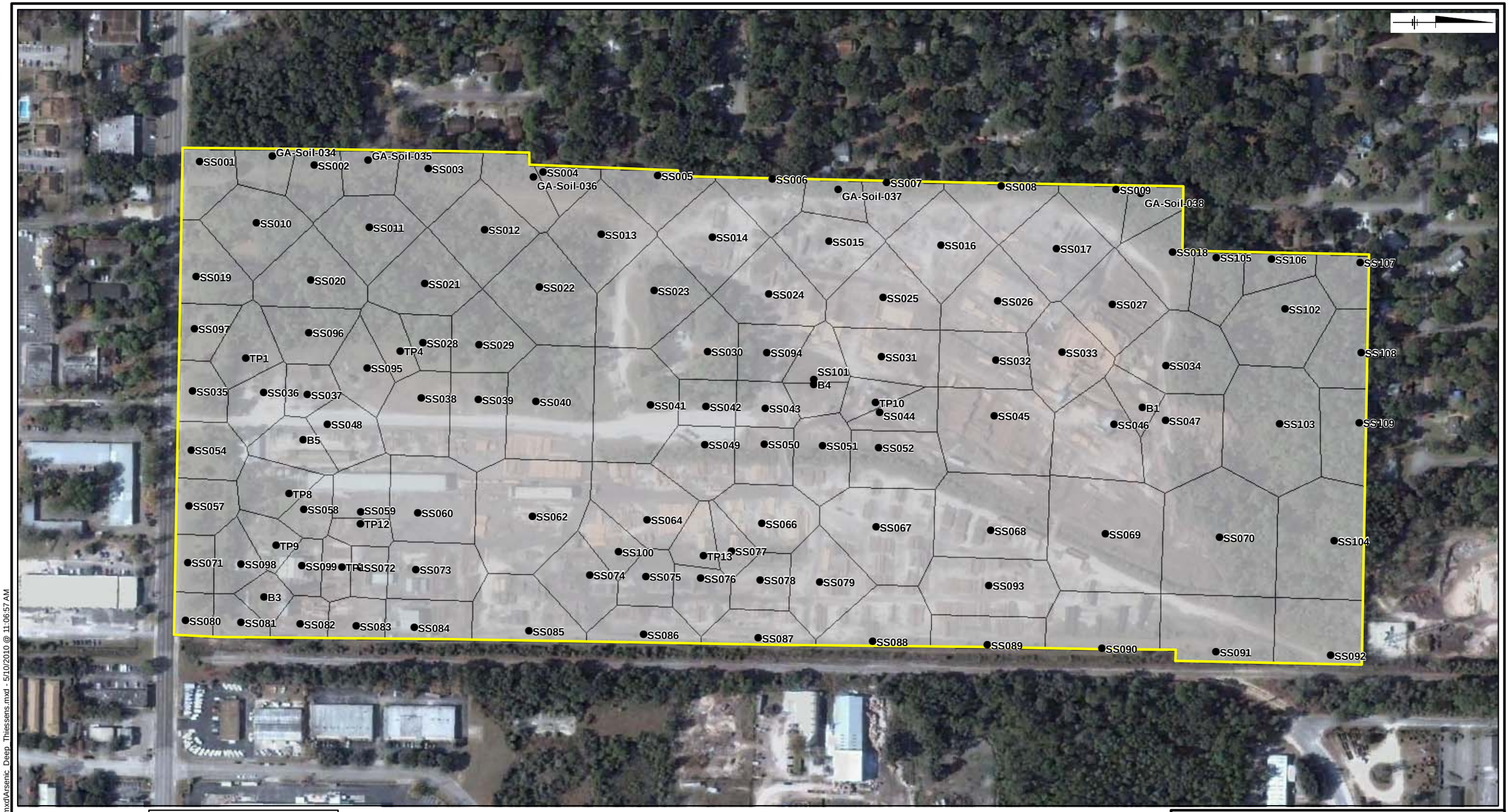
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR ANTIMONY

ARCADIS

FIGURE
3-11

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\Antimony_Deep_Thiessens.mxd - 5/10/2010 @ 10:58:18 AM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR ARSENIC

ARCADIS

FIGURE
3-12

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\Arsenic_Deep_Thiessens.mxd - 5/10/2010 @ 11:06:57 AM

DRAFT

LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

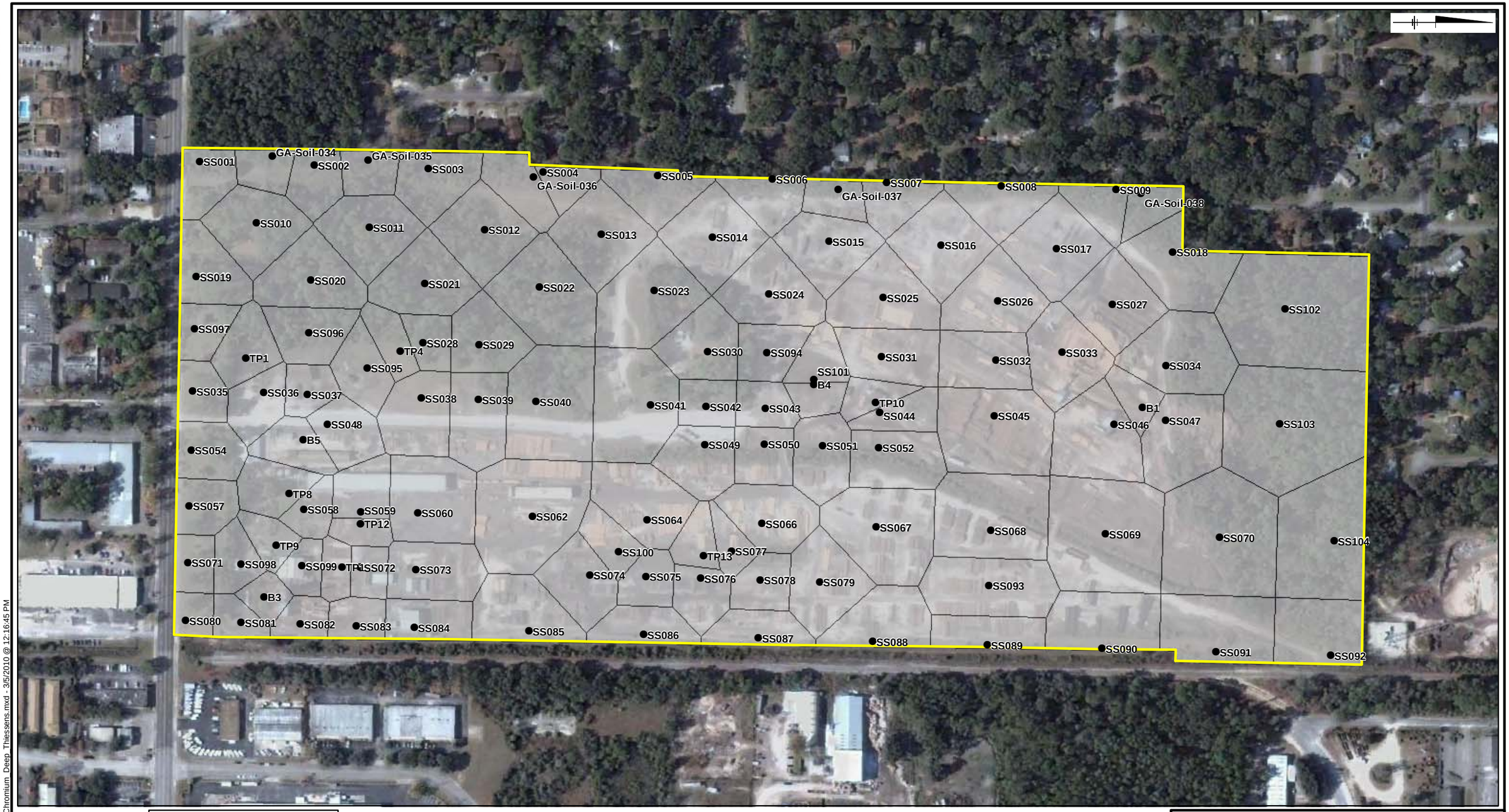
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR LEAD, CARBAZOLE, AND MERCURY

