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ENVIRONMENTAL

Mr. Owens Hull
Remedial Project Manager
Iowa/Nebraska Branch
Superfund Division
US EPA Region VII
901 North 5th Street
Kansas City, KS 66101

Subject:
John Deere Dubuque Works
Screening-Level Ecological Risk Assessment - Revised

Tampa,
9 October 2014

Contact:
Kathy Thalman

Extension:
813 353-5781

Dear Mr. Hull:

A concentration unit error for mercury was found in the Screening-Level Ecological Risk Assessment data tables submitted on October 2, 2014. All of the metals data were reported by the laboratory in milligrams per kilogram (mg/kg) with the exception of mercury which was reported in micrograms per kilogram (ug/kg). During preparation of data Table 3-2, the difference in units was not noticed and the ug/kg concentrations were reported as mg/kg. We have corrected Table 3-2 and all other SLERA tables that include mercury data by converting the ug/kg mercury concentrations to mg/kg. ARCADIS apologizes for this oversight. Attached is a revised copy of the complete SLERA report. Please send the report submitted on October 2 back to ARCADIS in the FedEx envelope included with the revised document.

If you have any questions, please contact Katherine L. Thalman at the ARCADIS, Tampa Office (813) 353-5781, or Jack Dallal at the John Deere Dubuque Works (563) 589-5254.

Sincerely,
ARCADIS

Katherine L. Thalman

Katherine L. Thalman
Senior Scientist

Copies:
Jack Dallal; JDDW
Melanie Gotto; Deere & Company World Headquarters
Cal Lundberg; IDNR

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John Deere Dubuque Works

Screening-Level Ecological Risk Assessment

Dubuque, Iowa

October 9, 2014

ARCADIS

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Screening-Level Ecological Risk Assessment

John Deere Dubuque Works
Dubuque, Iowa

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Our Ref.:
TF001034.0028
Date:
October 9, 2014

Tables

Figures

Appendices

Acronyms and Abbreviations

AE	assessment endpoint
ARCADIS	ARCADIS U.S., Inc.
BAF	bioaccumulation factor
BERA	Baseline Ecological Risk Assessment
BTEX	benzene, toluene, ethylbenzene, and xylenes
bw	body weight
Cf	concentration of COPECs in food
CLP	Contract Laboratory Program
CMSP	Chicago, Milwaukee, St. Paul
COPEC	constituent of potential ecological concern
CSM	conceptual site model
ft	feet
JDDW	John Deere Dubuque Works
Eco-SSL	Ecological Soil Screening Level
EPC	exposure point concentrations
ESV	ecological screening values
G&M	Geraghty and Miller, Inc.
HMW	High molecular weight
HHRA	Human Health Risk Assessment
HQ	hazard quotient
HMW	high molecular weight
lbs/day	pounds per day
IDNR	Iowa Department of Natural Resources
kg	kilograms
LOAEL	lowest observed adverse effects level

ME	measurement endpoint
mg	milligrams
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
msl	mean sea level
NOAEL	no observed adverse effects level
NaOH	Sodium Hydroxide
NPDES	National Pollutant Discharge Elimination System
PCBs	Polychlorinated biphenyls
PAH	Polycyclic aromatic hydrocarbon
RI	Remedial Investigation Report
SLERA	Screening-Level Ecological Risk Assessment
SMDP	scientific management decision point
SUF	Site use factor
SVOC	semi-volatile organic compound
TCL	target compound list
TRV	Toxicity Reference Value
TTO	total toxic organic
UCL	upper confidence level
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1. Introduction

On behalf of John Deere Dubuque Works (JDDW), ARCADIS U.S., Inc. (ARCADIS) conducted a Screening Level Ecological Risk Assessment (SLERA) at the JDDW Facility located at 18600 South John Deere Road, Dubuque, Iowa, in response to the Fifth Five-Year Review Report (United States Environmental Protection Agency [USEPA] 2013) and subsequent explanatory emails. The need for a SLERA stems from the deferral of a Protectiveness Determination as indicated in the issue and protectiveness statement (USEPA 2013) that follows:

Issue: *An ecological risk assessment was never completed for the site since the remedial investigation was conducted in 1988 prior to the issuance of EPA's Ecological Risk Assessment Guidance (USEPA 1997). A potential ecological exposure pathway may exist at the site. The site is located near the confluence of the Little Maquoketa and Mississippi Rivers. The portion of the Mississippi River adjacent to the site is part of the Upper Mississippi River National Wildlife and Fish Refuge.*

Recommendation: *A screening level ecological risk assessment needs to be conducted to determine if any ecological exposure pathways exist at the site.*

Protectiveness Statement: *A protectiveness determination of the remedy cannot be made at this time until further information is obtained. Further information will be obtained by conducting a screening level ecological risk assessment to determine if any ecological exposure pathways exist. It is expected these actions will take approximately one year to complete, at which time a protectiveness determination will be made.*

The objective of the SLERA is to assess potential risks to ecological receptors as a result of possible exposure to Site-related constituents. The SLERA was performed consistent with guidance from the USEPA, including, but not limited to, the following sources:

- Ecological Risk Assessment Guidance for Superfund – Process for Designing and Conducting Ecological Risk Assessments (USEPA 1997).
- ECO-Update: Role of Screening-level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (USEPA 2001).

A tiered approach following USEPA's eight-step process (Figure 1-1) and subsequent refinements (USEPA 2000 and 2001) was used. Although the SLERA technically ends at Step 2, the first step of the Baseline Ecological Risk Assessment (BERA) includes a rescreening of the available data to refine the list of constituents of potential ecological concern (COPECs) that may warrant further evaluation. It is common practice to conduct and report this refining process, referred to as Step 3a, at the same time as the SLERA (USEPA 2000 and 2001). Thus, the risk assessment report that constitutes the first scientific management decision point (SMDP) in the eight-step process may be completed after either Step 2 or Step 3a (Figure 1-1).

This SLERA presents the risk characterization in Step 3a based on hazard quotients (HQs) generated for direct contact COPECs using the USEPA (2005) ecological soil screening levels (EcoSSLs) and alternative effects values (Section 4.1), as well as HQs for bioaccumulative COPECs based on food web modeling (Section 4.2).

Specific issues addressed in this SLERA were identified in an email to Mr. Russ Eberlin from USEPA (Hull, personal communication, July 17, 2013), and include the following:

- The landfill soils evaluated in the Former Landfill Human Health Risk Assessment (HHRA; ARCADIS 2012) are evaluated for potential ecological risk.
- Surface runoff and seepage from the landfill that could enter the Little Maquoketa River and the Upper Mississippi River Wildlife and Fish Refuge are addressed.
- The list of threatened and endangered species located in Table 3-20 of the 1988 Remedial Investigation (RI) Report (Geraghty and Miller, Inc. [G&M], 1988) is updated.
- The Old Foundry Ponds are described with respect to how the ponds were filled in, including any pond surface water samples, drainage of the ponds, fill material, and any associated soil samples.
- Monitoring results for Outfall 002 and 005 benzene, toluene, ethylbenzene, and xylene (BTEX) compounds are addressed.

1.1 Report Organization

The remainder of this report is organized into the following sections:

- Section 2 describes the site location and regulatory history.
- Section 3 describes Step 1 and 2 and identifies the COPECs that are further refined and evaluated in Step 3a.
- Section 4 (Step 3a) develops the conceptual site model (CSM) to assess the relationship between potential constituent sources, transport and exposure

pathways, and potential ecological receptors. This step is necessary as a result of preliminary COPECs being identified in Step 2.

- Section 5 (Step 3a) describes the dose estimates of each COPEC identified in Step 2 to which the identified receptors are exposed.
- Section 6 summarizes the results (i.e., risk characterization) for the ecological receptors identified.
- Section 7 describes potential sources of uncertainty in the risk characterization.
- Section 8 summarizes the implications of the risk characterization and path forward.
- Section 9 summarizes the conclusions.
- Section 10 lists references used to prepare this SLERA.

2. Site Description

The JDDW plant is located approximately 2.5 miles north of the City of Dubuque in northeastern Iowa and covers 1,447 acres near the confluence of the Mississippi and the Little Maquoketa Rivers. Land surface elevations vary from 600 feet (ft) above mean sea level (msl) along the Mississippi River close to the JDDW plant to greater than 850 ft above msl on the uplands away from the river. The Mississippi River is located east of the site, and the Little Maquoketa River bisects the JDDW property and enters the Mississippi River east of the northeast facility boundary. A site map is included as Figure 2-1. The plant buildings are located on a relatively flat area at the confluence of the Little Maquoketa River and the Mississippi River.

The portion of the Mississippi River adjacent to the site is part of the Upper Mississippi River Wildlife and Fish Refuge established in 1924. A Chicago, Milwaukee, St. Paul (CMSP) & Pacific Railroad track lies between the plant and the Mississippi River (Figure 2-1). Approximately 20 cottages are located between the JDDW facility and the Mississippi River on the flood plain (USEPA 2013).

Potential sources of environmental contamination were identified in the RI conducted at the JDDW site in 1988. Identified sources of contamination included a former landfill, a foundry, a chrome basin at the industrial wastewater treatment plant, a coal storage yard, and a diesel fuel line leak located under the plant which occurred in 1980.

2.1 Foundry Ponds

Two ponds, the Current Foundry Pond (S11) and Former Foundry Pond (S12), were located at the foundry and identified as waste management units in the RI (G&M 1988). The locations of the foundry ponds are shown on Figure 2-1. The Former Foundry Pond (S12) was used between 1960 and 1974 for disposal of foundry process water and sediment, and the Current Foundry Pond (S11) was used between 1974 and 1987 for disposal of foundry process wastewater. Note that the Current and Former Foundry Ponds are located outside of the Superfund Site (Figure 2-1), as presented in Appendix I of the Consent Decree (USEPA 1989b). The RI states the following about the Current Foundry Pond disposal method, "Sand and slag fines [were] dried and stored on-site usually by berming around the pond. Ninety percent of the pond waters [were] recirculated [...] [and the remaining water was] discharged to the Little Maquoketa River via National Pollutant Discharge Elimination System (NPDES) [permitted outfalls] (Table 3-4 of G&M 1988). According to the RI, the Former Foundry Pond disposal method was similar to the Current Foundry Pond (Table 3-4 of G&M 1988). A review of RI surficial features figures indicates the Former Foundry Pond was completely filled in September 1979 (Figure 3-8 of G&M 1988). The foundry was closed and demolished sometime between 1987 and 1988. A review of historical imagery available on Google Earth indicates the Current Foundry Pond was completely filled in October 2004. Additional fill from a dredging project along the Mississippi River was placed on the eastern side of the filled Current Foundry Pond, where the fill had settled, in 2012.

In December 1987, two surficial samples (SL-F1 and SL-F2) of the Former Foundry Pond fill material were collected during the RI. The samples were analyzed for USEPA Contract Laboratory Program (CLP) Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides and polychlorinated biphenyls (PCBs) and cyanide. A summary of detected analytes is included in Appendix A. Sample results are not available for the Current Foundry Pond fill material or for associated soil. Both the Current and Former Foundry Ponds have been filled as discussed above, therefore, surface water is not relevant to current conditions. Both the Current and Former Foundry Ponds were photographed during the Site reconnaissance in May 2014, as provided in Appendix B. Photographs 20 and 21 are of the Former Foundry Pond located to the east of Herber Road (S-12) and Photographs 22 and 23 are of the Current Foundry Pond located to the west of Herber Road. Site observations indicated that both areas are heavily vegetated with no evidence of stressed vegetation, and no standing water was present.

2.2 Former Landfill

Throughout its history, the JDDW facility has used two separate landfills for waste disposal. The older landfill, identified as a potential source of contamination in the RI report, was placed in a natural depression in the Little Maquoketa River floodplain, near the northern end of the facility. Landfill operations began soon after the plant opened in 1946. The approximate extent of the landfill area, defined in the RI Report as the “former landfill” or “LF2,” is shown on Figure 2-1. Landfill activities that occurred in this area included filling low areas and waste disposal. During plant expansion, soils were removed from higher ground and used to fill lower areas to create plant grade prior to construction. JDDW personnel indicated the majority of waste disposal at the facility, from 1946 to 1974, was at the northern end of the former landfill. The former landfill area covers approximately 20 acres, and the area where the majority of waste disposal activity reportedly occurred covers approximately 10 acres (G&M 1988; Figure 2-1). A review of lithologic logs for wells installed in the former landfill area indicates the landfill materials are approximately 15 to 25 ft thick. This fill thickness is an estimate since the logs for some borings don’t indicate a clear demarcation between native and landfill materials (G&M 1988).

This paragraph provides a summary of the solid and liquid wastes that may have potentially been disposed of in the former landfill area. According to the RI (Table 3-6 of G&M 1988), greater than 88 percent of the waste materials disposed of in the former landfill were foundry sands and powerhouse ash. Additional solid wastes that may have potentially been disposed of in the former landfill include: coolant filter media, coke breeze, shot blast dust, steel bands, broken parts, yard clean up, stabilized domestic sludge, asbestos waste, paint sludge, paint filters, alkali (sodium hydroxide [NaOH]) salt bath residues, and wastes containing heavy metals and cyanide (Table 3-6 of G&M 1988). Liquid waste disposal in the former landfill is not well defined but could have included petroleum products, waste oils, and organic solvents. These wastes were reported to have been disposed of in surface pits that were periodically burned. Paint solvent, caustic paint stripping sludge, and cyanide electroplating wastes were reported to be contained in the paint sludge and filters deposited in the former landfill. Waste oils containing solvents and machine tool coolants were spread to control fugitive dust and burned in pits. Limited quantities of acid (hydrochloric and sulfuric) also were deposited in the former landfill. As discussed above, JDDW personnel recall that the majority of waste disposal was at the northern end of the former landfill area (G&M 1988; Figure 2-1).

In 1974, the Iowa Natural Resources Council and Iowa Department of Environmental Quality requested that all wastes at the former landfill be placed at least 140 ft from the banks of the Little Maquoketa River. During that year, JDDW closed the former landfill and wastes were excavated and relocated to the northern tip of the former landfill to comply with the state request (G&M 1988).

In 1987 and 1988 when the RI field work was conducted, the Dittmer Salvage Operation was located northeast of building Z, and buildings E, E1, E2, E3, U, V, and V1 were located in the southern portion of the former landfill area (Figure 2-1). The Dittmer Salvage Operation is no longer located on the former landfill. JDDW closed and demolished Heat Treat buildings E, E1, E2, and E3 in 1997, and demolished Engine Manufacturing buildings U, V, and V1 in 2003 (USEPA 2008).

Since 20 years had passed since the RI soil data were collected, additional surface soil data were collected and a HHRA assessment was conducted to evaluate the analytical results and potential human health risk during the Fifth Five-Year Review period. On September 27 and 28, 2011, surface soil samples (LF-SL-1 through LF-SL-20) were collected from 20 locations in the area of the former landfill where historical waste disposal activities occurred. These results are further discussed and evaluated in Section 3.2.

