Ecological Risk Assessment
Steps 1-4 - Screening-Level Assessment, Problem Formulation, and Study Design

Sonford Products Site
Flowood, Rankin County, Mississippi

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Acronyms and Abbreviations

Ah	Aryl hydrocarbon
ATSDR	Agency of Toxic Substances and Disease Registry
ATV	Alternate toxicity value
BAF	Bioaccumulation factor
BSAF	Biota-sediment-accumulation factors
BW	Body weight
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Chemical of potential concern
CSM	Conceptual site model
DDT	Dichlorodiphenyltrichloroethane
DQO	Data quality objective
dw/bw/day	dry weight per body weight per day
dw/g BW/day	dry weight per gram of body weight per day
Eco-SSL	Ecological Soil Screening Levels
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentrations
ERA	Ecological Risk Assessment
ESV	Ecological screening value
FDEP	Florida Department of Environmental Protection
FoD	Frequency of Detection
g	gram
g/gBW	grams per gram of body weight
ha	hectare
HQ	Hazard quotient
kg	kilogram
Kow	Octanol-water partitioning coefficient
L	Liter
LOAEL	Lowest-Observed-Adverse-Effect-Level
MBPC	Mississippi Bureau of Pollution Control
MDEQ	Mississippi Department of Environmental Quality
MDNR	Mississippi Department of Natural Resources
µg	microgram
µg/kg	micrograms per kilogram
µg/kg/day	micrograms per kilogram per day
mg	milligram
mg/kgBW/day	milligrams per kilogram of body weight per day
mg/L	milligrams per liter
mL	milliliter
ng	nanogram
ng/kgBW/day	nanograms per kilogram of body weight per day
NOAEL	No-observed-adverse-effect-level
PAHs	Polycyclic aromatic hydrocarbons

Acronyms and Abbreviations
(Continued)

PA/SI	Preliminary Assessment/Site Investigation
PCBs	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzodioxin
PCDF	Polychlorinated dibenzofuran
PCOPC	Preliminary chemical of potential concern
PCP	Pentachlorophenol
pg/g	picograms per gram
QAPP	Quality Assurance Project Plan
RGOs	Remedial Goal Options
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
RME	Reasonable Maximum Exposure
SAP	Sampling and Analysis Plan
SCTLs	Soil Cleanup Target Levels
SESD	Science and Ecosystems Support Division
SMDP	Scientific/Management Decision Point
SQL	Sample quantitation limits
SVOC	Semivolatile organic compounds
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEF	Toxic equivalency factors
TEQ	Toxic equivalency quotient
TRV	Toxicity reference values
UCL	Upper Confidence Limit
USDI	U.S. Department of the Interior
VOC	Volatile organic compounds

1.0 Introduction

The Sonford Products Site encompasses a 6-acre site in the City of Flowood, Rankin County, Mississippi. The facility housed two separate chemical processing facilities operated by Sonford International and Sonford Products from 1972 to 1985. The operations of both companies involved turning solid pentachlorophenol (PCP) into liquid formulations. Sonford International operated at the site from 1972 to 1980 and produced a water-soluble product, sodium pentachlorophenate, that is used for protection of wood products [Mississippi Bureau of Pollution Control (MBPC), 1989]. Sonford Products operated at the site from 1980 to March 1985 and produced PCP-based chemicals for the control of pests and products to control the growth of mold and sap stains in freshly cut lumber (MBPC, 1989; Weston, 2005).

The site was placed on the U.S. Environmental Protection Agency (USEPA) National Priorities List on March 7, 2007, and several environmental studies have been conducted on the site related to actions pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.1 Purpose and Overview

The purpose of this document is to begin the ecological risk assessment (ERA) process that will provide information necessary to assist risk managers in making informed decisions regarding the potential adverse impacts to the environment from a release or threat of release of hazardous substances. The risk assessment is developed as part of a Remedial Investigation and Feasibility Study (RI/FS) under CERCLA, consistent with *Guidelines for Ecological Risk Assessment* (USEPA, 1998), the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997a), and EPA Region 4 supplemental risk assessment guidance (USEPA, 2001).

The first two steps of EPA's 1997 risk assessment process provide for a screening-level evaluation of available data to determine if:

- Ecological risks are negligible.
- The ERA process should continue to determine whether a risk exists (that is, whether to continue to Step 3).

- There is a potential for adverse ecological effects, and a more detailed assessment, incorporating more site-specific information, is needed.

Typically, EPA considers the results of Steps 1 and 2 before proceeding to subsequent steps, if proceeding is determined to be appropriate. For this Site, however, EPA effectively made the decision that the ERA process should proceed to the next steps to determine whether a risk exists. This is because EPA completed a few interim removal actions at the site in order to reduce threats to human health and the environment, and a more thorough assessment of ecological risks is needed for the RI/FS to assist in identifying a final remedy. For this reason, this document includes Steps 3 and 4 of the risk assessment process. Because there have been interim removal actions to protect human health and the environment, concentrations of hazardous substances at the site have been substantially reduced. The potential to further reduce exposures is evaluated in Step 3 - Problem Formulation. The outcome of Step 3 and its associated Scientific/Management Decision Point (SMDP), include identifying the assessment and measurement endpoints, exposure pathways, risk questions, a conceptual site model, and a detailed evaluation of the ecosystem potentially at risk.

1.2 Site Description and History

1.2.1 Background

The Sonford Products Site is a 6-acre site located at 3506 Payne Drive, Flowood, Rankin County, Mississippi and is located within a light industrial/residential area. The property currently contains a concrete pad, a shed, a concrete cistern, a building formerly used as the forming area for fiberglass septic tanks, three steel-beam framed structures with metal roofs, and one steel-beam framed structure without a roof. In addition to these structures, there is a multi-family residential structure containing approximately five apartment units located on the northeast portion of the site. A single-wide mobile home is located at the southeast corner of the site. In 2006, a total of five people resided on the Sonford property, three in the apartments and two in the mobile home (Weston, 2005). The general study area is shown in Figure 1-1.

The primary chemicals produced from solid PCP at the Sonford site included sodium pentachlorophenate (used for the protection of wood products from mildew), an oil-soluble PCP product used for the long-term protection of wood products, and a few other PCP-related compounds used for the control of pests, molds, and sap stains in freshly cut lumber (Weston, 2005).

The Mississippi Department of Environmental Quality (MDEQ) conducted a hazardous waste inspection in December 1980 at the Sonford facility. The inspection identified quantities of chemicals and wastes generated during the facility's operations including 550 pounds of PCP and 6,000 pounds of sodium pentachlorophenate. The waste product was a sludge that was stored in drums on the site and transported for disposal at Chemical Waste Management in Emelle, Alabama (MBPC, 1980). The sodium pentachlorophenate was also stored on site in drums and then transported to a Sonford facility in St. Paul, Minnesota for reuse (MBPC, 1980).

1.2.2 Remedial Actions and Investigations

On April 18, 1985, approximately 2,000 gallons of PCP were spilled into the wetland south of the property [U.S. Department of the Interior (USDI), 1974; USEPA, 1985]. The Mississippi Department of Natural Resources (MDNR) responded to the spill and began remediation of the adjacent forest wetland area. On April 21 and 22, 1985, EPA assumed responsibility for remediation at the Sonford site (USEPA, 1985; MBPC, 1985). Remediation of the wetland included the excavation and removal of approximately 2,500 cubic yards of impacted soils. The contaminated soils were transported to a chemical waste disposal facility in Emelle, Alabama. The remediation efforts also included the disposal of more that 10,000 gallons of oil and treating solution at an incinerator in South Carolina and the treatment and disposal of approximately 100,000 gallons of existing wastewater. The remedial action was completed on May 10, 1985 (USEPA, 1985).

In 2004, Weston Solutions, Inc. (Weston) prepared a Preliminary Assessment/Site Investigation (PA/SI) for the Sonford site. The PA/SI was prepared in order to determine if the Sonford site had the potential to be placed on the National Priorities List. Several soil, sediment, surface water and shallow ground water samples were collected during the investigation and elevated concentrations of PCP, dioxins, several pesticides, and a few metals were reported (Weston, 2004).

1.2.3 Organization of Document

This report has been organized to follow the elements of Steps 1-4 of the ERA process. Section 1.3 (the screening-level problem formulation and ecological effects evaluation) represents Step 1 of the process. Section 2 (Step 2) describes the screening-level exposure estimates and risk calculations. Section 3 presents the risk assessment problem formulation for the Sonford Chemical site. Section 4 is a study design that provides an approach for assessing ecological risks at the site. References are listed in Section 5.0.

1.3 Screening-Level Problem Formulation and Ecological Effects Evaluation

This section covers Step 1 of the EPA risk assessment process and provides a general discussion of the following issues:

- Environmental setting.
- Contaminant fate and transport mechanisms that exist on the site.
- Likely receptors and mechanisms of ecotoxicity.
- Identification of complete exposure pathways.
- Selection of endpoints for ecological risk screening.

1.3.1 Environmental Setting

This section provides a brief description of the ecological conditions at the site. Additional information is provided in the ecological checklist (Appendix A).

1.3.1.1 Habitat. The site is located on a gravel pad adjacent to relatively undisturbed bottomland hardwood forest east and south of the site that is characterized and maintained by a natural hydrologic regime of alternating wet and dry periods generally following seasonal precipitation events. The bottomland hardwood forest is partially comprised of palustrine forested wetlands that periodically has standing water in depressions after rain events. There are no aquatic resources within the site boundary and the wetlands do not support lentic or lotic aquatic habitats. A gravel access road exists and an associated shallow drainage ditch exists on the west side of the property; these connect the Sonford site with Custom Products. A small culvert under the access road allows sheet flow to migrate south of Customs Products along an abandoned railroad for about 700 feet, then merging with the Flowood Drive road ditch.

Adjacent to the site, the forest canopy is dominated by green ash and red maple. Approximately 200-300 feet east of the site, the presence of mature bald cypress becomes more noticeable along with more wildlife signs (tree hollows, tracks, scat) where human disturbance (mostly noise) to wildlife is distant. Tables 1-1 and 1-2 provide a list of common plants and wildlife that have been observed and/or are likely to occur at the site.

1.3.1.2 Endangered, Threatened, and Sensitive Species. A check with the Mississippi Natural Heritage database revealed that there are two federally-listed threatened species in Rankin County; the ringed map turtle (*Graptemys oculifera*), and the bald eagle (*Haliaeetus leucocephalus*). The ring map turtle is almost exclusively found along high sand and gravel bars in the Pearl River. No collections have been found outside the Pearl River (McCoy and Vogt, 1980) and its habitat does not exist at the Sonford site. The bald eagle has recently been de-listed as threatened but still remains a State critically imperiled species. There are no known nesting or roosting sites in the Sonford site area and it is not expected to feed in the bottomland forest adjacent to the site.

There are no federally-listed or State critically imperiled plant species in Rankin County.

1.3.2 Contaminant Fate and Transport Mechanisms

Potential contaminants associated with the Sonford Products Site include PCP, dioxins, a few pesticides, and a few metals. Technical grade PCP has historically contained dioxins (e.g., tetra-, hexa-, and octochlorodibenzo-p-dioxin) and other chlorinated phenols. The primary release pathways to the terrestrial environment were from spills and leakage of chemicals to the soils from operations handling. Soil sampling has indicated that the highest concentrations of these chemicals are found in area immediately adjacent to the former melting pot. The dioxins are considered persistent chemicals that are highly susceptible to biomagnification within food webs; therefore, food-web transfer of dioxins is a pathway of concern. PCP can be metabolized by various soil microorganisms, especially in anaerobic environments. Direct contact and uptake of metals in the affected media generally results in local bioaccumulation.

The presence of an intermittent ditch on the east side of the site that drains toward the south may provide a contaminant pathway for runoff. In addition, large precipitation events may carry contaminated runoff into the small forest wetland depressions via sheet flow.

Although most of the organic chemicals strongly sorb to soil and sediment particles and are generally insoluble in water, some of these chemicals could be transported as resuspended material in surface waters of the ditches.

The historical spills of PCP resulted in the leaching of contaminants to the groundwater. Data from monitoring wells have also identified PCP and process-related chemicals. The nature and extent of groundwater contamination is currently being investigated to determine if there may be a pathway for contaminated groundwater to be discharged to the surface as seeps or springs. Therefore, the groundwater pathway may be of ecological concern.

1.3.3 Likely Ecological Receptors and Ecotoxicity

Soil organisms and small mammals (e.g., mice, rabbits, and feral cats) are likely to be most exposed to soil contamination. Indirect food-web transfer of PCP and dioxins to birds of prey (e.g., turkey vulture and hawks) is also considered likely.

PCP is an insecticide and fungicide that was used primarily to protect lumber from fungal rot and wood-boring insects. Substantial quantities of PCP in soils could alter the soil invertebrate community. Food web transfers of PCP and its associated dioxins may pose a threat to higher order consumers.

The major contaminants of interest at the Sonford site are PCP, dioxins/furans, and a few pesticides and metals. The toxic mechanisms of these compounds are both direct toxicity and bioaccumulation through the food chain. These chemicals are also the most likely compounds to bioaccumulate in biotic tissue (USEPA, 2000), and their concentrations may exert adverse impacts on ecological receptors.

1.3.4 Identification of Complete Exposure Pathways

The following areas at the site are identified as having potentially contaminated media, either by direct contamination from former process or waste management activities, or through subsequent transport:

- Site soils, especially in the vicinity of the former operations area.
- Adjacent forest wetland soils and ditches.
- Surface waters of the drainage ditches may receive contaminants during periods of storm runoff from the site or remobilization from potentially contaminated soil.

The soils support terrestrial receptors across several trophic levels (e.g., primary producers, primary consumers, secondary and tertiary consumers) and feeding guilds (e.g., detritovores, herbivores, omnivores, and carnivores). The intermittent drainage ditches in the site vicinity do not support an aquatic community, but does support vegetation and terrestrial invertebrates. The primary exposure routes to these ecological receptors may include the following:

- Uptake by vegetation through roots or leaves.
- Direct contact and inadvertent ingestion of contaminated media.

- Indirect exposure of predatory wildlife to bioaccumulative contaminants in prey items.

1.3.5 Screening-Level Assessment and Measurement Endpoints

Screening-level assessment endpoints include plant and animal populations and communities, habitats, and sensitive environments. EPA Region 4 soil and freshwater screening-values will be used as measurement endpoints.

2.0 Screening-Level Exposure Estimate and Risk Calculation

Threats to ecological receptors from releases of PCP and dioxins/furans at the site have been substantially reduced as a result of an interim removal action in response to a spill release (see Section 1.2.2); however, risks may still remain. This section provides a summary of the screening-level assessment (considered Step 2 of the 1997 EPA guidance), which includes an initial estimate of exposure to receptors and calculates preliminary risks by comparing the maximum documented exposure concentrations in soil, sediment, and surface water with the EPA Region 4 ecotoxicity screening-level values.

2.1 Screening-Level Exposure Estimates

2.1.1 Data Used for Screening Assessment

As part of a remedial investigation (RI) of the Sonford site, soil, sediment, surface water, and groundwater samples were collected by Weston in 2004 and by Black & Veatch and EPA's Science and Ecosystems Support Division (SESD) in 2006 and 2007.

Subsurface soil boring samples that were collected at various depth intervals greater than two feet depth were not used for screening purposes due to the general lack of local terrestrial receptor exposures to these depths. Due to the ongoing groundwater investigation, existing groundwater samples are not used for ecological screening purposes. Rather surface water is subject to screening and would represent potential exposure concentrations if contaminated groundwater would intercept surface water in the form of seeps or springs. Groundwater will be included in this assessment if it is determined that a complete pathway to surface water occurs.

Data qualified as rejected (i.e., R- or UR-qualified) were considered unusable and excluded. Although some laboratory results reported tentatively identified compounds, these non-standard analytes were not used for screening-purposes at this site. In the case of field duplicate quality control samples, the higher of the two values were used for screening.

Media samples were analyzed for various chemical groups including dioxin/furans, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), pesticides/polychlorinated biphenyls, and inorganics (metals). The following is a summary of the number of samples and chemical groups analyzed that were selected for this screening assessment.

Analyte Group	Soil/Sediment	Surface Water
Dioxin/furans	107	14
SVOCs	105	14
Inorganics	71	14
Pesticides	88	14

2.1.2 Exposure Estimates

In order to ensure that potential ecological risks are not missed, screening-level exposure estimates were performed using the highest measured, estimated (i.e., J-qualified), or presumed (i.e., N-qualified) abiotic media concentrations. In cases where there were no analyte detections for a given analyte (i.e., all data were U-, UJ-, or UN-qualified), the maximum sample quantitation limit (SQL) was used to estimate the exposure concentration.

Dioxin and furan analytical data were assessed based on individual congeners' toxic equivalency to 2,3,7,8-tetrachlorodibenzo-p-dioxin as described by Van den Berg et al. (2006). Toxic Equivalency Factors (TEFs) for mammals (the most conservative TEFs) were used to calculate a Toxic Equivalency Quotient (TEQ) as represented by the following equation:

$$[\text{TEF}] \times [\text{congener concentration}] = \text{TEQ}$$

If a congener was not detected in a sample, then one-half the SQL was used. The individual congener TEQs were then summed to provide a total TEQ.

Some analytes in surface soil and sediment were screened as the combined total concentration of a group [e.g., dichlorodiphenyltrichloroethane (DDT) and metabolites, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs)]. The total concentrations of these groups were calculated as the sum of the values of detected results and one-half the values of non-detected results.

Hardness-dependent metals (i.e., cadmium, chromium, copper, lead, nickel, and zinc) in water were adjusted based on the default ecological screening value (ESV) published in EPA Region 4 Ecological Risk Assessment Bulletins (USEPA, 2001). Based on 14 surface water samples collected, the average hardness was calculated to be 63.5 milligrams per liter (mg/L) calcium carbonate.

2.2 Screening-Level Risk Calculation

Screening-level risks to ecological receptors were evaluated by calculating a hazard quotient (HQ) for each analyte in each medium. The HQ in this case is the ratio of the maximum exposure concentration to the EPA Region 4 ESV. A HQ less than one indicates that the analyte alone is unlikely to cause adverse effects to ecological receptors. A HQ greater than or equal to one indicates potential for ecological impact from exposure to that analyte exists at the site, and the analyte becomes designated as a Preliminary Chemical of Potential Concern (PCOPC). The screening-level risk calculation is a very conservative estimate to ensure that potential risk to ecological receptors is not underestimated. The results of this screening calculation serve only to determine whether an analyte presents negligible risk or whether additional site-specific information is warranted.

Table 2-1 and 2-2 present the results of the screening assessment by identifying PCOPCs for soil and surface water, respectively. As mentioned in Section 1.3.1, the bottomland hardwood forest community contains wetlands but does not support lentic or lotic aquatic habitats; therefore, only soil ESVs are used to protect terrestrial organisms. There are four categories defined by EPA Region 4 to help organize and refine the PCOPCs, these are:

- Category 1: Analytes that were detected at a concentration greater than the detection limit, and were detected at a concentration greater than or equal to the ESV.
- Category 2: Analytes that were not detected at a concentration greater than the detection limit, but who's reported SQL was greater than or equal to the ESV.
- Category 3: Analytes that were detected at a concentration greater than the detection limit, but can not be quantitatively screened due to the lack of ESVs.
- Category 4: Analytes that were not detected at a concentration greater than the detection limit, but its reported SQL can not be quantitatively screened due to the lack of ESVs.

2.3 Screening-Level Summary

Based on the numbers and magnitude of the HQs in Tables 2-1 and 2-2, the screening-level process has confirmed that chemicals typical of operations that convert PCP into liquid formulations for wood treatment such as PCP, dioxins/furans are of concern. EPA's decision to continue the risk assessment process is reaffirmed.

3.0 Problem Formulation

This step of the EPA 1997 risk assessment process (Step 3) expands on the ecological issues of concern at the Sonford Products site with additional information to determine the scope and goals for the ERA.

3.1 Refinement of Preliminary Chemicals of Potential Concern

A first step in the refinement of potential site contaminants is to consider chemicals known to be used at the site. As mentioned in Section 1.2, PCP-related compounds were developed for use primarily as wood preservatives. Approximately 4 to 10 percent of commercial grade PCP is comprised of tetrachlorophenol, about 6 percent chlorinated phenoxyphenols, and about 0.1 percent dioxins/furans (USEPA, 1992).

3.1.1 Methodology

The PCOPCs identified in Section 2.2 are refined to include additional information such as the abundance and magnitude of the constituents, alternative screening values, and the primary exposure pathways. The outcome of the refinement is to identify those chemicals of potential concern (COPCs) that will be evaluated further. PCOPCs were eliminated from further consideration from this ERA using one or more of the following criteria:

- The maximum detected, estimated (i.e., J-qualified), or presumed (i.e., N-qualified) concentration was less than the alternate toxicity value (ATV).
- The chemical is an essential nutrient or electrolyte (e.g., calcium, magnesium, sodium or potassium), whereby additional justification was provided.
- The maximum detected, estimated, or presumed concentration was less than two times the background or reference arithmetic mean concentrations for inorganic or ubiquitous organic chemicals.
- The average concentrations, and the number of samples and magnitude of concentrations were low (<5%) in comparison to ATVs or background concentrations.
- The frequency of samples exceeding the ATV was low (≤ 5%).

Tables 3-1 and 3-2 provide information for the refinement of PCOPCs in soil and surface water, respectively. The following information is provided in the set of tables for each medium:

- Analysis performed.
- Frequency of detection.
- Range of detections or SQLs.
- Screening PCOPC category.
- Exposure point concentration.
- Data flags or qualifiers.
- Location of the maximum detected concentration.
- Background concentration, if applicable.
- ATVs and their sources.
- Frequency of samples exceeding the ATVs.
- Retention or deletion as a COPC.
- Rationale for elimination of a chemical from further consideration from the ERA.

The results of the refinement and identification of chemicals of potential concern in each environmental medium is presented in Section 3.1.3.

3.1.2 Alternate Toxicity Values

Because the EPA Region 4 screening-level values used in the Screening Level Ecological Risk Assessment are extremely limited in number and utility, additional or alternate toxicity values are needed to continue the conservative screening process for COPCs. The ATVs used for the PCOPC refinement for the Sonford site were obtained from other EPA regions, other federal, state, or local agencies, and peer-reviewed journal articles. Some of the ATVs utilized for the PCOPC refinement are described below. The original documents may be consulted for details on how the individual ATVs were derived.

3.1.2.1 Water Quality Criteria. The MDEQ (2002) freshwater chronic water quality criteria for protection of aquatic life were used where available. In some cases, the EPA national recommended water quality criteria (USEPA, 2006) were used if the state did not have a particular criterion.

3.1.2.2 Ecotox Thresholds. Ecotox thresholds are defined as media-specific contaminant concentrations above which there is sufficient concern regarding adverse ecological effects to warrant further site investigation (USEPA, 1996). The threshold values are meant to be used only for screening purposes but were used in the refinement when it was deemed appropriate or when there were no ATVs available in the literature.