ARCADIS

FIGURE
3-13

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Lead-Mercury-Carbazole_Deep_Thiessens.mxd - 3/5/2010 @ 12:06:12 PM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

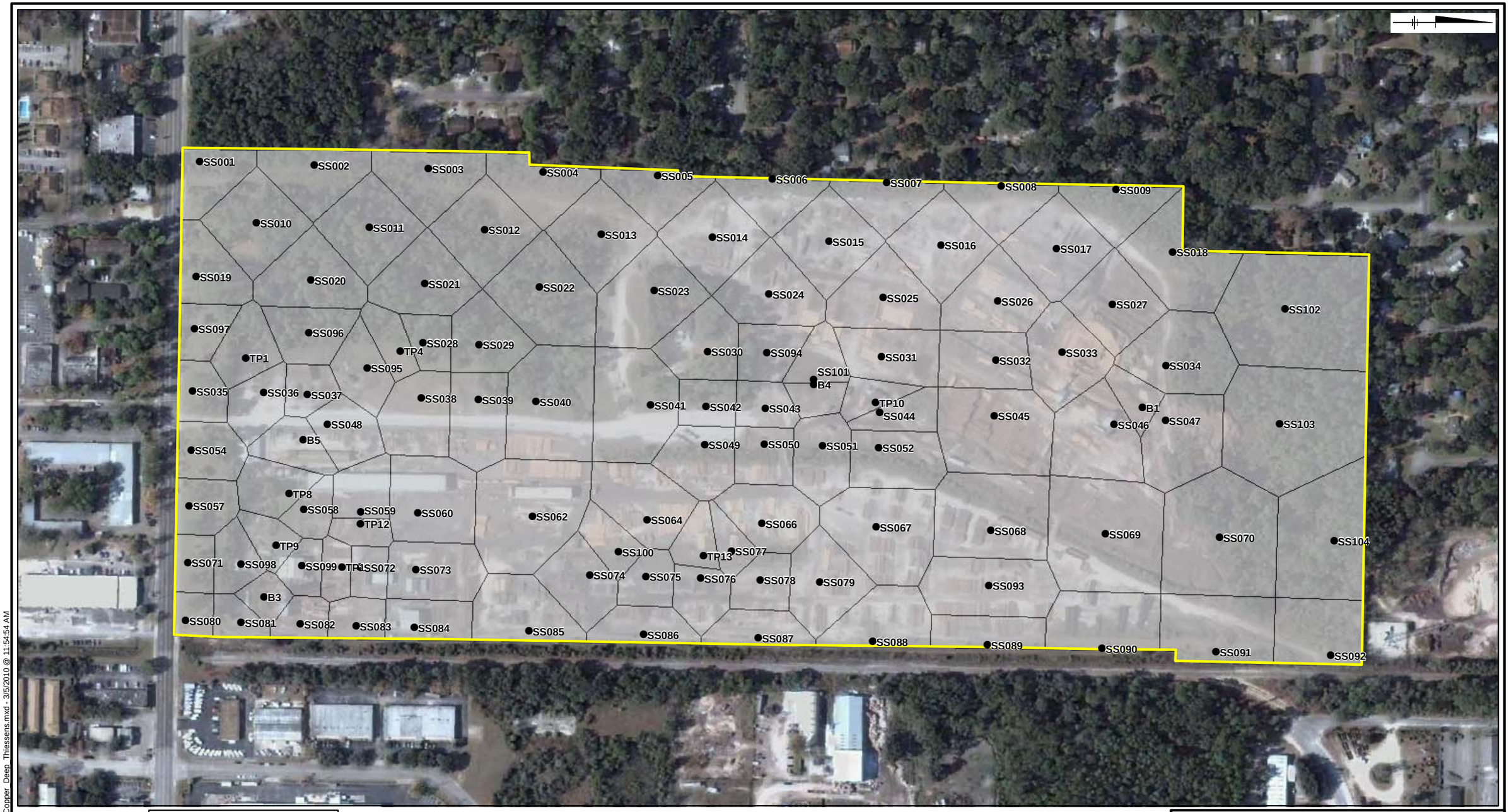
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR CHROMIUM

ARCADIS

FIGURE
3-14

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Chromium_Deep_Thiessens.mxd - 3/5/2010 @ 12:16:45 PM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

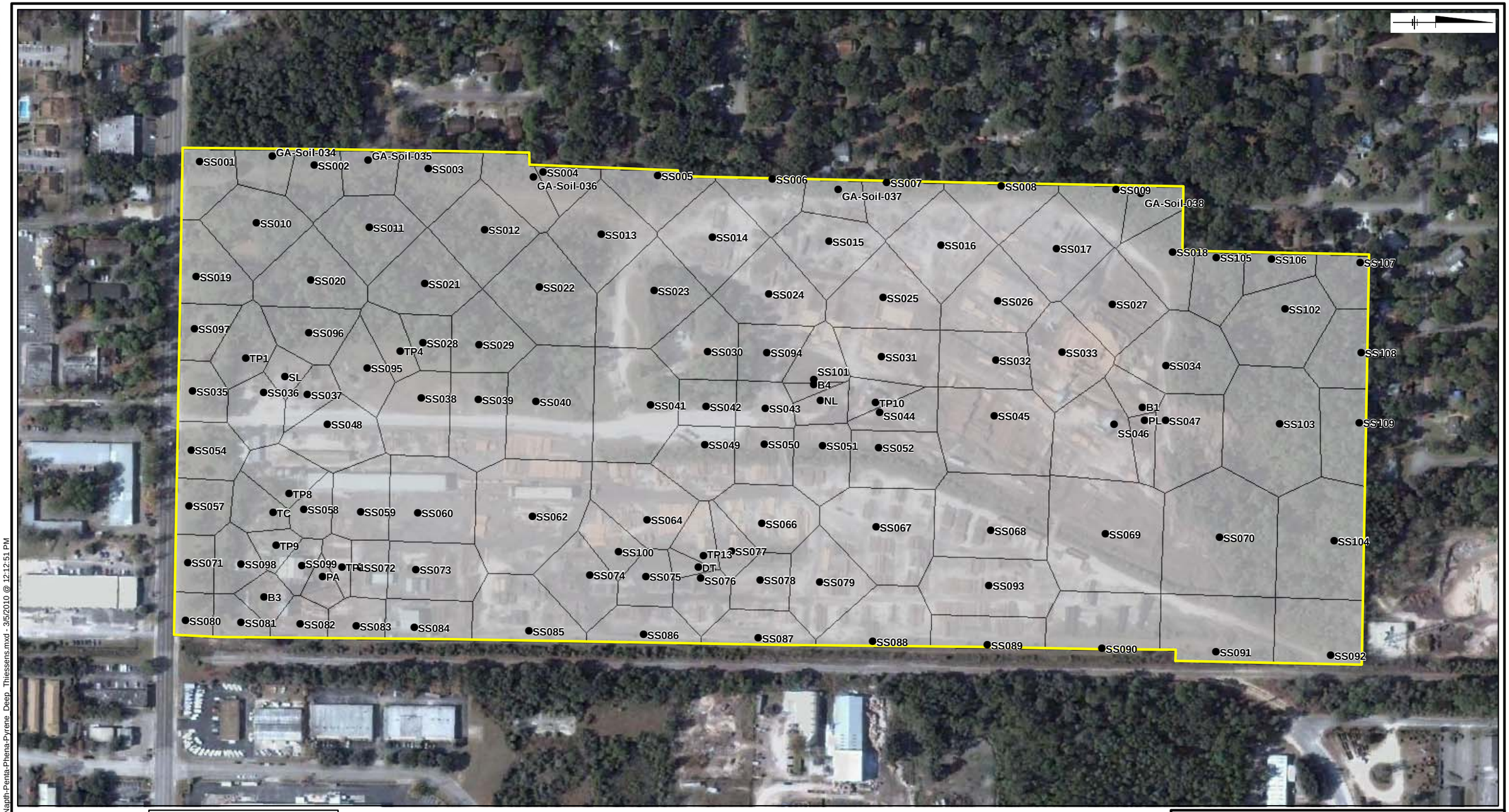
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR COPPER