2.3 NPDES Outfalls

The JDDW site has multiple permitted outfalls with various monitoring requirements and discharge limits. Surface water discharges through the NPDES permitted outfalls to the Mississippi River and the Little Maquoketa River are monitored and reported in monthly wastewater monitoring reports, in accordance with the NPDES Permit for the JDDW facility. Locations of NPDES outfalls and surface areas that are drained by them are presented in the RI (Figure 3-3 of G&M 1988). This RI figure is included as part of Appendix A. Only Outfalls 002, 005, and 011 were identified by the Consent Decree for monitoring discharges for the constituents of concern which included lead, copper, hexavalent chromium, and volatile organic compounds (VOCs). The locations of these outfalls are shown on Figure 2-1. In response to USEPA's request to address Outfalls 002 and 005 (Hull, personal communication, July 17, 2013), the analytical results and monitoring status are discussed in further detail below. The Fifth Five-Year Review report discusses the NPDES monitoring data collected from the outfalls between September 1990 and March 2013 (USEPA 2013).

NPDES-permitted Outfalls 002 and 005 discharge noncontact cooling water, drinking fountain water, and stormwater through the north and south sedimentation-ponds, respectively. A March 5,1991 NPDES permit amendment required that Outfalls 002 and 005 be monitored monthly for copper and quarterly for total toxic organic (TTO) pollutants. The permit established copper limits for Outfall 002 (0.071 milligrams per liter [mg/L], 0.39 pounds per day [lbs/day]) and Outfall 005 (0.04 mg/L, 3.004 lbs/day). The permit did not establish effluent limitations for TTO pollutants.

Outfalls 002 and 005 were analyzed for copper and TTO pollutants in July 1992. Copper levels identified in Outfalls 002 (0.01 mg/L, 0.07 lbs/day) and 005 (0.01 mg/L, 0.35 lbs/day) in July 1992 did not exceed established effluent limitations (USEPA 1995). The TTO constituents identified in Outfalls 002 (0.042 mg/L, 0.277 lbs/day) and 005 (0.041 mg/L, 1.269 lbs/day) were all BTEX compounds (USEPA 1995). A revised permit was issued by Iowa Department of Natural Resources (IDNR) for the facility on September 3, 1992; IDNR did not consider it necessary to continue to monitor Outfalls 002 or 005 for copper and TTO pollutants; however, monitoring for acute toxicity testing was included in the permit (IDNR 1992; Section 4.4.2.5 of Fifth Five-Year Review [USEPA 2013]). The revised permit expired on September 1, 1997 and at IDNR's direction, JDDW continued operating under this permit until a new permit was issued on July 15, 1999. The July 1999 permit expired on July 14, 2004. The site operated under the July 1999 permit until the current site permit was issued on September 1, 2014 (IDNR 2014b).

Outfalls 002 and 005 are regularly monitored for flow rate, oil and grease, pH, and temperature and Outfall 002 is also monitored for total residual chlorine. The combined flow from Outfall 005 and 006, referred to as Outfall 801 in the July 1999 NPDES Permit, and Outfall 002 were also monitored for Acute Toxicity, *Ceriodaphnia* and Acute Toxicity, *Pimephales,* but under the current permit established on September 1, 2014, are no longer required. 2013 effluent tests are presented in Appendix A. Both locations "passed" effluent tests (i.e., there was no significant difference between control and effluent samples). Effluent limitations and monitoring requirements for these parameters are set in the NPDES permits. As mentioned above, the current NPDES Permit took effect September 1, 2014. The new permit added monitoring of total phosphorus for Outfalls 002 and 005. There are no effluent limits established in the new permit for flow rate, total phosphorus, and temperature.

3. Screening Level Problem Formulation

The evaluation of potential ecological effects in Step 1 is limited to the compilation of conservative ecological screening values (ESVs) for ambient media. USEPA Region VII does not have region-specific ESVs for soil. Instead, the USEPA (2005) Eco-SSLs are the sole source of ESVs for this initial screening. This section presents the environmental setting, identifies the COPECs (Step 2), and develops a CSM. The CSM identifies the media impacted by Site-related chemicals and identifies potential exposure pathways and ecological receptors.

3.1 Ecological Setting

The RI Report (G&M 1988) presents a discussion of the ecological setting. The list of state and federal special status species was updated as part of this SLERA through information provided by the IDNR and is discussed below.

The predominant land use surrounding the facility is agricultural and low density residential. Reported sightings of threatened and endangered plant and animal species are recorded by the IDNR (2014a). Table 3-1 presents a list of special concern, threatened, or endangered species that potentially may be in Dubuque County, Iowa, updated from the list presented in the RI (G&M 1988). The list was compiled in the IDNR database from a variety of sources, including surveys to locate rare plants and animals in their natural habitats, collection of information from museums, herbariums, and scientific literature, and observations from naturalists around the state, ranging from historical observations made in the 1800s to present day sightings (IDNR 2014).

Indiana bat, spotted skunk, and ornate box turtle are listed as threatened or endangered in the state of Iowa, consistent with the RI (G&M 1988). Indiana bat is also a federally listed endangered species. No threatened or endangered bird species were found in the updated query, however bald eagle was listed as a species of special concern in the state[1].

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[1] Special Concern means any species about which problems of status or distribution are suspected, but not documented. Not protected by the Iowa Threatened and Endangered Species law, but many animal species listed as Special Concern are protected under other state and federal laws addressing hunting, fishing, collecting, and harvesting.

Photographs documenting the May 29, 2014 site visit (further discussed in Section 3.3) are presented in Appendix B. A few birds species were observed during the site visit (i.e., American robin [*Turdus migratorius*], killdeer [*Charadrius vociferus*], red-winged blackbird [*Agelaius phoeniceus*], and rock pigeon [*Columba livia*]), but no other indications of wildlife using the site were identified at the time.

3.2 Identification of Contaminants of Potential Ecological Concern

This section describes potential exposure media and identifies COPECs. As identified in the SLERA work plan (ARCADIS 2014), relevant surface water samples were not available. Surface soil samples (LF-SL-1 through LF-SL-20) were collected in September 2011 in the area of the former landfill where historical waste disposal activities occurred. Based on an evaluation of the surface soil data collected during the RI (G&M 1988), the surface soils collected in 2011 were analyzed for target compound list (TCL) semi-volatile organic compounds (SVOCs) and metals, as presented in the SLERA work plan (ARCADIS 2014). To respond to USEPA concerns, surface soil samples were collected from areas with exposed soil (without vegetation) at the locations shown on Figure 3-1.

Surface soil sampling was conducted in accordance with the procedures presented in the Five-Year Review Investigation Work Plan (ARCADIS 2011) and as described in the SLERA work plan (ARCADIS 2014). The resulting risk assessment dataset for surface soil used in the HHRA is the same dataset used for this SLERA (Table 3-2).

As stated above, Step 2 is the screening level exposure estimation and risk characterization based on conservative assumptions to identify preliminary COPECs. COPECs in soil were identified by comparing the maximum detected concentration to ESV to calculate an HQ (Table 3-3). HQs less than a value of one (reported using one significant figure) indicate that adverse ecological impacts are unlikely (USEPA 1997). HQs exceeding a value of one indicate that further assessment may be necessary to evaluate the potential for adverse impacts to wildlife. Therefore, the constituents with HQs greater than one were identified as a preliminary COPEC and retained for further evaluation in Step 3a (i.e., identification and evaluation of assessment endpoints [AEs] and the refinement screening of preliminary COPECs). Constituents that lack an EcoSSL were also identified as a preliminary COPEC and retained for further evaluation. Use of the maximum detected concentration provides an upper-bound estimate of potential exposure for ecological receptors, resulting in a conservative estimate of risk.

Refinement of COPECs was based on the following additional considerations:

- Frequency of Detection Screening. If the frequency of detection is less than or equal to 5 percent (e.g., one out of 20), the preliminary COPEC was eliminated from further evaluation. Acetophenone, benzaldehyde, and di-n-butylphthalate were detected in only one out of 20 samples and were not further evaluated.
- Essential Nutrient Screening. Certain inorganic chemicals are essential nutrients for most organisms. These essential nutrients include elements that are toxic to receptors only at very high concentrations. Calcium, magnesium, and potassium were eliminated from further evaluation due to their minimal potential for toxicity to ecological receptors.
- Background Screening: Site concentrations were compared to available background data for inorganics. The maximum and average concentrations of each constituent at the site was compared to its local or regional background value, as well as the range of background concentrations, provided in the RI (G&M 1988). Preliminary COPECs for which the maximum concentration is less than a background screening level or within the background range was eliminated from further evaluation, even if they have an HQ value equal to or greater than one. The maximum site concentration for antimony, cobalt, manganese, and vanadium were in the range of background values and were not further evaluated (Table 3-4).

Six metals and nine SVOCs were identified as COPECs based on exceedances of one or more ESVs (Table 3-3) and background concentrations (Table 3-4). Four SVOCs and two metals were retained as COPECs because an ESV was not available (Table 3-3). Therefore, these preliminary COPECs were evaluated further in the BERA as part of Step 3a, discussed in the following sections.

4. Conceptual Site Model

A CSM provides a framework for understanding potential ecological exposures to COPECs in the environment through the relationship between potential constituent sources, transport and exposure pathways, and potential ecological receptors. This is part of Step 3a and is necessary as a result of preliminary COPECs being identified in Step 2. A description of these elements is provided below.

As stated in Section 2, potential sources of environmental contamination were identified in the RI conducted at the JDDW site in 1988. Identified sources of contamination included a former landfill, a foundry, a chrome basin at the industrial wastewater treatment plant, a coal storage yard, and a diesel fuel line leak located under the plant which occurred in 1980. The primary exposure pathway for ecological receptors to be exposed to Site-related chemicals is through direct contact with or ingestion of surface soil in the former landfill. In addition, ingestion of contaminated food items (e.g., plants, earthworms, invertebrates) presents another potential exposure route.

The potential for surface runoff and seepage from the former landfill was evaluated through observations obtained during a site reconnaissance conducted on May 29, 2014 (Appendix B). During the site visit, observational data regarding the layout and general condition of the Site was documented, focusing on the landfill located north of building Z. This information was used to qualitatively evaluate any potential surface runoff and seepage from the landfill that could enter the Little Maquoketa River and the Upper Mississippi River Wildlife and Fish Refuge. Photographs documenting the Site visit are presented in the photo log (Appendix B). This site survey did not find evidence of runoff or seepage from the former landfill. No samples were collected or analyzed[2].

Groundwater to surface water is assumed to be an incomplete pathway, because there is a positive inward gradient at the site. Therefore, groundwater to surface water is not addressed in the SLERA. The only potentially complete ecological exposure pathway quantitatively evaluated as part of this SLERA is for ecological receptors exposed to surface soil.

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[2] Relevant surface water chemistry data are not available. However, through previous correspondence, USEPA has indicated collecting additional data is not necessary to conduct the SLERA.

4.1 Ecological Receptors

Potential ecological receptor groups that may be exposed to COPECs in surface soil are plants and soil invertebrates, avian, and mammalian populations. Because it is not feasible to evaluate the relationship of COPECs to every species at the Site, specific receptors are selected to represent the organisms that could be present most frequently or are likely to be sensitive to the effects of Site-related COPECs. Potential ecological receptors are considered as populations in this SLERA rather than individuals, as the likelihood of threatened and endangered species occurring at the Site is low. Areas on the site are primarily disturbed/maintained and do not provide quality habitat to the receptors.

Based on the above criteria, the following ecological receptor populations were considered in this SLERA to evaluate soil exposures:

- Terrestrial plants and soil invertebrates
- Omnivorous small mammals (short-tailed shrew [*Blarina brevicauda*])
- Omnivorous birds (American robin [*Turdus migratorius*])
- Carnivorous avian populations (red-tailed hawk [*Buteo jamaicensis*])
- Carnivorous mammalian populations (red fox [*Vulpes vulpes*])

4.2 Assessment and Measurement Endpoints

AEs are defined as adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments (USEPA 1997).The general types of effects of concern include:

- Mortality, growth, or reproductive effects resulting from direct exposure to contaminants that affect a significant proportion of a receptor population.
- Mortality, growth, or reproductive effects resulting from exposure to contaminants that have bioaccumulated in the ecological food chain that affect a significant proportion of a (higher trophic level) receptor population.
- Indirect effects associated with a substantial reduction in abundance of prey populations.

Measurement endpoints (ME) are quantifiable ecological characteristics, through laboratory or field experimentation, that are related to the valued characteristic chosen as the assessment endpoint (EPA 1992, 1998). The measurement endpoint is sensitive and represents the same exposure pathway and mechanisms of toxicity as the assessment endpoint that it represents. The MEs used in this SLERA are based on a comparison of estimated or measured exposure levels of COPECs to levels known to cause adverse effects.

The ecological assessment and measurement endpoints for the JDDW Site are provided below.

- Evaluate potential risk for adverse effects to terrestrial plant and invertebrate communities from exposure to COPECs at the site through direct comparison of soil concentrations (i.e., estimated dose) to ecological benchmarks.
- Evaluate potential risk for adverse effects to populations of avian (i.e, American robin and red-tailed hawk) and mammalian populations (i.e., short-tailed shrew and red fox) from exposure to COPECs at the site through exposure dose modeling.

5. Exposure Assessment

In addition to the CSM, the exposure assessment is part of Step 3a and estimates the dose of each COPEC to which the identified receptors (Section 4.2) are exposed. As indicated in Section 4.2, the dose for plants and soil invertebrates is defined solely by the Site-specific soil concentration. Exposure to the upper-trophic level receptors, however, is estimated through a simple, conservative dose model.

5.1 Exposure Point Concentrations

The exposure point concentration (EPC) is the concentration of a constituent in a medium that may be contacted by the receptor. The EPC is defined as "the arithmetic average of the concentration that is contacted over the exposure period" (USEPA 1989a). For this evaluation, three different EPC values were used to estimate potential risk to ecological receptors, 1) the maximum concentration, 2) the 95 percent upper confidence limit of the mean (95% UCL), and 3) the mean concentration for detected results. USEPA (1989a) recommends using a 95% UCL an estimate for the EPC. The UCL is a statistical number calculated to represent the mean concentration with a high percent confidence that the true arithmetic mean concentration for a site will be less than the UCL. The high level of confidence (i.e. 95 percent) is used to compensate for the uncertainty involved in representing site conditions with a finite number of samples. UCLs were calculated using ProUCL version 4.1.00. UCLs can only be calculated with datasets that have at least 5 detects and 8 samples per USEPA guidance (USEPA 2010).

EPCs are presented in Table 5-1. ProUCL output summaries were provided as part of the approved HHRA (ARCADIS 2012), and are included as Appendix C of this report.

5.2 Wildlife Dose Model

To evaluate potential effects to upper-trophic level wildlife (e.g., mammals and birds), a dose-exposure model was used to estimate the daily intake of bioaccumulative COPECs by each receptor:

$$ADD = \frac{\{[(IR_f \times C_f) + (IR_s \times C_s)] \times SUF\}}{BW}$$

Where:

ADD = Average daily dose of COPEC (milligrams per kilogram per day [mg/kg-day])

IR_f	=	Daily ingestion of food (kilograms per day [kg/day])
C_f	=	Concentration of a COPEC in food (mg/kg)
IR_s	=	Daily incidental ingestion rate of soil/sediment (kg/day)
C_s	=	Concentration of a COPEC in soil (mg/kg)
SUF	=	Site use factor (unitless)
BW	=	Body weight (kg)

5.2.1 Bioaccumulation Factors

In the absence of Site-specific tissue concentrations, bioaccumulation factors (BAFs) were used to estimate the concentration of COPECs in food (C_f). The BAFs and resulting tissue concentrations are presented in Table 5-2. Each BAF incorporates the soil EPC to obtain an estimated concentration in food items (e.g., invertebrates, plants, or tissue). The bioavailability of each COPEC is highly variable and dependent on many Site-specific conditions; therefore, the use of BAFs introduces significant uncertainty.