3.1.2.3 USEPA Sources. The USEPA has recently developed the Ecological Soil Screening Levels (Eco-SSLs) (USEPA, 2005) for various organic and inorganic chemicals. Eco-SSLs are conservative concentrations of contaminants in soils that are protective of ecological receptors that come into contact with soil or ingest biota that comes into contact with soil. Because of their conservative nature, Eco-SSLs are recommended for use in the screening stage. These Eco-SSLs are revised routinely as more data becomes available. EPA Regions 3 and 5 have also developed ecological screening levels which are often based on various food-web exposure models as well as from other sources [e.g., Canadian Council of Ministers of the Environment (CCME), 2002]. Some of these screening values are used as ATVs when appropriate.

3.1.2.4 U.S. Fish and Wildlife Service. Beyer (1990) compiled soil screening values from North America, Europe, Japan and the former Soviet Union. Screening values used from the Netherlands were taken from the interim Dutch Soil Cleanup Act (Richardson, 1987). Category A numbers refer to background concentrations. Category B numbers refer to moderate soil contamination, and Category C numbers refer to threshold values that require immediate clean up. Category A numbers were used as initial and alternative toxicity values.

3.1.2.5 Florida Department of Environmental Protection. The Florida Department of Environmental Protection (FDEP) developed Soil Cleanup Target Levels (SCTLs) for the protection of human health and the environment. The target levels for cancer causing contaminants have been determined by FDEP to be the most conservative and also determined to be protective of ecological receptors (FDEP, 1999). These SCTLs are also used in the PCOPC refinement when necessary.

3.1.2.6 Other Sources. In addition to government organizations, individual scientists and researchers have reported ecological toxicity values from their research. These values are used as ATVs for the different media and are discussed in the PCOPC refinement. The individual authors will be discussed as needed in the Problem Formulation.

The results of the PCOPC refinement and the rationale for eliminating chemicals from further evaluation from the ERA are presented in Tables 3-1 and 3-2. In these tables, ATVs were selected for detected chemicals only. No attempts were made to select ATVs for all of the non-detected chemicals. The non-detected chemicals are discussed in groups whenever possible.

In general, the detection limits were adequate for screening-level purposes. However, in some cases where there were very high concentrations of pentachlorophenol, there was a tendency for some SVOCs to become not-detected in the same sample. It is possible that a few SVOCs may have been present in the very high PCP concentration samples and have not been identified as COPCs.

3.1.3 Chemicals of Potential Concern in Environmental Media

This section identifies the COPCs in each medium by chemical group.

3.1.3.1 Surface Soil/Sediment. The results of the PCOPC refinement in the surface soils and sediment are presented in Table 3-1. Refer to Figure 3-1 for the soil/sediment sampling locations. Frequency of detection (FoD) was determined by taking the number of samples exceeding the ATV divided by the total number of samples taken.

Inorganics. The metals copper (HQ 4.3, FoD 5.5%), lead (HQ 1.2), nickel (HQ 3.4), silver (HQ 1.1), and thallium (FoD 5.1%) had low HQs and frequencies of detection. Iron, vanadium, and zinc exceeded their screening values in 5.6%, 20%, and 28% of their samples, respectively. Mercury is elevated in about half of the samples. The highest detections for most of these metals were located adjacent to large rusted metal and galvanized containers and frames. Although these metals are not considered a part of the waste stream in processing pentachlorophenate, they may be related to metal debris at the site. Therefore these metals are retained as COPCs.

Semi-Volatile Organic Compounds. Fourteen SVOCs were detected in soils. Of these, PCP and 2,3,4,6-tetrachlorophenol (a degradation product of PCP) are retained as COPCs. Although (3-and/or 4)methylphenol, 1,2,4-trichlorobenzene, 2,4-dichlorophenol, 2-chlorophenol, and hexachlorobenzene had HQs > 1, their frequency of detections in over 100 samples were less than 5 percent. These chemicals will not be evaluated quantitatively in the risk assessment.

The exposure point concentrations (EPCs) in Table 3-1 are based on the maximum detected or non-detected values. Using the maximum non-detected value particularly for organic analytes is wholly dependent on the most overall contaminated soil sample location. In this case, soil station SP09 drives the maximum EPC for all other SVOCs for the entire site. This sample contained 14 million micrograms per kilogram (µg/kg) of PCP. In order for the laboratory to quantify this, the typical quantitation levels for most other SVOCs in the sample had to be elevated considerably, and likely resulted in not identifying the presence of other chemicals in that sample. However, this does not mean the high non-detected values in this one sample apply to all other samples. A review of the soil data indicates that with the exception of a few hot spot samples, the detection limits were well within typical analytical data quality objectives (DQOs). Therefore, the non-detected SVOCs will not be evaluated quantitatively in the risk assessment.

Pesticides. Total DDT, and lindane (BHC) and its isomers (alpha, beta, delta, and gamma isomers of benzene hexachloride) were the most common pesticides with detection frequencies of about 36 percent for tDDT and less than 20 percent for BHC. Some of the higher detections were on the gravel pad suggesting prior human use in the area. Lindane and DDT are not associated with sodium pentachlorophenate processing. These two pesticides are retained as COPCs and will be addressed qualitatively to assess their additional stress on ecological receptors. If additional data such as tissue studies show elevated concentrations of these pesticides, then they will be quantified in a food web model.

Aldrin, alpha-chlordane, endosulfan-1, endrin, endrin aldehyde, and toxaphene had low frequencies (< 5 percent) and low magnitude of exceedances of their ATVs and will not be evaluated further.

Polychlorinated Biphenyls (PCBs). PCBs were not detected in any of the samples and are not known to be associated with pentachlorophenol or related byproducts or degradation products. These chemicals are not considered COPCs.

PAHs. Total PAHs are not retained as COPCs in soil because the ATV was not exceeded.

Dioxins/Furans. Because the TEQ for dioxins and furans greatly exceeded the ATV, they are retained as chemicals of potential concern in soil.

Volatile Organic Compounds (VOCs). Acetone was detected in 9 of 28 samples with a maximum HQ of 5.3. Acetone is a common laboratory contaminant. Six other detected VOCs with known ATVs all had HQs < 1. A few chlorobenzenes were categorized in nine samples as tentatively identified compounds, so their identity is uncertain. VOCs generally do not persist in soil unless high concentrations were released or spilled on the ground. VOCs are not retained for further analysis in the ERA.

3.1.3.2 Surface Water. The results of the PCOPC refinement in the surface water are presented in Table 3-2. Figure 3-2 shows the locations of the water samples. All of the water samples were unfiltered and collected in very shallow depressions. Unfiltered samples are subject to turbidity interferences from sampling techniques and often pick up suspended matter and clay silts that tend to overestimate water exposure to inorganic chemicals.

Inorganics. Several metals exceeded their respective ATVs (aluminum, barium, copper, iron, lead, manganese and zinc). These metals have not been directly related to site operations and are not considered major risk drivers relative to PCP and dioxins/furans, therefore they will only be addressed qualitatively in further steps of the ERA process. One cyanide sample exceeded its ATV, although in other samples collected in adjacent forest pond water, cyanide was not detected and it is not associated with PCP processing or associated with the facility to the south of the site. This sample has been rejected as an analytical anomaly, and will not be retained as a COPC.

Semi-Volatile Organic Compounds. PCP was detected several times in surface water and exceeded its ATVs and is a major contaminant. Bis(2-ethylhexyl)phthalate was detected twice with a maximum HQ of 2. It is a common laboratory cross-contaminant and will not be considered further. Most of the SVOCs were not detected (with reasonable SQLs).

Pesticides/PCBs. Gamma-BHC was detected in 3 out of 12 samples and heptachlor epoxide was detected once. Both of these pesticides exceeded their respective ATVs for surface water. These chemicals are retained as COPCs but will be evaluated qualitatively. The remaining non-detected pesticides and PCBs will not be evaluated further.

PAHs. The PAHs were virtually non-detected in the 14 surface water samples and all within reasonable SQLs. PAHs tend to partition out of the water column and into the soils; however they are not of concern in soils, either. Therefore PAHs are not retained as COPCs in surface water.

Dioxins/Furans. The HQs for TEQ dioxins/furans in surface water were less than one. This is likely reflective of their insolubility and strong adsorption affinity of dioxins to soil.

Volatile Organic Compounds. No volatile compounds were detected except acetone in 5 of 7 samples and the HQ was less than one. Acetone is not considered a part of the Sonford waste stream and is a common laboratory contaminant. VOCs are not of concern in water samples from the site.

3.1.3.3 Summary of Final COPCs. The primary COPCs in soil are penta- and tetra-chlorophenols and dioxins/furans. Lindane isomers, tDDT, and mercury are of additional concern due to their strong bioaccumulation potential and will be addressed qualitatively (or quantitatively depending on tissue data and/or a geospatial analysis). The few elevated concentrations of metals such as iron, vanadium, and zinc appear may be related to scrap metal lying about the site, but will be evaluated qualitatively.

In surface water, PCP is retained as a COPC. Elevated concentrations of aluminum, iron, and manganese, gamma-BHC, and heptachlor epoxide are not considered process-related COPCs and will only be addressed qualitatively. Table 3-3 summarizes the COPCs.

The metals are not anticipated to be risk drivers relative to PCP-related COPCs. In addition, some of the highest metal concentrations are associated (co-located) with metal debris areas of the former buildings, tanks, etc. The occasional detections of pesticides may contribute to excess exposure, but may complicate estimates of risks from the primary site-related contaminants. Therefore, ecotoxicological reviews will be prepared for PCP and dioxins/furans.

3.2 Ecotoxicity Literature Review

This section provides a general summary of the toxicity of the major site-related COPCs to potentially exposed organisms and receptors of concern that currently exist at the Sonford Products site. PCP and its associated dioxins/furans are highlighted because of their high potential for bioaccumulation. No toxicity tests have been performed with soil or water from the site.

3.2.1 Pentachlorophenol

PCP has been used as a wood preservative due to its insecticidal and fungicidal properties. A primary mechanism of toxicity for PCP is binding to the cellular protein known as the aryl hydrocarbon (Ah) receptor. This may explain the relatively high screening-effect levels of 5 mg/kg in soil for plants and 31 mg/kg for soil invertebrates

(USEPA, 2005). The CCME developed a soil PCP benchmark of 7.6 mg/kg that is considered protective of parklands and agriculture (CCME, 2002).

Mammals. In a study of PCP effects on rat embryonal and fetal development, Schwetz et al. (1974), administered PCP by gavage to female rats on days 6 to 15 of gestation. They reported a no-observed-adverse-effect-level (NOAEL) of commercial grade PCP to be 5 milligrams per kilogram of body weight (mg/kg-BW/day) for embryo and fetal development. In another study (Schwetz et al., 1978), rats were exposed to dietary PCP at concentrations of 3 and 30 mg/kg/BW/day for 62 days prior to mating through lactation. Survival and growth were significantly reduced at the higher exposure concentration. No significant reproductive effects were reported at the lower dose.

Birds. In a study by Nebeker et al. (1994), four day old mallard ducklings were exposed for 11 days to a series of PCP concentrations. No significant growth effects were observed in the ducklings exposed to a diet of 423.2 mg/kg (169 mg/kg/BW/day). At a diet of 961 mg/kg (490 mg/kg/BW/day), the ducklings had lower lipid tissue, lower body weights, and were less active than controls.

Although bioaccumulation may be substantial, biomagnification is not thought to be significant because of PCP's rapid break down in living organisms. For example, once absorbed by fish, pure PCP and its metabolites are rapidly excreted with a biological half-life of about 10 hours [Agency of Toxic Substances and Disease Registry (ATSDR), 1992].

3.2.2 Dioxins and Furans

Studies with laboratory animals show that exposure to dioxins results in a wide spectrum of toxic responses in a range of vertebrate species. Depending on the duration of exposure and the dose, these toxic responses range from cellular level biochemical effects to acute lethality. Adverse responses as reported in USEPA (2000) and Van den Berg et al (1998, 2006) include:

- Reproductive impairment.
- Developmental abnormalities in young.
- Endocrine and immune dysfunction.
- Neurological dysfunction.
- Edema and hemorrhaging.

Not all dioxin-like congeners are equally toxic, however, and not all of the effects caused by exposure are observed in every single species; but, rather, the aderse effects can differ between species and life-stage.

Dioxin-like compounds [polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and PCBs] share a common toxic mechanism, which involves binding to the cellular protein Ah receptor, where they form complexes that translocate to the nucleus and initiate changes in gene expression. Binding to this receptor appears to be the initial step leading to biochemical, cellular, and tissue-level changes occurring in organisms exposed to dioxins (Poland and Knutson, 1982; Hahn and Stegeman, 1992). Whether individual PCDD and PCDF congeners have dioxin-like toxicity or not depends largely on their chemical structure and shape of the molecule and its ability to fit to the Ah receptor (USEPA, 2000).

Studies (e.g., as compiled in USEPA, 1993a) indicate that aquatic plants and invertebrates including midges, cladocerans, sandworms, snails, grass shrimp, and amphipods are not sensitive to the toxic effects of dioxins. The observed lack of sensitivity of aquatic plants, and freshwater and marine invertebrates is consistent with the view that the Ah receptor is not present in invertebrates.

In addition to the PCDDs, and PCDFs, a wide variety of structurally diverse anthropogenic chemicals are capable of interacting with the Ah receptor. These chemicals also have a broad range of potencies at inducing dioxin-like effects in experimental systems. Other compounds that bind and activate the Ah receptor include industrial chemicals (e.g., PCP, other PCBs, halogenated naphthalenes, chlorinated paraffins), pesticides (e.g., hexachlorobenzene), combustion products (e.g., unsubstituted PAHs), and flame retardants (e.g., biphenyls, diphenyl ethers, and naphthalenes). Van den Berg et al., (1998) concluded that "at present, insufficient environmental and toxicological data are available to establish a TEF value" for these other compounds.

The presence of an Ah receptor in an organism also governs whether dioxins are toxic to the organism or not. The observed lack of sensitivity of plants and invertebrates is consistent with the view that the Ah receptor is not present in invertebrates (USEPA, 1993a). There is also evidence that amphibians and reptiles possess this receptor; however, the binding affinity of tetrachlorodibenzo-p-dioxin (TCDD) for these animals is substantially lower or the Ah receptor is present in low concentrations, relative to mammals, birds, and fish. This is mainly because higher doses are generally required to induce toxicity to cellular mechanisms (such as the mixed function oxidase system, hepatic cytochrome P450 system, and the ethoxyresorufin-O-deethylase system) compared to other animals. (Hahn et al, 1994; Jung and Walker, 1997; Hall, 1980).

Mammals. Hochstein et al. (1998) fed female adult mink diets supplemented with 0, 0.001, 0.01, 0.1, 1, 10, and 100 µg/kg TCDD for up to 125 days. They observed a dose-dependent decrease in feed consumption and body weight, wasting syndrome, as well as mortality. The authors calculated a 125-day LC50 concentration, based on feed consumption of control mink, to be 0.047 µg/kg TCDD body weight per day.

Murray *et al* (1979) conducted a three generational study on rats fed TCDD to evaluate the effects of chronic, low level ingestion. Sprague-Dawley rats were fed dose levels of 0, 0.001, 0.01 or 0.1 µg/kg TCDD/day. Rats receiving 0.01 micrograms of TCDD per kilogram per day (µgTCDD/kg/day) showed a decrease in litter size with reduced neonatal and gestational survival and growth. Reproductive capacity was affected in all three generations receiving 0.01 and 0.1 micrograms per kilogram per day (µg/kg/day). In a longer term study, rats were maintained on a diet of 0.1, 0.01 and 0.001 µgTCDD/kg/day. Rats on the highest dose showed increased incidence of hepatocellular carcinomas and squamous cell carcinomas of the lung, hard palate and tongue. Rats given 0.01 µg/kg/day exhibited a lesser degree of toxicity while those dosed with 0.001 µg/kg/day exhibited no sign of toxicity.

For this risk assessment, the mammal NOAEL and lowest-observed-adverse-effect-level (LOAEL) doses will be 0.001 and 0.01 micrograms of TCDD per kilogram of body weight per day (µgTCDD/kgBW/day), respectively; or 1 and 10 nanograms per kilogram of body weight per day (ng/kgBW/day).

Birds. Domestic chickens have been reported to be relatively sensitive to PCDDs (Kociba and Schwetz, 1982). Schwetz et al. (1973) administered 0, 0.01, or 0.1, 1.0 and 10 micrograms per kilogram of body weight per day (µg/kg BW/day) of TCDD to white leghorn chicks or 21 days. The chicks showed signs of edema at concentrations at the 1.0 and 10 µg/kg BW/day dose levels. No chicks survived the 10 µg/kgBW/day dose. No edema was observed at the 0.1 dose or lower (<100 ng/kgBW/day).

Nosek et al. (1992) administered weekly doses of 1, 10, 100, and 1,000 picograms per gram (pg/g) BW TCDD intraperitoneally to ring-necked pheasant hens for 10 weeks. The hens were paired with untreated roosters during the final 2 weeks of exposure and egg production was observed for 9 to 13 weeks. There was 57 percent mortality in the highest concentration group, but no mortalities occurred in the control group and the two lowest doses. There was also a significant decrease in adult body weight and egg production in the 1,000 pg/g BW TCDD group. A significant decrease in egg production and 100 percent embryo mortality were observed in the highest treatment group. This study is used to develop toxicity reference values (TRVs) for the birds even though the injection exposure route does not represent oral dietary exposure, and would likely require much higher concentrations to produce similar results.

To express the exposure concentration in units of nanograms per kilogram per day (ng/kg/day), the doses of picograms per gram of body weight per week (pg/g BW/week) the units were converted to ng and the results were divided by the estimated body weight of the pheasant (1 kg) and then divided by 7 to convert weeks to days. Based on these calculations, the NOAEL for birds was calculated to be 14 ng/kgBW/day, and the LOAEL was 140 ng/kg BW/day.

3.2.3 DDT and Metabolites

DDT is highly insoluble in water but very soluble in fats. Because DDTs are difficult to excrete and are lipid-soluble, they tend to accumulate and concentrate in the fatty tissues of receptor organisms, leading to bioaccumulation and biomagnification through the food web. When organochlorines are stored in fatty tissues, they become biologically available and physiologically active only when fat tissues are metabolized. Receptors may therefore acquire considerable body burden of DDTs but show no ill effects except during conditions of starvation, when fat reserves are mobilized. Accordingly, it is difficult to be precise about the potential effect of these contaminants based on tissue concentrations.

Mammals. The USEPA criteria documents for protection of wildlife (USEPA, 1995) developed a toxicological reference values based on studies with rats and reported a low (NOAEL) TRV of 0.8 mg/kg-day and a LOAEL of 16 mg/kg-day. These values are also used as recommended mammal TRVs by EPA Region 9.

Birds. In general, birds are more susceptible to the effects of DDTs than mammals. The most critical sublethal effect of DDT and its residues on birds is interference with calcium metabolism, resulting in thinning of eggshells. During its use as a pesticide, bioaccumulation of DDT led to significant population declines of several top-level avian predator species such as osprey, eagles, and brown pelicans (e.g., Blus et al. 1979 and

Wiemeyer et al. 1988). USEPA (1995) recommended a low TRV (NOAEL) of 0.009 mg/kg-day that is based on assumptions of transfer of dietary intake of DDT into the eggs of the brown pelican that would result in egg shell thinning. A high TRV (LOAEL) of 1.5 mg/kg-day was developed based on reproductive studies with mallard ducks (USEPA, 1995).

3.2.4 Lindane

Lindane is one of the most currently active organochlorine pesticides. It is used on seeds, hardwood lumber and livestock. Lindane is readily metabolized and excreted by birds, minimally accumulated in tissues, and without implication as a significant problem in the field (Blus et al., 1984).

Mammals. One of the most significant studies regarding the long-term effects of lindane was conducted by Palmer et al. (1978) which involved a 3-generational study of dietary intake of gamma-lindane by rats with reproductive and developmental effects as endpoints They reported a no-effect level at a dietary dose of 100 mg/kg. Sample et al. (1996) used the study to develop a NOAEL of 8 mg/kg-day and a LOAEL of 80 mg/kg-day.

Birds. Reproductive effects of lindane on birds can be represented by the study conducted by Chakravarty and Lahiri (1986) where they mallard ducks were fed 20 mg/kg/day of gamma-lindane by oral intubation. After 8 weeks, eggshell thickness was reduced, the ducks laid fewer eggs, and had longer time intervals between eggs. This value is considered a chronic LOAEL and a NOAEL from this study is assumed to be 2 mg/kg-day.

3.2.5 Mercury

Mercury levels and uptake rates in exposed plants and wildlife depend on the source and type of mercury to which the organisms are exposed and on the structure of the local food web (i.e., the uptake pathway). Terrestrial plants take up inorganic and methyl mercury from water, soil/sediment, and the atmosphere. Mercury concentrations in wildlife and birds at higher trophic levels are directly correlated with diet. Factors influencing mercury levels include species-specific sensitivity, foraging area, size of prey consumed, and the percentages of the types of food sources in the diet.

Mercury tends to concentrate in the muscle tissue of fish. For this reason, piscivorous mammals and birds such as mink, herons, and kingfishers tend to bioaccumulate more mercury than species that feed on a greater variety of foods. Species such as the clapper rail that consume primarily invertebrates are also likely to be vulnerable to bioaccumulation of methyl mercury in the food web (USEPA, 1997b). The toxic effects of mercury depend on the level of methylation. In general, methylmercury is more toxic than inorganic mercury (USEPA, 1997b). However many laboratory toxicity tests with rats and birds (e.g., mallard) have used highly available inorganic mercury such as mercuric chloride. These tests are of limited utility when compared to ingestion of complex mercury in the natural environment.

At the Sonford site, the highest mercury concentrations were found on the gravel pads near metal debris. Mercury levels diminish substantially in the forest floor away from the site. The forested wetland areas are considered poor methylating environments (see Section 3.3.4). Therefore, the literature toxicity studies considered here utilize the inorganic forms.

Mammals. In a study by Aulerich et al. (1974), mink were fed a dietary dose of 10 mg/kg of mercuric chloride for six months. Reproductive fertility and kit survival were not affected. Sample et al. (1996) used this study to estimate the dietary dose of 7.39 mg/kg and converted this dose to a NOAEL of 1.0 mg/kg-day.

Birds. Most of the body concentration of mercury in piscivorous birds is stored in the plumage (Clark 2001). Virtually all of it is in the methylated form and is shed when the birds molt. As much as 50 percent of the remaining body burden of mercury is transferred to the growing feathers following molt; the plumage thus provides an important elimination pathway for methyl mercury in many birds.

Because ground birds such as woodcock are likely to occur at the site, studies using Japanese quail were preferred over mallard ducks. Hill and Schaffner (1976) exposed Japanese quail to five dietary doses of mercuric chloride for one year. They reported reduced fertility and hatchability. Sample et al. (1996) converted the no-effect and lowest-effect oral doses from this study to a NOAEL of 0.45 mg/kg-day and LOAEL of 0.9 mg/kg-day.

3.3 Contaminant Fate and Transport Mechanisms

An understanding of fate and transport processes for the COPCs at the Sonford site is important for developing exposure pathways, identifying receptors of concern, and in formulating hypotheses for designing an approach to assess ecological risk. This section describes the processes by which chemicals of concern are currently transported from their sources to environmental exposure points.