ARCADIS

FIGURE
3-15

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Copper_Deep_Thiessens.mxd - 3/5/2010 @ 11:54:54 AM

DRAFT



LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

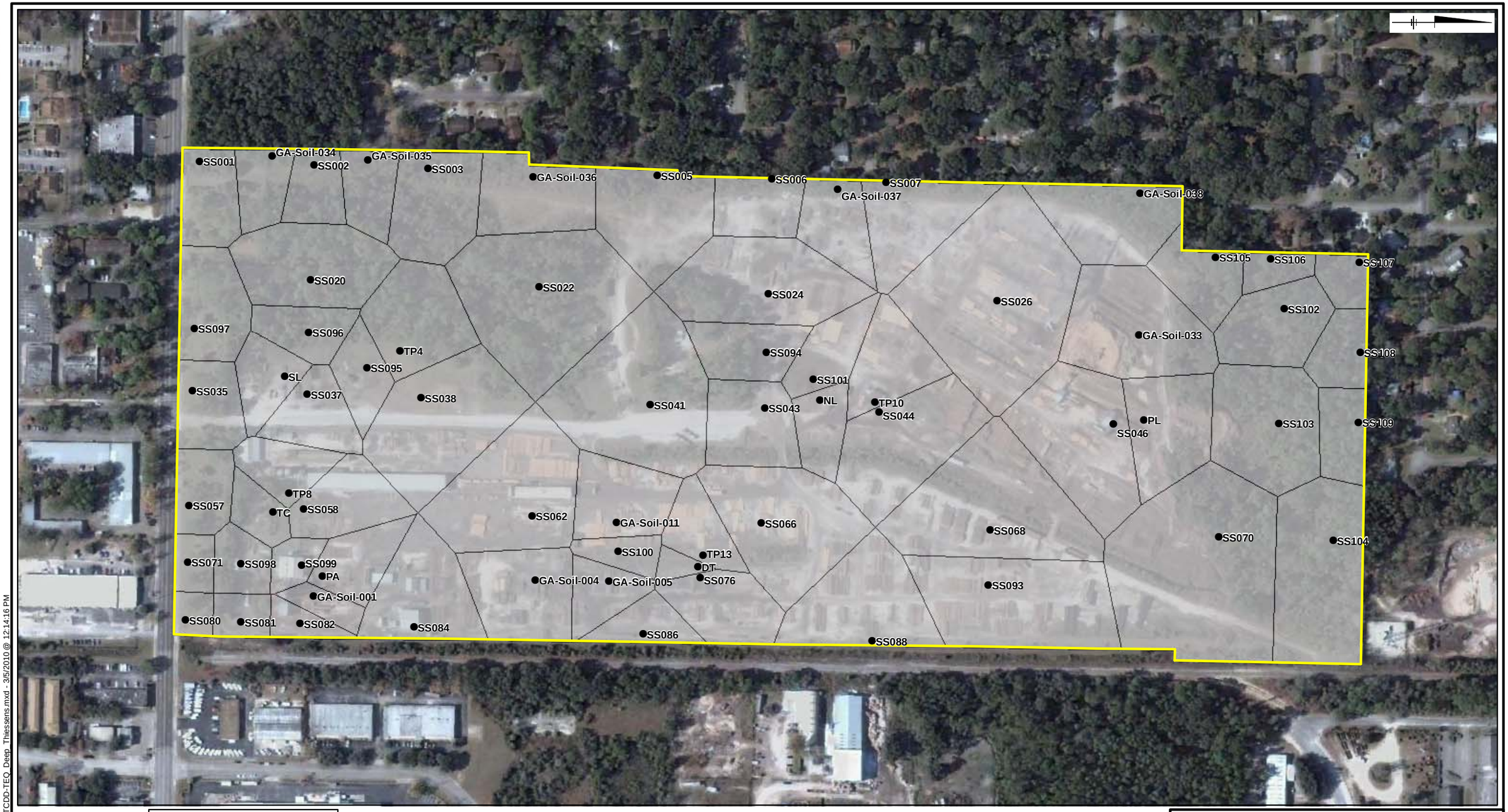
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR NAPTHALENE, PHENANTHRENE, PENTACHLOROPHENOL AND PYRENE

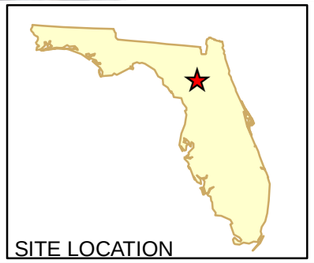
ARCADIS

FIGURE
3-16

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\Napth-Penta-Phena-Pyrene_Deep_Thiessens.mxd - 3/5/2010 @ 12:12:51 PM

DRAFT





LEGEND:

- SAMPLE LOCATION
- SITE BOUNDARY
- THEISSEN POLYGON

0 250 500 Feet

GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

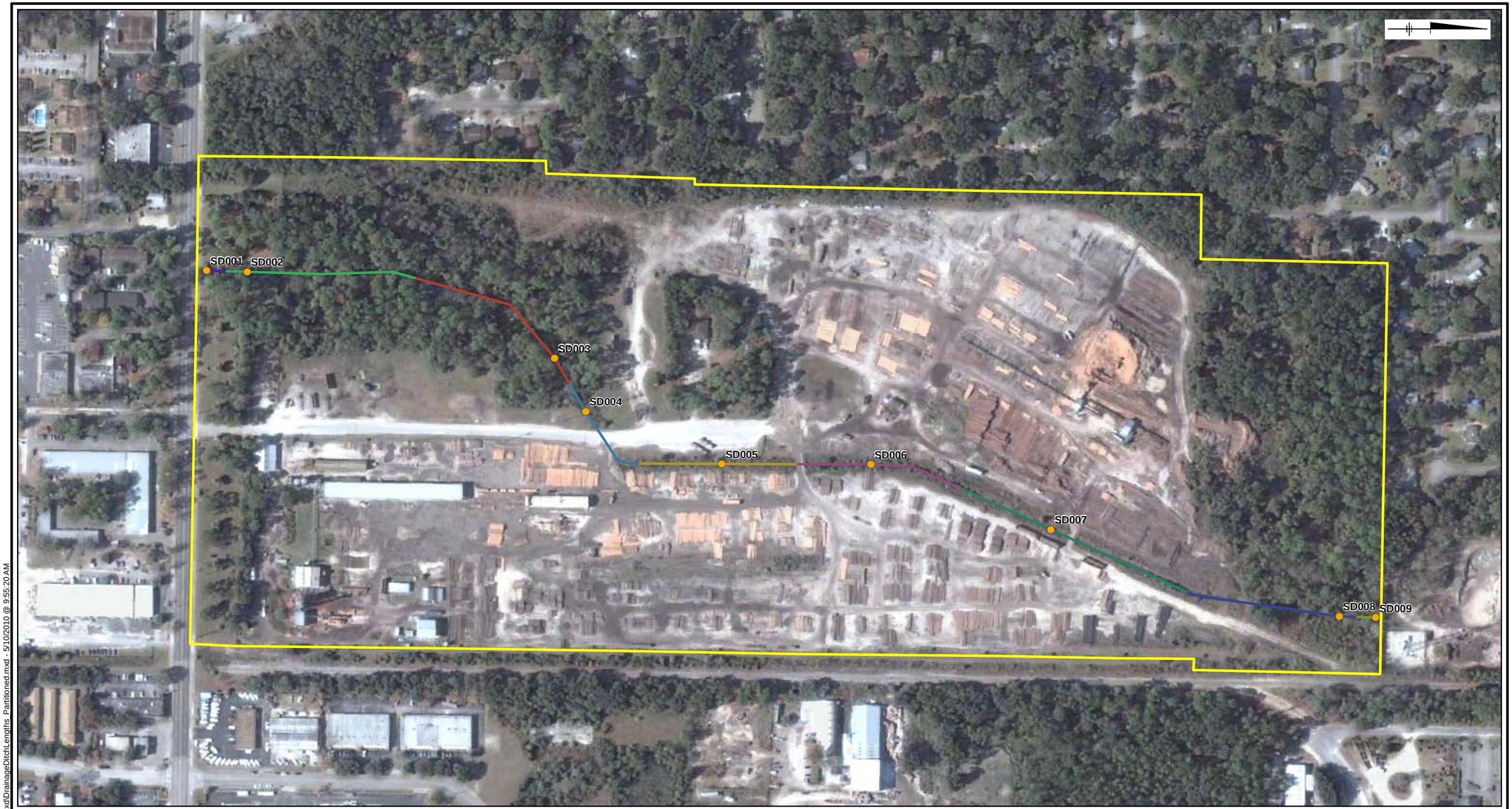
THIESSEN POLYGONS FOR 0-6 FOOT SOIL SAMPLE FOR TCDD-TEQ

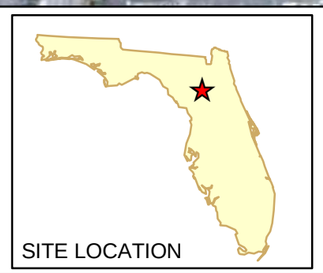
ARCADIS

FIGURE 3-17

CITY: SYR DIV/GROUP: IM/AIT DB: JCR LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\Basemapping\mxd\TCDD-TEQ_Deep_Thiessens.mxd - 3/5/2010 @ 12:14:16 PM

DRAFT





LEGEND:

- SEDIMENT SAMPLE LOCATION
- SITE BOUNDARY

DRAINAGE DITCH LENGTH:

SD001 SD004 SD007
SD002 SD005 SD008
SD003 SD006 SD009

0 250 500 Feet
GRAPHIC SCALE

NOTE:

1. IMAGERY FROM GOOGLE EARTH, ACQUIRED SEPTEMBER 11, 2008.

KOPPER'S INC., WOOD TREATING FACILITY
GAINESVILLE, FLORIDA

EVALUATION OF POTENTIAL THEORETICAL ON-SITE HUMAN HEALTH RISKS ASSOCIATED WITH SOILS AND SEDIMENTS

LENGTHS OF THE DRAINAGE DITCH PARTITIONED FOR SEDIMENT SAMPLE LOCATIONS

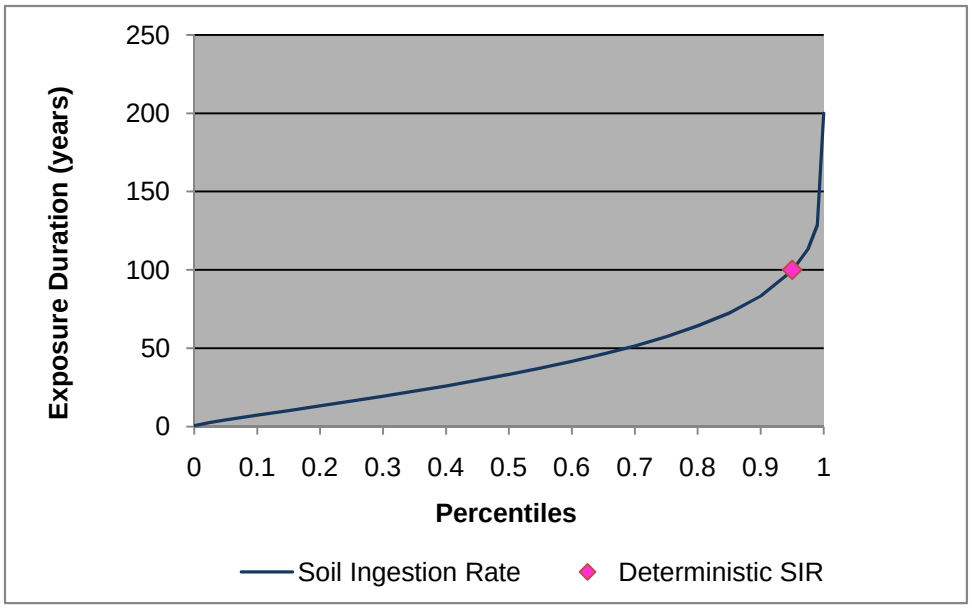
ARCADIS

FIGURE
3-18

CITY: SYR DIV/GROUP: IM/AIT DB: J.RAPP LD: EAL PIC: PM: TM: TR:
BEAZER (39191.2)
Q:\Beazer\Gainesville_FL\EvalPotentialRisks\mxd\DrainageDitchLengths_Partitioned.mxd - 5/10/2010 @ 9:55:20 AM

FIGURE 3-19
THEORETICAL SOIL INGESTION RATE DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

@RISK Parameters	
Number of iterations	NA
@Risk Function	PertAlt(0.5,10,200)

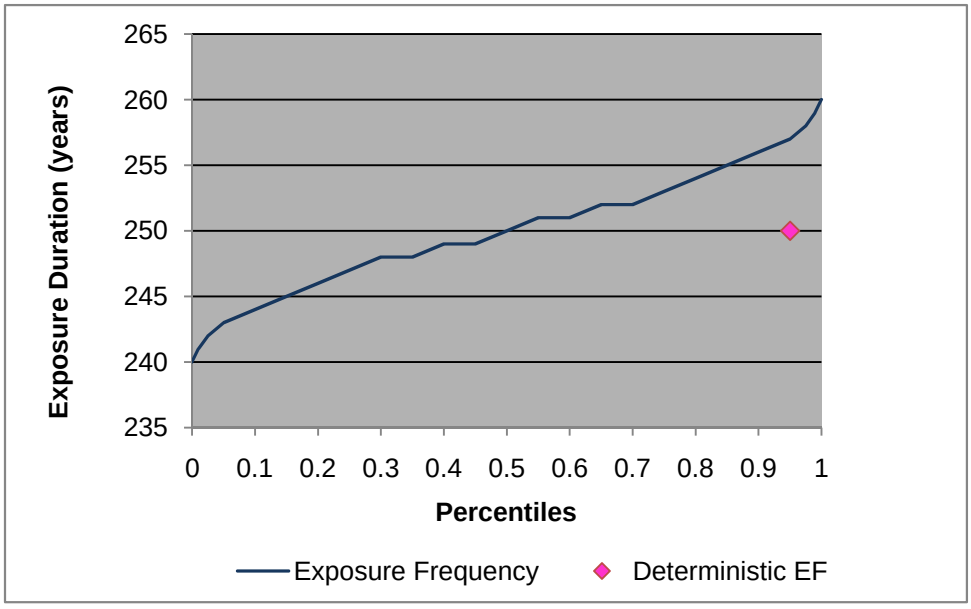


PERT distribution was developed using minimum of 0.5 mg/day, mode of 10 mg/day, and maximum of 200 mg/day (EPA, 1997; Stanek, 1997; professional judgment).

Metric	Soil Ingestion Rates (mg/day)
Mean	0.1090
SD	0.0560
0% (Min)	0.5000
1%	1.4260
2.5%	2.5185
5%	4.1657
10%	7.2406
15%	10.2271
20%	13.2151
25%	16.2510
30%	19.3682
35%	22.5957
40%	25.9628
45%	29.5015
50%	33.2496
55%	37.2535
60%	41.5730
65%	46.2884
70%	51.5130
75%	57.4159
80%	64.2682
85%	72.5544
90%	83.2962
95%	99.4644
97.5%	113.2884
99%	128.6030
100% (Max)	200.0000

FIGURE 3-20
THEORETICAL EXPOSURE FREQUENCY DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

@RISK Parameters	
Number of iterations	5,000
@Risk Function	RiskTriang(240,250,260)