BAFs were obtained from a variety of sources, including:

- Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs (USEPA 2007);
- Review and Analysis of Parameters and Assessing Transport of Environmentally Released Radionuclides During Agriculture (Baes et al. 1984);
- Development and Validation of Bioaccumulation Models for Earthworms and Mammals (Sample et al. 1998a, 1998b);
- Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants (Bechtel Jacobs 1998);
- The environmental fate of phthalate esters: A literature review (Staples et al 1997); and
- Mechanistic approach for estimating bioconcentration of organic chemicals in earthworms (Jager 1998).

5.2.2 Exposure Parameters for Wildlife

Exposure parameters for upper-trophic level wildlife receptors include dietary and soil ingestion rates, body weights, and dietary composition. These values were obtained from USEPA's Exposure Factors Handbook (USEPA 1993), Nagy (2001), and Beyer et al. (1994).

For parameters used to estimate exposures for which sufficient Site-specific information is lacking, conservative assumptions were used in this assessment. For instance, all COPECs are estimated to be 100% bioavailable. Although this is highly unlikely given various chemical and physical factors, it is a conservative assumption. In addition, the Site use factor (SUF), a term that is used to represent the portion of a wildlife receptor's foraging range that is encompassed by the Site, was conservatively set to 1 for the maximum EPC scenario. This implies that the receptor spends 100% of its time in the exposure area and is generally used as a conservative estimate in a SLERA (USEPA 1997). For the exposure scenarios using the 95% UCL and the mean concentration, the SUF was estimated based on the home range for each receptor. If a receptor's home range is expected to be larger than the site area (i.e., 20 acres), the site area was divided by the home range, resulting in a SUF less than one. This was the case for the red-tailed hawk and red fox. Exposure parameters are presented in Table 5-3. Exposure parameters were used in the dose model presented in Section 5.2. Average daily dose intakes for wildlife receptors are presented in Table 5-4a (Maximum Exposure), Table 5-4b (95% UCL Scenario) and Table 5-4c (Mean Concentration Exposure).

6. Effects Assessment

The ecological effects assessment is another component of Step 3a and describes the potential adverse effects associated with the identified COPECs to ecological receptors, and reflects the type of assessment endpoints selected. For the effects assessment, ecological benchmarks (Table 6-1) and wildlife toxicity reference values (TRVs; Table 6-2) are selected.

6.1 Ecological Benchmarks

The ecological screening benchmarks used to evaluate potential direct contact risks to terrestrial receptors were derived from the available literature and are defined as threshold values below which adverse effects are unlikely. Ecological benchmarks for plants and invertebrates exposed to soil included the following sources (Table 6-1):

- EcoSSLs (USEPA 2005);
- Region 5 Ecological Screening Levels (USEPA 2003);
- Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants and Soil and Litter Invertebrates (Efroymson et al 1997a,b); and
- Screening Level Ecological Risk Assessment Protocol, Appendix E: Toxicity Reference Values (USEPA 1999).

6.2 Wildlife Toxicity Reference Values

A wildlife TRV is defined as a dose level (based on laboratory toxicological investigations) above which a particular ecologically relevant effect may be expected to occur in an organism following chronic dietary exposure, and below which it is reasonably expected that such effects will not occur (USEPA 2005). Rather than deriving a single point-estimate associated with specific adverse biological effects, both high and low TRVs are derived for each wildlife receptor and each COPEC to better bracket the threshold effect level. The low TRV is a conservative value consistent with a chronic no observed adverse effects level (NOAEL). It represents a level at which adverse effects are unlikely to occur, and is used to identify COPECs posing little or no risk. The high TRV is a less conservative estimator of potential adverse effects, representing a level at which adverse effects are more likely to occur, and is consistent with a chronic lowest observed adverse effects level (LOAEL).

For this SLERA, toxicity values commonly used in BERAs and those reported by the USEPA (e.g., EcoSSLs; USEPA 2005) were utilized whenever available.

In the case of sources, such as USEPA EcoSSL Guidance (2008), where only a NOAEL-based TRV is provided, paired LOAEL-based TRVs were selected according to the following criteria:

- If the recommended NOAEL-based TRV was bounded[3], the LOAEL from the same study and endpoint was selected;
- If the recommended NOAEL-based TRV was unbounded, the lowest reproduction, growth, and survival LOAEL greater than the NOAEL-based TRV was selected;
- If the recommended NOAEL-based TRV was a geometric mean of the reproduction and growth NOAELs, the lower value from the following two methods was selected as the LOAEL TRV:
    - the geometric mean of bounded reproduction and grown LOAELs was calculated, and if no bounded NOAELs or LOAELs were contained in the dataset, the lowest reproduction or growth LOAEL greater than the NOAEL-based TRV was conservatively selected as the LOAEL-based TRV, and
    - the lowest bounded LOAEL for survival endpoints.

Additional published TRVs were selected from Sample et al (1996) and Trust et al. (1994). TRVs developed for a high molecular weight (HMW) PAH such as benzo(a)pyrene were used as surrogates for all HMW PAHs. For mammals, EcoSSL TRVs were available and used in this SLERA (Table 6-2; USEPA 2005).

For birds, an EcoSSL was not available, therefore, for HMW PAHs, a study by Trust et al. (1994) reporting a NOAEL of 10 mg/kg bw-day and a LOAEL of 100 mg/kg bw-day for overt signs of toxicity, such as decreased body mass in European starlings exposed to 7,12-dimethylbenz(a)anthracene, was selected to develop TRVs for this BERA. Immunosuppression was observed at higher doses. The exposures were via oral gavage, and the study was conducted on nestlings, a sensitive life-stage. No UFs were applied, and therefore, an avian NOAEL-based TRV of 10 mg/kg bw-day and an avian LOAEL-based TRV of 100 mg/kg bw-day were used for individual HMW PAHs.

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[3] The term "bounded" indicates both a NOAEL and LOAEL TRV were derived from the same study.

7. Risk Characterization

The final component of Step 3a is to characterize risk. Risk characterization was refined by evaluation of weight-of-evidence and ecological significance. In general, the risk characterization was based on HQs generated for direct contact COPECs using the Eco-SSLs and alternative effects values (Section 6.1), as well as HQs for bioaccumulative COPECs based on food web modeling (Section 5.2) compared to TRVs (Section 6.2). Ultimately, the HQs were considered within the context of weight-of-evidence and ecological significance of the risk estimates.

For direct contact exposures (i.e., plants and invertebrates) risks were evaluated by dividing the EPCs by risk-based soil benchmark values, described in Section 6.1, to develop a simple ratio defined as the HQ. This was done using the 95% UCL and mean soil concentration for the EPC as discussed in Section 5.1.

Similarly, HQs for upper trophic level species were calculated by comparing the estimated dose to the TRV to obtain a HQ. As described in Section 6.2, two HQs were calculated for each COPEC and receptor, one representing a threshold value below which no effects are expected to occur (NOAEL) and the other a concentration at which some effects may occur (LOAEL). HQs below one indicate that adverse effects should not be expected; however, because this SLERA was based on conservative exposure parameters, an HQ >1 indicates only the potential for adverse effects and suggests the need for further analysis to confirm the potential and the magnitude of the potential risk.

7.1 Potential Risk to Plants and Invertebrates

Potential risks to plants and soil invertebrates based on the three EPCs are presented in Table 6-1. The maximum concentration was compared to ecological benchmarks and resulting in potential risk for multiple SVOCs and a few metals. Using the 95% UCL, potential risk is identified for plants exposed to three SVOCs (benzo[b]fluoranthene, fluoranthene, and pyrene), and three metals (chromium, lead, and selenium). Using the mean soil concentration, only chromium and selenium result in HQs greater than one.

SVOCs based on the 95% UCL only slightly exceed an HQ of one (all are approximately 2), and do not exceed benchmarks based on the mean concentration. Chromium and lead appear to be driven by two samples located near the northern portion of the former landfill (LF-SL-1 and LF-SL-2), as demonstrated by the reduction in concentration using the mean, rather than the maximum and 95% UCL. Confidence in the chromium plant benchmark is low based on the small number of studies on which it is based (Efroymson et al. 1997a). Additionally, the studies were based on hexavalent chromium, and site-specific chromium speciation is unknown. Selenium is detected in only two out of 20 samples. Therefore, a 95% UCL was not calculated. The HQ for plants estimated using the maximum and mean concentration is just slightly greater than one (HQ = 2).

For invertebrates, HQs based on the maximum concentration, the 95% UCL, and mean concentration are less than one with the exception of chromium and mercury (Table 6-1).

As discussed above for plants, chromium seems to be driven by two samples in the northern portion of the former landfill. The benchmark for chromium was based on a study by Abbasi and Soni (1983), and confidence in the selected benchmark is low overall because there are only five reported concentrations causing toxicity to earthworms (Efroymson et al. 1997b).

Additionally, the landfill area does not have observed areas of stressed or dead vegetation, and the majority of the area has vegetative cover, suggesting that plant growth is not adversely affected by site-related concentrations. Areas lacking vegetative cover are more likely due to high foot/vehicle traffic from equipment storage. In summary, adverse effects to plants and terrestrial communities are not expected based on site-related concentrations in soil.

7.2 Potential Risk to Wildlife

Potential risks to avian and mammalian receptors are presented in Table 7-1a (Maximum Scenario), Table 7-1b (95% UCL Scenario), and Table 7-1c (Mean Concentration Scenario).

7.2.1 Birds

<u>American robin</u>

- LOAEL-based and NOAEL-based HQs for the American robin using the maximum concentration as the EPC are greater than one for chromium and lead. The NOAEL-based HQ for mercury is greater than one.
- LOAEL-based and NOAEL-based HQs using the 95% UCL as the EPC are greater than one for chromium and lead.

- LOAEL-based and NOAEL-based HQs using the mean concentration are greater than one for lead.

Red-tailed Hawk

- LOAEL-based and NOAEL-based HQs for the red-tailed hawk using the maximum concentration as the EPC are all less than one.
- LOAEL-based and NOAEL-based HQs using the 95% UCL as the EPC and the mean concentration as the EPC are all less than one.

7.2.2 Mammals

Short-tailed shrew

- NOAEL-based HQs for the short-tailed shrew using the maximum concentration as the EPC are greater than one for multiple SVOCs and cadmium, chromium, lead, and nickel. LOAEL-based HQs using the maximum concentration are greater than one for chromium and lead.
- NOAEL-based HQs using the 95% UCL are greater than one for chromium and lead. The LOAEL-based HQ using the 95% UCL as the EPC is greater than one for lead.
- NOAEL-based HQs using the mean concentration for lead is greater than one, and no LOAEL-based HQs are greater than one.

Red Fox

- LOAEL-based and NOAEL-based HQs for the maximum concentration, 95% UCL, and mean concentration used as the EPC are less than one.

7.3 Summary of Potential Risks

As mentioned previously, the former landfill was specifically mentioned in the request for a SLERA and it is the only potential ecological exposure area with reasonably current data. The SLERA focused on the potentially complete pathways for exposure of ecological receptors to chemical constituents in former landfill soil. The potential for surface runoff and seepage from the former landfill was evaluated during a site reconnaissance and found no evidence of potential transport to the Mississippi River Wildlife and Fish Refuge or Little Maquoketa River. In addition, as mentioned in

Section 2.3, acute toxicity results for Outfalls 002 and combined Outfalls 005 and 006 passed effluent tests (Appendix A).

Potential risk for plants was identified for a few SVOCs, chromium, lead, and selenium (Table 6.1). As mentioned above in Section 7.1, SVOCs only slightly exceed an HQ of one for the 95% UCL and do not exceed benchmarks based on the mean concentration. Chromium and lead appear to be driven by two samples located near the northern portion of the former landfill (LF-SL-1 and LF-SL-2), confidence in the chromium plant benchmark is low, and selenium is detected in only two out of 20 samples.

Potential risk for invertebrates was identified for only chromium using the maximum concentration, 95% UCL, and mean concentration (Table 6-1). As discussed above for plants, chromium seems to be driven by two samples, and confidence in the benchmark is low. The uncertainty regarding COPECs without available ESVs is discussed in Section 8.4.

Additionally, the landfill area does not have areas of stressed or dead vegetation, and the majority of the area has vegetative cover, suggesting that plants are not adversely affected by site-related concentrations. Areas lacking vegetative cover are more likely due to high foot/vehicle traffic from equipment storage. In summary, adverse effects to plants and terrestrial invertebrate communities are not expected based on site-related concentrations in soil.

Potential risk to wildlife receptors was identified for LOAEL-based HQs in the maximum exposure scenario (Table 7-1a) for American robin and short-tailed shrew exposed to chromium and lead. Potential risk was not identified for red-tailed hawk or red fox for any scenario. LOAEL-based HQs using the 95% UCL as the EPC (Table 7-1b) were greater than one for chromium and lead for the robin, and lead for the shrew. LOAEL-based HQs using the mean concentration as the EPC (Table 7-1c) were greater than one for lead for the robin. As an additional weight of evidence, a target soil concentration was back calculated for chromium to result in a NOAEL-based HQ equal to one. When the dataset for chromium is compared to the target soil concentration, only the two maximum concentrations (LF-SL-1 and LF-SL-2) are greater than this value. If 10% of the former landfill area (i.e., 10% of 20 acres = 2 acres) is assumed to have concentrations greater than this target soil concentration, and receptor-specific home ranges are considered for robin and shrew, approximately 7-8 individuals may be present in this area, which is not expected to maintain or adversely affect an entire population. Based on the results of the SLERA, potential risk is identified for American robin and short-tailed shrew exposed to lead.

8. Uncertainty Assessment

There are multiple factors that can contribute to the uncertainty of a risk assessment, including inputs to the ecological receptor use of the site, exposure parameters and media concentrations, and benchmarks or toxicity values.

8.1 Ecological Receptors

The SLERA assumes that the Site provides habitat of suitable size and quality to attract and support the receptors identified for evaluation. However, due to the industrial nature of the site and that more appropriate habitat is available in the adjacent wildlife refuge, current use by ecological receptors is likely to be somewhat limited. In addition, the former landfill is maintained and mowed frequently, minimizing the vegetative cover for potential use by wildlife. Therefore, the assumptions regarding habitat quality and availability presented in the SLERA are conservative and would tend to overestimate risk.

8.2 Exposure Parameters

Site Use Factor

Some of the upper-trophic level receptors considered in this SLERA typically have home ranges that span over a significantly large area. Given the industrial nature of the Site and size, the available habitat at the Site may be limited relative to these home ranges. Therefore, the conservative use of 1 for the SUF likely overestimates potential risk to those receptors with a much larger home range.