3.3.1 Source Areas

The primary source of contamination at the Sonford site is contaminated soil. The previous EPA removal action described in Section 1.2.2 reduced risks to ecological receptors by removing 2,500 cubic yards of impacted soil. However, soils adjacent to the site and in local drainage ditches are also sources of elevated concentrations of COPCs. Groundwater is a source of contamination but there has not yet been any indication that surface water has been impacted by seeps or springs.

3.3.2 Physical Transport Mechanisms

The principal existing physical transport mechanisms at the Sonford site include runoff and erosion of site soils, downstream transport of contaminated sediments, and migration of contaminated groundwater.

Runoff and Erosion. The former processing area is susceptible to erosion and contaminated runoff. This area has some of the highest concentrations of PCP and dioxins. Wind erosion of soils is not of concern due to vegetation covering most of the site, along with cement pads, gravel roads, and debris piles.

Downstream Transport of Contaminated Soil. Former contaminant discharges into site ditches and/or runoff from soils have migrated downgradient south of the site in the palustrine forested wetland.

Migration of Contaminated Groundwater. There is contaminated groundwater beneath the Sonford site; however, the nature and extent of contamination is currently being investigated. There may be an exposure pathway if groundwater is expressed as seeps or springs that may enter surface water channels. This potential pathway may be assessed as new information becomes available.

3.3.3 Chemical Transport Mechanisms

Transport of organic and inorganic constituents at the site can be affected by media pH, water flow rates, and mineral characteristics of soil, sediment, and water. These media properties impact a contaminant's ability to be dissolved in solution or become attached to sediment/soil particles (sorption/desorption mechanisms). Some of the major factors influencing contaminant mobility are discussed in relation to organic contaminants below:

- The organic COPCs generally are not readily soluble in aqueous media. However, the solubility of PCP can be altered by pH, dissolved organic carbon content, and ionic strength.
- Organic contaminants and many inorganic contaminants can adsorb to solid particle surfaces by mechanisms such as cationic or anionic exchange, hydrogen bonding, and other electrostatic mechanisms. These processes are controlled and driven by the physical and chemical properties of both the contaminant and the soil/sediment particles. Dioxins/furans, PCP, tDDT and lindane are strongly adsorbed to organic matter but less so to aluminosilicate minerals. This tendency to adsorb to the organic-rich soils of the adjacent forested area dramatically reduces the mobility of these contaminants.
- Low pH in surface water, soils, or sediment tends to mobilize metals and a few organics compounds such as PCP.

3.3.4 Biological/Ecological Transport Mechanisms

Biological transport may occur through uptake, bioaccumulation, and food-chain transfer. The most significant properties that affect the biological movement of a chemical through the environment are its water solubility and octanol-water partitioning coefficient (Kow). In biological transport, these factors are often expressed as bioaccumulation factor (BAFs) or biota soil/sediment accumulation factors (BSAFs).

The organic COPCs tend to be hydrophobic and readily associate with organic components of solid environmental media. This association with organic phases leads to their tendency to accumulate in lipid tissues. These compounds then are metabolized by the organism or elicit toxic responses in the organism. Chemicals with a high Kow value are more soluble in lipid tissue than in water and tend to bioconcentrate in organisms. Chemicals with BCF values greater than 100, BAF values greater than 1, and log Kow values greater than 4 are considered to have the potential for movement into and through the food chain (Howard, 1989).

Dioxins and furans are the most bioaccumulative along with the few chlorinated pesticides. Dioxins and furans generally have low solubility in water and high solubility in lipids. These compounds have very high log Kow values between 6 to 9. Because of their high affinity to lipids, dioxins can bioaccumulate in the bodies of organisms when they are exposed to these chemicals in water, soil, sediment, or in their diet. BSAFs (includes partitioning on organic carbon and in lipids) for dioxins are generally reported in the literature for a variety of species. Dietary intake is the primary mechanism governing the levels of dioxin-like chemicals in biota (Gobas et al., 1993), although ultimately, the levels in the diet depend on the levels in soil and sediment. Dioxins generally increase in concentration at each successive trophic level and the receptor organisms most at risk from exposure to dioxins are those occupying the top of the food chain (Jones et al., 1993).

Mercury may be converted through both biotic and abiotic processes to its more bioavailable methylated form. Factors conducive to methylation of mercury include low-flow or stagnant waters, hypoxic or anoxic conditions in water or sediments, low pH (pH<6), and high concentrations of dissolved carbon. Most of these factors are in turn affected by biological processes such as metabolism, growth, and decay; for example, mercury methylation has been linked to the activity of sulfate-reducing bacteria in the shallow anoxic sediment column (USEPA, 1997b). Certain streams, bogs, and swamps may be conducive of methylation; however, the forest wetlands at the Sonford site are not expected to be a significant methylating environment.

3.4 Ecosystem Potentially at Risk and Complete Exposure Pathways

The terrestrial system at the Sonford site is dominated by a palustrine hardwood forest wetland community and adjacent suburban human environment. Terrestrial organisms potentially at most risk from direct contact or inadvertent ingestion of soils are localized wildlife such as mice, shrews, and raccoons. A few birds such as woodcocks and owls could be indirectly exposed through consumption of local wildlife from the site. Exposures are largely from direct contact to and ingestion of soil, and to a lesser extent from water that is intermittently present in forest depressions or ditches. Due to the bioaccumulation and biomagnification potential of the primary COPCs, invertebrates such as earthworms and snails provide an indirect pathway of contamination through the food chain.

Since there is no aquatic habitat in the nearby site vicinity, aquatic organisms are not considered to be threatened by contaminant releases. However, if the groundwater investigation suggests that contaminants may enter the oxbow lake in the Pearl River floodplain located approximately 0.4 mile west of the site, then aquatic resources could potentially be exposed.

3.5 Selection of Assessment Endpoints

Endpoint selection is an important component of the problem formulation stage of a risk assessment (USEPA, 1998, 1997a). Assessment endpoints are the ecological resources or receptors whose protection from adverse effects is the goal of risk management actions. Defining assessment endpoints for the affected ecosystem at the Sonford site involves the actual environmental values that are to be protected. Rather than assess all environmental attributes and receptors, EPA guidance specifies three factors to be considered in making a selection: ecological relevance; susceptibility to the stressors; and policy goals and societal values. Assessment endpoints are also selected based on key ecosystem, community, or ecological functions, type and concentrations of contaminants present, the extent and magnitude of contamination, mechanisms of toxicity, COPC fate, and exposure pathways.

There are no unique terrestrial or aquatic habitats within 0.4 mile of the site. Surrounding land use is light industrial and residential. The future land use of the site is expected to be the same. An oxbow lake in the Pearl River floodplain lies about one-half mile west of provides aquatic habitat and recreational value for humans, including fishing and boating. There are no known sensitive species at the site, or important nesting sites, spawning areas, or rookeries.

Initial consideration is given to protect all potential receptors exposed to site contaminants, these include:

- Soil invertebrates,
- Herbivorous mammals,
- Insectivorous mammals,
- Omnivorous mammals,
- Carnivorous mammals,
- Herbivorous birds,
- Insectivorous birds
- Omnivorous birds,
- Carnivorous birds,
- Herptiles (reptiles and amphibians), and
- Plants.

However, a detailed analysis of each of these receptor groups would not focus the risk assessment on those receptors most relevant to the Sonford site. Many of the initial receptor groups listed above are less exposed to site COPCs due to differing pathways of uptake, toxic mode of action and their trophic position in the food web. Because the primary COPCs readily bioaccumulate and biomagnify through the food chain, the upper trophic levels (e.g., carnivores) are more at risk from exposure than plants and invertebrates. Although each of the receptor groups may be exposed, a quantitative evaluation of all pathways to all receptors would be cumbersome and non-focused. Terrestrial receptors are most exposed to contamination will be evaluated qualitatively.

Vegetation adjacent to the site suggest that plant populations or the development of wildlife habitat are is not likely to be adversely affected by site COPCs, relative to contaminant transfer into wildlife that consume plants and soil invertebrates. However, potential effects may occur to plants and soil invertebrates in localized areas within the site that have very high concentrations of COPCs.

Amphibians and reptiles are generally less susceptible to the effects of dioxins than birds, mammals, and fish (Section 3.2). In addition, little direct toxicity and exposure data for amphibians and reptiles are available in the literature. However, small mammals are known to be sensitive to dioxins and other chlorinated organic compounds, and there is a large body of exposure and toxicity information related to small mammals.

Aquatic benthic organisms and fish are not likely to be found in the drainage ditches on site, so these receptor groups will not be evaluated.

Based on existing information, the following assessment endpoints are selected for quantitative analysis of exposures to COPCs released from the Sonford site. The remaining receptors groups and their associated contaminant pathways will be retained qualitatively.

3.5.1 Protection of Insectivorous Mammals

Resident populations of soil invertebrates and small mammals (e.g., shrews, mice, rats) are important links in a functioning terrestrial ecosystem. These organisms provide food to high-order consumers including weasels, raccoons, hawks, and owls. The presence of several highly bioaccumulative organic compounds indicates that the food web pathway is of primary concern. Shrews and mice could get substantial doses of these contaminants from consuming invertebrates. The short-tailed shrew (*Blarina brevicauda*) is selected as a receptor primarily because its diet is comprised mostly of soil invertebrates such as earthworms. The shrew is also a conservative surrogate species for mice and to a lesser extent bats, and herptilians (insectivorous reptiles and amphibians).

3.5.2 Protection of Carnivorous Mammals

This assessment endpoint provides for the protection of omnivorous and carnivorous mammals to ensure that ingestion of contaminants in prey and incidental ingestion of contaminated abiotic media do not adversely impact their growth, reproduction, and survival. This assessment endpoint will help define the potential risks from the ingestion of contaminated prey and the incidental ingestion of soil by most mammals such as raccoons, weasels, opossum, rabbits, squirrels, skunks, and feral cats. The long-tailed weasel (*Mustela frenata*) is considered a conservative surrogate species for carnivorous mammals. The presence of contaminants in the adjacent forest community provides a scenario for the weasel that generally feeds on small rodents.

3.5.3 Protection of Insectivorous Birds

This assessment endpoint provides for the protection of insectivorous birds to ensure that ingestion of prey and incidental ingestion of contaminants in soil do not result in any adverse effects on the survival, growth, and reproduction of the birds. The COPCs tend to bioaccumulate in soil invertebrates and are transferred to consumers. The American woodcock (*Scolopax minor*) is a representative receptor species of insectivorous birds for this site as it inhabits woodland areas, abandoned fields, and riparian zones.

3.5.4 Protection of Carnivorous Birds

The presence of owls, hawks, and occasional turkey vultures in the site vicinity suggests an assessment endpoint for this receptor group. These birds represent the highest trophic level potentially at risk for consumption of bioaccumulative and biomagnifyable chemicals. The barred owl (*Strix varia*) is selected as a representative species in this receptor group. It is relatively common in the bottomland hardwood forest area and is assumed to feed on small mammals such as shrews, voles, and mice.

3.6 Conceptual Model and Risk Questions

3.6.1 Conceptual Site Model

The information presented in the previous sections is consolidated and summarized in this section in the development of a conceptual site model (CSM). A CSM is often used to convey a summary of the sources of contamination, mechanisms of contaminant release and transport, and pathways of exposure. The CSM also provides the basis for relating the assessment endpoints to the measurement endpoints. Figure 3-3 provides the initial conceptual site model for the Sonford site. The initial CSM is not intended to illustrate a web of all possible routes to all receptors, but rather highlight the major mechanisms and pathways of concern.

3.6.2 Ecological Risk Questions

The purpose of the risk questions is to outline the basis of the study design and methods to be used to evaluate the results of data collection activities. Principal risk questions are provided for each assessment endpoint.

Protection of Insectivorous and Carnivorous Mammals

- Are the concentrations of COPCs in soil and prey items sufficient to cause adverse effects on the long-term health and reproductive capacity of these mammals?

Protection of Insectivorous and Carnivorous Birds

- Are the concentrations of COPCs in soil and prey items sufficient to cause adverse effects on the long-term health and reproductive capacity of these birds utilizing the site area?

3.7 Data Gaps and Uncertainties

At this step in the risk assessment process, three major data gaps have been identified:

- No biological data (toxicity tests or invertebrate and small mammal tissue data) have been collected from the site area. Associated data gaps also include organic carbon data and tissue lipids since dioxins and PCP partition strongly to these media.

- Only a brief field reconnaissance was performed at the site. Data on habitat quality and specific wildlife use is generally lacking.

Up to this point in the ERA process, the major sources of uncertainty include:

- The selection of literature-based TRVs. Even though low to moderate doses of PCP may be readily ingested by animals, they are generally rapidly metabolized and eliminated from the body (ATSDR, 1992). In laboratory tests, many of the animals require periodic injections or feeding by gavage or tube because high doses often cause a taste aversion response and vomiting. Therefore, laboratory tests especially by injection or gavage tend to overestimate actual feeding habits in the field.

- The focus on quantitative analyses of four assessment endpoints out of many. Although a comprehensive examination of more receptor groups could allow for a broad range of potential effects, the ability to focus the risk assessment on reasonably conservative receptors at the upper trophic levels would be lost. However, a qualitative assessment of potential risks to other receptor groups is retained.

- Different receptors respond differently to chemical challenge. The use of surrogate receptors may not capture potential risks to all receptors.

- A few semi-volatile samples had quantitation limits that were quite high because of laboratory dilution in those samples with high concentrations of PCP. This may result in underestimation of the concentrations of other SVOCs in the affected co-located samples.

- Measurement of total metal concentrations in unfiltered water samples, although relevant to actual exposure conditions, does not provide a direct estimation of potentially bioavailable fraction of metal in the samples. Use of total (unfiltered) metal concentrations generally overestimates risk potential relative to exposure to dissolved-phase metals.

- SQLs for some contaminants were greater than the ATVs. There is uncertainty whether these contaminants are actually present within the analyzed medium or whether the concentration of these contaminants is greater than their screening value. Using the SQL to represent the contaminant concentration in the medium could overestimate potential risk from exposure to these contaminants.

- USEPA Region 4 screening values and ATVs were not available for all chemicals; therefore, the potential impacts to receptors from chemicals with no ATVs are uncertain.

- Tentatively identified compounds were detected in a few samples from the VOC and SVOC analyses for all media but are not used in this risk assessment because their actual existence or potential impacts cannot be ascertained.

- The introduction of error in the process embedded in the literature used for obtaining toxicity information.

- The use of twice the average soil background concentrations to eliminate COPCs may result in underestimation of risks for certain compounds, especially if the background concentrations are high or inadequately characterized.

- Soil screening values were used even though wetland soils could be considered sediments if permanently inundated. This could under- or overestimate risk.

3.8 Scientific/Management Decision Point

At this point, the SMDP participants should evaluate the information presented and obtain agreement on the COPCs, exposure pathways, and assessment endpoints, and to determine if additional information is necessary to continue the risk assessment process in more detail.

4.0 Study Design and Data Quality Objectives

This section continues the ERA process (Step 4) and describes the study design and DQOs for assessing potential risks to ecological receptors. This step includes measurement endpoints selected for the Sonford site. Measurement endpoints are measurable physical, chemical, and ecological characteristics that represent the assessment endpoints identified in Section 3.5 of this document. Steps 3 and 4 of the ecological risk assessment process is essentially the DQO process (USEPA, 1997a). The products of Step 4 are the work plan, sampling and analysis plan (SAP) and quality assurance project plan (QAPP).

4.1 Measurement Endpoints Related to Each Assessment Endpoint

The following summarizes the measurement endpoints for each assessment endpoint.

Protection of Insectivorous Mammals. The short-tailed shrew (*Blarina brevicauda*) was selected as a representative species for this receptor group. The exposure pathways for this endpoint are ingestion of soil, water and earthworms. An earthworm bioaccumulation test with site soils will be conducted to measure the concentration of COPCs for this food web species. A food web model that includes assumptions of food and soil ingestion rates, body weights, and other exposure parameters will be used to estimate shrew exposure (see Section 4.3.1). The estimated exposures would then be compared to TRVs obtained from the literature.

Protection of Carnivorous Mammals. The long-tailed weasel (*Mustela frenata*) is selected as a representative species for this receptor group. The exposure pathways for this endpoint are ingestion of soil, water and small mammals such as shrews and mice. A food web model will be used to estimate weasel exposure by using the predicted tissue concentrations in shrews along with soil and water concentrations (see Section 4.3.2). The estimated exposures would then be compared to TRVs obtained from the literature.

Protection of Insectivorous Birds. The American woodcock (*Scolopax minor*) is selected as a representative species for this receptor group. The exposure pathways for this endpoint are ingestion of soil, water and soil invertebrates. Results of the earthworm bioaccumulation test with site soils will be used to measure the concentration of COPCs in earthworm as the surrogate organism for soil invertebrates. A food web model will be used to estimate woodcock exposures (see Section 4.3.3.). The estimated exposures would then be compared to TRVs obtained from the literature.

Protection of Carnivorous Bird Populations. The barred owl (*Strix varia*) is selected as a representative species for this receptor group. The exposure pathways for this endpoint are ingestion of soil and field rodents. A food web model will be used to estimate the owl's exposure to the COPCs (see Section 4.3.4). The estimated exposures would then be compared to TRVs obtained from the literature.

4.2 Toxicological Reference Values

TRVs are site-specific or literature-based values considered to either represent the NOAEL or the LOAEL to specific receptors in each exposure media. Many published studies provide a range of media-specific TRVs to a variety of test organisms or have modeled NOAEL/LOAEL effects in these receptor groups from representative species.

For this risk assessment, endpoint TRVs will be based on reproductive or growth effects to the test organisms whenever possible. Toxicity information was provided in Section 3.2. Table 4-1 summarizes the TRVs that will be used for this assessment.

4.3 Proposed Methodology for Evaluating Food Web Exposures

The assessment endpoints are for the protection of wildlife populations. Protecting wildlife populations requires complicated dynamic population models with parameters such as population size, survival rates, fecundity, and immigration. Because these data are lacking, individual risk measures (i.e., comparing exposure and effect levels on individual organisms) are assumed to be important in influencing the sustainability of wildlife populations.

4.3.1 General Approach

Representative receptor species from different trophic levels were selected to evaluate exposure to COPCs. The exposure characterization estimates the daily COPC exposure to the receptors for comparison to benchmark values to determine if a potential for adverse effects may occur. The COPC concentrations in tissues of earthworms will be measured, in order to estimate the dose to higher order consumers. The complete exposure pathways for each receptor were discussed in section 4.1 above.

A conservative general dietary exposure model to predict the COPC dose for the selected representative species (shrew, weasel, woodcock, and barred owl) is defined by the following equation:

$$IR_{chemical} = \sum(C_i * M_i * F_i) / BW$$

Where:

$IR_{chemical}$ = total ingestion rate of chemical from all dietary components (mg/kgBW/day)].

C_i = concentration of chemical in a given dietary component and medium (mg/kg dry weight).

M_i = ingestion rate of a particular medium [kilograms per day (kg/day) dry weight].

F_i = fraction of daily media intake from the affected area.

BW = body weight of receptor (kg).

The total ingestion rate can be expanded to specify each ingestion medium which could include one or more food items and/or abiotic media. For example,

$$IR_{chemical} = [(C_{food} * M_{food} * F_{food}) + (C_{water} * M_{water} * F_{water}) + (C_{soil} * M_{soil} * F_{soil})] / BW$$

The above equations assume that the gastrointestinal absorption efficiency of the COPCs is 100 percent. Due to the intermittent presence of surface water (after precipitation events) in depressions of the bottomland hardwood forest or in the side ditches near the site, the ingestion of surface water is also considered intermittent and consumed part of the time. For this assessment, the fractional water ingestion pathway for ground dwelling receptors (excluding the barred owl) is assumed to occur one-half of the time (or F_{water} = 0.5).

Many of the exposure parameters will be obtained from EPA's *Wildlife Exposure Factors Handbook* (USEPA, 1993b), with other parameters derived from literature studies. In some cases, BAFs may be compiled from the literature or from site-specific BAF studies in order to predict concentrations of contaminants in receptor food items.

4.3.2 Receptor Exposure Profile Information

Given the primary contaminants at the site, their mechanisms of toxicity, and using reasonably conservative exposure pathways (including specific behaviors, patterns of habitat use, or feeding habits), receptor species were selected to represent different trophic levels potentially at risk. Another consideration was the availability of appropriate toxicity information on which risk calculations could be based. A description of each of the selected receptor species and their exposure profiles are described below. Table 4-2 provides a summary of the exposure parameters for each food web receptor.

4.3.2.1 Soil Invertebrate. The representative terrestrial invertebrate receptor is the earthworm (*Eisenia foetida*). These organisms have a fairly ubiquitous distribution throughout many habitats and soil conditions, and are an important food base for many small- to medium-sized predators. They are easy to culture in the laboratory and because of their direct contact with soils, they are ideal organisms for soil bioaccumulation and toxicity evaluations. Their diet of detritus, microflora, and microfauna, combined with their direct contact with the surrounding soil presents a link between soil contaminants and soil-invertebrate consumers. Tissue residue analysis of the earthworms from the bioaccumulation tests will be used to estimate exposures to predators that consume them (i.e., the shrew).

4.3.2.2 Insectivorous Mammal – Shrew. The shrew represents a small predatory mammal in the terrestrial environment. Exposure parameters will primarily be based on the short-tailed shrew. These shrews strongly prefer animal matter but are sometimes referred as opportunistic omnivores and will consume whatever food items are in ample supply (Whitaker and Ferraro, 1963; Hamilton, 1941). Plant matter is generally consumed to a greater extent in winter and in some regions plant matter (mostly seeds) may constitute up to 20 percent of the shrew's diet (Barbour and Davis, 1974). Dietary exposure for the short-tailed shrew in this assessment is assumed to be 100 percent of earthworms (based on *E. foetida*).

Data on the body weights of short-tailed shrew are limited. Guilday (1957) reported female shrew body weights ranging from 14 to 21 grams. A mean body weight was not available. For this assessment, the minimum body weight of 14 grams (0.014 kg) will be used.

Shrews are voracious eaters for their body size. Using caged shrews, Morrison et al. (1957) reported mean consumption rates (fed beef livers and neonate rats) between 0.49

and 0.62 grams wet weight per gram body weight for shrews with a mean body weight of 21 grams. For this assessment, the upper mean value of 0.62 grams per gram of body weight (g/gBW) will be used. To convert this to dry weight, a moisture content of 70 percent is assumed (Nagy et al. 1999). This results in 0.2 g/gBW or 0.0028 kg/day for a 0.014 kg shrew.

There are no known studies of incidental soil ingestion by the shrew as it feeds on worms, beetles, and other soil invertebrates. The proportion of total food intake that is soil for the shrew was estimated by EPA at three percent (USEPA, 2005). This results in a value of 0.000084 kilograms of soil per day (kg soil/day).

Chew (1951) reported a daily water ingestion rate of 0.223 g water/g BW. Assuming 1g = 1 milliliter (mL), then a 14g shrew would consume 3.1 mL or 0.0031 L/day.

The home range for shrews has been reported by a few investigators and in general, it is less than an acre in size (Platt, 1976; Buckner, 1966). Therefore, the fractional area use factor for exposure to contaminants at the Sonford site is 1.0. Natural predators of the shrew include snakes, raccoons, feral cats, owls, and hawks.