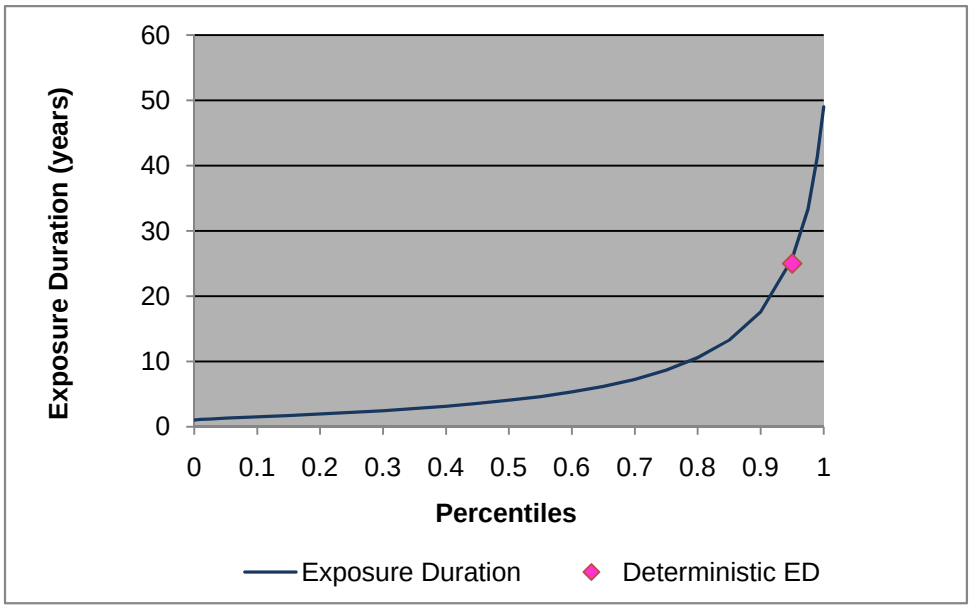


PERT distribution was developed using minimum of 0.5 mg/day, mode of 10 mg/day, and maximum of 200 mg/day (EPA, 1997; Stanek, 1997; professional judgment).

Metric	EF (days/year)
Mean	250
SD	4.1
0% (Min)	240
1%	241
2.5%	242
5%	243
10%	244
15%	245
20%	246
25%	247
30%	248
35%	248
40%	249
45%	249
50%	250
55%	251
60%	251
65%	252
70%	252
75%	253
80%	254
85%	255
90%	256
95%	257
97.5%	258
99%	259
100% (Max)	260

FIGURE 3-21
THEORETICAL EXPOSURE DURATION DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

@RISK Parameters	
Number of iterations	NA
@Risk Function	NA (Empirical data)

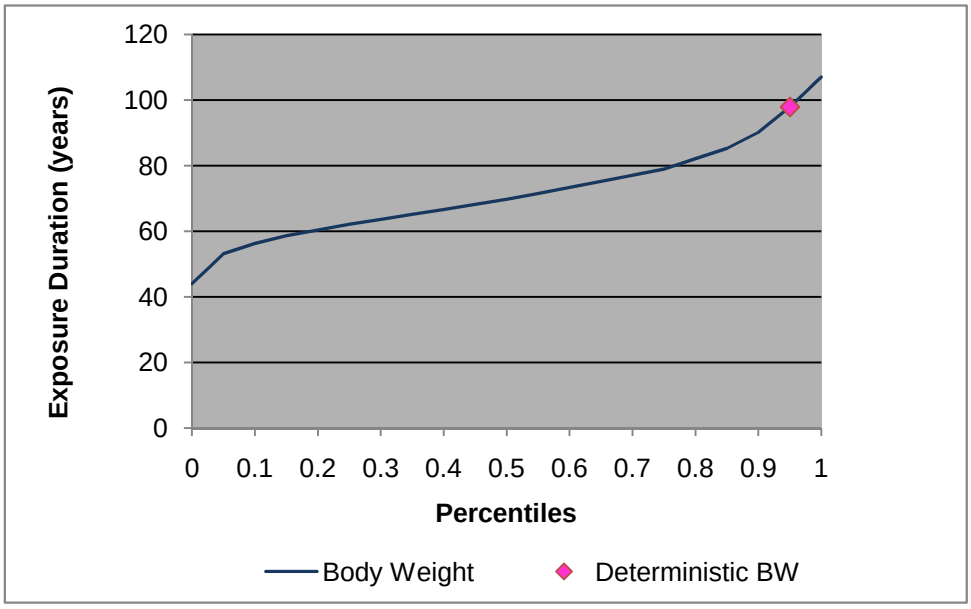


Metric	ED (years)
0% (Min)	1.0252
1%	1.1107
2.5%	1.1855
5%	1.2928
10%	1.4934
15%	1.7016
20%	1.9252
25%	2.1720
30%	2.4496
35%	2.7670
40%	3.1294
45%	3.5448
50%	4.0321
55%	4.6099
60%	5.3093
65%	6.1650
70%	7.2551
75%	8.6480
80%	10.5545
85%	13.2843
90%	17.5732
95%	25.6597
97.5%	33.3066
99%	41.3539
100% (Max)	49.0036

FIGURE 3-22
THEORETICAL BODY WEIGHT DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

@RISK Parameters	
Number of iterations	NA
@Risk Function	RiskCumul(44,107,{52.3, 57.6, 68.7, 84.4, 97}, {0.05, 0.15, 0.5, 0.85, 0.95})

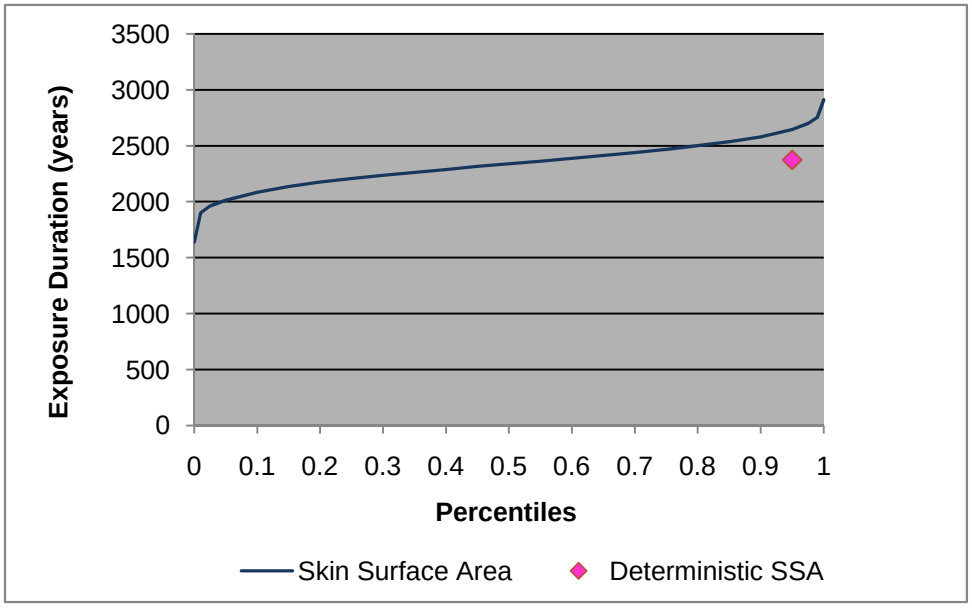
Distribution for Combined Male and Female Body Weight



Metric	Body Weight (kg)
0% (Min)	44.0218
1%	45.8308
2.5%	48.5778
5%	53.1798
10%	56.2953
15%	58.5957
20%	60.3447
25%	62.0948
30%	63.6187
35%	65.1375
40%	66.6583
45%	68.1760
50%	69.6960
55%	71.5367
60%	73.3788
65%	75.2193
70%	77.0568
75%	78.8992
80%	82.0929
85%	85.2901
90%	90.0844
95%	97.8910
97.5%	102.4423
99%	105.1649
100% (Max)	106.9725

FIGURE 3-23
THEORETICAL SKIN SURFACE AREA DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