Bioavailability

All COPECs are conservatively estimated to be 100% bioavailable to all receptors, but this is generally not the case for most chemicals, especially in soils. The bioavailability of chemicals in soil depends on the form originally released as well as various physical characteristics of the soil. Potential interactions among metals may also influence their bioavailability and uptake to terrestrial organisms. In addition, it is also important to note that the TRVs are typically based on laboratory dosing studies in which highly soluble forms of the COPECs were used. As a result, these toxicity estimates can overestimate the bioavailability, uptake, and ultimate toxicity of COPECs in the receptors' gut. However, for the purpose of the SLERA, it is assumed that the TRVs represent actual exposures to the receptors evaluated. As a result of these assumptions about bioavailability, potential risks are likely overestimated.

8.3 Exposure Point Concentrations

An important contributor to uncertainty is the data or information upon which the risk assessment is based. COPECs were screened using maximum chemical concentrations and risks were assessed using the maximum concentrations, 95% UCLs, and mean concentrations to estimate a range of potential risk. The use of a greater number of sample points would lead to greater confidence in the development of a single point concentration to which the receptors are likely to be exposed, especially for COPECs with insufficient data to calculate a UCL (e.g., selenium). The direction and magnitude of this uncertainty are not completely measurable; however, the use of the maximum concentration or the UCL likely overestimates risk.

Terrestrial plant and invertebrate exposure point concentrations were estimated through the use of literature-based bioaccumulation factors, which tend to be conservative and can vary greatly based on site-specific conditions. In general, significant regression equations are preferred over simple uptake factors, which were not available for all COPECs.

8.4 Constituents Lacking Ecological Benchmarks and Toxicity Values

Only a few COPECs do not have available ESVs for both plants and invertebrates (i.e., carbazole, dibenzofuran, and iron). Carbazole and dibenzofuran were infrequently detected (2 out of 20 and 3 out of 20 samples, respectively). These two COPECs are not expected to contribute significantly to potential risk to plant or invertebrate populations. Iron is recognized as essential to plant growth (USEPA 2005) and typical iron concentrations in soil range from 20,000 to 550,000 mg/kg (Morel and Hering 1993 as cited in USEPA 2005). Toxicity is dependent on site-specific conditions, however in well-aerated soil, iron is not expected to be toxic to plants (USEPA 2005). Even though site concentrations of iron are greater than background, the maximum falls within the lower range of the typical concentrations found in soil, therefore, it is not expected to adversely affect populations of plants.

Carbazole, dibenzofuran, phenol, and iron do not have available TRVs to estimate potential risk to wildlife receptors. As discussed above, carbazole, dibenzofuran and iron are not expected to result in potential risk. Phenol was detected in 100% of samples, however, the maximum concentration was two orders of magnitude less than available plant and invertebrate benchmarks, and based on the low Log Kow (i.e., less than 3.5) indicating it is not bioaccumulative (USEPA 2007) it is not expected to adversely affect wildlife receptors potentially exposed to soil.

9. Conclusions

Based on the results of this conservative assessment, potential adverse effects to plants and invertebrates are not expected. Potential risk could not be excluded for wildlife receptors (i.e., shrew and robin) for exposure to lead. Therefore, additional evaluation is warranted.

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TABLES

ARCADIS

Tables

Table 3-1
Threatened and Endangered Species Recorded in Dubuque County, Iowa
John Deere Dubuque Works
Dubuque, Iowa

Common Name	Scientific Name	Class	State Status	Federal Status
Bald Eagle	*Haliaeetus leucocephalus*	Birds	S	
Pugnose Minnow *	*Opsopoeodus emiliae*	Fish	S	
Butterfly	*Ellipsaria lineolata*	Freshwater Mussels	T	
Creek Heelsplitter	*Lasmigona compressa*	Freshwater Mussels	T	
Creeper	*Strophitus undulatus*	Freshwater Mussels	T	
Cylindrical Papershell	*Anodontoides ferussacianus*	Freshwater Mussels	T	
Ellipse	*Venustaconcha ellipsiformis*	Freshwater Mussels	T	
Higgin's-eye Pearly Mussel	*Lampsilis higginsii*	Freshwater Mussels	E	E
Pistolgrip	*Tritogonia verrucosa*	Freshwater Mussels	E	
Purple Wartyback	*Cyclonaias tuberculata*	Freshwater Mussels	T	
Round Pigtoe	*Pleurobema sintoxia*	Freshwater Mussels	E	
Slippershell Mussel	*Alasmidonta viridis*	Freshwater Mussels	E	
Indiana Bat *	*Myotis sodalis*	Mammals	E	E
Spotted Skunk *	*Spilogale putorius*	Mammals	E	
Alderleaf Buckthorn	*Rhamnus alnifolia*	Plants (Dicots)	S	
American Speedwell	*Veronica americana*	Plants (Dicots)	S	
Bigroot Prickly-pear	*Opuntia macrorhiza*	Plants (Dicots)	E	
Cutleaf Water-milfoil	*Myriophyllum pinnatum*	Plants (Dicots)	S	
False Mermaid-weed	*Floerkea proserpinacoides*	Plants (Dicots)	E	
Fineberry Hawthorn	*Crataegus chrysocarpa*	Plants (Dicots)	S	
Golden Saxifrage	*Chrysosplenium iowense*	Plants (Dicots)	T	
Grape-stemmed Clematis	*Clematis occidentalis*	Plants (Dicots)	S	
Green Violet	*Hybanthus concolor*	Plants (Dicots)	T	
Hill's Thistle	*Cirsium hillii*	Plants (Dicots)	S	
Jeweled Shooting Star	*Dodecatheon amethystinum*	Plants (Dicots)	T	
Kidney-leaf White Violet	*Viola renifolia*	Plants (Dicots)	T	
Limestone Rockcress	*Arabis divaricarpa*	Plants (Dicots)	S	
Low Bindweed	*Calystegia spithamaea*	Plants (Dicots)	S	
Mountain Maple *	*Acer spicatum*	Plants (Dicots)	S	
Muskroot	*Adoxa moschatellina*	Plants (Dicots)	S	
Narrowleaf Pinweed	*Lechea intermedia*	Plants (Dicots)	T	
Northern Black Currant	*Ribes hudsonianum*	Plants (Dicots)	T	
Northern Monkshood	*Aconitum noveboracense*	Plants (Dicots)	T	T
Pale False Foxglove	*Agalinis skinneriana*	Plants (Dicots)	E	
Partridge Berry	*Mitchella repens*	Plants (Dicots)	T	
Pearly Everlasting	*Anaphalis margaritacea*	Plants (Dicots)	S	
Pinesap	*Monotropa hypopithys*	Plants (Dicots)	T	
Prairie Dock	*Silphium terebinthinaceum*	Plants (Dicots)	S	
Prickly Rose	*Rosa acicularis*	Plants (Dicots)	E	
Purple Angelica	*Angelica atropurpurea*	Plants (Dicots)	S	
Rock Sandwort	*Minuartia michauxii*	Plants (Dicots)	S	
Rough Bedstraw	*Galium asprellum*	Plants (Dicots)	S	
Rough Buttonweed	*Diodia teres*	Plants (Dicots)	S	
Scarlet Hawthorn	*Crataegus coccinea*	Plants (Dicots)	S	
Shadbush	*Amelanchier sanguinea*	Plants (Dicots)	S	
Spreading Hawthorn	*Crataegus disperma*	Plants (Dicots)	S	
Summer Grape	*Vitis aestivalis*	Plants (Dicots)	S	
Twinleaf	*Jeffersonia diphylla*	Plants (Dicots)	T	
Yellow Monkey Flower	*Mimulus glabratus*	Plants (Dicots)	T	
Bog Bluegrass	*Poa paludigena*	Plants (Monocots)	S	
Carey Sedge	*Carex careyana*	Plants (Monocots)	S	
Field Sedge	*Carex conoidea*	Plants (Monocots)	S	
Glomerate Sedge	*Carex aggregata*	Plants (Monocots)	S	
Great Plains Ladies'-tresses	*Spiranthes magnicamporum*	Plants (Monocots)	S	
Hooker's Orchid	*Platanthera hookeri*	Plants (Monocots)	T	
Mountain Ricegrass	*Oryzopsis asperifolia*	Plants (Monocots)	S	
Nodding Onion	*Allium cernuum*	Plants (Monocots)	T	
Oval Ladies'-tresses	*Spiranthes ovalis*	Plants (Monocots)	T	
Rosy Twisted Stalk	*Streptopus roseus*	Plants (Monocots)	T	
Slender Sedge	*Carex tenera*	Plants (Monocots)	S	
Slim-leaved Panic Grass	*Dichanthelium linearifolium*	Plants (Monocots)	T	
Spotted Coralroot	*Corallorhiza maculata*	Plants (Monocots)	T	
Yellow Trout-lily	*Erythronium americanum*	Plants (Monocots)	T	

Table 3-1
Threatened and Endangered Species Recorded in Dubuque County, Iowa
John Deere Dubuque Works
Dubuque, Iowa

Common Name		Scientific Name	Class	State Status	Federal Status
Crowfoot Clubmoss		*Lycopodium digitatum*	Plants (Pteriodophytes)	S	
Dwarf Scouring-rush		*Equisetum scirpoides*	Plants (Pteriodophytes)	S	
Glandular Wood Fern		*Dryopteris intermedia*	Plants (Pteriodophytes)	T	
Leathery Grape Fern	*	*Botrychium multifidum*	Plants (Pteriodophytes)	T	
Ledge Spikemoss		*Selaginella rupestris*	Plants (Pteriodophytes)	S	
Limestone Oak Fern		*Gymnocarpium robertianum*	Plants (Pteriodophytes)	S	
Marginal Shield Fern		*Dryopteris marginalis*	Plants (Pteriodophytes)	T	
Oak Fern		*Gymnocarpium dryopteris*	Plants (Pteriodophytes)	T	
Purple Cliff-brake Fern		*Pellaea atropurpurea*	Plants (Pteriodophytes)	E	
Tree Clubmoss		*Lycopodium dendroideum*	Plants (Pteriodophytes)	T	
Ornate Box Turtle	*	*Terrapene ornata*	Reptiles	T	
Bluff Vertigo		*Vertigo meramecensis*	Snails	E	
Frigid Ambersnail		*Catinella gelida*	Snails	E	
Iowa Pleistocene Snail		*Discus macclintocki*	Snails	E	E
Midwest Pleistocene Vertigo		*Vertigo hubrichti hubrichti*	Snails	T	
Variable Pleistocene Vertigo		*Vertigo hubrichti variabilis*	Snails	T	

* = Identified in the Remedial Investigation (Geraghty & Miller 1988).
S = special concern, T = threatened, E = endangered

Source: Iowa Natural Areas Inventory (INAI) Interactive Website (Accessed July 18, 2014). Available at:
https://programs.iowadnr.gov/naturalareasinventory/pages/Query.aspx

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Analyte: Lab Sample ID: Sample Date: Area:	LF-SL-1 280-20905-1 9/27/2011 Former Landfill	LF-SL-DUP001 280-20905-21 9/27/2011 Former Landfill	LF-SL-2 280-20905-2 9/27/2011 Former Landfill	LF-SL-3 280-20905-3 9/27/2011 Former Landfill	LF-SL-4 280-20905-4 9/27/2011 Former Landfill	LF-SL-5 280-20905-5 9/27/2011 Former Landfill	LF-SL-6 280-20905-6 9/27/2011 Former Landfill	LF-SL-7 280-20905-7 9/27/2011 Former Landfill	LF-SL-8 280-20905-8 9/27/2011 Former Landfill	LF-SL-9 280-20905-9 9/27/2011 Former Landfill	LF-SL-10 280-20905-10 9/27/2011 Former Landfill
USEPA TCL SEMIVOLATILE ORGANIC COMPOUNDS (ug/kg):											
1,1'-Biphenyl	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
1,2,4,5-Tetrachlorobenzene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,2'-oxybis[1-chloropropane]	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,3,4,6-Tetrachlorophenol	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
2,4,5-Trichlorophenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,4,6-Trichlorophenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,4-Dichlorophenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,4-Dimethylphenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,4-Dinitrophenol	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
2,4-Dinitrotoluene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2,6-Dinitrotoluene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2-Chloronaphthalene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2-Chlorophenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2-Methylnaphthalene	<330	<320	**44 J**	<3300	<330	<330	<320	<330	<310	<330	<330
2-Methylphenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
2-Nitroaniline	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
2-Nitrophenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
3,3'-Dichlorobenzidine	<660	<640	<630	<6500	<650	<650	<640	<650	<620	<660	<660
3-Nitroaniline	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
4,6-Dinitro-2-methylphenol	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
4-Bromophenyl phenyl ether	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
4-Chloro-3-methylphenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
4-Chloroaniline	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
4-Chlorophenyl phenyl ether	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
4-Methylphenol	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
4-Nitroaniline	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
4-Nitrophenol	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
Acenaphthene	<330	<320	**480**	<3300	<330	<330	<320	<330	<310	<330	<330
Acenaphthylene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Acetophenone	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Anthracene	**17 J**	<320	**1200**	<3300	<330	<330	<320	<330	<310	<330	<330
Atrazine	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Benzaldehyde	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Benzo[a]anthracene	**63 J**	**42 J**	**3300**	<3300	**28 J**	**24 J**	**96 J**	<330	**23 J**	<330	<330
Benzo[a]pyrene	**64 J**	**48 J**	**2800**	<3300	**34 J**	**25 J**	**140 J**	<330	**29 J**	<330	<330

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Analyte: Lab Sample ID: Sample Date: Area:	LF-SL-11 280-20905-11 9/28/2011 Former Landfill	LF-SL-12 280-20905-12 9/28/2011 Former Landfill	LF-SL-13 280-20905-13 9/27/2011 Former Landfill	LF-SL-14 280-20905-14 9/27/2011 Former Landfill	LF-SL-15 280-20905-15 9/27/2011 Former Landfill	LF-SL-16 280-20905-16 9/28/2011 Former Landfill	LF-SL-17 280-20905-17 9/28/2011 Former Landfill	LF-SL-18 280-20905-18 9/28/2011 Former Landfill	LF-SL-19 280-20905-19 9/28/2011 Former Landfill	LF-SL-20 280-20905-20 9/28/2011 Former Landfill
USEPA TCL SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg):										
1,1'-Biphenyl	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
1,2,4,5-Tetrachlorobenzene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,2'-oxybis[1-chloropropane]	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,3,4,6-Tetrachlorophenol	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
2,4,5-Trichlorophenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,4,6-Trichlorophenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,4-Dichlorophenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,4-Dimethylphenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,4-Dinitrophenol	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
2,4-Dinitrotoluene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2,6-Dinitrotoluene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2-Chloronaphthalene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2-Chlorophenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2-Methylnaphthalene	<320	**44 J**	<320	<310	<320	<320	<330	<330	**24 J**	<330
2-Methylphenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
2-Nitroaniline	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
2-Nitrophenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
3,3'-Dichlorobenzidine	<630	<630	<650	<620	<640	<640	<660	<650	<630	<660
3-Nitroaniline	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
4,6-Dinitro-2-methylphenol	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
4-Bromophenyl phenyl ether	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
4-Chloro-3-methylphenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
4-Chloroaniline	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
4-Chlorophenyl phenyl ether	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
4-Methylphenol	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
4-Nitroaniline	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
4-Nitrophenol	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
Acenaphthene	**11 J**	**28 J**	<320	<310	<320	<320	<330	<330	**16 J**	<330
Acenaphthylene	<320	<320	<320	<310	**51 J**	<320	<330	<330	<320	<330
Acetophenone	<320	<320	<320	<310	<320	<320	<330	<330	**23 J**	<330
Anthracene	<320	**56 J**	<320	<310	**48 J**	<320	<330	<330	**27 J**	<330
Atrazine	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Benzaldehyde	<320	<320	<320	<310	<320	<320	<330	<330	**74 J**	<330
Benzo[a]anthracene	**150 J**	**250 J**	**54 J**	**73 J**	**180 J**	**38 J**	<330	<330	**64 J**	**31 J**
Benzo[a]pyrene	**160 J**	**270 J**	**54 J**	**85 J**	**190 J**	**39 J**	<330	**20 J**	**45 J**	**30 J**