4.3.2.3 Carnivorous Mammal – Long-tailed Weasel. The long-tailed weasel is selected as the representative receptor species model for mammalian carnivores. The diet of long-tailed weasels is variable and depends on several factors, including age, sex, season, and environment. In general, however, more than 75 percent of their prey is small rodents; the remainder of the diet is medium-sized rodents (e.g., squirrels, chipmunks, rats, and rabbits) and birds (King, 1990; Polderboer et al. 1941; Simms, 1978; Svendsen, 1982; Quick, 1944). Insects may also be consumed, but are not considered a staple food. Vegetation is almost never consumed. Long-tailed weasels inhabit areas from alpine-arctic to tropical, except deserts (Svendsen, 1982). Favored habitats include patches of small rodent cover, such as brushland, brushy field borders, and grasslands near creeks, lakes, and swamps. In contrast, disturbed agricultural land and open-floored woodland with little understory are avoided.

Long-tailed weasels exhibit considerable geographic variation in body size and pronounced sexual dimorphism. Fagerstone (1987) reviewed female body weights for the long-tailed weasel and reported them to range from 0.080 to 0.250 kg. King (1990) summarized mean female body weights from at least two studies including the

Fagerstone data and reported 0.102 to 0.122 kg. For this assessment, a body weight of 0.102 kg will be used.

EPA (2005) conservatively estimated a food ingestion rate of 0.13 g dry weight per gram of body weight per day (dw/g BW/day) which would be 0.0133 kg/day for a 0.102 kg weasel. No measurements of incidental soil/sediment ingestion were identified in the scientific literature for the long-tailed weasel. However, EPA (2005) estimated the proportion of the total food intake that is soil for the weasel was 4.3 percent, or 0.00029 kg soil/day.

The water ingestion rate is based on the algorithm by Calder and Braun (1983) where L water/day = 0.099 * $kgBW^{0.9}$; which results in 0.013 L/day. This is then multiplied by 0.5 to account for the intermittent presence of surface water at the site for an ingestion rate of 0.0065 L/day.

The home range of long-tailed weasel varies, and appears to depend on food availability season, and sex. King (1990) summarized home range data for long-tailed weasels and a review of these data indicates that home range estimates vary from 6 to 160 hectare (ha) (15 – 395 acres). Given that the forested land south and east of the Sonford Chemical is roughly 20 acres, it is assumed that the area use factor for the weasel is 1.0.

4.3.2.4 Insectivorous Bird – American Woodcock. The American woodcock (*Scolopax minor*) is selected as the representative receptor species model of insectivorous birds. Woodcock inhabit woodlands and abandoned fields and appear to feed primarily on worms, but also consume other invertebrates and some plant material (Keppie and Whiting, 1994; Vander Haegen et al. 1993). Dietary exposure for woodcock can be evaluated based on COPC concentrations in worms.

Numerous investigators have reported body weights for American woodcock (Dunning, 1992; Keppie and Redmond, 1985; Nelson and Martin, 1953; Owen and Krohn, 1973; Sheldon, 1967; Tufts, 1940; Vander Haegen et al. 1993). Body weights for adult females reported in these studies range from 160 to 278g. The lowest mean adult female body weight identified in the literature of 181 g (Vander Haegen et al. 1993) and this value is used for this assessment.

EPA (2005) estimated a food ingestion rate for the American woodcock at 0.214 g dry weight per body weight per day (dw/bw/day) based on studies by Sheldon (1967) and

Stickel et al. (1965). Assuming a body weight of 181 g, this results in a prey ingestion rate of 38 g of dry food/day (0.038 kg dry weight/day).

EPA (2005) also estimated the soil ingestion rate for the American woodcock at 16.4 percent of the total daily food consumption rate, or 0.0062 kg/day.

The water ingestion rate is based on the algorithm by Calder and Braun (1983) for avians where L water/day = 0.059 * $kgBW^{0.67}$; which results in 0.019 L/day. This is then multiplied by 0.5 to account for the intermittent presence of surface water at the site for an ingestion rate of 0.0095 L/day.

Information on the home range of American woodcock has been reported (Gregg, 1984; Horton and Causey, 1979; Hudgins et al. 1985; Ingram, 1981; Sepik and Derleth, 1993). Mean total home ranges for female American woodcock vary in these studies from 12 to 42 ha (30 - 104 acres), and mean daytime home ranges vary from 8 to 13 ha (20 - 32 acres). The size and habitat conditions of the Sonford Chemical Site suggest that the area use factor for the woodcock would be 1.0.

4.3.2.5 Carnivorous Bird – Barred Owl. The barred owl represents an upper trophic-level consumer. These birds appear to prefer moist forests, wooded swamps, and woodlands near waterways. They hunt primarily from elevated perches and feed on small mammals such as mice, rabbits, and squirrels with an occasional snake or lizard. Because this owl feeds mostly on animal matter, it is considered a conservative representative species relative to other birds that consume mostly seeds and other plant matter. For this assessment, the dietary consumption of the barred owl is assumed to consist entirely of small mammals.

An average body weight of the barred owl was reported by Dunning (1992) as 0.717 kg, with the females being larger (~ 0.8 kg) than males at about 0.63 kg. Studies on the dietary intake for barred owls are very limited. However, Craighead and Craighead (1956) reported food intake for the owl at 0.084 kg/day.

No measurements of incidental soil/sediment ingestion were identified in the scientific literature for the barred owl. However, EPA (2005) estimated that a red-tailed hawk's diet could be composed of approximately 5.7 percent soil. Because the owl has a similar diet, this would translate to 0.0048 kg soil/day.

The home range of the barred owl varies from about 85 hectares (210 acres) to over 365 ha (900 ac) (Duncan, 2003). The limited size of the Sonford site relative to adjoining off-site habitat reduces potential exposure to contaminants. Assuming a local resident owl in the site vicinity, the fractional area use factor is conservatively assumed to be 0.2. Due to the owl's large home range, ingestion of surface water from the site is assumed to be negligible.

4.4 Work Plan

The WP and supplemental SAP identify investigative tasks needed to evaluate ecological risks. The WP describes in general terms how ecological risks will be assessed at the Sonford Chemical Site and will provide the basis for developing the SAP. The SAP, which includes the field sampling objectives, analytical methods, and QAPP will be developed under separate cover by the EPA SESD in cooperation with Black & Veatch risk assessors.

This section describes existing data gaps that should be fulfilled for assessing ecological exposures and potential risks, and how site data will be used to assess risks. This work plan is considered iterative depending on the actual field data collected and accepted for use in the risk assessment.

4.4.1 Data Needs for Ecological Assessment

Based on a review of the RI site data, the screening-level risk assessment (Section 3), and a site reconnaissance on October 23, 2006, the following data is needed for assessing ecological risks. Details of the sample requirements, test methods, and quality assurance are provided in the SAP/QAPP.

Soil bioaccumulation tests to earthworms are recommended to assess bioaccumulation and potential toxic effects of contaminants along a spatial or and/or concentration gradient of PCP and dioxins from six or seven stations. The site-specific bioaccumulation data would be used for input into food chain models (for insectivorous mammals and birds) to reduce uncertainties. Co-located soil chemistry at these stations will also be needed and should include semi-volatile organics, dioxins/ furans, pesticides, TAL metals, total organic carbon, and field soil pH.

The soil bioaccumulation tests should be performed using a modification of the *Eisenia foetida Toxicity Test for Soils* described in Greene et al. (1989) using adult fully clitellated (breeding) worms exposed for a duration of 28 days. After 28 days the number of worms from the soil will be counted, weighed, and pooled. The worms will then be frozen without depuration and shipped to the analytical laboratory for chemical analyses. The *E. foetida* tissues will be analyzed for TAL metals (including mercury), extractable organic compounds, dioxins/furans, pesticides, percent moisture, and percent lipids.

4.4.2 Estimates of Exposure

This section describes the basic approach to assessing exposures to the assessment endpoints. Section 4.3 provided detailed discussions regarding the approach for food web models.

Exposure Point Concentrations. To the extent practical, all of the RI data from 2003 through the proposed field effort will be used to assess potential exposures. EPCs will include an upper bound concentration (defined as the reasonable maximum exposure or RME) that is represented by the 95 percent upper confidence limit (UCL) of the mean (i.e., 95% UCL). If the calculated 95%UCL exceeded the maximum concentration, then the maximum will be used. A statistical package such as ProUCL will be used to determine the distribution and selection of the RME. The arithmetic average may also be used to provide a measure of central tendency of the data. A hot spot analysis may be conducted if there are a few anomalous high soil concentrations that may drastically skew the mean or UCL values, especially where samples are collected on the gravel pad with lack of habitat.

Bioaccumulation Factors. Site-specific soil to earthworm BAFs will be calculated by dividing the biotic media concentrations by the abiotic media concentrations as follows:

$$BAF = C_{tissue} / C_{soil}$$

where: C_{tissue} = tissue concentration

C_{soil} = soil concentration

The tissue and soil concentrations will be reported in dry weight and the moisture contents will also be provided.

Dioxin/Furan Toxicity Equivalence. The TEF/TEQ approach will be used to quantify exposure to dioxins/furans based on the approach in USEPA (1993a) and Van den Berg et al. (1998, 2006). This method estimates the exposure concentration of a dioxin/furan mixture by assuming dose-additivity and describes the mixture in terms of an equivalent mass of TCDD (the most toxic congener). The TEQs will be calculated for mammals, fish, and birds using TEF values (Van den Berg et al. 2006) and the congener concentrations in the different media according to the following general equation:

$$Total\ TEQ = \Sigma_{n1}\ [PCDD_i\ x\ TEF_i] + \Sigma_{n2}\ [PCDF_i\ x\ TEF_i]$$

Where: PCDD is the individual polychlorinated dibenzodioxin
PCDF is the individual polychlorinated dibenzofuran
TEF = the congener-specific multiplier (See Table 4-3)

4.4.3 Risk Estimation and Characterization

The characterization of ecological risks includes numerical estimates. The hazard quotient approach will be used to provide numerical estimates of potential risks to each of the receptors. The HQ is expressed as the ratio of a potential exposure level for a target receptor to the TRV (using both NOAELs and LOAELs as appropriate). A HQ less than 1.0 indicates that the COPC is unlikely to cause adverse effects to the organism. If multiple contaminants have similar modes of toxicity, then it may be appropriate to sum individual contaminant HQs.

In addition to the various numerical estimates for the multiple assessment endpoints, results of site-specific toxicity tests and other knowledge of contaminant fate and transport (as developed in the Remedial Investigation) will be used to characterize risks at the site. As mentioned in Section 4.2.1, reconciling potential conflicts in risk interpretation may likely require a more thorough analysis of the quality of each data and measurement endpoint.

4.4.4 Remedial Goal Options

Remedial goal options (RGOs) will be included in the ERA. RGOs are threshold abiotic media concentrations considered to be safe for the site receptors and are calculated as follows:

$$RGO = TRV * BW/(IR_{food} * BAF + IR_{soil})$$

Where: TRV = toxicity reference value
BW = body weight of receptor
IR_{food} = ingestion rate of chemical from food items

BAF = bioaccumulation factor

IR_{soil} = ingestion rate of chemical from soil or sediment

Both the NOAEL and LOAEL will be used as the TRV for each receptor to provide a threshold range. The various threshold concentrations for the receptors will then be evaluated relative to their levels of uncertainties regarding dose parameters, TRV uncertainties, spatial and temporal site media contamination patterns and other site-specific conditions.

4.4.5 Uncertainties

The significant uncertainties associated with this step of the ERA process are the estimation of exposures and selection of TRVs. In any risk assessment, many sources of uncertainty exist, including the number and magnitude of subjective conservative assumptions, model uncertainty, parameter uncertainty, and natural variability.

The selection of TRVs is a major source of uncertainty because they are not based on any site-specific data, but rather obtained for individual chemicals under controlled laboratory conditions, and rarely with chemical mixtures.

The selection of representative species as surrogates for all species that may be exposed to contaminants on the Sonford site may under or over-estimate risks to certain species. Therefore, the lines of evidence approach with multiple receptors at different trophic levels will help reduce some uncertainty.

4.5 Sampling and Analysis Plan

A SAP and QAPP for the collection of additional soil samples for the earthworm bioaccumulation/toxicity tests and the co-located analytical data will be prepared under separate cover by EPA-SESD, in consultation with Black & Veatch risk assessors. The SAP/QAPP will incorporate the details of the Data Needs Section (4.4.1) with respect to specific number of samples, field collection techniques, analytical methods, containers, shipping and handling, laboratory coordination, and quality control of all field and analytical data collected as part of this work plan.

4.6 Scientific/Management Decision Point (SMDP)

The completion of this step, which includes a review of the companion SAP/QAPP, should conclude with a SMDP conference where the risk assessors and risk managers agree on the major aspects of the measurement endpoint, site investigation methods, and data use. The risk assessment process should not be delayed due to minor differences in model input parameters, as these issues can be resolved interactively as new information becomes available.

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TABLES

Table 1-1
Common Plants at the Sonford Chemical Site

Red maple *Acer rubrum*	Green ash *Fraxinus pennsylvanica*
Sweetgum *Liquidambar styraciflua*	Sugarberry *Celtis laevigata*
Overcup Oak *Quercus lyrata*	Red Mulberry *Morus rubra*
Bald Cyprus *Taxodium distichum*	Dewberry *Rubus trivialis*
Dwarf palmetto *Sabal minor*	Greenbrier *Smilax spp.*

Table 1-2
Common Wildlife at the Sonford Chemical Site

Mammals	*Reptiles/Amphibians*	*Birds*
Weasel *Mustela frenata*	Green tree frog *Hyla cinerea*	Woodpecker *Picoides spp.*
Raccoon *Procyon lotor*	Southern leopard frog *Rana sphenocephala*	American woodcock *Scolopax minor*
Gray squirrel *Sciurus carolinensis*	Green anole *Anolis carolinensis*	Red-shouldered hawk *Buteo lineatus*
Mice *Peramyscus spp.*	Colubrid Snakes *Colubridae*	Barred owl *Strix varia*
Shrews *Blarina spp.*	Land Turtles *Emydidae*	Brown thrasher *Toxostoma rufum*
		Towhee *Pipilo erythrophthalmus*
		Kentucky warbler *Oporornis formosus*

Table 2-1
Step 2 Screening of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
Inorganics (mg/kg)													
Aluminum	71 / 71	1,400		8,800	J	SD-55_1206	8,800	J	50	176	71	Yes	1
Antimony	4 / 31	0.5	J	1.5	J	SP23SS_0405	1.5	J	3.5	0.4	None	No	NA
Arsenic	67 / 71	0.7		17	J	SP47SS_0806	17	J	10	1.7	1	Yes	1
Barium	53 / 54	13		260		SP02SS_0405	260		165	1.6	5	Yes	1
Beryllium	22 / 54	0.03	J	0.7		SP03SD_0405	0.7		1.1	0.6	None	No	NA
Cadmium	24 / 37	0.1		1.9		SP43SS_0806	1.9		1.6	1.2	1	Yes	1
Calcium	54 / 54	180		68,000		SP44SS_0806	68,000		nv	–	–	Yes	3
Chromium	54 / 54	2.70	J	230	J	SP47SS_0806	230	J	0.4	575	54	Yes	1
Cobalt	41 / 53	0.46		32		SP47SS_0806	32		20	1.6	1	Yes	1
Copper	54 / 54	3		410	J	SP47SS_0806	410	J	40	10.3	8	Yes	1
Iron	71 / 71	1,200		250,000	J	SP47SS_0806	250,000	J	200	1,250	71	Yes	1
Lead	54 / 54	4		610		SP43SS_0806	610		50	12.2	24	Yes	1
Magnesium	54 / 54	130		3,200		SP44SS_0806	3,200		nv	–	–	Yes	3
Manganese	54 / 54	22		1,800		SP03SD_0405	1,800		100	18	39	Yes	1
Mercury	26 / 54	0.11		97	J	SP45SS_0806	97	J	0.1	4	26	Yes	1
Molybdenum	6 / 8	0.51		0.65		SP07SS_0403	0.65		nv	–	–	Yes	3
Nickel	41 / 54	0.88	J	100		SP47SS_0806	100		30	3.3	1	Yes	1
Potassium	52 / 54	85	J	1,900		SP44SS_0806	1,900		nv	–	–	Yes	3
Selenium	6 / 50	0.47	J	0.77	J	SP03SD_0405	0.77	J	0.8	1	None	No	NA
Silver	21 / 45	0.18	J	2.20	J	SS-54_1206	2.20	J	2	1.1	1	Yes	1
Sodium	25 / 54	130	J	2,500		SP23SS_0405	2,500		nv	–	–	Yes	3
Strontium	8 / 8	4.60		70		SP07SS_0403	70		nv	–	–	Yes	3
Thallium	3 / 53	0.61		7		SP47SS_0806	7		1	7	2	Yes	1
Tin	1 / 8	2.70		2.70		SP04SS_0403	2.70		nv	–	–	Yes	3
Titanium	8 / 8	2.20		110		SP07SS_0403	110		nv	–	–	Yes	3
Vanadium	50 / 54	3.80		39		SP24SS_0405	39		2	19.5	50	Yes	1
Yttrium	8 / 8	0.88		6.4		SP07SS_0403	6.4		nv	–	–	Yes	3
Zinc	54 / 54	6.90	J	1,200		SP23SS_0405	1,200		50	24	33	Yes	1
Semivolatile Organic Compounds (Extractables) (ug/kg)													
(3-and/or 4-)Methylphenol	1 / 103	19	J	19	J	SP08SS_0403	19	J	nv	–	–	Yes	3
1,1'-Biphenyl	0 / 105	33	U	670	U	SS-956_1206	670	U	60,000	0.01	None	No	NA
1,2,4,5-Tetrachlorobenzene	0 / 18	180	U	250	U	SS-956_1206	250	U	nv	–	–	Yes	4
1,2,4-Trichlorobenzene	3 / 79	28		14,000		SP45SS_0806	14,000		nv	–	–	Yes	3
2,3,4,6-Tetrachlorophenol	21 / 69	41	J	300,000		SP45SS_0806	300,000		nv	–	–	Yes	3
2,4,5-Trichlorophenol	4 / 105	42	J	2,300	J	SP45SS_0806	2,300	J	4,000	0.6	None	No	NA
2,4,6-Trichlorophenol	4 / 105	260	J	3,900		SP45SS_0806	3,900		10,000	0.4	None	No	NA
2,4-Dichlorophenol	3 / 105	380		1,500		SP45SS_0806	1,500		3	500	3	Yes	1
2,4-Dimethylphenol	0 / 104	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
2,4-Dinitrophenol	0 / 105	330	U	3,700	U	SS-956_1206	3,700	U	20,000	0.2	None	No	NA
2,4-Dinitrotoluene	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
2,6-Dinitrotoluene	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
2-Chloronaphthalene	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
2-Chlorophenol	1 / 105	340	J	340	J	SP45SS_0806	340	J	nv	–	–	Yes	3
2-Methylphenol	0 / 104	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
2-Nitroaniline	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4

Table 2-1
Step 2 Screening of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
2-Nitrophenol	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
3,3'-Dichlorobenzidine	0 / 101	170	U	3,500	UJ	SS-956_1206	3,500	UJ	nv	–	–	Yes	4
3-Nitroaniline	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
4,6-Dinitro-2-methylphenol	0 / 105	330	U	3,700	U	SS-956_1206	3,700	U	nv	–	–	Yes	4
4-Bromophenyl-phenylether	0 / 105	170	U	3,500	U	SS-956_1206	3,500	U	nv	–	–	Yes	4
4-Chloro-3-methylphenol	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
4-Chloroaniline	0 / 102	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
4-Chlorophenyl-phenyl ether	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
4-Nitroaniline	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
4-Nitrophenol	0 / 105	330	U	3,700	U	SS-956_1206	3,700	U	7,000	0.5	None	No	NA
Acetophenone	5 / 105	25	J	130	J	SP09DSS_0405	130	J	nv	–	–	Yes	3
Atrazine	0 / 105	170	U	3,500	U	SS-956_1206	3,500	U	0.1	70,000	None	Yes	2
Benzaldehyde	14 / 105	26	J	850	J	SP02DSS_0405	850	J	nv	–	–	Yes	3
Bis(2-chloroethoxy)methane	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
Bis(2-chloroethyl)ether	0 / 87	170	U	1,900	U	SS-86-0507	1,900	U	nv	–	–	Yes	4
bis(2-Chloroisopropyl)ether	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
Bis(2-ethylhexyl)phthalate	6 / 105	520		1,200		SP009SS_0405	1,200		nv	–	–	Yes	3
Butylbenzylphthalate	4 / 105	240		1,000		SP02SS_0403	1,000		nv	–	–	Yes	3
Caprolactam	0 / 103	170	UJ	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
Carbazole	2 / 105	46	J	100	J	SP24SS_0405	100	J	nv	–	–	Yes	3
Diethylphthalate	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	100,000	0.02	None	No	NA
Dimethylphthalate	0 / 105	18	U	1,900	U	SS-956_1206	1,900	U	200,000	0.01	None	No	NA
Di-n-butylphthalate	0 / 105	170	U	3,500	U	SS-956_1206	3,500	U	200,000	0.02	None	No	NA
Di-n-octylphthalate	1 / 105	2,800		2,800		SP47SS_0806	2,800		nv	–	–	Yes	3
Diphenylamine	0 / 43	330	U	3,500	U	SS-86-0507	3,500	U	nv	–	–	Yes	4
Hexachlorobenzene	16 / 105	32	J	1,400		SP009SS_0405	1,400		2.5	1,400	16	Yes	1
Hexachlorobutadiene	0 / 114	0.98	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
Hexachlorocyclopentadiene	0 / 105	170	UJ	1,900	U	SS-956_1206	1,900	U	10,000	0.2	None	No	NA
Hexachloroethane	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
Isophorone	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
Nitrobenzene	1 / 105	85	J	85	J	SS-69-0507	85	J	40,000	0.05	None	No	NA
N-Nitroso-di-n-propylamine	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	nv	–	–	Yes	4
N-Nitrosodiphenylamine	1 / 62	22	J	22	J	SS-54_1206	22	J	20,000	0.001	None	No	NA
Pentachlorophenol	44 / 105	84	J	14,000,000		SP45SS_0806	14,000,000		2	7,000,000	44	Yes	1
Phenol	0 / 105	170	U	1,900	U	SS-956_1206	1,900	U	50	38	None	Yes	2
PAHs (ug/kg)													
2-Methylnaphthalene	11 / 105	10	J	1,900		SP45SS_0806							
Acenaphthene	2 / 105	4.3	J	79	J	SP24SS_0405							
Acenaphthylene	2 / 105	9.3		720		SP45SS_0806							
Anthracene	5 / 105	5.1	J	740		SP45SS_0806							
Benzo(a)anthracene	14 / 105	6.1		490		SP13SS_0405							
Benzo(a)pyrene	16 / 105	6.5		300	J	SP13SS_0405							
Benzo(b)fluoranthene	17 / 105	10		540		SP13SS_0405							
Benzo(g,h,i)perylene	9 / 105	6.5	J	110	J	SP24SS_0405							
Benzo(k)fluoranthene	13 / 105	9.0		170	J	SP13SS_0405	Persuant to Region 4 guidance, individual analytes were screened as the summed total concentration.						
Chrysene	23 / 105	5.3		570		SP13SS_0405							
Dibenzo(a,h)anthracene	0 / 105	17	U	670	U	SS-956_1206							