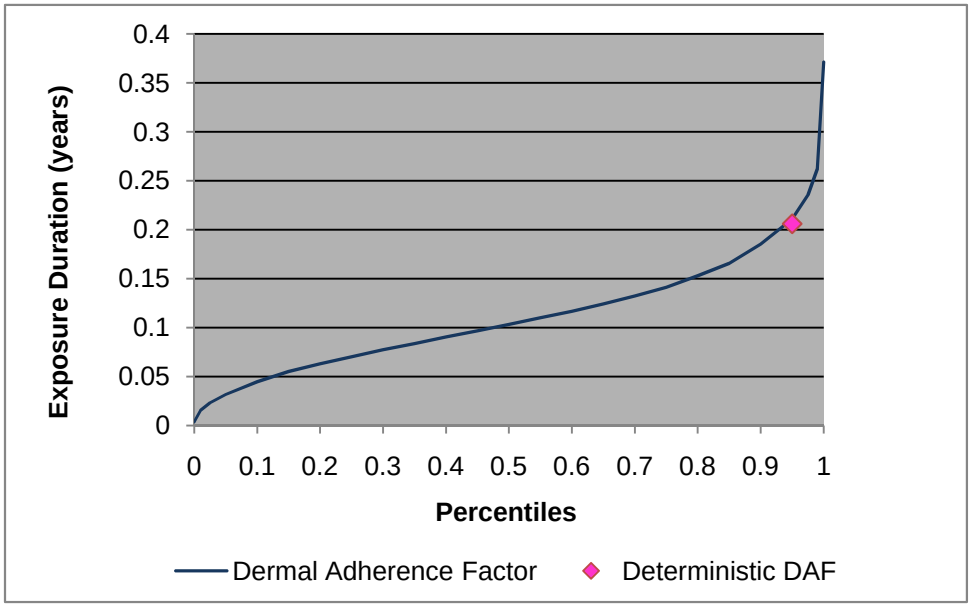
@RISK Parameters	
Number of iterations	NA
@Risk Function	NA (Calculated by the model)



Metric	SSA (cm^2 / worker day)
0% (Min)	1,638
1%	1,901
2.5%	1,960
5%	2,011
10%	2,084
15%	2,136
20%	2,176
25%	2,206
30%	2,235
35%	2,262
40%	2,287
45%	2,315
50%	2,339
55%	2,362
60%	2,387
65%	2,412
70%	2,438
75%	2,466
80%	2,500
85%	2,536
90%	2,578
95%	2,644
97.5%	2,700
99%	2,755
100% (Max)	2,912

FIGURE 3-24
THEORETICAL DERMAL ADHERENCE FACTOR DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

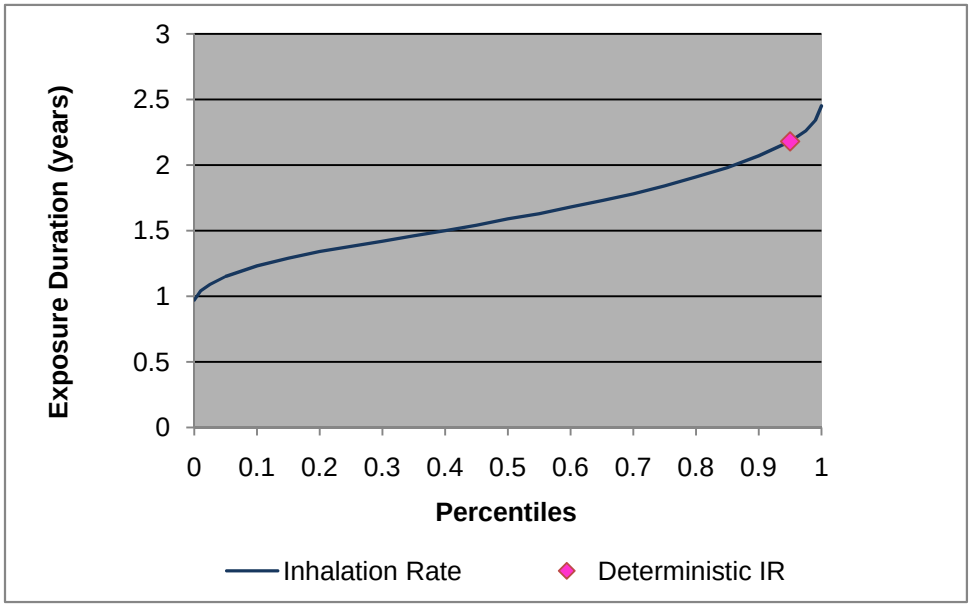
@RISK Parameters	
Number of iterations	NA
@Risk Function	NA (Calculated by the model)



Metric	DAF (mg/cm^2)
Mean	0.1090
SD	0.0560
0% (Min)	0.0037
1%	0.0155
2.5%	0.0230
5%	0.0317
10%	0.0446
15%	0.0551
20%	0.0629
25%	0.0701
30%	0.0774
35%	0.0835
40%	0.0906
45%	0.0967
50%	0.1032
55%	0.1099
60%	0.1165
65%	0.1242
70%	0.1324
75%	0.1412
80%	0.1527
85%	0.1657
90%	0.1852
95%	0.2106
97.5%	0.2356
99%	0.2621
100% (Max)	0.3713

FIGURE 3-25
THEORETICAL INHALATION RATE DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

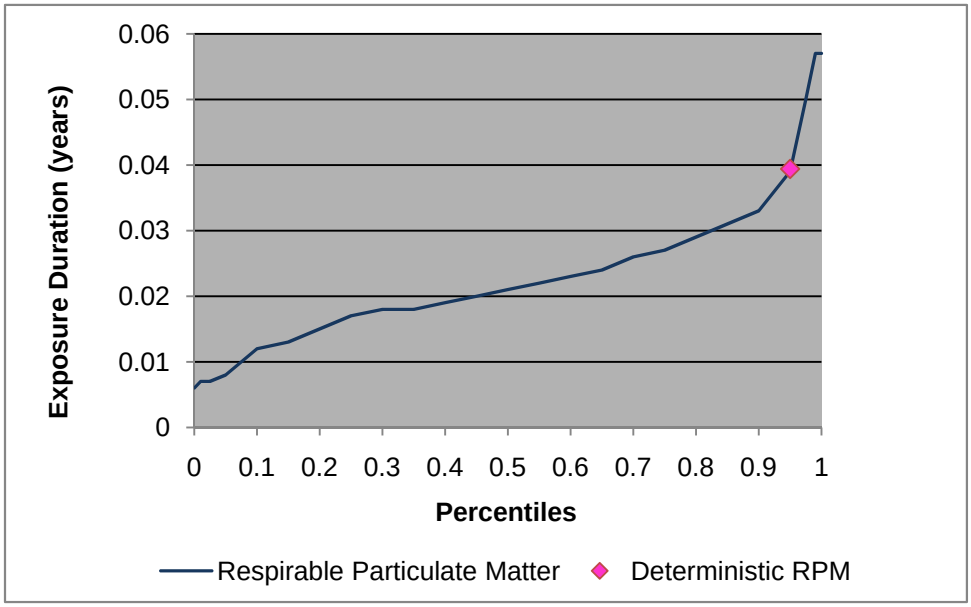
@RISK Parameters	
Number of iterations	5,000
@Risk Function	RiskTriang(0.96,1.44,2.46)



Metric	IR (m^3/hour)
Mean	2.0
SD	0.6
0% (Min)	0.97
1%	1.04
2.5%	1.09
5%	1.15
10%	1.23
15%	1.29
20%	1.34
25%	1.38
30%	1.42
35%	1.46
40%	1.50
45%	1.54
50%	1.59
55%	1.63
60%	1.68
65%	1.73
70%	1.78
75%	1.84
80%	1.91
85%	1.98
90%	2.07
95%	2.18
97.5%	2.26
99%	2.34
100% (Max)	2.45

FIGURE 3-26
THEORETICAL RESPIRABLE PARTICULATE MATTER DISTRIBUTION
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

@RISK Parameters	
Number of iterations	NA
@Risk Function	N/A (used measured data)



Metric	RPM (mg/cm^3)
Mean	0.022
SD	0.001
0% (Min)	0.006
1%	0.007
2.5%	0.007
5%	0.008
10%	0.012
15%	0.013
20%	0.015
25%	0.017
30%	0.018
35%	0.018
40%	0.019
45%	0.020
50%	0.021
55%	0.022
60%	0.023
65%	0.024
70%	0.026
75%	0.027
80%	0.029
85%	0.031
90%	0.033
95%	0.039
97.5%	0.050
99%	0.057
100% (Max)	0.057