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Analyte:	LF-SL-1	LF-SL-DUP001	LF-SL-2	LF-SL-3	LF-SL-4	LF-SL-5	LF-SL-6	LF-SL-7	LF-SL-8	LF-SL-9	LF-SL-10
Lab Sample ID:	280-20905-1	280-20905-21	280-20905-2	280-20905-3	280-20905-4	280-20905-5	280-20905-6	280-20905-7	280-20905-8	280-20905-9	280-20905-10
Sample Date:	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011
Area:	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill
Benzo[b]fluoranthene	**130 J K *JY***	**95 J K *JY***	**4800 K *JY***	<3300	**66 J K *JY***	**45 J K *JY***	**270 J K *JY***	<330	**65 J K *JY***	<330	<330
Benzo[g,h,i]perylene	**63 J**	**42 J**	**2200**	<3300	**29 J**	**20 J**	**120 J**	<330	**26 J**	<330	<330
Benzo[k]fluoranthene	***115 JY***	***84 JY***	***4255 JY***	<3300	***59 JY***	**40 JY**	***239 JY***	<330	***58 JY***	<330	<330
Bis(2-chloroethoxy)methane	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Bis(2-chloroethyl)ether	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Bis(2-ethylhexyl) phthalate	<330	110 J B *UB*	<320	<3300	<330	<330	**62 J**	<330	**46 J**	<330	<330
Butyl benzyl phthalate	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Caprolactam	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
Carbazole	<330	<320	**720**	<3300	<330	<330	<320	<330	<310	<330	<330
Chrysene	**73 J**	**54 J**	**3300**	<3300	**36 J**	<330	**120 J**	<330	**29 J**	<330	<330
Dibenz(a,h)anthracene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Dibenzofuran	<330	<320	**220 J**	<3300	<330	<330	<320	<330	<310	<330	<330
Diethyl phthalate	<660	<640	<630	<6500	<650	<650	<640	<650	<620	<660	<660
Dimethyl phthalate	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Di-n-butyl phthalate	<330	<320	<320	<3300	<330	**39 J**	<320	<330	<310	<330	<330
Di-n-octyl phthalate	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Fluoranthene	**120 J**	**84 J**	**5800**	<3300	**52 J**	**45 J**	**130 J**	<330	**43 J**	<330	<330
Fluorene	<330	<320	**480**	<3300	<330	<330	<320	<330	<310	<330	<330
Hexachlorobenzene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Hexachlorobutadiene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Hexachlorocyclopentadiene	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
Hexachloroethane	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Indeno[1,2,3-cd]pyrene	**53 J**	**38 J**	**2300**	<3300	**25 J**	<330	**100 J**	<330	**24 J**	<330	<330
Isophorone	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Naphthalene	<330	<320	**66 J**	<3300	<330	<330	<320	<330	<310	<330	<330
Nitrobenzene	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
N-Nitrosodi-n-propylamine	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
n-Nitrosodiphenylamine(as diphenylamine)	<330	<320	<320	<3300	<330	<330	<320	<330	<310	<330	<330
Pentachlorophenol	<1600	<1600	<1500	<16000	<1600	<1600	<1500	<1600	<1500	<1600	<1600
Phenanthrene	**79 J**	**44 J**	**4300**	<3300	**24 J**	**22 J**	**47 J**	<330	<310	<330	<330
Phenol	**41 J**	**38 J**	**49 J**	**410 J**	**24 J**	**22 J**	**36 J**	**42 J**	**19 J**	**35 J**	**19 J**
Pyrene	**120 J**	**80 J**	**6100**	**120 J**	**49 J**	**40 J**	**140 J**	**15 J**	**44 J**	**19 J**	<330

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Analyte:	LF-SL-11	LF-SL-12	LF-SL-13	LF-SL-14	LF-SL-15	LF-SL-16	LF-SL-17	LF-SL-18	LF-SL-19	LF-SL-20
Lab Sample ID:	280-20905-11	280-20905-12	280-20905-13	280-20905-14	280-20905-15	280-20905-16	280-20905-17	280-20905-18	280-20905-19	280-20905-20
Sample Date:	9/28/2011	9/28/2011	9/27/2011	9/27/2011	9/27/2011	9/28/2011	9/28/2011	9/28/2011	9/28/2011	9/28/2011
Area:	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill
Benzo[b]fluoranthene	**360 K** *JY*	**540 K** *JY*	**100 J K** *JY*	**180 J K** *JY*	**370 K** *JY*	**82 J K** *JY*	<330	**41 J K** *JY*	**78 J K** *JY*	**56 J K** *JY*
Benzo[g,h,i]perylene	**140 J**	**230 J**	**35 J**	**69 J**	**140 J**	**32 J**	<330	<330	**31 J**	**22 J**
Benzo[k]fluoranthene	***319 JY***	***479 JY***	***89 JY***	***160 JY***	***328 JY***	***73 JY***	<330	***36 JY***	**69 JY**	***50 JY***
Bis(2-chloroethoxy)methane	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Bis(2-chloroethyl)ether	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Bis(2-ethylhexyl) phthalate	**53 J**	**71 J**	<320	**94 J**	<320	**65 J**	<330	<330	**62 J**	<330
Butyl benzyl phthalate	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Caprolactam	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
Carbazole	<320	**59 J**	<320	<310	<320	<320	<330	<330	<320	<330
Chrysene	**210 J**	**300 J**	**55 J**	**83 J**	**200 J**	**52 J**	<330	<330	**77 J**	**33 J**
Dibenz(a,h)anthracene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Dibenzofuran	<320	**24 J**	<320	<310	<320	<320	<330	<330	**25 J**	<330
Diethyl phthalate	<630	<630	<650	<620	<640	<640	<660	<650	<630	<660
Dimethyl phthalate	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Di-n-butyl phthalate	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Di-n-octyl phthalate	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Fluoranthene	**380**	**550**	**99 J**	**150 J**	**280 J**	**81 J**	<330	**45 J**	**140 J**	**57 J**
Fluorene	<320	**23 J**	<320	<310	<320	<320	<330	<330	<320	<330
Hexachlorobenzene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Hexachlorobutadiene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Hexachlorocyclopentadiene	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
Hexachloroethane	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Indeno[1,2,3-cd]pyrene	**130 J**	**200 J**	**34 J**	**77 J**	**120 J**	**29 J**	<330	<330	**23 J**	<330
Isophorone	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Naphthalene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Nitrobenzene	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
N-Nitrosodi-n-propylamine	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
n-Nitrosodiphenylamine(as diphenylamine)	<320	<320	<320	<310	<320	<320	<330	<330	<320	<330
Pentachlorophenol	<1500	<1500	<1600	<1500	<1600	<1600	<1600	<1600	<1500	<1600
Phenanthrene	**170 J**	**310 J**	**39 J**	**76 J**	**99 J**	**63 J**	**42 J**	**22 J**	**290 J**	**24 J**
Phenol	**37 J**	**60 J**	**32 J**	**31 J**	**22 J**	**27 J**	**33 J**	**22 J**	**30 J**	**22 J**
Pyrene	**330**	**550**	**89 J**	**140 J**	**260 J**	**77 J**	**26 J**	**39 J**	**150 J**	**53 J**

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Analyte:	LF-SL-1	LF-SL-DUP001	LF-SL-2	LF-SL-3	LF-SL-4	LF-SL-5	LF-SL-6	LF-SL-7	LF-SL-8	LF-SL-9	LF-SL-10
Lab Sample ID:	280-20905-1	280-20905-21	280-20905-2	280-20905-3	280-20905-4	280-20905-5	280-20905-6	280-20905-7	280-20905-8	280-20905-9	280-20905-10
Sample Date:	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011	9/27/2011
Area:	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill
USEPA TCL METALS (mg/kg):											
Aluminum	3400	3600	3000	7200	1100	3800	3300	2200	980	3600	3500
Antimony	1.1 J *J*	0.73 J *J*	1.3 *J*	<1.4 *J*	<1.3 *J*	<1.4 J	<1.4 *J*	<1.4 *J*	<1.4 *J*	<1.4 *J*	<1.4 *J*
Arsenic	3.5	4.6	2.9	2.5	13	3.3	3.9	1.8 J	3.7	2.0	2.6
Barium	41	45	45	340	32	57	47	220	21	41	35
Beryllium	0.29 J	0.36 J	0.18 J	0.50	0.24 J	0.24 J	0.34 J	0.12 J	0.097 J	0.20 J	0.19 J
Cadmium	1.2	1.2	0.81	0.20 J	0.59	0.20 J	0.32 J	0.52	0.43 J	0.16 J	0.10 J
Calcium	3800 *J*	4100 *J*	3700 *J*	14000 *J*	130000 *J*	44000 *J*	34000 *J*	64000 *J*	170000 *J*	8100 *J*	3900 *J*
Chromium	230	180	280	24	21	10	57	19	22	9.7	8.9
Cobalt	4.6	4.6	5.2	1.6	2.0	3.5	1.6	3.0	1.4	5.2	5.1
Copper	45 *J*	23 *J*	20 *J*	8.2 *J*	22 *J*	10 *J*	33 *J*	79 *J*	20 *J*	7.7 *J*	6.2 *J*
Iron	11000	12000 B	10000	8800	16000	8800	15000	9900	11000	7800	6900 B
Lead	940	740	1100	60	42	11	27	76	36	10	6.4
Magnesium	2300 *J*	2300 *J*	2100 *J*	3000 *J*	69000 *J*	26000 *J*	19000 *J*	40000 *J*	85000 *J*	4500 *J*	2500 *J*
Manganese	230	240 B	190	87	360	410	630	290	420	390	320 B
Mercury	0.029	0.027	0.021	0.0071 J	0.024	0.067	0.12	0.1	0.025	0.005 J	< 0.015
Nickel	13	15 B	15	6.0	10	10	46	9.8	8.3	12	12 B
Potassium	320	340	290	400	220 J	460	170 J	190 J	300	460	350
Selenium	<1.3	<1.3	<1.1	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Silver	<0.97	<0.99	<0.87	<0.91	<0.88	<0.92	0.15 J	<0.93	<0.93	<0.94	<0.94
Sodium	94 J *UB*	110 J *UB*	87 J *UB*	220 J *UB*	240 J *UB*	180 J *UB*	250 J *UB*	180 J *UB*	340 J *UB*	100 J *UB*	99 J *UB*
Thallium	<1.2	<1.2	<1.0	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
Vanadium	12	13	11	10	5.9	14	6.2	7.5	4.3	14	14
Zinc	150	160	110	36	34	23	32	32	28	21	16

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Analyte:	LF-SL-11	LF-SL-12	LF-SL-13	LF-SL-14	LF-SL-15	LF-SL-16	LF-SL-17	LF-SL-18	LF-SL-19	LF-SL-20
Lab Sample ID:	280-20905-11	280-20905-12	280-20905-13	280-20905-14	280-20905-15	280-20905-16	280-20905-17	280-20905-18	280-20905-19	280-20905-20
Sample Date:	9/28/2011	9/28/2011	9/27/2011	9/27/2011	9/27/2011	9/28/2011	9/28/2011	9/28/2011	9/28/2011	9/28/2011
Area:	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill	Former Landfill
USEPA TCL METALS (mg/kg):										
Aluminum	1000	3100	5100	2100	3300	3200	2500	1300	640	3400
Antimony	<1.3 J	<1.4 J	<1.5 J	<1.4 J	<1.4 J	<1.3 J	<1.4 J	<1.3 J	<1.4 J	<1.3 J
Arsenic	4.6	6.3	1.6 J	6.2	2.9	3.0	3.0	3.6 J	5.7	2.6
Barium	32	130	33	39	40	44	37	23	12	40
Beryllium	0.096 J	0.29 J	0.20 J	0.13 J	0.20 J	0.20 J	0.17 J	0.11 J	0.36 J	0.19 J
Cadmium	0.46	1.5	0.083 J	0.93	0.25 J	0.25 J	0.15 J	0.15 J	0.20 J	0.14 J
Calcium	160000 J	94000 J	2400 J	35000 J	5100 J	10000 J	11000 J	150000 J	92000 J	2800 J
Chromium	18	48	8.2	55	18	29	7.1	5.0	7.9	24
Cobalt	1.7	3.6	4.0	4.7	4.8	5.3	4.4	1.9	2.6	5.4
Copper	21 J	33 J	6.1 J	43 J	13 J	17 J	5.8 J	4.4 J	7.0 J	9.5 J
Iron	10000 B	16000 B	6800 B	29000 B	12000 B	10000 B	6500 B	5500 B	5400 B	8600 B
Lead	39	130	5.5	120	32	66	7.4	9.1	13	57
Magnesium	79000 J	57000 J	1900 J	21000 J	3000 J	5900 J	4700 J	76000 J	57000 J	2000 J
Manganese	380 B	450 B	270 B	440 B	380 B	420 B	310 B	370 B	250 B	370 B
Mercury	0.01 J	0.14	< 0.016	0.08	0.014 J	0.015	0.0066 J	< 0.017	0.0092 J	0.0063 J
Nickel	8.4 B	16 B	9.9 B	20 B	13 B	15 B	10 B	6.3 B	8.8 B	13 B
Potassium	280	510	270 J	290	460	440	370	290	190 J	430
Selenium	1.0 J	<1.3	<1.3	<1.3	<1.3	<1.1	<1.2	0.79 J	<1.3	<1.2
Silver	<0.84	0.24 J	<0.97	0.24 J	<0.96	<0.88	<0.93	<0.89	<0.96	<0.89
Sodium	310 J *UB*	280 J *UB*	83 J *UB*	160 J *UB*	96 J *UB*	94 J *UB*	93 J *UB*	300 J *UB*	250 J *UB*	73 J *UB*
Thallium	<1.0	<1.2	<1.2	<1.2	<1.2	<1.1	<1.1	<1.1	<1.2	<1.1
Vanadium	4.9	11	15	11	13	15	12	5.0	3.8	15
Zinc	37	140	18	69	40	34	18	25	25	26

Table 3-2
Surface Soil Results
John Deere Dubuque Works
Dubuque, Iowa

Notes:
"--" = Not analyzed
Bold = Detected values.
LF-SL-1 is the parent sample of LF-SL-DUP001.
mg/kg = milligrams per kilogram
TCL = Target Compound List
µg/kg = micrograms per kilogram
USEPA = United States Environmental Protection Agency

Data qualifiers in italics were determined during data validation.
B = Compound was found in the blank and sample.
J = Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
JY = Two compounds, benzo(b)fluoranthene and benzo(k)fluoranthene, co-eluted and could not be chromatographically resolved. The laboratory quantitated the peaks as benzo(b)fluoranthene and reported benzo(k)fluoranthene as non-detect. As part of the data validation process, the concentration of benzo(k)fluoranthen for these sample locations was calculated from the peak area identified as benzo(b)fluoranthene using the appropriate benzo(k)fluoranthene response factor. The values listed are estimated.
K = Benzo (b&k) fluoranthene are unresolved due to matrix, result is reported as Benzo(b)fluoranthene.
UB = Compound considered non-detect at the listed value due to associated blank contamination.