Table 2-1
Step 2 Screening of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
Dibenzofuran	3 / 105	36		50	J	SP24SS_0405							
Fluoranthene	25 / 105	14	J	910		SP13SS_0405							
Fluorene	2 / 105	8.6	J	71	J	SP24SS_0405							
Indeno(1,2,3-cd)pyrene	9 / 105	4.8	J	200		SP13SS_0405							
Naphthalene	13 / 105	14		760		SP45SS_0806							
Phenanthrene	22 / 105	7.3	J	730		SP45SS_0806							
Pyrene	28 / 105	13	J	660		SP13SS_0405							
Total PAHs (5)		4886.00		4,886		SP45SS_0806	4886		1,000	4.9	4	Yes	1
Pesticides/PCBs (ug/kg)													
4,4'-DDD	7 / 84	4.60		91		SP07SS_0405							
4,4'-DDE	38 / 85	2.10		20,000	J	SP45SS_0806	Persuant to Region 4 guidance, individual analytes were screened as the summed total concentration.						
4,4'-DDT	31 / 86	7.90		190,000	J	SP45SS_0806							
Total DDTr		2.10		210,000		SP45SS_0806	210,000		2.5	84,000	43	Yes	1
Aldrin	2 / 87	63.00	J	52,000	J	SP45SS_0806	52,000	J	nv	–	–	Yes	3
alpha-BHC	9 / 85	1.90		290,000	J	SP45SS_0806	290,000	J	nv	–	–	Yes	3
alpha-Chlordane	15 / 86	2.30	J	110		SP009SS_0405	110		nv	–	–	Yes	3
alpha-Chlordene	0 / 8	13	U	210	U	SP11SD_0403	210	U	nv	–	–	Yes	4
Aroclor-1016	0 / 27	37	U	1,000	U	SP24SS_0405							
Aroclor-1221	0 / 27	37	U	1,000	U	SP24SS_0405							
Aroclor-1232	0 / 27	37	U	1,000	U	SP24SS_0405							
Aroclor-1242	0 / 27	37	U	1,000	U	SP24SS_0405	Persuant to Region 4 guidance, individual analytes were screened as the summed total concentration.						
Aroclor-1248	0 / 27	37	U	1,000	U	SP24SS_0405							
Aroclor-1254	0 / 27	37	U	1,000	U	SP24SS_0405							
Aroclor-1260	0 / 27	37	U	1,000	U	SP24SS_0405							
Total PCBs	0 / 27	37	U	1,000	U	SP24SS_0405	1,000	U	20	–	–	Yes	4
beta-BHC	13 / 78	3.10		64,000	J	SP45SS_0806	64,000	J	nv	–	–	Yes	3
beta-Chlordene	0 / 8	13	U	19	U	SP11SD_0403	19	U	nv	–	–	Yes	4
Chlordane	0 / 9	26	UJ	28,000	UJ	SP48SS_0806	28,000	UJ	nv	–	–	Yes	4
Chlordene	0 / 17	2	UJ	2,200	UJ	SP48SS_0806	2,200	UJ	nv	–	–	Yes	4
cis-Nonachlor	0 / 17	4	UJ	17,000	UJ	SP48SS_0806	17,000	UJ	nv	–	–	Yes	4
delta-BHC	16 / 84	2.6		92,000	J	SP45SS_0806	92,000	J	nv	–	–	Yes	3
Dieldrin	13 / 86	3.2		10,000	J	SP45SS_0806	10,000	J	nv	–	–	Yes	3
Endosulfan I	1 / 85	320		320		SP009SS_0405	320		nv	–	–	Yes	3
Endosulfan II	2 / 88	6.2	J	6.9	J	SP06SD_0405	6.9	J	nv	–	–	Yes	3
Endosulfan sulfate	0 / 88	3.5	U	11,000	UJ	SS-956_1206	11,000	UJ	nv	–	–	Yes	4
Endrin	2 / 88	18.0	J	410	J	SP44SS_0806	410	J	nv	–	–	Yes	3
Endrin aldehyde	1 / 79	27.0		27		SP08SS_0405	27		nv	–	–	Yes	3
Endrin ketone	0 / 87	3.5	U	11,000	UJ	SS-956_1206	11,000	UJ	nv	–	–	Yes	4
gamma-BHC	13 / 81	3.1		680,000	J	SP45SS_0806	680,000	J	nv	–	–	Yes	3
gamma-Chlordane	1 / 45	2.2		230		SS-79-0507	230		nv	–	–	Yes	3
Heptachlor	4 / 86	2.1		45		SS-79-0507	45		nv	–	–	Yes	3
Heptachlor epoxide	10 / 88	2.6		89		SS-76S-0507	89		nv	–	–	Yes	3
Methoxychlor	1 / 88	11	J	11		SD-50_1206	11		nv	–	–	Yes	3
Oxychlordane	0 / 8	13	U	19	U	SP11SD_0403	19	U	nv	–	–	Yes	4
Toxaphene	3 / 88	330		640		SP24SS_0405	640		nv	–	–	Yes	3
trans-Nonachlor	2 / 17	1.9	J	5.5	J	SP08SS_0403	5.5	J	nv	–	–	Yes	3

Table 2-1
Step 2 Screening of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
Volatile Organic Compounds (ug/kg)													
1,1,1,2-Tetrachloroethane	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
1,1,1-Trichloroethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,1,2,2-Tetrachloroethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,1,2-Trichloro-1,2,2-trifluor	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,1,2-Trichloroethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,1-Dichloroethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,1-Dichloroethene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,1-Dichloropropene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
1,2,3-Trichlorobenzene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
1,2,3-Trichloropropane	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
1,2,4-Trimethylbenzene	1 / 9	31		31		SP10SD_0403	31		nv	–	–	Yes	3
1,2-Dibromo-3-chloropropane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,2-Dibromoethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,2-Dichlorobenzene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,2-Dichloroethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,2-Dichloropropane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,3,5-Trimethylbenzene	2 / 9	0.57	J	17		SO08SB_0403	17		nv	–	–	Yes	3
1,3-Dichlorobenzene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
1,3-Dichloropropane	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
1,4-Dichlorobenzene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
2,2-Dichloropropane	0 / 9	0.98	UJ	3.4	UJ	SP11SD_0403	3.4	UJ	nv	–	–	Yes	4
2-Butanone	2 / 28	180		200		SP02SD_0405	200		nv	–	–	Yes	3
2-Hexanone	0 / 28	10	U	86	U	SP24SS_0405	86	U	nv	–	–	Yes	4
4-Chlorotoluene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
4-Methyl-2-pentanone	0 / 28	10	U	43	U	SP24SS_0405	43	U	nv	–	–	Yes	4
Acetone	9 / 28	10		300	J	SP11SD_0403	300	J	nv	–	–	Yes	3
Benzene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Bromobenzene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
Bromochloromethane	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
Bromodichloromethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Bromoform	0 / 28	4.90	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Bromomethane	0 / 28	4.90	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Carbon disulfide	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Carbon tetrachloride	0 / 28	0.98	UJ	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Chlorobenzene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Chloroethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Chloroform	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Chloromethane	0 / 28	0.98	UJ	35	UJ	SP24SS_0405	35	UJ	nv	–	–	Yes	4
cis-1,2-Dichloroethene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
cis-1,3-Dichloropropene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Cyclohexane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Dibromochloromethane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Dibromomethane	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
Dichlorodifluoromethane	0 / 28	0.98	UJ	35	UJ	SP24SS_0405	35	UJ	nv	–	–	Yes	4
Ethylbenzene	2 / 28	1.70	J	2.2	J	SP11SD_0403	2.2	J	nv	–	–	Yes	3
Isopropylbenzene	1 / 28	1.60	J	1.6	J	SP10SD_0403	1.6	J	nv	–	–	Yes	3

Table 2-1
Step 2 Screening of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
m,p-Xylene	1 / 28	5.2		5.2		SP10SD_0403	5.2		nv	–	–	Yes	3
Methyl acetate	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Methyl tert-butyl ether	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Methylcyclohexane	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Methylene chloride	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
n-Butylbenzene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
n-Propylbenzene	1 / 9	2.2		2.2		SP10SD_0403	2.2		nv	–	–	Yes	3
o-Chlorotoluene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
o-Xylene	1 / 9	11		11		SP10SD_0403	11		nv	–	–	Yes	3
p-Isopropyltoluene	2 / 9	6		12		SP09SD_0403	12		nv	–	–	Yes	3
sec-Butylbenzene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
Styrene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
tert-Butylbenzene	0 / 9	0.98	U	3.4	U	SP11SD_0403	3.4	U	nv	–	–	Yes	4
Tetrachloroethene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Toluene	10 / 28	2	J	23		SP11SD_0403	23		nv	–	–	Yes	3
trans-1,2-Dichloroethene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
trans-1,3-Dichloropropene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Trichloroethene	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Trichlorofluoromethane	2 / 28	2	J	3.0	J	SP05SD_0405	3.0	J	nv	–	–	Yes	3
Vinyl Chloride	0 / 28	0.98	U	35	U	SP24SS_0405	35	U	nv	–	–	Yes	4
Dioxins/Furans (ug/kg)													
TEQ (Avian 2006)	63 / 99	0.003	J	400	J	SP47SS_0806	400	J	0.0025	160,000	63	Yes	1
TEQ (Mammalian 2006)	38 / 52	0.01	J	520	J	SP47SS_0806	520	J	0.0025	208,000	38	Yes	1

Notes:
nv - no value (value not available)
NA - not applicable

Data Qualifiers:
U - Analyte not detected at or above reporting limit. The number is the minimum quanititation limit.
J - Identification of anlayte is acceptable; reported value is estimated.
(1) Maximum detected of SQL
(2) Value in EPA Region 4 Supplement to RAGS; unless dependent on those of analyte
(3) HQ = Exposure Point Concentration / ESV
(4) Chemicals of Potential Concern (COPC) Categories:
1 - Detected and HQ >= 1
2 - Not Detected, maximum SQL >= ESV
3 - Detected but no ESV
4 - Not Detected and no ESV
TEQ - Toxicity Equivelency Quotient using factors from Van den Berg et al, (2006)

Table 2-2
Step 2 Screening of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Chemical Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
Inorganics (ug/L)													
Aluminum	3 / 14	1,100	J	2,200	J	SP03SW_0405	2,200	J	87	25	3	Yes	1
Antimony	0 / 14	60	U	60	U	SP01SW_0405	60	U	160	0.38	None	No	NA
Arsenic	1 / 14	7	J	7	J	SP03DSW_0405	7	J	190	0.03	None	No	NA
Barium	14 / 14	18	J	95	J	SP04SW_0405	95	J	nv	–	–	Yes	3
Beryllium	0 / 14	0.16	UJ	5	U	SW-51_1206	5	U	0.53	9.43	14	Yes	2
Cadmium	0 / 14	5	U	5	U	SW-54_1206	5	U	0.66	7.58	14	Yes	2
Calcium	14 / 14	1,900	J	56,000		SP03SW_0405	56,000		nv	–	–	Yes	3
Chromium	7 / 10	0.9	J	7	J	SP03SW_0405	7	J	11	0.64	None	No	NA
Cobalt	2 / 12	4.4	J	5.9	J	SP04SW_0405	5.9	J	nv	–	–	Yes	3
Copper	2 / 10	4.7	J	7.9	J	SW-55_1206	7.9	J	6.54	1.21	1	Yes	1
Cyanide	1 / 14	10	U	100		SP06SW_0405	100		5.2	19	1	Yes	1
Iron	14 / 14	540	J	11,000	J	SP04SW_0405	11,000	J	1000	11	12	Yes	1
Lead	4 / 12	3.7	J	30		SP03SW_0405	30		1.32	23	4	Yes	1
Magnesium	14 / 14	690	J	4,400	J	SP03SW_0405	4,400	J	nv	–	–	Yes	3
Manganese	14 / 14	41		8,800		SW-54_1206	8,800		nv	–	–	Yes	3
Mercury	0 / 14	0.03	UJ	0.2	U	SP01SW_0405	0.2	U	0.012	17	14	Yes	2
Nickel	6 / 12	1.6	J	10	J	SW-53_1206	10	J	87.71	0.11	None	No	NA
Potassium	14 / 14	960	J	12,000	J	SP05SW_0405	12,000	J	nv	–	–	Yes	3
Selenium	0 / 14	35	U	35	U	SW-55_1206	35	U	5	7	14	Yes	2
Silver	0 / 14	10	U	10	U	SP03DSW_0405	10	U	0.012	833	14	Yes	2
Sodium	14 / 14	3,400	J	39,000		SW-50_1206	39,000		nv	–	–	Yes	3
Thallium	0 / 14	25	U	25	U	SP03DSW_0405	25	U	4	6	14	Yes	2
Vanadium	10 / 11	1.2	J	8.5	J	SW-53_1206	8.5	J	nv	–	–	Yes	3
Zinc	8 / 14	11	J	80		SW-53_1206	80		58.91	1.36	1	Yes	1
Semivolatile Organic Compounds (Extractables) (ug/L)													
(3-and/or 4-)Methylphenol	3 / 14	0.6	J	12		SP04SW_0405	12		nv	–	–	Yes	3
1,1'-Biphenyl	0 / 14	5	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
1,2,4,5-Tetrachlorobenzene	0 / 7	5	U	5	U	SW-53_1206	5	U	nv	–	–	Yes	4
2,3,4,6-Tetrachlorophenol	0 / 7	5	U	5	U	SW-951_1206	5	U	nv	–	–	Yes	4
2,4,5-Trichlorophenol	0 / 14	5	U	25	U	SP04SW_0405	25	U	nv	–	–	Yes	4
2,4,6-Trichlorophenol	0 / 14	5	U	10	U	SP01SW_0405	10	U	3.2	3.13	14	Yes	2
2,4-Dichlorophenol	0 / 14	5	U	10	U	SP03DSW_0405	10	U	36.5	0.27	None	No	NA
2,4-Dimethylphenol	0 / 14	5	U	10	U	SP06SW_0405	10	U	21.2	0.47	None	No	NA
2,4-Dinitrophenol	0 / 14	10	U	25	U	SP02SW_0405	25	U	6.2	4.03	14	Yes	2
2,4-Dinitrotoluene	0 / 14	5	U	10	U	SP02SW_0405	10	U	310	0.03	None	No	NA
2,6-Dinitrotoluene	0 / 14	5	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
2-Chloronaphthalene	0 / 14	5	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
2-Chlorophenol	0 / 14	5	U	10	U	SP06SW_0405	10	U	43.8	0.23	None	No	NA
2-Methylphenol	0 / 14	5	U	10	U	SP03DSW_0405	10	U	nv	–	–	Yes	4
2-Nitroaniline	0 / 14	10	U	25	U	SP02SW_0405	25	U	nv	–	–	Yes	4
2-Nitrophenol	0 / 14	5	U	10	U	SP03SW_0405	10	U	3500	0.003	None	No	NA
3,3'-Dichlorobenzidine	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
3-Nitroaniline	0 / 14	10	U	25	U	SP03SW_0405	25	U	nv	–	–	Yes	4
4,6-Dinitro-2-methylphenol	0 / 14	10	U	25	U	SP06SW_0405	25	U	2.3	10.87	14	Yes	2
4-Bromophenyl-phenylether	0 / 14	5	U	10	U	SP02SW_0405	10	U	12.2	0.82	None	No	NA
4-Chloro-3-methylphenol	0 / 14	5	U	10	U	SP02SW_0405	10	U	0.3	33.33	14	Yes	2
4-Chloroaniline	0 / 14	5	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
4-Chlorophenyl-phenyl ether	0 / 14	5	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
4-Nitroaniline	0 / 14	10	U	25	U	SP02SW_0405	25	U	nv	–	–	Yes	4

Table 2-2
Step 2 Screening of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Chemical Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
4-Nitrophenol	0 / 14	10	U	25	U	SP01SW_0405	25	U	82.8	0.30	None	No	NA
Acetophenone	0 / 14	5	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
Atrazine	0 / 14	5	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
Benzaldehyde	0 / 14	5	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
Bis(2-chloroethoxy)methane	0 / 14	5	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
Bis(2-chloroethyl)ether	0 / 14	5	U	10	U	SP05SW_0405	10	U	2380	0.004	None	No	NA
bis(2-Chloroisopropyl)ether	0 / 14	5	U	10	U	SP02SW_0405	10	U	nv	–	–	Yes	4
Bis(2-ethylhexyl)phthalate	2 / 14	5		36		SP06SW_0405	36		0.3	120	2	Yes	1
Butylbenzylphthalate	1 / 14	16		16		SP04SW_0405	16		nv	–	–	Yes	3
Caprolactam	0 / 14	5	UJ	10	U	SP02SW_0405	10	U	nv	–	–	Yes	4
Carbazole	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Diethylphthalate	1 / 14	10		10		SW-55_1206	10		521	0.02	None	No	NA
Dimethylphthalate	0 / 14	5	U	10	U	SP05SW_0405	10	U	330	0.03	None	No	NA
Di-n-butylphthalate	0 / 14	5	U	10	U	SP04SW_0405	10	U	9.4	1.06	7	Yes	2
Di-n-octylphthalate	0 / 14	5	U	10	U	SP03DSW_0405	10	U	nv	–	–	Yes	4
Hexachlorobenzene	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Hexachlorobutadiene	0 / 14	5	U	10	U	SP06SW_0405	10	U	0.93	11	14	Yes	2
Hexachlorocyclopentadiene	0 / 14	5	UJ	10	U	SP05SW_0405	10	U	0.07	143	14	Yes	2
Hexachloroethane	0 / 14	5	U	10	U	SP04SW_0405	10	U	9.8	1.02	7	Yes	2
Isophorone	0 / 14	5	U	10	U	SP04SW_0405	10	U	1170	0.01	None	No	NA
Nitrobenzene	0 / 14	5	U	10	U	SP01SW_0405	10	U	270	0.04	None	No	NA
N-Nitroso-di-n-propylamine	0 / 14	5	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
N-Nitrosodiphenylamine	0 / 14	5	U	10	U	SP03SW_0405	10	U	58.5	0.17	None	No	NA
Pentachlorophenol	5 / 14	3	J	16	J	SP03DSW_0405	16	J	13	1.23	1	Yes	1
Phenol	2 / 14	9		10		SP04SW_0405	10		256	0.04	None	No	NA
PAHs (ug/L)													
2-Methylnaphthalene	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Acenaphthene	0 / 14	5	U	10	U	SP05SW_0405	10	U	17	0.59	None	No	NA
Acenaphthylene	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Anthracene	0 / 14	5	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
Benzo(a)anthracene	0 / 14	5	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
Benzo(a)pyrene	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Benzo(b)fluoranthene	1 / 14	2	J	2	J	SP03DSW_0405	2	J	nv	–	–	Yes	3
Benzo(g,h,i)perylene	0 / 14	5	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
Benzo(k)fluoranthene	1 / 14	1	J	1	J	SP03DSW_0405	1	J	nv	–	–	Yes	3
Chrysene	0 / 14	5	U	10	U	SP02SW_0405	10	U	nv	–	–	Yes	4
Dibenzo(a,h)anthracene	1 / 14	1	J	1	J	SP03DSW_0405	1	J	nv	–	–	Yes	3
Dibenzofuran	0 / 14	5	U	10	U	SP03SW_0405	10	U	nv	–	–	Yes	4
Fluoranthene	0 / 14	5	U	10	U	SP05SW_0405	10	U	39.8	0.25	None	No	NA
Fluorene	0 / 14	5	U	10	U	SP03DSW_0405	10	U	nv	–	–	Yes	4
Indeno(1,2,3-cd)pyrene	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Naphthalene	0 / 14	5	U	10	U	SP02SW_0405	10	U	62	0.16	None	No	NA
Phenanthrene	0 / 14	5	U	10	U	SP02SW_0405	10	U	nv	–	–	Yes	4
Pyrene	0 / 14	5	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Pesticides/PCBs (ug/L)													
4,4'-DDD	0 / 14	0.1	U	0.1	U	SP03DSW_0405	0.1	U	0.006	17	14	Yes	2
4,4'-DDE	0 / 14	0.1	U	0.1	UJ	SW-51_1206	0.1	UJ	10.5	0.01	None	No	NA
4,4'-DDT	0 / 14	0.1	U	0.1	U	SP06SW_0405	0.1	U	0.001	100	14	Yes	2
Aldrin	0 / 14	0.1	U	0.1	U	SW-52_1206	0.1	U	0.3	0.17	None	No	NA
alpha-BHC	5 / 14	0.4		1.1		SP05SW_0405	1.1		500	0.002	None	No	NA