FIGURE 3-27
THEORETICAL RELATIVE ABSORPTION FACTOR DISTRIBUTIONS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

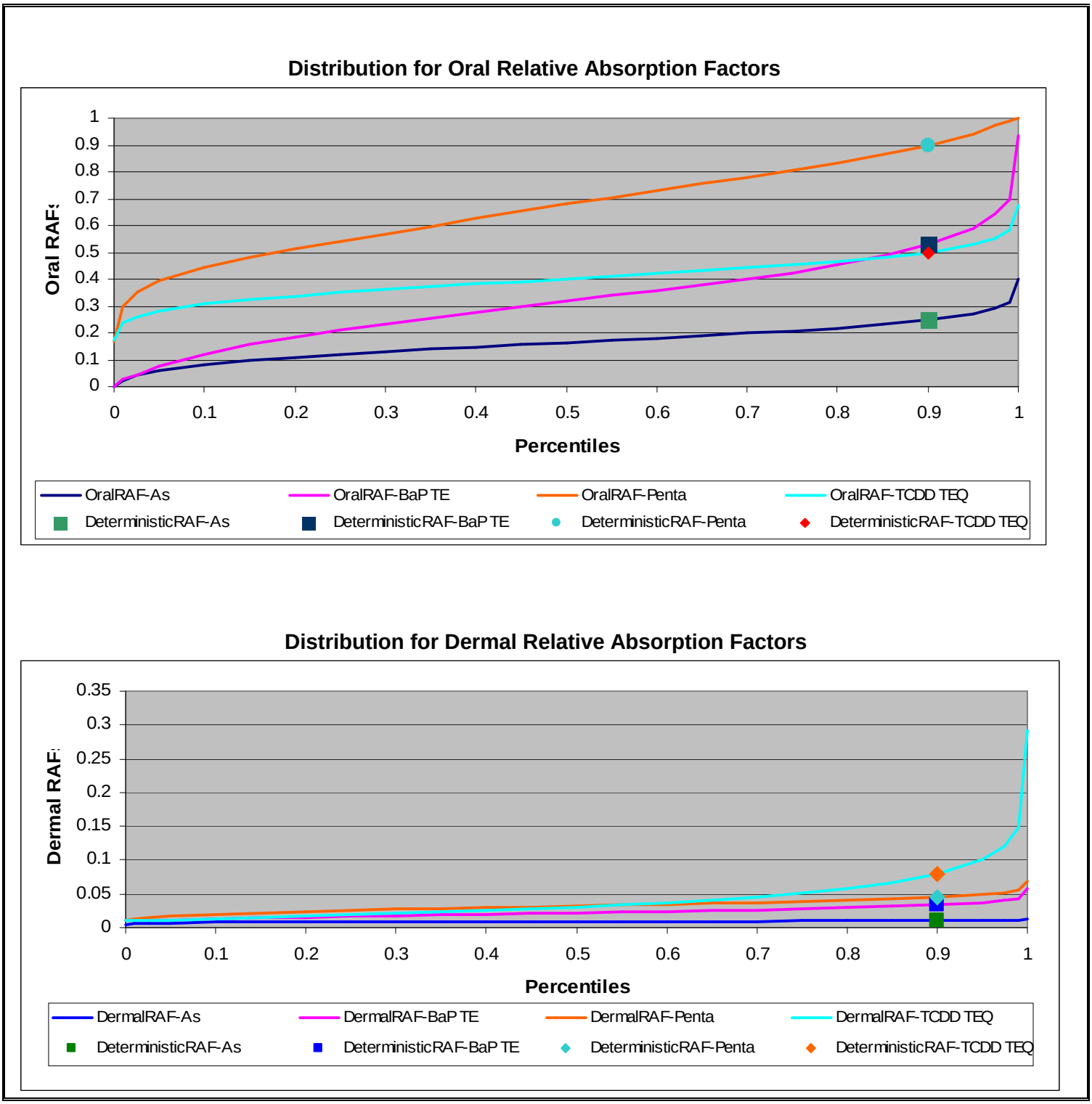


FIGURE 3-27
THEORETICAL RELATIVE ABSORPTION FACTOR DISTRIBUTIONS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Summary Statistics – Oral Relative Absorption Factors

Metric	Oral RAF – Arsenic (unitless)	Oral RAF – BaP-TE (unitless)	Oral RAF – Pentachlorophenol (unitless)	Oral RAF - TCDD-TEQ (unitless)
Mean	0.163	0.31	0.66	0.4
SD	0.065	0.17	0.23	0.07
Distribution Type	Normal	Normal	Percentile	Bootstrap
0% (Min)	0.0006	0.0004	0.1652	0.1746
1%	0.0234	0.0272	0.2986	0.2397
2.5%	0.0416	0.0457	0.3520	0.2611
5%	0.0595	0.0749	0.3950	0.2821
10%	0.0817	0.1203	0.4436	0.3059
15%	0.0970	0.1559	0.4791	0.3230
20%	0.1094	0.1837	0.5109	0.3375
25%	0.1201	0.2088	0.5403	0.3489
30%	0.1297	0.2330	0.5696	0.3603
35%	0.1386	0.2556	0.5971	0.3714
40%	0.1471	0.2758	0.6253	0.3811
45%	0.1554	0.2965	0.6526	0.3907
50%	0.1635	0.3168	0.6792	0.4001
55%	0.1716	0.3381	0.7052	0.4098
60%	0.1799	0.3583	0.7298	0.4198
65%	0.1884	0.3793	0.7547	0.4301
70%	0.1974	0.4000	0.7797	0.4409
75%	0.2071	0.4228	0.8058	0.4529
80%	0.2180	0.4530	0.8333	0.4658
85%	0.2306	0.4858	0.8648	0.4811
90%	0.2465	0.5286	0.8992	0.4996
95%	0.2701	0.5880	0.9432	0.5275
97.5%	0.2904	0.6431	0.9704	0.5500
99%	0.3142	0.6956	0.9869	0.5815
100% (Max)	0.3997	0.9373	0.9999	0.6766

FIGURE 3-27
THERETICAL RELATIVE ABSORPTION FACTOR DISTRIBUTIONS
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

Summary Statistics – Dermal Relative Absorption Factors

Metric	Dermal RAF – Arsenic (unitless)	Dermal RAF – BaP-TE (unitless)	Dermal RAF – Pentachlorophenol (unitless)	Dermal RAF - TCDD-TEQ) (unitless)
Mean	0.009	0.02	0.032	0.03
SD	0.001	0.01	0.01	0.06
Distribution Type	Normal	Normal	Normal	Exponential
0% (Min)	0.005	0.010	0.010	0.010
1%	0.007	0.010	0.012	0.010
2.5%	0.007	0.011	0.014	0.011
5%	0.007	0.012	0.017	0.012
10%	0.008	0.013	0.020	0.013
15%	0.008	0.014	0.022	0.015
20%	0.008	0.016	0.024	0.017
25%	0.008	0.017	0.026	0.019
30%	0.008	0.018	0.027	0.021
35%	0.009	0.019	0.028	0.023
40%	0.009	0.020	0.030	0.025
45%	0.009	0.021	0.031	0.028
50%	0.009	0.022	0.032	0.031
55%	0.009	0.023	0.033	0.034
60%	0.009	0.024	0.035	0.037
65%	0.009	0.025	0.036	0.041
70%	0.010	0.027	0.037	0.046
75%	0.010	0.028	0.039	0.052
80%	0.010	0.030	0.041	0.058
85%	0.010	0.031	0.042	0.067
90%	0.010	0.034	0.045	0.079
95%	0.011	0.037	0.049	0.100
97.5%	0.011	0.040	0.052	0.121
99%	0.011	0.044	0.055	0.148
100% (Max)	0.013	0.059	0.069	0.292

FIGURE 5-1
MEE MODEL RESULTS - POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISK FOR ALL COPCS AND ALL EXPOSURE PATHWAYS AND COMPARISON TO DETERMINISTIC RESULTS - HYPOTHETICAL FUTURE ON-SITE INDOOR WORKER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA

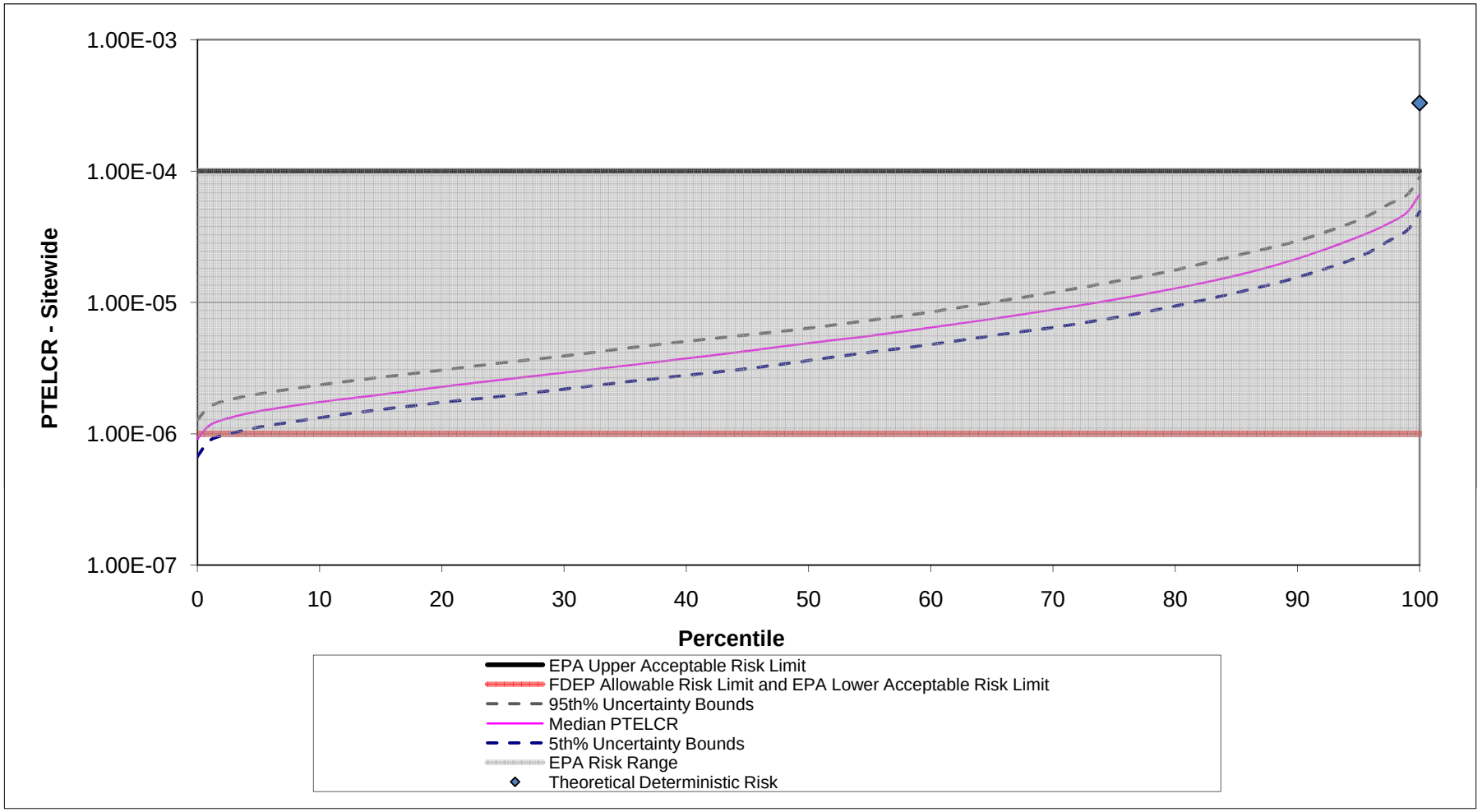
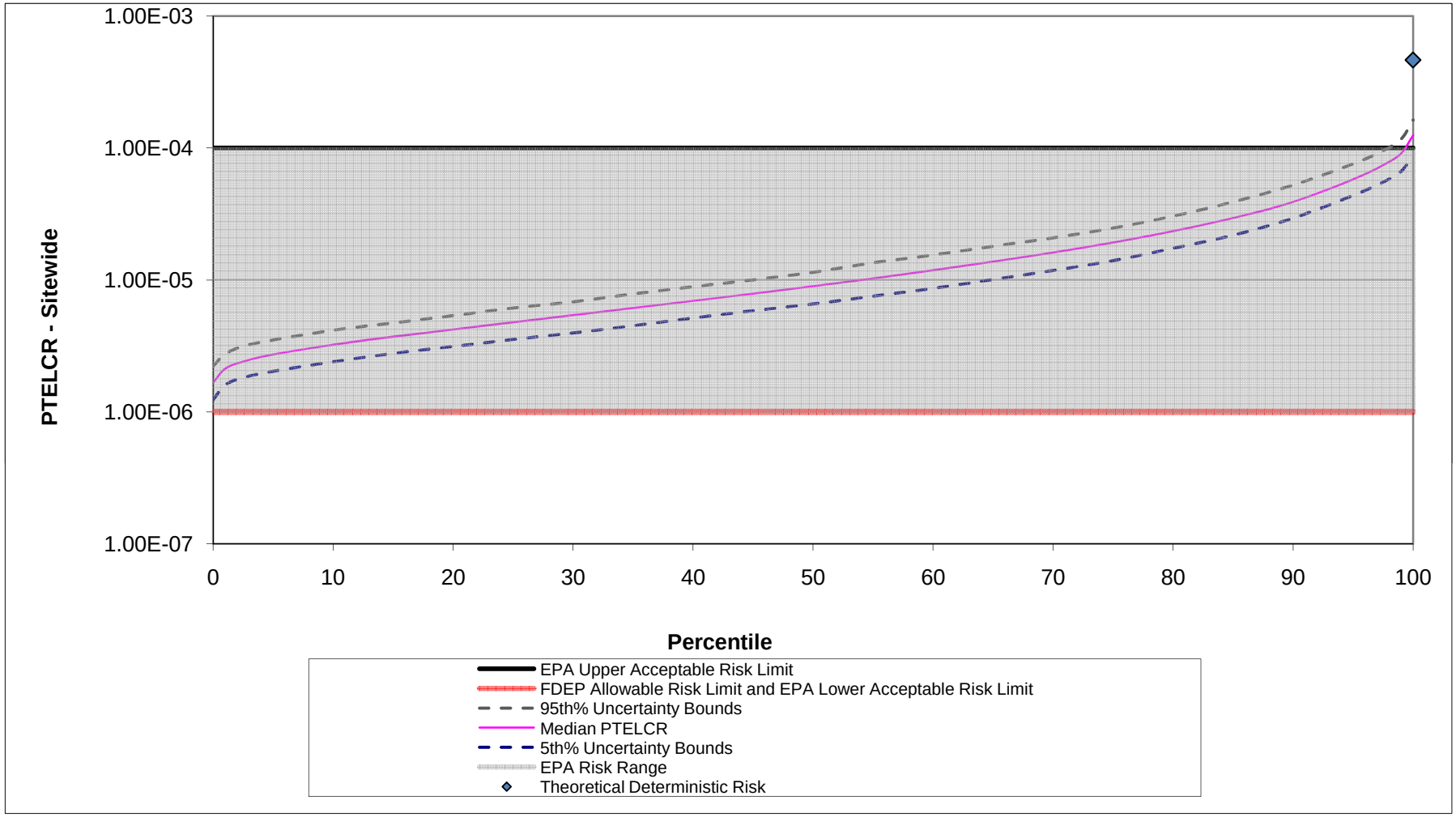



FIGURE 5-2
MEE MODEL RESULTS - POTENTIAL THEORETICAL EXCESS LIFETIME CANCER RISK FOR ALL COPCS AND ALL EXPOSURE PATHWAYS AND COMPARISON TO DETERMINISTIC RESULTS - HYPOTHETICAL FUTURE ON-SITE OUTDOOR WORKER
FORMER KOPPERS, INC. WOOD-TREATING FACILITY
GAINESVILLE, FLORIDA