Table 3-3
Constituents of Potential Ecological Concern in Soil
John Deere Dubuque Works
Dubuque, Iowa

Constituent [a]		CASN	Frequency of Detection [b] Detects / n	(%)	Detection Limits Min (mg/kg)	Detection Limits Max (mg/kg)	Detected Concentrations Min (mg/kg)	Detected Concentrations Max (mg/kg)	Location of Maximum Concentration (Sample Date)	Ecological Screening Level [c] Plant ESV (mg/kg)	Plant HQ	Invertebrate ESV (mg/kg)	Invertebrate HQ	Bird ESV (mg/kg)	Bird HQ	Mammal ESV (mg/kg)	Mammal HQ	Is Constituent a COPEC? [d] (YES, no)	Rationale
Semi Volatile Organic Compounds																			
Acenaphthene	L	83-32-9	4 - 20	20	0.31	3.3	0.011	0.48	LF-SL-2(9/27/2011)	NA	NSV	29	0.0	NA	NSV	100	0.005	no	BSV
Acenaphthylene	L	208-96-8	1 - 20	5	0.31	3.3	0.051	0.051	LF-SL-15(9/27/2011)	NA	NSV	29	0.002	NA	NSV	100	0.001	no	BSV, FOD
Acetophenone		98-86-2	1 - 20	5	0.31	3.3	0.023	0.023	LF-SL-19(9/28/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	no	FOD
Anthracene	L	120-12-7	5 - 20	25	0.31	3.3	0.017	1.2	LF-SL-2(9/27/2011)	NA	NSV	29	0.04	NA	NSV	100	0.01	no	BSV
Benzaldehyde		100-52-7	1 - 20	5	0.31	3.3	0.074	0.074	LF-SL-19(9/28/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	no	FOD
Benzo(a)anthracene	H	56-55-3	14 - 20	70	0.33	3.3	0.023	3.3	LF-SL-2(9/27/2011)	NA	NSV	18	0.2	NA	NSV	1.1	**3**	**YES**	ASV
Benzo(a)pyrene	H	50-32-8	15 - 20	75	0.33	3.3	0.020	2.8	LF-SL-2(9/27/2011)	NA	NSV	18	0.2	NA	NSV	1.1	**3**	**YES**	ASV
Benzo(b)fluoranthene	H	205-99-2	15 - 20	75	0.33	3.3	0.041	4.8	LF-SL-2(9/27/2011)	NA	NSV	18	0.3	NA	NSV	1.1	**4**	**YES**	ASV
Benzo(k)fluoranthene	H	207-08-9	15 - 20	75	0.33	3.3	0.036	4.3	LF-SL-2(9/27/2011)	NA	NSV	18	0.2	NA	NSV	1.1	**4**	**YES**	ASV
Benzo(g,h,i)perylene	H	191-24-2	14 - 20	70	0.33	3.3	0.020	2.2	LF-SL-2(9/27/2011)	NA	NSV	18	0.1	NA	NSV	1.1	**2**	**YES**	ASV
Bis(2-ethylhexyl) phthalate		117-81-7	7 - 20	35	0.11	3.3	0.046	0.094	LF-SL-14(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	**YES**	NSV
Carbazole		86-74-8	2 - 20	10	0.31	3.3	0.059	0.72	LF-SL-2(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	**YES**	NSV
Chrysene	H	218-01-9	13 - 20	65	0.33	3.3	0.029	3.3	LF-SL-2(9/27/2011)	NA	NSV	18	0.2	NA	NSV	1.1	**3**	**YES**	ASV
Dibenzofuran		132649	3 - 20	15	0.31	3.3	0.024	0.22	LF-SL-2(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	**YES**	NSV
Di-n-butylphthalate		84-74-2	1 - 20	5	0.31	3.3	0.039	0.039	LF-SL-5(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	no	NSV, FOD
Fluoranthene	H	206-44-0	15 - 20	75	0.33	3.3	0.043	5.8	LF-SL-2(9/27/2011)	NA	NSV	18	0.3	NA	NSV	1.1	**5**	**YES**	ASV
Fluorene	L	86-73-7	2 - 20	10	0.31	3.3	0.023	0.48	LF-SL-2(9/27/2011)	NA	NSV	29	0.02	NA	NSV	100	0.005	no	BSV
Indeno(1,2,3-cd)pyrene	H	193-39-5	12 - 20	60	0.33	3.3	0.023	2.3	LF-SL-2(9/27/2011)	NA	NSV	18	0.1	NA	NSV	1.1	**2**	**YES**	ASV
2-Methylnaphthalene	L	91-57-6	3 - 20	15	0.31	3.3	0.024	0.044	LF-SL-2(9/27/2011), LF-SL-12(9/28/2011)	NA	NSV	29	0.002	NA	NSV	100	0.0004	no	BSV
Naphthalene	L	91-20-3	1 - 20	5	0.31	3.3	0.066	0.066	LF-SL-2(9/27/2011)	NA	NSV	29	0.002	NA	NSV	100	0.001	no	BSV, FOD
Phenanthrene	L	85-01-8	15 - 20	75	0.31	3.3	0.022	4.3	LF-SL-2(9/27/2011)	NA	NSV	29	0.1	NA	NSV	100	0.04	no	BSV
Phenol		108-95-2	20 - 20	100	NA	NA	0.019	0.41	LF-SL-3(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	**YES**	NSV
Pyrene	H	129-00-0	19 - 20	95	0.33	0.33	0.015	6.1	LF-SL-2(9/27/2011)	NA	NSV	18	0.3	NA	NSV	1.1	**6**	**YES**	ASV
Inorganics																			
Aluminum	e	7429-90-5	20 - 20	100	NA	NA	640	7,200	LF-SL-3(9/27/2011)	pH > 5.5	NA	pH > 5.5	NA	pH > 5.5	NA	pH > 5.5	NA	no	BSV
Antimony		7440-36-0	2 - 20	10	1.3	1.5	1.1	1.3	LF-SL-2(9/27/2011)	NA	NSV	78	0.02	NA	NSV	0.27	**5**	**YES**	ASV
Arsenic		7440-38-2	20 - 20	100	NA	NA	1.6	13	LF-SL-4(9/27/2011)	18	1	NA	NSV	43	0.3	46	0.3	no	BSV
Barium		7440-39-3	20 - 20	100	NA	NA	12	340	LF-SL-3(9/27/2011)	NA	NSV	330	1	NA	NSV	2,000	0.2	no	BSV
Beryllium		7440-41-7	20 - 20	100	NA	NA	0.096	0.50	LF-SL-3(9/27/2011)	NA	NSV	40	0.01	NA	NSV	21	0.02	no	BSV
Cadmium		7440-43-9	20 - 20	100	NA	NA	0.083	1.5	LF-SL-12(9/28/2011)	32	0.05	140	0.01	0.77	**2**	0.36	**4**	**YES**	ASV
Calcium		7440-70-2	20 - 20	100	NA	NA	2,400	170,000	LF-SL-8(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	no	EN
Chromium		7440-47-3	20 - 20	100	NA	NA	5.0	280	LF-SL-2(9/27/2011)	NA	NSV	NA	NSV	26	**11**	34	**8**	**YES**	ASV
Cobalt		7440-48-4	20 - 20	100	NA	NA	1.4	5.4	LF-SL-20(9/28/2011)	13	0.4	NA	NSV	120	0.05	230	0.02	no	BSV
Copper		7440-50-8	20 - 20	100	NA	NA	4.4	79	LF-SL-7(9/27/2011)	70	1	80	1	28	**3**	49	**2**	**YES**	ASV
Iron		7439-89-6	20 - 20	100	NA	NA	5,400	29,000	LF-SL-14(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	**YES**	NSV
Lead		7439-92-1	20 - 20	100	NA	NA	5.5	1,100	LF-SL-2(9/27/2011)	120	**9**	1,700	1	11	**100**	56	**20**	**YES**	ASV

Table 3-3
Constituents of Potential Ecological Concern in Soil
John Deere Dubuque Works
Dubuque, Iowa

Constituent [a]		CASN	Frequency of Detection [b]				Detection Limits			Detected Concentrations			Location of Maximum Concentration (Sample Date)	Ecological Screening Level [c]								Is Constituent a COPEC? [d]	
														Plant		Invertebrate		Bird		Mammal			
							Min	-	Max	Min	-	Max		ESV	HQ	ESV	HQ	ESV	HQ	ESV	HQ		
			Detects / n			(%)	(mg/kg)		(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(YES, no)	Rationale
Magnesium		7439-95-4	20	-	20	100	NA	-	NA	1,900	-	85,000	LF-SL-8(9/27/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	no	EN
Manganese		7439-96-5	20	-	20	100	NA	-	NA	87	-	630	LF-SL-6(9/27/2011)	220	3	450	1	4,300	0.1	4,000	0.2	YES	ASV
Mercury		7439-97-6	17	-	20	85	0.015	-	0.017	0.005	-	0.140	LF-SL-12(9/28/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	YES	NSV
Nickel		7440-02-0	20	-	20	100	NA	-	NA	6.0	-	46	LF-SL-6(9/27/2011)	38	1	280	0.2	210	0.2	130	0.4	no	BSV
Potassium		7440-09-7	20	-	20	100	NA	-	NA	170	-	510	LF-SL-12(9/28/2011)	NA	NSV	NA	NSV	NA	NSV	NA	NSV	no	EN
Selenium		7782-49-2	2	-	20	10	1.1	-	1.3	0.79	-	1.0	LF-SL-11(9/28/2011)	0.52	2	4.1	0.2	1.2	1	0.63	2	YES	ASV
Silver		7440-22-4	3	-	20	15	0.84	-	0.97	0.15	-	0.24	LF-SL-12(9/28/2011), LF-SL-14(9/27/2011)	560	0.0004	NA	NSV	4.2	0.1	14	0.02	no	BSV
Vanadium		7440-62-2	20	-	20	100	NA	-	NA	3.8	-	15	LF-SL-13(9/27/2011), LF-SL-16(9/28/2011), LF-SL-20(9/28/2011)	NA	NSV	NA	NSV	7.8	2	280	0.05	YES	ASV
Zinc		7440-66-6	20	-	20	100	NA	-	NA	16	-	160	LF-SL-1	160	1	120	1	46	3	79	2	YES	ASV

Notes:

HQ ≥ 1

% = percent
ASV = above screening value
BSV = below screening value
CASN = Chemical abstracts registry number
COPEC = Constituent of Potential Ecological Concern
EN = essential nutrient
ESV = ecological screening value
FOD = frequency of detect
H = high molecular weight
HQ = Hazard quotient
L = Designated as low molecular weight
mg/kg = milligrams per kilogram
n = sample size
NA = No screening value available
NSV = no screening value

a. Only detected constituents are presented.
b. For duplicate samples, the maximum detected concentration or the minimum detection limit were used for statistics.
c. The USEPA (2005) ecological soil screening levels (Eco-SSLs) are the only source of ESVs for this initial screening.
d. Constituents detected with maximum concentrations above screening values (ASV) were identified as COPECs unless: (1) they are considered essential nutrients (EN) (e.g., calcium, magnesium, potassium), (2) they are considered common laboratory contaminants, or (3) they are detected in 5% or less of samples. Constituents detected with maximum concentrations below the screening values (BSV) were not considered COPECs. Constituents with no screening values (NSV) were retained as preliminary COPECs for further evaluation.
e. Aluminum is identified as a COPEC only at sites where the soil pH is less than 5.5 (USEPA 2005).

References:

United States Environmental Protection Agency (USEPA). 2005. Guidance for Developing Ecological Soil Screening Levels. November 2003, Revised February 2005.

Table 3-4
Summary of Chemical Analyses for Background Soil Samples
John Deere Dubuque Works
Dubuque, Iowa

Inorganics	Background Soil (mg/kg)					Maximum Site Concentration	COPEC after Background Screening?[a]
	BG-H-11 4/14/1988	NIPY3011 4/14/1988	BG-M-II 4/14/1988	BG-SP-11 4/14/1988	SL-BG-3 12/2/1987		
Aluminum	3590	5200	3890	2930	5160	7200	no
Antimony	ND (6)	1.0 U	ND (6)	ND (6)	50	1.3	no
Arsenic	8	10 U	2	ND (1)	ND (5)	13	no
Barium	75	95	72	29	35	340	no
Beryllium	--	--	--	--	--	--	no
Cadmium	0.5	0.23	0.7	ND (0.5)	ND (2)	1.5	Yes
Calcium	10000	12000	14600	9000	2100	170000	no
Chromium	6	9	6	11	6	280	Yes
Cobalt	ND (4)	6.5	ND (4)	4	ND (15)	5.4	no
Copper	10	12	7	5	7.5	79	Yes
Iron	9200	11000	8200	6460	10400	29000	Yes
Lead	13	14	17	18	6.7	1100	Yes
Magnesium	4800	5600	7800	5600	1650	85000	no
Manganese	558	660	526	307	360	630	no
Mercury	--	--	--	--	--	0.140	Yes
Nickel	15	17	12	11	ND (12)	46	no
Potassium	500	950	600	200	ND (700)	510	no
Selenium	--	--	--	--	--	1	Yes
Silver	--	--	--	--	--	--	no
Vanadium	11	19	7	8	12	15	no
Zinc	39	55	36	15	23	160	Yes

Notes:

"--" Not analyzed

COPEC = constituent of potential ecological concern

a. Maximum detected concentration in site soil was compared to maximum background concentration.

mg/kg = milligrams per kilogram

ND = not detected above method detection limit, indicated by "( )"

U = Not detected above quantitation limit

Source: Geraghty and Miller, Inc. (G&M). 1988. Remedial Investigation Report. Prepared for John Deere Dubuque Works, Dubuque, Iowa. August 1988

Table 5-1
Exposure Point Concentrations for Soil
John Deere Dubuque Works
Dubuque, Iowa

COPEC [a]		CASN	Maximum Detection (mg/kg)	EPC [b,c]			Mean [d]
				Selected Value (mg/kg)		UCL Basis	(mg/kg)
Semi Volatile Organic Compounds							
Benzo(a)anthracene	H	56-55-3	3.3	1.3		97.5% KM (Chebyshev) UCL	0.31
Benzo(a)pyrene	H	50-32-8	2.8	1.1		97.5% KM (Chebyshev) UCL	0.27
Benzo(b)fluoranthene	H	205-99-2	4.8	1.9		97.5% KM (Chebyshev) UCL	0.48
Benzo(k)fluoranthene	H	207-08-9	4.3	1.7		97.5% KM (Chebyshev) UCL	0.43
Benzo(g,h,i)perylene	H	191-24-2	2.2	0.90		97.5% KM (Chebyshev) UCL	0.23
Bis(2-ethylhexyl) phthalate		117-81-7	0.094	0.075		95% KM (Percentile Bootstrap) UCL	0.065
Carbazole		86-74-8	0.72	0.72	m	NA	0.39
Chrysene	H	218-01-9	3.3	1.3		97.5% KM (Chebyshev) UCL	0.35
Dibenzofuran		132649	0.22	0.22	m	NA	0.090
Fluoranthene	H	206-44-0	5.8	2.2		97.5% KM (Chebyshev) UCL	0.53
Indeno(1,2,3-cd)pyrene	H	193-39-5	2.3	0.94		97.5% KM (Chebyshev) UCL	0.26
Phenol		108-95-2	0.41	0.13		95% Chebyshev (Mean, Sd) UCL	0.051
Pyrene	H	129-00-0	6.1	2.3		97.5% KM (Chebyshev) UCL	0.44
Inorganics							
Cadmium		7440-43-9	1.5	0.61		95% Approximate Gamma UCL	0.43
Chromium		7440-47-3	280.0	117		95% Chebyshev (Mean, Sd) UCL	45
Copper		7440-50-8	79	29		95% Approximate Gamma UCL	21
Iron		7439-89-6	29,000	12,820		95% Approximate Gamma UCL	10,800
Lead		7439-92-1	1,100	436		95% Chebyshev (Mean, Sd) UCL	139
Mercury		7439-97-6	0.140	0.076		95% KM (Chebyshev) UCL	0.040
Selenium		7782-49-2	1.0	1.0	m	NA	0.90
Zinc		7440-66-6	160	87		95% Chebyshev (Mean, Sd) UCL	46

Notes:

CASN = Chemical abstracts registry number
COPEC = Constituent of Potential Ecological Concern
EPC = exposure point concentration
H = high molecular weight
m = maximum detected concentration
mg/kg = milligrams per kilogram
NA = not available
UCL = upper confidence limit

a. Only COPECs identified in Table 3-3 are presented.
b. For duplicate samples, the maximum detected concentration or the minimum detection limit were used for statistics.
c. The upper confidence levels on the mean (UCLs) were calculated using ProUCL 4.1.00 and were used for the reasonable maximum exposure (RME). The UCLs presented as the EPCs are the values recommended by the ProUCL software. EPCs marked with "m" are based on the maximum detected concentration because a UCL could not be calculated due to insufficient detections (i.e. detects < 5).
d. The arithmetic mean of detected concentrations was used in the most likely exposure scenario (MLE).