Table 2-2 Step 2 Screening of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Chemical Site - Flowood, Mississippi													
Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
alpha-Chlordane	0 / 14	0.1	U	0.1	U	SP05SW_0405	0.1	U	0.004	12.5	14	Yes	2
Aroclor-1016	0 / 7	1	U	1	U	SP03SW_0405	1	U	0.014	71.43	7	Yes	2
Aroclor-1221	0 / 7	2	U	2	U	SP05SW_0405	2	U	0.014	142.86	7	Yes	2
Aroclor-1232	0 / 7	1	U	1	U	SP03SW_0405	1	U	0.014	71.43	7	Yes	2
Aroclor-1242	0 / 7	1	U	1	U	SP02SW_0405	1	U	0.014	71.43	7	Yes	2
Aroclor-1248	0 / 7	1	U	1	U	SP03SW_0405	1	U	0.014	71.43	7	Yes	2
Aroclor-1254	0 / 7	1	U	1	U	SP01SW_0405	1	U	0.014	71.43	7	Yes	2
Aroclor-1260	0 / 7	1	U	1	U	SP03DSW_0405	1	U	0.014	71.43	7	Yes	2
beta-BHC	4 / 13	0.2		1.3		SP03DSW_0405	1.3		5000	0.00026	None	No	NA
delta-BHC	6 / 14	0.1		3		SP03DSW_0405	3		nv	–	–	Yes	3
Dieldrin	0 / 14	0.1	U	0.1	U	SW-50_1206	0.1	U	0.002	50	14	Yes	2
Endosulfan I	0 / 14	0.1	U	0.1	U	SW-53_1206	0.1	U	0.056	0.89	None	No	NA
Endosulfan II	0 / 14	0.1	U	0.1	U	SW-51_1206	0.1	U	0.056	1.79	14	Yes	2
Endosulfan sulfate	0 / 14	0.1	U	0.1	U	SP06SW_0405	0.1	U	nv	–	–	Yes	4
Endrin	0 / 14	0.1	U	0.1	U	SP01SW_0405	0.1	U	0.002	50	14	Yes	2
Endrin aldehyde	0 / 14	0.1	U	0.1	U	SW-51_1206	0.1	U	nv	–	–	Yes	4
Endrin ketone	0 / 14	0.1	U	0.1	U	SP03SW_0405	0.1	U	nv	–	–	Yes	4
gamma-BHC	3 / 12	1.2		3.6		SP05SW_0405	3.6		0.08	45	3	Yes	1
gamma-Chlordane	0 / 14	0.1	U	0.1	U	SW-50_1206	0.1	U	0.004	13	14	Yes	2
Heptachlor	0 / 14	0.1	U	0.1	U	SW-50_1206	0.1	U	0.004	13	14	Yes	2
Heptachlor epoxide	1 / 13	0.1		0.1		SP03SW_0405	0.1		0.004	23	1	Yes	1
Methoxychlor	0 / 14	0.5	UJ	0.5	U	SP03SW_0405	0.5	U	0.03	17	14	Yes	2
Toxaphene	0 / 14	5	U	5.0	UJ	SW-51_1206	5.0	UJ	0.0002	25,000	None	Yes	2
Volatile Organic Compounds (ug/L)													
1,1,1-Trichloroethane	0 / 7	10	U	10	U	SP03DSW_0405	10	U	528	0.02	None	No	NA
1,1,2,2-Tetrachloroethane	0 / 7	10	U	10	U	SP05SW_0405	10	U	240	0.04	None	No	NA
1,1,2-Trichloro-1,2,2-trifluo	0 / 7	10	U	10	U	SP03DSW_0405	10	U	nv	–	–	Yes	4
1,1,2-Trichloroethane	0 / 7	10	U	10	U	SP05SW_0405	10	U	940	0.01	None	No	NA
1,1-Dichloroethane	0 / 7	10	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
1,1-Dichloroethene	0 / 7	10	U	10	U	SP01SW_0405	10	U	303	0.03	None	No	NA
1,2,4-Trichlorobenzene	0 / 7	10	UJ	10	UJ	SP06SW_0405	10	UJ	44.9	0.22	None	No	NA
1,2-Dibromo-3-chloropropane	0 / 7	10	U	10	U	SP03DSW_0405	10	U	nv	–	–	Yes	4
1,2-Dibromoethane	0 / 7	10	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
1,2-Dichlorobenzene	2 / 7	2	J	2	J	SP03SW_0405	2	J	15.8	0.13	None	No	NA
1,2-Dichloroethane	0 / 7	10	U	10	U	SP01SW_0405	10	U	2000	0.01	None	No	NA
1,2-Dichloropropane	0 / 7	10	U	10	U	SP02SW_0405	10	U	525	0.02	None	No	NA
1,3-Dichlorobenzene	0 / 7	10	U	10	U	SP05SW_0405	10	U	50.2	0.20	None	No	NA
1,4-Dichlorobenzene	3 / 7	1	J	4	J	SP03SW_0405	4	J	11.2	0.36	None	No	NA
2-Butanone	0 / 7	10	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
2-Hexanone	0 / 7	10	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
4-Methyl-2-pentanone	0 / 7	10	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
Acetone	5 / 7	11		23		SP03SW_0405	23		nv	–	–	Yes	3
Benzene	0 / 7	10	U	10	U	SP01SW_0405	10	U	53	0.19	None	No	NA
Bromodichloromethane	0 / 7	10	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
Bromoform	0 / 7	10	U	10	U	SP02SW_0405	10	U	293	0.03	None	No	NA
Bromomethane	0 / 7	10	U	10	U	SP01SW_0405	10	U	110	0.09	None	No	NA
Carbon disulfide	0 / 7	10	U	10	U	SP03DSW_0405	10	U	nv	–	–	Yes	4
Carbon tetrachloride	0 / 7	10	U	10	U	SP06SW_0405	10	U	352	0.03	None	No	NA
Chlorobenzene	3 / 7	1	J	6	J	SP03SW_0405	6	J	195	0.03	None	No	NA
Chloroethane	0 / 7	10	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
Chloroform	0 / 7	10	U	10	U	SP04SW_0405	10	U	289	0.03	None	No	NA

Table 2-2
Step 2 Screening of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Chemical Site - Flowood, Mississippi

Analyte	Frequency of Detection	Range of Detections or Sample Quantitation Limits (SQL)				Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	EPA Region 4 ESV (2)	Maximum Hazard Quotient (3)	Number of Samples Exceeding ESV	Preliminary COPC?	PCOPC Category (4)
		Minimum	Q	Maximum	Q								
Chloromethane	0 / 7	10	UJ	10	UJ	SP01SW_0405	10	UJ	5500	0.00	None	No	NA
cis-1,2-Dichloroethene	0 / 7	10	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
cis-1,3-Dichloropropene	0 / 7	10	U	10	U	SP01SW_0405	10	U	24.4	0.41	None	No	NA
Cyclohexane	0 / 7	10	U	10	U	SP03SW_0405	10	U	nv	–	–	Yes	4
Dibromochloromethane	0 / 7	10	U	10	U	SP02SW_0405	10	U	nv	–	–	Yes	4
Dichlorodifluoromethane	0 / 7	10	UJ	10	UJ	SP03SW_0405	10	UJ	nv	–	–	Yes	4
Ethylbenzene	0 / 7	10	U	10	U	SP04SW_0405	10	U	453	0.02	None	No	NA
Isopropylbenzene	0 / 7	10	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
m,p-Xylene	0 / 7	10	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
Methyl acetate	0 / 7	10	U	10	U	SP01SW_0405	10	U	nv	–	–	Yes	4
Methyl tert-butyl ether	0 / 7	10	U	10	U	SP02SW_0405	10	U	nv	–	–	Yes	4
Methylcyclohexane	0 / 7	10	U	10	U	SP06SW_0405	10	U	nv	–	–	Yes	4
Methylene chloride	0 / 7	10	UJ	10	UJ	SP05SW_0405	10	UJ	1930	0.01	None	No	NA
Styrene	0 / 7	10	U	10	U	SP05SW_0405	10	U	nv	–	–	Yes	4
Tetrachloroethene	0 / 7	10	U	10	U	SP06SW_0405	10	U	84	0.12	None	No	NA
Toluene	1 / 7	3	J	3	J	SP04SW_0405	3	J	175	0.02	None	No	NA
trans-1,2-Dichloroethene	0 / 7	10	U	10	U	SP04SW_0405	10	U	1350	0.01	None	No	NA
trans-1,3-Dichloropropene	0 / 7	10	U	10	U	SP04SW_0405	10	U	24.4	0.41	None	No	NA
Trichloroethene	0 / 7	10	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
Trichlorofluoromethane	0 / 7	10	U	10	U	SP04SW_0405	10	U	nv	–	–	Yes	4
Vinyl Chloride	0 / 7	10	UJ	10	UJ	SP06SW_0405	10	UJ	nv	–	–	Yes	4
Dioxins (ug/L)													
TEQ (Avian 2006)	14 / 14	0.000002	J	0.0041		SP03DSW_0405	0.0041		nv	–	–	Yes	3
TEQ (Fish 2006)	14 / 14	0.000002	J	0.0044		SP03DSW_0405	0.0044		nv	–	–	Yes	3
TEQ (Mammalian 2006)	14 / 14	0.000002	J	0.0054		SP03DSW_0405	0.0001	J	nv	–	–	Yes	3

Notes:
nv - no value (value not available)
NA - not applicable

Data Qualifiers:
U - Analyte not detected at or above reporting limit. The number is the minimum quanititation limit.
J - Identification of anlayte is acceptable; reported value is estimated.
UJ - Analyte not detected at or above reporting limit. Reporting limit is an estimate.
(1) Maximum detected of SQL
(2) Value in EPA Region 4 Supplement to RAGS; unless dependent on those of analyte
(3) HQ = Exposure Point Concentration / ESV
(4) Chemicals of Potential Concern (COPC) Categories:
1 - Detected and HQ >= 1
2 - Not Detected, maximum SQL >= ESV
3 - Detected but no ESV
4 - Not Detected and no ESV
TEQ - Toxicity Equivelency Quotient using factors from Van den Berg et al, (2006)

Table 3-1
Step 3 Refinement of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	Mean Background (BKG) Concentration	2x Mean BKG	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Inorganics (mg/kg)													
Aluminum	71 / 71	SD-55_1206	8,800	J	4200	8400	1	14,000	3	0.6	None	No	ATV HQ<1
Arsenic	67/71	SP47SS_0806	17	J	1.95	3.9	1	10	7	1.7	1	No	< 5% FoD
Barium	53 / 54	SP02SS_0405	260		54.5	109	1	1,040	2	0.3	None	No	ATV HQ<1
Cadmium	24 / 37	SP43SS_0806	1.9		–	–	1	2.2	2	0.9	None	No	ATV HQ<1
Calcium	54 / 54	SP44SS_0806	68,000		545	1,090	3	1,090	8	62	37	No	nutrient
Chromium	54 / 54	SP47SS_0806	230	J	5.1	10.2	1	400	2	0.6	None	No	ATV HQ<1
Cobalt	41 / 53	SP47SS_0806	32		–	–	1	50	1	0.6	None	No	ATV HQ<1
Copper	54 / 54	SP47SS_0806	410	J	4.4	8.8	1	95	6	4.3	3	No	see text
Iron	71 / 71	SP47SS_0806	250,000	J	5,800	11,600	1	20,000	1	12.5	4	Yes	ATV HQ>1
Lead	54 / 54	SP43SS_0806	610		7.75	15.5	1	500	7	1.2	1	No	< 5% FoD
Magnesium	54 / 54	SP44SS_0806	3,200		345	690	3	690	8	4.6	14	No	nutrient
Manganese	54 / 54	SP03SD_0405	1,800		269.5	539	1	4,200	5	0.4	None	No	ATV HQ<1
Mercury	26 / 54	SP45SS_0806	97	J	–	–	1	0.18	1	539	20	Yes	ATV HQ>1
Molybdenum	6 / 8	SP07SS_0403	0.7		–	–	3	nv	–	–	–	No	see text
Nickel	41 / 54	SP47SS_0806	100		–	–	1	50	5	2.0	1	No	< 5% FoD
Potassium	52 / 54	SP44SS_0806	1,900		280	560	3	560	8	3.4	12	No	nutrient
Silver	21 / 45	SS-54_1206	2.2	J	–	–	1	2	7	1.1	1	No	< 5% FoD
Sodium	25 / 54	SP23SS_0405	2,500		–	–	3	nv	–	–	–	No	nutrient
Strontium	8 / 8	SP07SS_0403	70		–	–	3	nv	–	–	–	No	see text
Thallium	3 / 53	SP47SS_0806	7.0		–	–	1	1	7	7.0	2	No	< 5% FoD
Tin	1 / 8	SP04SS_0403	2.7		–	–	3	7.62	2	0.4	None	No	ATV HQ<1
Titanium	8 / 8	SP07SS_0403	110		–	–	3	nv	–	–	–	No	see text
Vanadium	50 / 54	SP24SS_0405	39		8.75	17.5	1	17.5	7	2.2	11	Yes	ATV HQ>1
Yttrium	8 / 8	SP07SS_0403	6.4		–	–	3	nv	–	–	–	No	see text
Zinc	54 / 54	SP23SS_0405	1,200		16	32	1	121	1	9.9	15	Yes	ATV HQ>1
Semivolatile Organic Compounds (Extractables) (ug/kg)													
(3-and/or 4-)Methylphenol	1 / 103	SP08SS_0403	19	J	–	–	3	0.67	1	28.4	1	No	< 5% FoD
1,2,4,5-Tetrachlorobenzene	0 / 18	SS-956_1206	250	U	–	–	4	nv	–	–	–	No	see text
1,2,4-Trichlorobenzene	3 / 79	SP45SS_0806	14,000		–	–	3	2100	1	6.7	1	No	< 5% FoD
2,3,4,6-Tetrachlorophenol	21 / 69	SP45SS_0806	300,000		–	–	3	199	2	1,508	11	Yes	ATV HQ>1
2,4-Dichlorophenol	3 / 105	SP45SS_0806	1,500		–	–	1	117	1	12.8	3	No	< 5% FoD
2,4-Dimethylphenol	0 / 104	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
2,4-Dinitrotoluene	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
2,6-Dinitrotoluene	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
2-Chloronaphthalene	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
2-Chlorophenol	1 / 105	SP45SS_0806	340	J	–	–	3	243	2	1.4	1	No	< 5% FoD
2-Methylphenol	0 / 104	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
2-Nitroaniline	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
2-Nitrophenol	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
3,3'-Dichlorobenzidine	0 / 101	SS-956_1206	3,500	UJ	–	–	4	nv	–	–	–	No	not detected
3-Nitroaniline	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
4,6-Dinitro-2-methylphenol	0 / 105	SS-956_1206	3,700	U	–	–	4	nv	–	–	–	No	not detected
4-Bromophenyl-phenylether	0 / 105	SS-956_1206	3,500	U	–	–	4	nv	–	–	–	No	not detected
4-Chloro-3-methylphenol	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
4-Chloroaniline	0 / 102	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
4-Chlorophenyl-phenyl ether	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
4-Nitroaniline	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
Acetophenone	5 / 105	SP09DSS_0405	130	J	–	–	3	nv	–	–	–	No	not detected
Atrazine	0 / 105	SS-956_1206	3,500	U	–	–	2	nv	–	–	–	No	not detected
Benzaldehyde	14 / 105	SP02DSS_0405	850	J	–	–	3	nv	–	–	–	No	not detected
Bis(2-chloroethoxy)methane	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
Bis(2-chloroethyl)ether	0 / 87	SS-86-0507	1,900	U	–	–	4	nv	–	–	–	No	not detected
Bis(2-ethylhexyl)phthalate	6 / 105	SP009SS_0405	1,200		–	–	3	13,300	3	0.09	None	No	ATV HQ<1

Table 3-1
Step 3 Refinement of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	Mean Background (BKG) Concentration	2x Mean BKG	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Butylbenzylphthalate	4 / 105	SP02SS_0403	1,000		–	–	3	10,900	1	0.09	None	No	ATV HQ<1
Caprolactam	0 / 103	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
Carbazole	2 / 105	SP24SS_0405	100	J	–	–	3	nv	–	–	–	No	not detected
Di-n-octylphthalate	1 / 105	SP47SS_0806	2,800		–	–	3	709,000	2	0.004	None	No	ATV HQ<1
Diphenylamine	0 / 43	SS-86-0507	3,500	U	–	–	4	nv	–	–	–	No	not detected
Hexachlorobenzene	16 / 105	SP009SS_0405	1,400		–	–	1	199	2	7	5	No	< 5% FoD
Hexachlorobutadiene	0 / 114	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
Hexachloroethane	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
Isophorone	0 / 105	SS-956_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
N-Nitroso-di-n-propylamine	0 / 105	SS-54_1206	1,900	U	–	–	4	nv	–	–	–	No	not detected
Pentachlorophenol	44 / 105	SP45SS_0806	14,000,000		–	–	1	119	2	117,647	43	Yes	ATV HQ>1
PAHs (ug/kg)													
Phenol	0 / 105	SS-956_1206	1,900	U	–	–	2	Persuant to Region 4 Guidance, individual analytes were screened as the summed total concentration.					
2-Methylnaphthalene	11 / 105	SP45SS_0806	1,900		–	–	3						
Acenaphthene	2 / 105	SP24SS_0405	79	J	–	–	3						
Acenaphthylene	2 / 105	SP45SS_0806	720		–	–	3						
Anthracene	5 / 105	SP45SS_0806	740		–	–	3						
Benzo(a)anthracene	14 / 105	SP13SS_0405	490		–	–	3						
Benzo(a)pyrene	16 / 105	SP13SS_0405	300	J	–	–	3						
Benzo(b)fluoranthene	17 / 105	SP13SS_0405	540		–	–	3						
Benzo(g,h,i)perylene	9 / 105	SP24SS_0405	110	J	–	–	3						
Benzo(k)fluoranthene	13 / 105	SP13SS_0405	170	J	–	–	3						
Chrysene	23 / 105	SP13SS_0405	570		–	–	3						
Dibenzo(a,h)anthracene	0 / 105	SS-956_1206	670	U	–	–	4						
Dibenzofuran	3 / 105	SP24SS_0405	50	J	–	–	3						
Fluoranthene	25 / 105	SP13SS_0405	910		–	–	3						
Fluorene	2 / 105	SP24SS_0405	71	J	–	–	3						
Indeno(1,2,3-cd)pyrene	9 / 105	SP13SS_0405	200		–	–	3						
Naphthalene	13 / 105	SP45SS_0806	760		–	–	3						
Phenanthrene	22 / 105	SP45SS_0806	730		–	–	3						
Pyrene	28 / 105	SP13SS_0405	660		–	–	3						
Total PAHs (5)		SP45SS_0806	4,886		–	–	1	20,000	5	0.2	None	No	ATV HQ<1
Pesticides/PCBs (ug/kg)													
4,4'-DDD	7 / 84	SP07SS_0405	91		–	–	3	Persuant to Region 4 Guidance, individual analytes were screened as the summed total concentration.					
4,4'-DDE	38 / 85	SP45SS_0806	20,000	J	–	–	3						
4,4'-DDT	31 / 86	SP45SS_0806	190,000	J	–	–	3						
Total DDTr		SP45SS_0806	210,000		–	–	1	570	6	368	6	Yes	ATV HQ>1
Aldrin	2 / 87	SP45SS_0806	52,000	J	–	–	3	3.32	2	15,663	2	No	< 5% FoD
alpha-BHC	9 / 85	SP45SS_0806	290,000	J	–	–	3	6	1	48,333	7	Yes	ATV HQ>1
alpha-Chlordane	15 / 86	SP009SS_0405	110		–	–	3	99.4	2	1.1	3	No	< 5% FoD
alpha-Chlordene	0 / 8	SP11SD_0403	210	U	–	–	4	nv	–	–	–	No	not detected
Total PCBs	0 / 27	SP24SS_0405	1,000	U	–	–	4	nv	–	–	–	No	not detected
beta-BHC	13 / 78	SP009SS_0405	64,000	J	–	–	3	5	1	12,800	12	Yes	ATV HQ>1
beta-Chlordene	0 / 8	SP11SD_0403	19	U	–	–	4	nv	–	–	–	No	not detected
Chlordane	0 / 9	SP48SS_0806	28,000	UJ	–	–	4	nv	–	–	–	No	not detected
Chlordene	0 / 17	SP48SS_0806	2,200	UJ	–	–	4	nv	–	–	–	No	not detected
cis-Nonachlor	0 / 17	SP48SS_0806	17,000	UJ	–	–	4	nv	–	–	–	No	not detected
delta-BHC	16 / 84	SP45SS_0806	92,000	J	–	–	3	9,940	2	9.3	1	No	< 5% FoD
Dieldrin	13 / 86	SP45SS_0806	10,000	J	–	–	3	2.38	2	4,202	13	Yes	ATV HQ>1
Endosulfan I	1 / 85	SP009SS_0405	320		–	–	3	119	2	2.7	1	No	< 5% FoD
Endosulfan II	2 / 88	SP06SD_0405	6.9	J	–	–	3	119	2	0.1	None	No	ATV HQ<1
Endosulfan sulfate	0 / 88	SS-956_1206	11,000	UJ	–	–	4	nv	–	–	–	No	not detected
Endrin	2 / 88	SP44SS_0806	410	J	–	–	3	10.1	2	41	2	No	< 5% FoD

Table 3-1
Step 3 Refinement of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	Mean Background (BKG) Concentration	2x Mean BKG	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Endrin aldehyde	1 / 79	SP08SS_0405	27		–	–	3	10.5	2	2.6	1	No	< 5% FoD
Endrin ketone	0 / 87	SS-956_1206	11,000	UJ	–	–	4	nv	–	–	–	No	not detected
gamma-BHC	13 / 81	SP45SS_0806	680,000	J	–	–	3	5	2	136,000	11	Yes	ATV HQ>1
gamma-Chlordane	1 / 45	SS-79-0507	230		–	–	3	nv	–	–	–	No	< 5% FoD
Heptachlor	4 / 86	SS-79-0507	45		–	–	3	68	1	0.7	None	No	ATV HQ<1
Heptachlor epoxide	10 / 88	SS-76S-0507	89		–	–	3	152	2	0.6	None	No	ATV HQ<1
Methoxychlor	1 / 88	SD-50_1206	11		–	–	3	19.9	2	0.6	None	No	ATV HQ<1
Oxychlordane	0 / 8	SP11SD_0403	19	U	–	–	4	nv	–	–	–	No	not detected
Toxaphene	3 / 88	SP24SS_0405	640		–	–	3	119	1	5.4	3	No	< 5% FoD
trans-Nonachlor	2 / 17	SP08SS_0403	6	J	–	–	3	nv	–	–	–	No	see text
Volatile Organic Compounds (ug/kg)													
1,1,1,2-Tetrachloroethane	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
1,1,1-Trichloroethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,1,2,2-Tetrachloroethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,1,2-Trichloro-1,2,2-trifluor	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,1,2-Trichloroethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,1-Dichloroethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,1-Dichloroethene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,1-Dichloropropene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
1,2,3-Trichlorobenzene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
1,2,3-Trichloropropane	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
1,2,4-Trimethylbenzene	1 / 9	SP10SD_0403	31		–	–	3	nv	–	–	–	No	not detected
1,2-Dibromo-3-chloropropane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,2-Dibromoethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,2-Dichlorobenzene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,2-Dichloroethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,2-Dichloropropane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,3,5-Trimethylbenzene	2 / 9	SP08SB_0403	17		–	–	3	nv	–	–	–	No	not detected
1,3-Dichlorobenzene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
1,3-Dichloropropane	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
1,4-Dichlorobenzene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
2,2-Dichloropropane	0 / 9	SP11SD_0403	3.4	UJ	–	–	4	nv	–	–	–	No	not detected
2-Butanone	2 / 28	SP02SD_0405	200		–	–	3	nv	–	–	–	No	not detected
2-Hexanone	0 / 28	SP24SS_0405	86	U	–	–	4	nv	–	–	–	No	not detected
4-Chlorotoluene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
4-Methyl-2-pentanone	0 / 28	SP24SS_0405	43	U	–	–	4	nv	–	–	–	No	not detected
Acetone	9 / 28	SP11SD_0403	300	J	–	–	3	57.1	3	5.3	3	No	see text
Benzene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Bromobenzene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
Bromochloromethane	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
Bromodichloromethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Bromoform	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Bromomethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Carbon disulfide	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Carbon tetrachloride	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Chlorobenzene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Chloroethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Chloroform	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Chloromethane	0 / 28	SP24SS_0405	35	UJ	–	–	4	nv	–	–	–	No	not detected
cis-1,2-Dichloroethene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
cis-1,3-Dichloropropene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Cyclohexane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Dibromochloromethane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Dibromomethane	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected

Table 3-1

Step 3 Refinement of Preliminary Chemicals of Potential Concern in Soil -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Locations of Maximum Conc. Or SQL	Exposure Point Conc. (1)	Q	Mean Background (BKG) Concentration	2x Mean BKG	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Dichlorodifluoromethane	0 / 28	SP24SS_0405	35	UJ	–	–	4	nv	–	–	–	No	not detected
Ethylbenzene	2 / 28	SP11SD_0403	2.2	J	–	–	3	1,100	1	0.002	None	No	ATV HQ<1
Isopropylbenzene	1 / 28	SP10SD_0403	1.6	J	–	–	3	86	1	0.02	None	No	ATV HQ<1
m,p-Xylene	1 / 28	SP10SD_0403	5.2		–	–	3	10,000	2	0.001	None	No	ATV HQ<1
Methyl acetate	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Methyl tert-butyl ether	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Methylcyclohexane	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Methylene chloride	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
n-Butylbenzene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
n-Propylbenzene	1 / 9	SP10SD_0403	2.2		–	–	3	nv	–	–	–	No	not detected
o-Chlorotoluene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
o-Xylene	1 / 9	SP10SD_0403	11		–	–	3	10,000	2	0.001	None	No	ATV HQ<1
p-Isopropyltoluene	2 / 9	SP09SD_0403	12		–	–	3	nv	–	–	–	No	not detected
sec-Butylbenzene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
Styrene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
tert-Butylbenzene	0 / 9	SP11SD_0403	3.4	U	–	–	4	nv	–	–	–	No	not detected
Tetrachloroethene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Toluene	10 / 28	SP11SD_0403	23		–	–	3	5,450	2	0.004	None	No	ATV HQ<1
trans-1,2-Dichloroethene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
trans-1,3-Dichloropropene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Trichloroethene	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Trichlorofluoromethane	2 / 28	SP05SD_0405	3.0	J	–	–	3	16,400	2	0.0002	None	No	ATV HQ<1
Vinyl Chloride	0 / 28	SP24SS_0405	35	U	–	–	4	nv	–	–	–	No	not detected
Dioxins/Furans (ug/kg)													
TEQ (Avian 2006)	63 / 99	SP47SS_0806	400	J	–	–	3	0.004	4	100,000	61	Yes	ATV HQ>1
TEQ (Mammalian 2006)	38 / 52	SP47SS_0806	520	J	–	–	3	0.004	4	130,000	38	Yes	ATV HQ>1

Notes:
nv - no value (value not available)
NA - not applicable

Data Qualifiers:
U - Analyte not detected at or above reporting limit. The number is the minimum quanititation limit.
J - Identification of anlayte is acceptable; reported value is estimated.
UJ - Analyte not detected at or above reporting limit. Reporting limit is an estimate.
(1) Maximum detected of SQL
(2) Chemicals of Potential Concern (COPC) Categories:
1 - Detected and HQ >= 1
2 - Not Detected, maximum SQL >= ATV
3 - Detected but no ATV
4 - Not Detected and no ATV
(3) HQ = Exposure Point Concentration/ATV
ATV Sources:
1 - USEPA Region 3 (2007)
2 - USEPA Region 5 (2003)
3 - USEPA Region 6 (1999)
4 - CCME (2002)
5 - Sample et al (1996)
6 - USEPA 2005
7 - USEPA Region 4
8 - 2x Background Value
TEQ - Toxicity Equivelency Quotient using factors from Van den Berg et al, (2006)

Table 3-2 Step 3 Refinement of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Products Site - Flowood, Mississippi													
Analyte	Frequency of Detection	Locations of Maximum SQL	Exposure Point Conc. (1)	Q	Mean Background Concentration	2x Mean Background	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Inorganics (ug/L)													
Aluminum	3 / 14	SP03SW_0405	2,200	J	870	1,740	1	1,740	6	1.3	2	Yes	ATV HQ > 1
Barium	14 / 14	SP04SW_0405	95	J	30	60	3	60	6	2	6	Yes	ATV HQ > 1
Beryllium	0 / 14	SW-51_1206	5	U	NA	NA	2	0.66	1	7.6	None	No	see text
Cadmium	0 / 14	SW-54_1206	5	U	NA	NA	2	0.2	3	25	None	No	see text
Calcium	14 / 14	SP03SW_0405	56,000		NA	NA	3	116,000	1	0.5	None	No	ATV HQ < 1
Cobalt	2 / 12	SP04SW_0405	6	J	NA	NA	3	23	1	0.3	None	No	ATV HQ < 1
Copper	2 / 10	SW-55_1206	8	J	NA	NA	1	6	3	1.3	1	Yes	ATV HQ > 1
Cyanide	1/14	SP06SW_0405	100		NA	NA	1	5.2	5	19	1	No	see text
Iron	14 / 14	SP04SW_0405	11,000	J	NA	NA	1	1,000	5	11	12	Yes	ATV HQ > 1
Lead	4 / 12	SP03SW_0405	30		NA	NA	1	1.6	3	19	4	Yes	ATV HQ > 1
Magnesium	14 / 14	SP03SW_0405	4,400	J	NA	NA	3	82,000	1	0.1	None	No	ATV HQ < 1
Manganese	14 / 14	SW-54_1206	8,800		NA	NA	3	880	7	10	4	Yes	ATV HQ > 1
Mercury	0 / 14	SP01SW_0405	0.2	U	NA	NA	2	0.012	3	17	None	No	see text
Potassium	14 / 14	SP05SW_0405	12,000	J	NA	NA	3	53,000	1	0.2	None	No	ATV HQ < 1
Selenium	0 / 14	SW-55_1206	35	U	NA	NA	2	5	3	7.6	None	No	see text
Silver	0 / 14	SP03DSW_0405	10	U	NA	NA	2	1.47	3	15	None	No	see text
Sodium	14 / 14	SW-50_1206	39,000		NA	NA	3	680,000	1	0.1	None	No	ATV HQ < 1
Thallium	0 / 14	SP03DSW_0405	25	U	NA	NA	2	0.8	1	31	None	No	see text
Vanadium	10 / 11	SW-53_1206	8.5	J	NA	NA	3	20	1	0.4	None	No	ATV HQ < 1
Zinc	8 / 14	SW-53_1206	80		NA	NA	1	80	3	1.0	1	Yes	ATV HQ > 1
Semivolatile Organic Compounds (Extractables) (ug/L)													
(3-and/or 4-)Methylphenol	3 / 14	SP04SW_0405	12		NA	NA	3	543	1	0.02	None	No	ATV HQ < 1
1,1'-Biphenyl	0 / 14	SP05SW_0405	10	U	NA	NA	4	14	1	0.7	None	No	ATV HQ < 1
1,2,4,5-Tetrachlorobenzene	0 / 7	SW-53_1206	5	U	NA	NA	4	3	1	1.7	None	No	not detected
2,3,4,6-Tetrachlorophenol	0 / 7	SW-951_1206	5	U	NA	NA	4	1.2	1	4.2	None	No	not detected
2,4,5-Trichlorophenol	0 / 14	SP04SW_0405	25	U	NA	NA	4	4.9	1	5.1	None	No	not detected
2,4,6-Trichlorophenol	0 / 14	SP01SW_0405	10	U	NA	NA	2	4.9	1	2.0	None	No	not detected
2,4-Dinitrophenol	0 / 14	SP02SW_0405	25	U	NA	NA	2	19	2	1.3	None	No	not detected
2,6-Dinitrotoluene	0 / 14	SP04SW_0405	10	U	NA	NA	4	81	1	0.1	None	No	ATV HQ < 1
2-Chloronaphthalene	0 / 14	SP05SW_0405	10	U	NA	NA	4	0.4	2	25	None	No	not detected
2-Methylphenol	0 / 14	SP03DSW_0405	10	U	NA	NA	4	13	1	0.8	None	No	ATV HQ < 1
2-Nitroaniline	0 / 14	SP02SW_0405	25	U	NA	NA	4	nv	–	–	None	No	not detected
3,3'-Dichlorobenzidine	0 / 14	SP01SW_0405	10	U	NA	NA	4	4.5	1	2.2	None	No	not detected
3-Nitroaniline	0 / 14	SP03SW_0405	25	U	NA	NA	4	nv	–	–	None	No	not detected
4,6-Dinitro-2-methylphenol	0 / 14	SP06SW_0405	25	U	NA	NA	2	nv	–	–	None	No	not detected
4-Chloro-3-methylphenol	0 / 14	SP02SW_0405	10	U	NA	NA	2	nv	–	–	None	No	not detected
4-Chloroaniline	0 / 14	SP04SW_0405	10	U	NA	NA	4	232	1	0.04	None	No	ATV HQ < 1
4-Chlorophenyl-phenyl ether	0 / 14	SP04SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
4-Nitroaniline	0 / 14	SP02SW_0405	25	U	NA	NA	4	nv	–	–	None	No	not detected
Acetophenone	0 / 14	SP04SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Atrazine	0 / 14	SP06SW_0405	10	U	NA	NA	4	1.8	1	5.6	None	No	not detected
Benzaldehyde	0 / 14	SP06SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Bis(2-chloroethoxy)methane	0 / 14	SP05SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
bis(2-Chloroisopropyl)ether	0 / 14	SP02SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Bis(2-ethylhexyl)phthalate	2 / 14	SP06SW_0405	36		NA	NA	1	16	1	2.3	2	No	see text
Butylbenzylphthalate	1 / 14	SP04SW_0405	16		NA	NA	3	19	1	0.8	None	No	ATV HQ < 1
Caprolactam	0 / 14	SP02SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Carbazole	0 / 14	SP01SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Di-n-butylphthalate	0 / 14	SP04SW_0405	10	U	NA	NA	2	19	1	0.5	None	No	ATV HQ < 1
Di-n-octylphthalate	0 / 14	SP03DSW_0405	10	U	NA	NA	4	22	1	0.5	None	No	ATV HQ < 1
Hexachlorobenzene	0 / 14	SP01SW_0405	10	U	NA	NA	4	0.0003	1	33,333	None	No	not detected
Hexachlorobutadiene	0 / 14	SP06SW_0405	10	U	NA	NA	2	1.3	1	7.7	None	No	not detected

Table 3-2
Step 3 Refinement of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Locations of Maximum SQL	Exposure Point Conc. (1)	Q	Mean Background Concentration	2x Mean Background	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Hexachlorocyclopentadiene	0 / 14	SP05SW_0405	10	U	NA	NA	2	77	2	0.1	None	No	ATV HQ < 1
Hexachloroethane	0 / 14	SP04SW_0405	10	U	NA	NA	2	12	1	0.8	None	No	ATV HQ < 1
N-Nitroso-di-n-propylamine	0 / 14	SP06SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Pentachlorophenol	5 / 14	SP03DSW_0405	16	J	NA	NA	1	4	3	4.0	4	Yes	ATV HQ > 1
PAHs (ug/L)													
2-Methylnaphthalene	0 / 14	SP01SW_0405	10	U	NA	NA	4	330	2	0.03	None	No	ATV HQ < 1
Acenaphthylene	0 / 14	SP01SW_0405	10	U	NA	NA	4	4,840	2	0.002	None	No	ATV HQ < 1
Anthracene	0 / 14	SP06SW_0405	10	U	NA	NA	4	0.035	2	286	None	No	not detected
Benzo(a)anthracene	0 / 14	SP04SW_0405	10	U	NA	NA	4	0.03	2	400	None	No	not detected
Benzo(a)pyrene	0 / 14	SP01SW_0405	10	U	NA	NA	4	0.02	1	667	None	No	not detected
Benzo(b)fluoranthene	1 / 14	SP03DSW_0405	2	J	NA	NA	3	9.07	2	0.2	None	No	ATV HQ < 1
Benzo(g,h,i)perylene	0 / 14	SP06SW_0405	10	U	NA	NA	4	7.64	2	1.3	None	No	not detected
Benzo(k)fluoranthene	1 / 14	SP03DSW_0405	1	J	NA	NA	3	nv	–	–	None	No	see text
Chrysene	0 / 14	SP02SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Dibenzo(a,h)anthracene	1 / 14	SP03DSW_0405	1	J	NA	NA	3	nv	–	–	None	No	see text
Dibenzofuran	0 / 14	SP03SW_0405	10	U	NA	NA	4	3.7	1	2.7	None	No	not detected
Fluorene	0 / 14	SP03DSW_0405	10	U	NA	NA	4	19	2	0.5	None	No	ATV HQ < 1
Indeno(1,2,3-cd)pyrene	0 / 14	SP01SW_0405	10	U	NA	NA	4	19	2	0.5	None	No	ATV HQ < 1
Phenanthrene	0 / 14	SP02SW_0405	10	U	NA	NA	4	6.3	2	1.6	None	No	not detected
Pyrene	0 / 14	SP01SW_0405	10	U	NA	NA	4	0.3	2	33	None	No	not detected
Pesticides/PCBs (ug/L)													
4,4'-DDD	0 / 14	SP03DSW_0405	0.1	U	NA	NA	2	0.01	1	9.1	None	No	not detected
4,4'-DDT	0 / 14	SP06SW_0405	0.1	U	NA	NA	2	0.001	3	100	None	No	not detected
alpha-Chlordane	0 / 14	SP05SW_0405	0.1	U	NA	NA	2	0.0043	3	23	None	No	not detected
Aroclor-1016	0 / 7	SP03SW_0405	1	U	NA	NA	2	0.01	5	71	None	No	not detected
Aroclor-1221	0 / 7	SP05SW_0405	2	U	NA	NA	2	0.01	5	143	None	No	not detected
Aroclor-1232	0 / 7	SP03SW_0405	1	U	NA	NA	2	0.01	5	71	None	No	not detected
Aroclor-1242	0 / 7	SP02SW_0405	1	U	NA	NA	2	0.01	5	71	None	No	not detected
Aroclor-1248	0 / 7	SP03SW_0405	1	U	NA	NA	2	0.01	5	71	None	No	not detected
Aroclor-1254	0 / 7	SP01SW_0405	1	U	NA	NA	2	0.01	5	71	None	No	not detected
Aroclor-1260	0 / 7	SP03DSW_0405	1	U	NA	NA	2	0.01	5	71	None	No	not detected
delta-BHC	6 / 14	SP03DSW_0405	3		NA	NA	3	141	1	0.02	None	No	ATV HQ < 1
Dieldrin	0 / 14	SW-50_1206	0.1	U	NA	NA	2	0.056	3	1.8	None	No	not detected
Endosulfan II	0 / 14	SW-51_1206	0.1	U	NA	NA	2	0.056	3	1.8	None	No	not detected
Endosulfan sulfate	0 / 14	SP06SW_0405	0.1	U	NA	NA	4	2.22	2	0.05	None	No	ATV HQ < 1
Endrin	0 / 14	SP01SW_0405	0.1	U	NA	NA	2	0.036	3	2.8	None	No	not detected
Endrin aldehyde	0 / 14	SW-51_1206	0.1	U	NA	NA	4	0.15	2	0.7	None	No	ATV HQ < 1
Endrin ketone	0 / 14	SP03SW_0405	0.1	U	NA	NA	4	nv	–	–	None	No	not detected
gamma-BHC	3 / 12	SP05SW_0405	3.6		NA	NA	1	0.026	1	138	3	Yes	ATV HQ > 1
gamma-Chlordane	0 / 14	SW-50_1206	0.1	U	NA	NA	2	nv	–	–	None	No	not detected
Heptachlor	0 / 14	SW-50_1206	0.1	U	NA	NA	2	0.0038	1	13	None	No	not detected
Heptachlor epoxide	1 / 13	SP03SW_0405	0.1		NA	NA	1	0.0019	1	47	1	Yes	ATV HQ > 1
Methoxychlor	0 / 14	SP03SW_0405	0.5	U	NA	NA	2	0.019	1	26	None	No	not detected
Toxaphene	0 / 14	SW-51_1206	5	UJ	NA	NA	2	0.0002	3	25,000	None	No	not detected
Volatile Organic Compounds (ug/L)													
1,1,2-Trichloro-1,2,2-trifluo	0 / 7	SP03DSW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
1,1-Dichloroethane	0 / 7	SP01SW_0405	10	U	NA	NA	4	47	1	0.2	None	No	ATV HQ < 1
1,2-Dibromo-3-chloropropane	0 / 7	SP03DSW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
1,2-Dibromoethane	0 / 7	SP06SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
2-Butanone	0 / 7	SP06SW_0405	10	U	NA	NA	4	14,000	1	0.001	None	No	ATV HQ < 1
2-Hexanone	0 / 7	SP06SW_0405	10	U	NA	NA	4	99	1	0.1	None	No	ATV HQ < 1
4-Methyl-2-pentanone	0 / 7	SP04SW_0405	10	U	NA	NA	4	170	1	0.1	None	No	ATV HQ < 1

Table 3-2
Step 3 Refinement of Preliminary Chemicals of Potential Concern in Surface Water -- Sonford Products Site - Flowood, Mississippi

Analyte	Frequency of Detection	Locations of Maximum SQL	Exposure Point Conc. (1)	Q	Mean Background Concentration	2x Mean Background	PCOPC Category (4)	Alternative Toxicity Value (ATV)	Source of ATV	Alternative Hazard Quotient	Number of Samples Exceeding ATV	Retain as COPC?	Rationale for Elimination as a COPC
Acetone	5 / 7	SP03SW_0405	23		NA	NA	3	1,500	1	0.02	None	No	ATV HQ < 1
Bromodichloromethane	0 / 7	SP05SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Carbon disulfide	0 / 7	SP03DSW_0405	10	U	NA	NA	4	15	2	0.7	None	No	ATV HQ < 1
Chloroethane	0 / 7	SP05SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
cis-1,2-Dichloroethene	0 / 7	SP06SW_0405	10	U	NA	NA	4	65	2	–	None	No	ATV HQ < 1
Cyclohexane	0 / 7	SP03SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Dibromochloromethane	0 / 7	SP02SW_0405	10	U	NA	NA	4	98	1	0.1	None	No	ATV HQ < 1
Dichlorodifluoromethane	0 / 7	SP03SW_0405	10	UJ	NA	NA	4	nv	–	–	None	No	not detected
Isopropylbenzene	0 / 7	SP05SW_0405	10	U	NA	NA	4	2.6	1	3.8	None	No	not detected
m,p-Xylene	0 / 7	SP05SW_0405	10	U	NA	NA	4	27	2	0.4	None	No	ATV HQ < 1
Methyl acetate	0 / 7	SP01SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Methyl tert-butyl ether	0 / 7	SP02SW_0405	10	U	NA	NA	4	11,070	1	0.001	None	No	ATV HQ < 1
Methylcyclohexane	0 / 7	SP06SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Styrene	0 / 7	SP05SW_0405	10	U	NA	NA	4	72	1	0.1	None	No	ATV HQ < 1
Trichloroethene	0 / 7	SP04SW_0405	10	U	NA	NA	4	21	1	0.5	None	No	ATV HQ < 1
Trichlorofluoromethane	0 / 7	SP04SW_0405	10	U	NA	NA	4	nv	–	–	None	No	not detected
Vinyl Chloride	0 / 7	SP06SW_0405	10	UJ	NA	NA	4	930	1	0.01	None	No	ATV HQ < 1
Dioxins (ug/L)													
TEQ (Avian 2006)	14 / 14	SP03DSW_0405	0.0041		NA	NA	3	0.1	4	0.04	None	No	ATV HQ < 1
TEQ (Fish 2006)	14 / 14	SP03DSW_0405	0.0044		NA	NA	3	nv	–	–	None	No	ATV HQ < 1
TEQ (Mammalian 2006)	14 / 14	SP03DSW_0405	0.0054		NA	NA	3	0.008	4	0.71	None	No	ATV HQ < 1

Notes:
nv - no value (value not available)
NA - not applicable

Data Qualifiers:
U - Analyte not detected at or above reporting limit. The number is the minimum quanititation limit.
J - Identification of anlayte is acceptable; reported value is estimated.
UJ - Analyte not detected at or above reporting limit. Reporting limit is an estimate.
(1) Maximum detected of SQL
(2) Chemicals of Potential Concern (COPC) Categories:
1 - Detected and HQ >= 1
2 - Not Detected, maximum SQL >= ATV
3 - Detected but no ATV
4 - Not Detected and no ATV
(3) HQ = Exposure Point Concentration/ATV
ATV Sources:
1 - USEPA Region 3 (2007)
2 - USEPA Region 5 (2003)
3 - MDEQ (2002). Metals (Cd, Cu, Pb, Ag, Zn) based on site hardness of 63.5 mg/L Ca CO_3
4 - ORNL (2005)
5 - USEPA Region 4
6 - 2x Background Concentration
7 - BC Ministries of Environment
TEQ - Toxicity Equivelency Quotient using factors from Van den Berg et al, (2006)

Table 3-3
Summary of Ecological Chemicals of Potential Concern
Sonford Chemical Site

COPC	*Surface Water*	*Soils*	*Comments*
COPC assessed quantitatively			
Pentachlorophenol	**X**	**X**	Lindane, tDDT, and mercury are bioaccumulative and were detected frequently.
2,3,4,6-Tetrachlorophenol		**X**	
Dioxins/Furans		**X**	
Lindane (BHC)	**X**	**X**	
tDDT		**X**	
Mercury		**X**	
COPCs assessed qualitatively			
Aluminum	**X**		The unfiltered water samples do not display any spatial relation to PCP, lindane, or to areas with metal debris. The concentrations of metals in soil are more elevated near metal debris piles than away from debris areas. PCP and dioxins are also elevated near the former building and metal debris, suggesting co-location. Metals concentrations rapidly approach background levels as distance from the gravel pad increases.
Barium	**X**		
Copper	**X**	**X**	
Iron	**X**		
Lead	**X**	**X**	
Manganese	**X**		
Nickel		**X**	
Silver		**X**	
Thallium		**X**	
Vanadium		**X**	
Zinc	**X**	**X**	
Heptachlor epoxide	**X**		

Table 4-1 Toxicity Reference Values Sonford Chemical Site		
COPC / Media	*TRVs*	*Reference*
Water		
PCP	4.0 µg/L (at pH 6.5)	MDEQ, 2002
Lindane (BHC)	0.08 µg/L	MDEQ, 2002
Soil		
PCP	2.8 mg/kg - shrew 2.1 - woodcock	USEPA, 2007
Dioxin (2,3,7,8-TCDD)	21 ng/kg - birds, 2.5 ng/kg - wildlife	USEPA, 1993
Lindane (gamma- BHC)		
tDDT	0.063 mg/kg - shrew, 0.093 mg/kg - woodcock	USEPA, 2007
Mercury	0.1 mg/kg	Sample et al., 1996
Food-Web Receptors *		
PCP	mg/kgBW/day	
Mammals	5 NOAEL, 30 LOAEL	Schwetz et al., 1974
Avians	169 NOAEL, 490 LOAEL	Nebekar, 1994
Dioxin (2,3,7,8-TCDD)	ng/kgBW/day	
Mammals	1 NOAEL, 10 LOAEL	Murray et al., 1979
Avians	14 NOAEL, 140 LOAEL	Nosek et al., 1992
Dioxins/Furans	ng TEQ/kg diet ww	
Mammals	0.71	CCME, 2001
Avians	4.75	CCME, 2001
Lindane (gamma-BHC)	mg/kgBW/day	
Mammals	8 NOAEL, 80 LOAEL	Palmer et al., 1978
Avians	2 NOAEL, 20 LOAEL	Chakravarty and Lahiri, 1986
tDDT	mg/kgBW/day	
Mammals	0.8 NOAEL, 16, LOAEL	USEPA, 1995
Avains	0.009 NOAEL, 1.5 LOAEL	USEPA, 1995
Mercury	mg/kgBW/day	
Mammals	1.0 NOAEL, 10 LOAEL	Aulerich et al., 1974
Avains	0.45 NOAEL, 0.9 LOAEL	Hill and Shaffner, 1976

NOAEL – No-observed-adverse-effect-level
LOAEL – Lowest-observed-adverse-effect-level
* - TRVs are based on body weights for laboratory test species. Body weights not adjusted for wildlife receptors.