References:

United States Environmental Protection Agency (USEPA). 2005. Guidance for Developing Ecological Soil Screening Levels. November 2003, Revised February 2005.

USEPA. 2010. ProUCL Version 4.1. Technical Guide (Draft) May. EPA/600/R-07/041.

Table 5-2
Bioaccumulation Factors and Tissue Concentrations
John Deere Dubuque Works
Dubuque, Iowa

COPEC [a]		Soil EPC Max (mg/kg)	Soil EPC UCL (mg/kg)	Soil EPC Mean (mg/kg)	Plants BAF_{plant} (unitless)		Max Plant Conc. (mg/kg)	UCL Plant Conc. (mg/kg)	Mean Plant Conc. (mg/kg)	Invertebrates BAF_{invert} (unitless)		Max Invert Conc. (mg/kg)	UCL Invert Conc. (mg/kg)	Mean Invert Conc. (mg/kg)	Mammals/Birds BAF_{mammal} (unitless)		Max Mammal Conc. (mg/kg)	UCL Mammal Conc. (mg/kg)	Mean Mammal Conc. (mg/kg)
Semi Volatile Organic Compounds																			
Benzo(a)anthracene	H	3.3	1.3	0.31	$\ln(C_p) = 0.5944 * \ln(C_s) - 2.7078$	b	0.14	0.077	0.033	1.59	b	5.2	2.0	0.50	0	b	0	0	0
Benzo(a)pyrene	H	2.8	1.1	0.27	$\ln(C_p) = 0.9750 * \ln(C_s) - 2.0615$	b	0.35	0.14	0.035	1.33	b	3.7	1.5	0.35	0	b	0	0	0
Benzo(b)fluoranthene	H	4.8	1.9	0.48	0.31	b	1.5	0.58	0.15	2.60	b	12	4.8	1.2	0	b	0	0	0
Benzo(k)fluoranthene	H	4.3	1.7	0.43	$\ln(C_p) = 0.8595 * \ln(C_s) - 2.1579$	b	0.40	0.18	0.055	2.60	b	11	4.3	1.1	0	b	0	0	0
Benzo(g,h,i)perylene	H	2.2	0.90	0.23	$\ln(C_p) = 1.1829 * \ln(C_s) - 0.9313$	b	1.0	0.35	0.068	2.94	b	6.5	2.6	0.66	0	b	0	0	0
Bis(2-ethylhexyl) phthalate		0.094	0.075	0.065	0	i	0	0	0	0.090	j	0.0085	0.0067	0.0058	0	i	0	0	0
Carbazole		0.72	0.72	0.39	--		--	--	--	--		--	--	--	--		--	--	--
Chrysene	H	3.3	1.3	0.35	$\ln(C_p) = 0.5944 * \ln(C_s) - 2.7078$	b	0.14	0.078	0.036	2.29	b	7.6	2.9	0.80	0	b	0	0	0
Dibenzofuran		0.22	0.22	0.090	--		--	--	--	--		--	--	--	--		--	--	--
Fluoranthene	H	5.8	2.2	0.53	0.50	b	2.9	1.1	0.27	3.04	b	18	6.7	1.6	0	b	0	0	0
Indeno(1,2,3-cd)pyrene	H	2.3	0.94	0.26	0.11	b	0.25	0.10	0.029	2.86	b	6.6	2.7	0.74	0	b	0	0	0
Phenol		0.41	0.13	0.051	0	c	0	0	0	--	c	--	--	--	0		0	0	0
Pyrene	H	6.1	2.3	0.44	0.72	b	4.4	1.7	0.32	1.75	b	11	4.0	0.77	0	b	0	0	0
Inorganics																			
Cadmium		1.5	0.61	0.43	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	b	0.78	0.47	0.39	$\ln(C_e) = 0.795 * \ln(C_s) + 2.114$	b	11	5.6	4.2	$\ln(C_m) = 0.4723 * \ln(C_s) - 1.2571$	b	0.34	0.22	0.19
Chromium		280	117	45	0.041	b	11	4.8	1.8	0.306	b	86	36	14	$\ln(C_m) = 0.7338 * \ln(C_s) - 1.4599$	b	15	7.7	3.8
Copper		79	29	21	$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	b	11	7.3	6.4	0.515	b	41	15	11	$\ln(C_m) = 0.1444 * \ln(C_s) + 2.042$	b	14	13	12
Iron		29,000	12,820	10,800	0.004	d	116	51	43	0.391	f	11,339	5,013	4,223	$\ln(C_m) = 0.5969 * \ln(C_s) - 0.2879$	h	346	212	192
Lead		1,100	436	139	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	b	13	8.0	4.2	$\ln(C_e) = 0.807 * \ln(C_s) - 0.218$	b	229	108	43	$\ln(C_m) = 0.4422 * \ln(C_s) + 0.0761$	b	24	16	9.6
Mercury		0.140	0.076	0.040	$\ln(C_p) = 0.544 * \ln(C_s) - 0.996$	e	0.1	0.1	0.1	$\ln(C_e) = 0.3369 * \ln(C_s) - 0.0781$	g	0.5	0.4	0.3	0.054	h	0.008	0.004	0.002
Selenium		1.0	1.0	0.90	$\ln(C_p) = 1.104 * \ln(C_s) - 0.677$	b	0.51	0.51	0.45	$\ln(C_e) = 0.733 * \ln(C_s) - 0.075$	b	0.93	0.93	0.86	$\ln(C_m) = 0.3764 * \ln(C_s) - 0.4158$	b	0.66	0.66	0.63
Zinc		160	87	46	$\ln(C_p) = 0.554 * \ln(C_s) + 1.575$	b	80	57	40	$\ln(C_e) = 0.328 * \ln(C_s) + 4.449$	b	452	370	301	$\ln(C_m) = 0.0706 * \ln(C_s) + 4.3632$	b	112	108	103

Notes:

BAF = Bioaccumulation Factor
COPEC = Constituent of Potential Ecological Concern
Conc. = concentration
EPC = Exposure Point Concentration
ln = natural log
H = high molecular weight
Max = Maximum detected concentration
mg/kg = milligrams per kilogram
Mean = Mean of detected concentrations

UCL = Upper confidence limit
USEPA = United States Environmental Protection Agency
C_e = COPEC concentration in earthworm (mg/kg dry weight)
C_m = COPEC concentration in small mammal tissue (mg/kg dry weight)
C_p = COPEC concentration in plant tissue (mg/kg dry weight)
C_s = COPEC concentration in soil (mg/kg)

a. Only COPECs identified in Table 3-3 are presented.
b. BAFs selected from EcoSSL (USEPA 2007) unless otherwise noted.
c. These chemicals do not bioaccumulate in biota in accordance with USEPA (2007); VOCs and other chemicals with low log Kow (<3.5) do not bioaccumulate (USEPA 2000); therefore, BAFs for these chemicals = 0. Phenol log Kow = 1.46 (USNLM 2014).
d. Figure 2-1 from Baes et al. (1984).
e. Table 7 from Bechtel-Jacobs (1998).
f. A bioaccumulation factor was not available from the literature. The mean of inorganic empirical data of the metal COPECs identified soil at the Site (i.e., chromium and copper) is used as a surrogate value.
g. Table 4 from Sample et al. (1998a).
h. Table 7 (mercury- median) and Table 8 (iron- regression) from Sample et al. (1998b).
i. Staples et al. (1997)
j. Estimated using Jager (1998) methods, recommended in USEPA (2007). Bis(2-ethylhexyl) phthalate Octanol/Water Partition Coefficient (Log Kow) = 7.60. Di-n-butylphthalate Log Kow = 4.9. Selected from TOXNET (USNLM 2014).
k. Assumed 100% earthworm diet.

References:

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Table 5-3
Wildlife Exposure Parameters
John Deere Dubuque Works
Dubuque, Iowa

Receptor	Body Weight[a] (g)	Food Ingestion Rate[b]		Fraction of Diet Composed by Food Type (unitless)				Fraction of Soil in Diet[c]		Home Range		Site Use Factor (unitless)[e]	
		(g/day, dw)	Basis	Vegetation	Invertebrates/ Earthworms	Mammals/Birds	Source[d]	(unitless)	Basis	(acres)	Source[d]	Maximum	UCL and Mean
American robin (*Turdus migratorius*)	81	12.7	Passerines	0.505	0.495	0	Average of four seasons for central US (Wheelwright 1986)	0.104	American woodcock	0.297	0.12 hectare. Breeding season territory from Young (1951)	1	1
Short-tailed shrew (*Blarina brevicauda*)	17	2.9	Rodentia	0.13	0.79	0.081	Whitaker & Ferraro (1963)	0.104	American woodcock	0.259	0.105 hectare. Average of min/max home ranges for low and high prey density from Platt (1976)	1	1
Red-tailed hawk (*Buteo jamaicensis*)	1,134	90.0	Carnivores	0	0	1	Bohm (1978)	0	Assumed negligible	1,722	697 hectares. Mean adult breeding home range from Craighead and Craighead (1956).	1	0.012
Red fox (*Vulpes vulpes*)	4,535	169.7	All Mammals	0.046	0.020	0.93	Farm/woods, Illinois. Knable (1974)	0.028	Red fox	1,004	Average of 717 hectare (adult male) and 96 hectare (adult female) from Ables (1969).	1	0.020

Notes:
DMI = dry matter intake
dw = dry weight
g = grams
UCL = 95% upper confidence limit
Mean = mean concentration of detected results

a. Body weight is the average of all available male/female adults in USEPA (1993).
b. Food ingestion rates presented in Nagy (2001).
Passerines: DMI grams/day = 0.630*(body weight (g))$^{0.683}$
Carnivorous birds: DMI grams/day = 0.849*(body weight (g))$^{0.663}$
Rodentia: DMI grams/day = 0.332*(body weight (g))$^{0.774}$
All Mammals: DMI grams/day = 0.323*(body weight (g))$^{0.744}$
c. Fraction of soil in diet selected from Beyer et al (1994). Surrogates used as noted in table.
d. Dietary composition and home ranges selected from sources presented in USEPA Wildlife Exposure Factor Handbook (1993).
e. Conservatively assumed equal to one for the Maximum scenario. Area use factors were refined based on ecological receptor home range for the refined UCL and Mean scenarios. The former landfill is approximately 20 acres.

References:

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Table 5-4a
Average Daily Dose Intakes for Wildlife Receptors - Maximum Concentration Exposure*
John Deere Dubuque Works
Dubuque, Iowa

COPEC		Avian Omnivores			Mammalian Omnivores			Avian Carnivores			Mammalian Carnivores		
		American Robin			Short-tailed Shrew			Red-tailed Hawk			Fox		
		ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal
Semi Volatile Organic Compounds													
Benzo(a)anthracene	H	5.4E-02	4.2E-01	4.7E-01	6.0E-02	7.3E-01	7.9E-01	0.0E+00	0.0E+00	0.0E+00	3.5E-03	4.2E-03	7.6E-03
Benzo(a)pyrene	H	4.6E-02	3.2E-01	3.6E-01	5.1E-02	5.2E-01	5.8E-01	0.0E+00	0.0E+00	0.0E+00	2.9E-03	3.4E-03	6.3E-03
Benzo(b)fluoranthene	H	7.8E-02	1.1E+00	1.2E+00	8.8E-02	1.8E+00	1.9E+00	0.0E+00	0.0E+00	0.0E+00	5.0E-03	1.2E-02	1.7E-02
Benzo(k)fluoranthene	H	6.9E-02	8.9E-01	9.6E-01	7.8E-02	1.5E+00	1.6E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-03	9.0E-03	1.3E-02
Benzo(g,h,i)perylene	H	3.6E-02	5.8E-01	6.2E-01	4.0E-02	9.2E-01	9.6E-01	0.0E+00	0.0E+00	0.0E+00	2.3E-03	6.6E-03	8.9E-03
Bis(2-ethylhexyl) phthalate		1.5E-03	6.6E-04	2.2E-03	1.7E-03	1.2E-03	2.9E-03	0.0E+00	0.0E+00	0.0E+00	9.8E-05	6.3E-06	1.0E-04
Carbazole		1.2E-02	--	1.2E-02	1.3E-02	--	1.3E-02	0.0E+00	--	0.0E+00	7.5E-04	--	7.5E-04
Chrysene	H	5.4E-02	6.0E-01	6.5E-01	6.0E-02	1.1E+00	1.1E+00	0.0E+00	0.0E+00	0.0E+00	3.5E-03	5.9E-03	9.3E-03
Dibenzofuran		3.6E-03	--	3.6E-03	4.0E-03	--	4.0E-03	0.0E+00	--	0.0E+00	2.3E-04	--	2.3E-04
Fluoranthene	H	9.4E-02	1.6E+00	1.7E+00	1.1E-01	2.5E+00	2.6E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-03	1.8E-02	2.4E-02
Indeno(1,2,3-cd)pyrene	H	3.7E-02	5.3E-01	5.7E-01	4.2E-02	9.2E-01	9.6E-01	0.0E+00	0.0E+00	0.0E+00	2.4E-03	5.4E-03	7.8E-03
Phenol		6.7E-03	--	6.7E-03	7.5E-03	--	7.5E-03	0.0E+00	--	0.0E+00	4.3E-04	--	4.3E-04
Pyrene	H	9.9E-02	1.2E+00	1.3E+00	1.1E-01	1.6E+00	1.7E+00	0.0E+00	0.0E+00	0.0E+00	6.4E-03	1.6E-02	2.2E-02
Inorganics													
Barium		5.5E+00	6.6E+00	1.2E+01	6.2E+00	5.5E+00	1.2E+01	0.0E+00	1.8E-02	1.8E-02	3.6E-01	1.2E-01	4.8E-01
Cadmium		2.4E-02	9.5E-01	9.7E-01	2.7E-02	1.6E+00	1.6E+00	0.0E+00	2.7E-02	2.7E-02	1.6E-03	2.2E-02	2.4E-02
Chromium		4.6E+00	7.5E+00	1.2E+01	5.1E+00	1.2E+01	1.7E+01	0.0E+00	1.2E+00	1.2E+00	2.9E-01	5.9E-01	8.8E-01
Copper		1.3E+00	4.0E+00	5.3E+00	1.4E+00	6.1E+00	7.5E+00	0.0E+00	1.1E+00	1.1E+00	8.3E-02	5.6E-01	6.4E-01
Iron		4.7E+02	8.9E+02	1.4E+03	5.3E+02	1.6E+03	2.1E+03	0.0E+00	2.7E+01	2.7E+01	3.0E+01	2.1E+01	5.1E+01
Lead		1.8E+01	1.9E+01	3.7E+01	2.0E+01	3.2E+01	5.2E+01	0.0E+00	1.9E+00	1.9E+00	1.2E+00	1.0E+00	2.2E+00
Mercury		2.3E-03	4.7E-02	4.9E-02	2.6E-03	6.9E-02	7.2E-02	0.0E+00	6.0E-04	6.0E-04	1.5E-04	8.4E-04	9.9E-04
Nickel		7.5E-01	1.5E+00	2.3E+00	8.4E-01	2.6E+00	3.4E+00	0.0E+00	3.7E-01	3.7E-01	4.8E-02	1.8E-01	2.3E-01
Selenium		1.6E-02	1.1E-01	1.3E-01	1.8E-02	1.5E-01	1.7E-01	0.0E+00	5.2E-02	5.2E-02	1.0E-03	2.5E-02	2.6E-02
Zinc		2.6E+00	4.1E+01	4.4E+01	2.9E+00	6.6E+01	6.9E+01	0.0E+00	8.9E+00	8.9E+00	1.7E-01	4.4E+00	4.6E+00