Table 4-2 Receptor-Specific Exposure Model Parameters Sonford Chemical Site		
Model Parameter	*Value*	*References*
Short-tailed Shrew		
Body Weight (BW) *kg*	0.014	A
Ingestion Rate (IR) *kg/day*	0.0028	B
Intake Fraction Invertebrates *%* Soil *kg* Water *L*	 100 0.000084 0.0031	 C, D E F
Fractional area use factor *%*	100	G, H
Long-tailed Weasel		
Body Weight (BW) *kg*	0.102	I
Ingestion Rate (IR) *kg/day*	0.0068	E
Intake Fraction Vertebrates *%* Soil *kg* Water *L*	 100 0.00029 0.0065	 I, J E K
Fractional area use factor *%*	100	I
American Woodcock		
Body Weight (BW) *kg*	0.181	L
Ingestion Rate (IR) *kg/day*	0.038	E
Intake Fraction Vertebrates *%* Soil *kg* Water *L*	 100 0.0062 0.0095	 M E K
Fractional area use factor *%*	100	N
Barred Owl		
Body Weight (BW) *kg*	0.72	O
Ingestion Rate (IR) *kg/day*	0.084	P
Intake Fraction Vertebrates *%* Soil *kg*	 100 0.0048	 P E
Fractional area use factor *%*	20	Q

Table References:

A - Guilday, 1957
B - Morrison et al., 1957
C - Whitaker and Ferraro, 1963
D - Barbour and Davis, 1974
E - USEPA, 2005
F - Chew, 1951
G - Platt, 1976
H - Buckner, 1966
I - King, 1990
J - Hamilton, 1941
K - Caulder and Braun, 1983
L - Vander Haegen et al., 1993
M - Keppie and Whiting, 1994; Vander Haegen et al., 1993
N - Gregg, 1984; Sepik and Derleth, 1993
O - Dunning, 1992
P - Craighead and Craighead, 1956
Q - Duncan, 2003

Table 4-3
Toxic Equivalency Factors (TEFs) for Mammals, Fish, and Birds
Sonford Products Site - Flowood, Mississippi

Congener	Mammals	Fish	Birds
Chlorinated dibenzodioxins			
2,3,7,8 - TetraCDD	1	1	1
1,2,3,7,8 - PentaCDD	1	1	1
1,2,3,4,7,8 - HexaCDD	0.1	0.5	0.05
1,2,3,6,7,8 - HexaCDD	0.1	0.01	0.01
1,2,3,7,8,9 - HexaCDD	0.1	0.01	0.1
1,2,3,4,6,7,8 - HeptaCDD	0.01	0.001	0.0005
OctaCDD	0.0003	0.00005	0.0001
Chlorinated dibenzofurans			
2,3,7,8 - TetraCDF	0.1	0.05	1
1,2,3,7,8 - PentaCDF	0.03	0.05	0.1
2,3,4,7,8 - PentaCDF	0.3	0.5	1
1,2,3,4,7,8 - HexaCDF	0.1	0.1	0.1
1,2,3,6,7,8 - HexaCDF	0.1	0.1	0.1
1,2,3,7,8,9 - HexaCDF	0.1	0.1	0.1
2,3,4,6,7,8 - HexaCDF	0.1	0.1	0.1
1,2,3,4,6,7,8 - HeptaCDF	0.01	0.01	0.01
1,2,3,4,7,8,9 - HeptaCDF	0.01	0.01	0.01
OctaCDF	0.0003	0.00005	0.0001
Source: Van den Berg *et al* (1998, 2006)			

FIGURES

Site Location Map
Sonford Products Site
Ecological Risk Assessment
Flowood, Rankin County, Mississippi

Figure 1-1

0 200 400

Feet

NAD83 UTM Zone 16N

Soil and Sediment Sample Locations
Sonford Products Site
Ecological Risk Assesment
Flowood, Rankin County, Mississippi

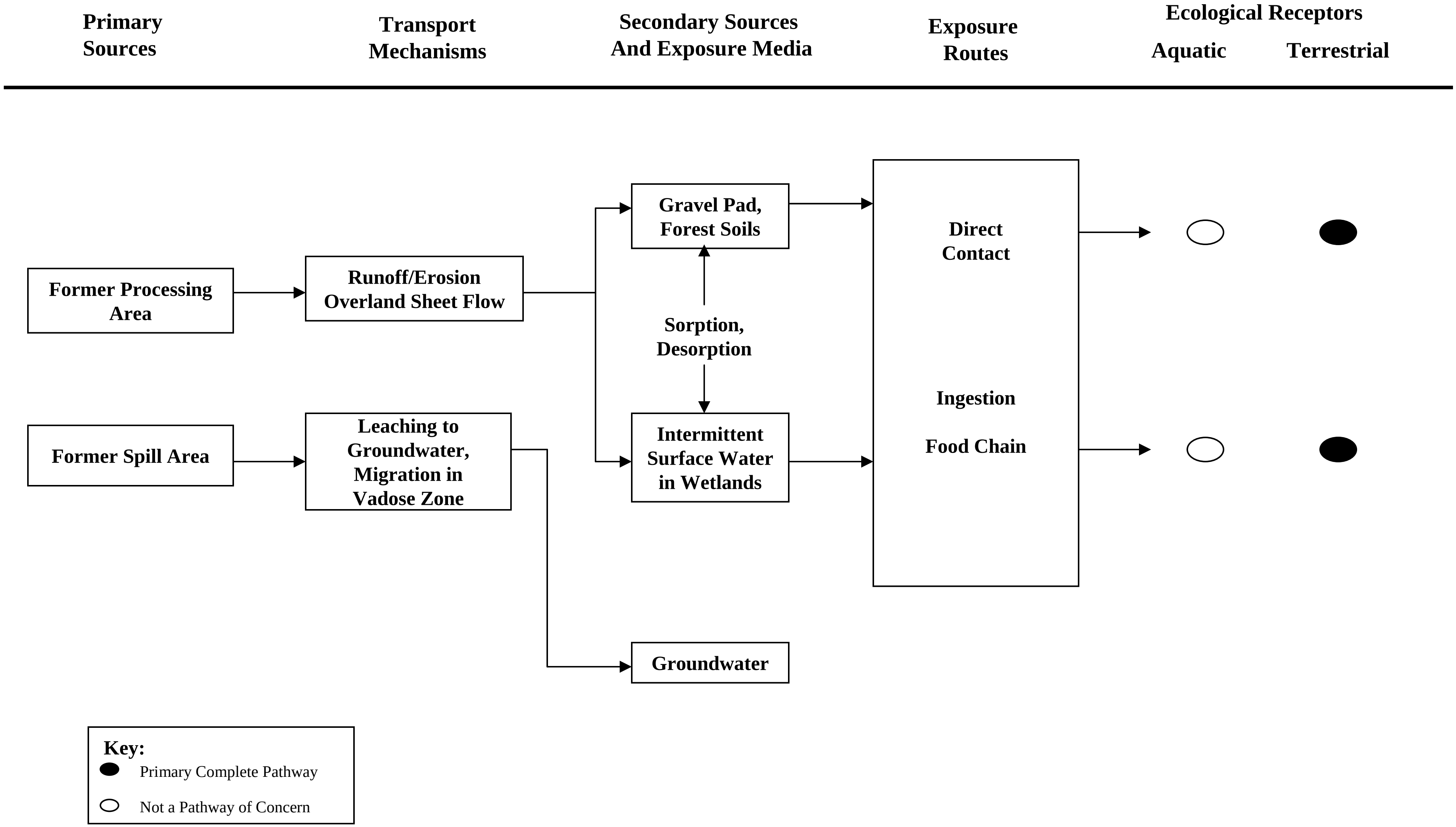
Figure 3-1

Surface Water Sample Locations
Sonford Products Site
Ecological Risk Assesment
Flowood, Rankin County, Mississippi

Figure 3-2

Y:\EPA\048685\SonfordChemical\GIS\Figures\September 2007\Fig3-1_Soil_Sediment_Sample_Locations.mxd

Figure 3-3
Initial Conceptual Site Model
Sonford Chemical Site



APPENDIX A

Checklist for Ecological Assessment/Sampling

Checklist for Ecological Assessment/Sampling
Sonford Products Site
Flowood, Rankin County, Mississippi

I. Site Description

1. Site Name: **Sonford Products Site**

   Location: **3506 Payne Drive**

   County: **Rankin** City: **Flowood** State: **Mississippi**

2. Latitude: **32° 17' 32" N (deg/min/sec)**
   Longitude: **90° 08' 33" W (deg/min/sec)**

3. What is the approximate area of the site? **6 acres**

4. Is this the first site visit? ☑ Yes ☐ No If no, attach trip report of previous site visit(s), if available.

   Date(s) of previous site visit(s):

5. Please attach to the checklist USGS topographic map(s) of the site, if available.

   See RI/FS report figures

6. Are aerial or other site photographs available? ☑ Yes ☐ No
   If yes, please attach any available photo(s) to the site map at the conclusion of this section.

   See RI/FS report figures

7. The land use on the site is: The area surrounding the site is:

The land use on the site is:	The area surrounding the site is: **1 Mile Radius**
% Urban	___ % Urban
% Rural	___ % Rural
25 % Residential	20 % Residential
75 % Industrial (**X** light heavy)	10 % Industrial (light heavy)
___ % Agricultural Crops	___ % Agricultural Crops
___ Recreational (*Describe; note if it is a park, etc.*)	___ Recreational (*Describe; note if it is a park, etc.*)
___ % Undisturbed	60 % Undisturbed - green belts
___ % Other	___ % Other

8. Has any movement of soil taken place at the site? ☑ Yes ☐ No

If yes, please identify the most likely cause of this disturbance:

☐ Agricultural Use ☐ Heavy Equipment ☐ Mining
☐ Natural Events ☑ Erosion ☑ Other

Please describe: **Some removal and rehab of site with debris piles at forest edge.**

9. Do any potentially sensitive environmental areas exist adjacent to or in proximity to the site, e.g., federal and state parks, national and state monuments, wetlands, prairie potholes? *Remember, floodplains and wetlands are not always obvious; do not answer "no" without confirming information.*

   ☑ Yes ☐ No **Pearl River floodplain with oxbow lake public recreation area approximately 0.4 mile to the west.**

   Please provide the source(s) of information used to identify these sensitive areas, and indicate their general location on the site map.

   Air photos and on-site observation.

10. What type of facility is located at the site?

    ☐ Chemical ☐ Manufacturing ☐ Mixing
    ☐ Waste Disposal ☑ Other (*specify*) **Partially active gravel storage pad for various pieces of commercial equipment. Remains (foundations, scrap metal) of former chemical plant.**

11. What are the suspected contaminants of concern at the site? If known, what are the maximum concentration levels?

    Pentachlorophenol (PCP) and associated dioxins/furans.

12. Check any potential routes of off-site migration of contaminants observed at the site:

    ☐ Swales ☑ Depressions ☑ Drainage Ditches
    ☑ Runoff ☐ Windblown Particulates ☑ Vehicular Traffic
    ☑ Other (*specify*) - **Groundwater**

13. If you know, what is the approximate depth to the water table? **4–15 feet**

14. Is the direction of surface runoff apparent from site observations? ☑ Yes ☐ No
    If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

    ☑ Surface Water ☑ Groundwater
    ☐ Sewer ☐ Collection Impoundment

15. Is there a navigable waterbody or tributary to a navigable waterbody?
☐ Yes ☑ No

16. Is there a waterbody anywhere on or in the vicinity of the site? If yes, also complete Section III: Aquatic Habitat Checklist—Non-Flowing Systems and/or Section IV: Aquatic Habitat Checklist—Flowing Systems.

☑ Yes (approx. distance: **0.4 mile**) ☐ No

17. Is there evidence of flooding? ☑ Yes ☐ No *Wetlands and floodplains are not always obvious; do not answer "no" without confirming information*. If yes, complete Section V: Wetland Habitat Checklist.

18. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. [Use a blank sheet if additional space is needed for text.]

Only general observations during 1 hour site visit.

19. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site?

☐ Yes ☑ No *If yes, you are required to verify this information with the U.S. Fish and Wildlife Service*. If species' identities are known, please list them next.

20. Record weather conditions at the time this checklist was prepared:

Date:
80 Temperature (°C/**°F**)
Wind **5 mph** from South No Precipitation
Partly Cloudy

IA. Summary of Observations and Site Setting

Light industrial land use adjacent to site, rural residential to the west, undisturbed green belt to the east. Bottomland hardwood forest mixed with palustrine wetlands and intermittent standing water. No aquatic benthic community or fish. Contaminant pathway is dominated by sheet erosion from rain events that migrate to forest bottomland. Wildlife use more prominent on east side with potential bird and owl nesting in tree hollows. Customs Product's gravel pad (south of Sonford) tends to restrict overland sheet flow further to the south.

Completed By: **Jim Eldridge** Affiliation: **Black & Veatch**
Additional Preparers: Date: **3/12/07**
Site Manager: **Keriema Newman**

II. Terrestrial Habitat Checklist

IIA. Wooded

1. Are there any wooded areas at the site? ☑ Yes ☐ No If no, go to Section IIB: Shrub/Scrub.

2. What percentage or area of the site is wooded? **80 %**
   Indicate the wooded area on the site map that is attached to a copy of this checklist. Please identify what information was used to determine the wooded area of the site. **Woodland between Sonford and Customs Products and to the east.**

3. What is the dominant type of vegetation in the wooded area?
   (Check one: ☐ Evergreen ☑ Deciduous ☐ Mixed) Provide a photograph, if available.

   Dominant plants include green ash, red maple, sugarberry, bald cypress.

4. What is the predominant size of the trees at the site? Use diameter at breast height.

   ☐ 0–6 in. ☑ 6–12 in. ☐ >12 in.

5. Specify type of understory present, if known. Provide a photograph, if available.
   See photographs

IIB. Shrub/Scrub (Not Applicable)

1. Is shrub/scrub vegetation present at the site? ☐ Yes ☑ No If no, go to Section IIC: Open Field.

2. What percentage of the site is covered by scrub/shrub vegetation?
   Indicate the areas of shrub/scrub on the site map. Please identify what information was used to determine this area.

3. What is the dominant type of shrub/scrub vegetation, if known? Provide a photograph, if available.

4. What is the approximate average height of the shrub/scrub vegetation?

   ☐ 0–2 ft ☐ 2–5 ft ☐ >5 ft

5. Based on site observations, how dense is the shrub/scrub vegetation?

   ☐ Dense ☐ Patchy ☐ Sparse

IIC. Open Field

1. Are there open (bare, barren) field areas present at the site? ☐ Yes ☑ No
   If yes, please indicate the type below:

   ☐ Prairie/Plains ☐ Savannah ☐ Old Field
   ☐ Other (*specify*):

2. What percentage of the site is open field?
   Indicate the open field on the site map.

3. What is/are the dominant plant(s)? Provide a photograph, if available.

4. What is the approximate average height of the dominant plant?

5. Describe the vegetation cover: ☐ Dense ☐ Sparse ☐ Patchy

IID. Miscellaneous (Not Applicable)

1. Are other types of terrestrial habitats present at the site, other than woods, shrub/scrub, and open field?
   ☑ Yes ☐ No If yes, identify and describe them below.

2. Describe the terrestrial miscellaneous habitat(s) and identify these area(s) on the site map.

   Gravel pad areas to keep elevated from wetland forest; also, rural residential area west of the site.

3. What observations, if any, were made at the site regarding the presence and/or absence of insects, fish, birds, mammals, etc.? **Wildlife tracks, bird sounds, scat, swatting bugs.**

4. Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.

III. Aquatic Habitat Checklist—Non-Flowing Systems

(Not Applicable)

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section V, Wetland Habitat Checklist.

1. What type of open-water, non-flowing system is present at the site?

   ☐ Natural (pond, lake)
   ☐ Artificially Created (lagoon, reservoir, canal, impoundment)

2. If known, what is the name(s) of the waterbody(ies) on or adjacent to the site?

3. If a waterbody is present, what are its known uses (e.g., recreation, navigation, etc.)?

4. What is the approximate size of the waterbody(ies)?

5. Is any aquatic vegetation present? ☐ Yes ☐ No

   If yes, please indicate the type below:

   ☐ Emergent ☐ Submergent ☐ Floating

6. If known, what is the depth of the water?

7. What is the general composition of the substrate? Check all that apply.

☐ Bedrock	☐ Sand (coarse)	☐ Muck (fine/black)
☐ Boulder (>10 in.)	☐ Silt (fine)	☐ Debris
☐ Cobble (2.5–10 in.)	☐ Marl (shells)	☐ Detritus
☐ Gravel (0.1–2.5 in.)	☐ Clay (slick)	☐ Concrete

   ☐ Other (*specify*) ________________________________

8. What is the source of water in the waterbody?

   ☐ River/Stream/Creek ☐ Groundwater
   ☐ Industrial Discharge ☐ Surface Runoff
   ☐ Other (*specify*) ________________________________

9. Is there a discharge from the site to the waterbody? ☐ Yes ☐ No
   If yes, please describe this discharge and its path.

10. Is there a discharge from the waterbody? ☐ Yes ☐ No
    If yes, and the information is available, identify from the list below the environment into which the waterbody discharges.

    ☐ River/Stream/Creek ☐ On-Site ☐ Off-Site Distance ____________

☐ Groundwater ☐ On-Site ☐ Off-Site
☐ Wetland ☐ On-Site ☐ Off-Site Distance ____________
☐ Impoundment ☐ On-Site ☐ Off-Site

11. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected provide the measurements and the units of measure below:

_____________ Area
_____________ Depth (average)
_____________ Temperature (depth of the water at which the reading was taken)
_____________ pH
_____________ Dissolved Oxygen
_____________ Salinity
_____________ Turbidity (clear, slightly turbid, turbid, opaque)
(Secchi disk depth _____________)
_____________ Other (*specify*) ______________________________________

12. Describe observed color and area of coloration.

13. Mark the open-water, non-flowing system on the site map attached to this checklist.

14. What observations, if any, were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?

IV. Aquatic Habitat Checklist—Flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section V, Wetland Habitat Checklist.

1. What type(s) of flowing water system(s) is (are) present at the site?

☐ River ☐ Stream ☐ Creek
☐ Dry Wash ☐ Arroyo ☐ Brook
☑ Artificially Created (ditch, etc.) ☐ Intermittent Stream ☐ Channeling
☐ Other (*specify*) ______________________________

2. If known, what is the name of the waterbody?

3. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)?
☐ Yes ☑ No If yes, please describe indicators that were observed.

4. What is the general composition of the substrate? Check all that apply.

☐ Bedrock	☐ Sand (coarse)	☐ Muck (fine/black)
☐ Boulder (>10 in.)	☐ Silt (fine)	☐ Debris
☐ Cobble (2.5–10 in.)	☐ Marl (shells)	☐ Detritus
☐ Gravel (0.1–2.5 in.)	☐ Clay (slick)	☐ Concrete
☐ Other (*specify*) ______________________		

5. What is the condition of the bank (e.g., height, slope, extent of vegetative cover)?

6. Is the system influenced by tides? ☐ Yes ☑ No
   If yes, please describe indicators that were observed.

7. Is the flow intermittent? ☑ Yes ☐ No
   If yes, please note the information that was used in making this determination.

   Ditch may flow during periods of no precipitation.

8. Is there a discharge from the site to the waterbody? ☐ Yes ☐ No
   If yes, please describe the discharge and its path.

   Potential sheet flow runoff from gravel pads/roads.

9. Is there a discharge from the waterbody? ☐ Yes ☑ No
   If yes, and the information is available, please identify what the waterbody discharges to and whether the discharge is on-site or off-site.

10. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected, provide the measurement and the units of measure in the appropriate space below: **Field measurements were not taken.**

    ____________ Width (feet)
    ____________ Depth (feet)
    ____________ Velocity (specify units): ______________
    ____________ Temperature (depth of the water at which the reading was taken)
    ____________ pH
    ____________ Dissolved Oxygen
    ____________ Salinity
    ____________ Turbidity (clear, slightly turbid, turbid, opaque) (Secchi disk depth ________________)
    ____________ Other (*specify*)

11. Describe observed color and area of coloration.

12. Is any aquatic vegetation present? ☐ Yes ☑ No
    If yes, please identify the type of vegetation present, if known.

☐ Emergent ☐ Submergent ☐ Floating

13. Mark the flowing water system on the attached site map.

14. What observations were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?

    The ditch may contain crayfish but does not support an aquatic benthic community or fish.

V. Wetland Habitat Checklist

1. Based on observations and/or available information, are designated or known wetlands definitely present at the site?

   ☑ Yes ☐ No

   Bottomland hardwood forest with palustrine wetlands.

   Please note the sources of observations and information used (e.g., USGS topographic maps, national wetland inventory, federal or state agency, etc.) to make this determination.

   USGS and state wetlands.

2. Based on the location of the site (e.g., along a waterbody, in a flood plain) and site conditions (e.g., standing water; dark, wet soils; mud cracks; debris line; water marks), are wetland habitats suspected?

   ☑ Yes ☐ No If yes, proceed with the remainder of the wetland habitat identification checklist.

3. What type(s) of vegetation are present in the wetland?

   ☐ Submergent ☐ Emergent
   ☐ Shrub/Scrub ☑ Wooded
   ☑ Other (*specify*) **Urban impacted**

4. Provide a general description of the vegetation present in and around the wetland (height, color, etc.). Provide a photograph of the known or suspected wetlands, if available.
   See sections IA and IIA

5. Is standing water present? ☑ Yes ☐ No **Intermittently**
   If yes, is this water. ☑ Fresh ☐ Brackish

   What is the approximate area of the water (sq. ft.)? **Varies in small forest depressions**

Please complete questions 4, 11, 12 in Checklist III, Aquatic Habitat—Non-Flowing Systems.

6. Is there evidence of flooding at the site? ☑ Yes ☐ No
   What observations were noted?

   ☐ Buttressing ☐ Water Marks ☐ Mud Cracks
   ☑ Debris Line ☐ Other (describe below)

7. If known, what is the source of the water in the wetland?

   ☐ Stream/River/Creek/lake/Pond ☐ Other (describe below)
   ☑ Flooding ☑ Surface Runoff

8. Is there a discharge from the site to a known or suspected wetland?
   ☑Yes ☐ No If yes, please describe. **Overland sheet flow from major rains.**

9. Is there a discharge from the wetland? ☐ Yes ☑ No **Just into roadside ditch.**
   If yes, to what waterbody is discharge released?

   ☐ Surface Stream/River ☐ Groundwater
   ☐ Lake/Pond ☐ Marine

10. If a soil sample was collected, describe the appearance of the soil in the wetland area. Check or type in the best response.

    Color: ☐ Blue/Gray ☐ Brown ☐ Black ☐ Mottled
    Water Content: ☐ Dry ☐ Wet ☐ Saturated/Unsaturated

Gravel pad at Sonford Chemical looking south at former buildings.

Gravel pad at Sonford Chemical looking south at truck in access road.

Typical vegetation in bottomland hardwood forest between Sonford Chemical and Custom Products.

Standing water about 2 in deep in forest depression.

Typical habitat southeast of Sonford Chemical pad.