Notes:

*The soil exposure point concentration used in this scenario is represented by the maximum detection, and the site use factor is equal to 1.

$$ADD = \frac{\{[(IR_f \times C_f) + (IR_s \times C_s)] \times SUF\}}{BW}$$

Where:

ADD	=	Average daily dose of COPEC (mg/kg-day)
C_f	=	Concentration of a COPEC in food (mg/kg)
IR_f	=	Daily ingestion of food (kg/day)
C_s	=	Concentration of a COPEC in soil (mg/kg)
IR_s	=	Daily incidental ingestion rate of soil/sediment (kg/day)
SUF	=	Site use factor (unitless)
BW	=	Body weight (kg)

ADDf = average daily dose from bioaccumulation of COPEC through food intake
ADDs = average daily dose from incidental soil ingestion
COPEC = constituent of potential ecological concern
H = high molecular weight
kg = kilogram
mg/kg = milligrams per kilogram

Table 5-4b
Average Daily Dose Intakes for Wildlife Receptors - Upper Confidence Limit Exposure*
John Deere Dubuque Works
Dubuque, Iowa

COPEC		Avian Omnivores			Mammalian Omnivores			Avian Carnivores			Mammalian Carnivores		
		American Robin			Short-tailed Shrew			Red-tailed Hawk			Fox		
		ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal
Semi Volatile Organic Compounds													
Benzo(a)anthracene	H	2.1E-02	1.6E-01	1.8E-01	2.3E-02	2.8E-01	3.0E-01	0.0E+00	0.0E+00	0.0E+00	2.6E-05	3.3E-05	5.9E-05
Benzo(a)pyrene	H	1.8E-02	1.3E-01	1.5E-01	2.1E-02	2.1E-01	2.3E-01	0.0E+00	0.0E+00	0.0E+00	2.4E-05	2.7E-05	5.1E-05
Benzo(b)fluoranthene	H	3.0E-02	4.2E-01	4.5E-01	3.4E-02	6.9E-01	7.2E-01	0.0E+00	0.0E+00	0.0E+00	3.9E-05	9.2E-05	1.3E-04
Benzo(k)fluoranthene	H	2.7E-02	3.5E-01	3.8E-01	3.0E-02	6.0E-01	6.3E-01	0.0E+00	0.0E+00	0.0E+00	3.5E-05	7.0E-05	1.1E-04
Benzo(g,h,i)perylene	H	1.5E-02	2.3E-01	2.5E-01	1.6E-02	3.7E-01	3.9E-01	0.0E+00	0.0E+00	0.0E+00	1.9E-05	5.1E-05	7.0E-05
Bis(2-ethylhexyl) phthalate		1.2E-03	5.2E-04	1.7E-03	1.4E-03	9.3E-04	2.3E-03	0.0E+00	0.0E+00	0.0E+00	1.6E-06	1.0E-07	1.7E-06
Carbazole		1.2E-02	--	1.2E-02	1.3E-02	--	1.3E-02	0.0E+00	--	0.0E+00	1.5E-05	--	1.5E-05
Chrysene	H	2.1E-02	2.3E-01	2.6E-01	2.4E-02	4.1E-01	4.3E-01	0.0E+00	0.0E+00	0.0E+00	2.7E-05	4.7E-05	7.3E-05
Dibenzofuran		3.6E-03	--	3.6E-03	4.0E-03	--	4.0E-03	0.0E+00	--	0.0E+00	4.6E-06	--	4.6E-06
Fluoranthene	H	3.6E-02	6.1E-01	6.5E-01	4.0E-02	9.6E-01	1.0E+00	0.0E+00	0.0E+00	0.0E+00	4.6E-05	1.4E-04	1.8E-04
Indeno(1,2,3-cd)pyrene	H	1.5E-02	2.2E-01	2.3E-01	1.7E-02	3.8E-01	3.9E-01	0.0E+00	0.0E+00	0.0E+00	2.0E-05	4.4E-05	6.3E-05
Phenol		2.2E-03	--	2.2E-03	2.4E-03	--	2.4E-03	0.0E+00	--	0.0E+00	2.8E-06	--	2.8E-06
Pyrene	H	3.7E-02	4.4E-01	4.8E-01	4.2E-02	6.0E-01	6.4E-01	0.0E+00	0.0E+00	0.0E+00	4.8E-05	1.2E-04	1.6E-04
Inorganics													
Barium		2.3E+00	2.8E+00	5.1E+00	2.6E+00	2.3E+00	4.9E+00	0.0E+00	9.0E-05	9.0E-05	3.0E-03	1.0E-03	4.0E-03
Cadmium		9.9E-03	4.7E-01	4.8E-01	1.1E-02	7.9E-01	8.0E-01	0.0E+00	2.1E-04	2.1E-04	1.3E-05	2.6E-04	2.7E-04
Chromium		1.9E+00	3.2E+00	5.1E+00	2.1E+00	5.2E+00	7.3E+00	0.0E+00	7.1E-03	7.1E-03	2.4E-03	6.0E-03	8.5E-03
Copper		4.7E-01	1.7E+00	2.2E+00	5.2E-01	2.4E+00	2.9E+00	0.0E+00	1.2E-02	1.2E-02	6.0E-04	9.2E-03	9.8E-03
Iron		2.1E+02	3.9E+02	6.0E+02	2.3E+02	7.0E+02	9.3E+02	0.0E+00	2.0E-01	2.0E-01	2.7E-01	2.2E-01	4.9E-01
Lead		7.1E+00	9.0E+00	1.6E+01	8.0E+00	1.5E+01	2.3E+01	0.0E+00	1.5E-02	1.5E-02	9.1E-03	1.3E-02	2.2E-02
Mercury		1.2E-03	3.7E-02	3.9E-02	1.4E-03	5.6E-02	5.8E-02	0.0E+00	3.8E-06	3.8E-06	1.6E-06	1.2E-05	1.3E-05
Nickel		2.6E-01	5.6E-01	8.2E-01	2.9E-01	9.3E-01	1.2E+00	0.0E+00	2.6E-03	2.6E-03	3.4E-04	2.1E-03	2.4E-03
Selenium		1.6E-02	1.1E-01	1.3E-01	1.8E-02	1.5E-01	1.7E-01	0.0E+00	6.1E-04	6.1E-04	2.1E-05	4.9E-04	5.1E-04
Zinc		1.4E+00	3.3E+01	3.5E+01	1.6E+00	5.4E+01	5.6E+01	0.0E+00	9.9E-02	9.9E-02	1.8E-03	8.2E-02	8.4E-02

Notes:

*The soil exposure point concentration for this scenario is represented by the upper confidence limit, and the site use factor is estimated using the receptor-specific home range (Table 5-3).

$$ADD = \frac{\{[(IR_f \times C_f) + (IR_s \times C_s)] \times SUF\}}{BW}$$

Where:

ADD = Average daily dose of COPEC (mg/kg-day)
C_f = Concentration of a COPEC in food (mg/kg)
IR_f = Daily ingestion of food (kg/day)
C_s = Concentration of a COPEC in soil (mg/kg)
IR_s = Daily incidental ingestion rate of soil/sediment (kg/day)
SUF = Site use factor (unitless)
BW = Body weight (kg)

ADDf = average daily dose from bioaccumulation of COPEC through food intake
ADDs = average daily dose from incidental soil ingestion
COPEC = constituent of potential ecological concern
H = high molecular weight
kg = kilogram
mg/kg = milligrams per kilogram

Table 5-4c
Average Daily Dose Intakes for Wildlife Receptors - Mean Concentration Exposure*
John Deere Dubuque Works
Dubuque, Iowa

COPEC		Avian Omnivores			Mammalian Omnivores			Avian Carnivores			Mammalian Carnivores		
		American Robin			Short-tailed Shrew			Red-tailed Hawk			Fox		
		ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal	ADDs	ADDf	ADDtotal
Semi Volatile Organic Compounds													
Benzo(a)anthracene	H	5.1E-03	4.1E-02	4.6E-02	5.7E-03	7.0E-02	7.5E-02	0.0E+00	0.0E+00	0.0E+00	6.5E-06	8.5E-06	1.5E-05
Benzo(a)pyrene	H	4.3E-03	3.0E-02	3.4E-02	4.9E-03	5.0E-02	5.5E-02	0.0E+00	0.0E+00	0.0E+00	5.5E-06	6.5E-06	1.2E-05
Benzo(b)fluoranthene	H	7.8E-03	1.1E-01	1.2E-01	8.7E-03	1.8E-01	1.8E-01	0.0E+00	0.0E+00	0.0E+00	1.0E-05	2.4E-05	3.4E-05
Benzo(k)fluoranthene	H	6.9E-03	9.0E-02	9.7E-02	7.8E-03	1.5E-01	1.6E-01	0.0E+00	0.0E+00	0.0E+00	8.9E-06	1.8E-05	2.7E-05
Benzo(g,h,i)perylene	H	3.7E-03	5.7E-02	6.0E-02	4.1E-03	9.4E-02	9.8E-02	0.0E+00	0.0E+00	0.0E+00	4.7E-06	1.2E-05	1.7E-05
Bis(2-ethylhexyl) phthalate		1.1E-03	4.5E-04	1.5E-03	1.2E-03	8.1E-04	2.0E-03	0.0E+00	0.0E+00	0.0E+00	1.3E-06	8.7E-08	1.4E-06
Carbazole		6.3E-03	--	6.3E-03	7.1E-03	--	7.1E-03	0.0E+00	--	0.0E+00	8.1E-06	--	8.1E-06
Chrysene	H	5.7E-03	6.5E-02	7.1E-02	6.4E-03	1.1E-01	1.2E-01	0.0E+00	0.0E+00	0.0E+00	7.3E-06	1.3E-05	2.1E-05
Dibenzofuran		1.5E-03	--	1.5E-03	1.6E-03	--	1.6E-03	0.0E+00	--	0.0E+00	1.9E-06	--	1.9E-06
Fluoranthene	H	8.6E-03	1.5E-01	1.5E-01	9.7E-03	2.3E-01	2.4E-01	0.0E+00	0.0E+00	0.0E+00	1.1E-05	3.3E-05	4.4E-05
Indeno(1,2,3-cd)pyrene	H	4.2E-03	6.0E-02	6.4E-02	4.7E-03	1.0E-01	1.1E-01	0.0E+00	0.0E+00	0.0E+00	5.4E-06	1.2E-05	1.7E-05
Phenol		8.2E-04	--	8.2E-04	9.3E-04	--	9.3E-04	0.0E+00	--	0.0E+00	1.1E-06	--	1.1E-06
Pyrene	H	7.2E-03	8.5E-02	9.2E-02	8.0E-03	1.1E-01	1.2E-01	0.0E+00	0.0E+00	0.0E+00	9.2E-06	2.2E-05	3.2E-05
Inorganics													
Barium		1.1E+00	1.3E+00	2.3E+00	1.2E+00	1.1E+00	2.3E+00	0.0E+00	4.1E-05	4.1E-05	1.4E-03	4.7E-04	1.8E-03
Cadmium		7.0E-03	3.6E-01	3.7E-01	7.9E-03	6.0E-01	6.1E-01	0.0E+00	1.8E-04	1.8E-04	9.0E-06	2.1E-04	2.2E-04
Chromium		7.3E-01	1.2E+00	1.9E+00	8.2E-01	2.0E+00	2.8E+00	0.0E+00	3.5E-03	3.5E-03	9.4E-04	2.9E-03	3.9E-03
Copper		3.3E-01	1.3E+00	1.7E+00	3.7E-01	1.8E+00	2.2E+00	0.0E+00	1.1E-02	1.1E-02	4.3E-04	8.7E-03	9.1E-03
Iron		1.8E+02	3.3E+02	5.1E+02	2.0E+02	5.9E+02	7.9E+02	0.0E+00	1.8E-01	1.8E-01	2.3E-01	2.0E-01	4.2E-01
Lead		2.3E+00	3.7E+00	5.9E+00	2.5E+00	6.2E+00	8.8E+00	0.0E+00	8.8E-03	8.8E-03	2.9E-03	7.4E-03	1.0E-02
Mercury		6.5E-04	2.9E-02	3.0E-02	7.3E-04	4.5E-02	4.6E-02	0.0E+00	2.0E-06	2.0E-06	8.3E-07	8.4E-06	9.2E-06
Nickel		2.1E-01	4.6E-01	6.7E-01	2.4E-01	7.7E-01	1.0E+00	0.0E+00	2.4E-03	2.4E-03	2.8E-04	1.9E-03	2.2E-03
Selenium		1.5E-02	1.0E-01	1.2E-01	1.6E-02	1.4E-01	1.5E-01	0.0E+00	5.8E-04	5.8E-04	1.9E-05	4.7E-04	4.9E-04
Zinc		7.5E-01	2.6E+01	2.7E+01	8.4E-01	4.4E+01	4.5E+01	0.0E+00	9.5E-02	9.5E-02	9.6E-04	7.7E-02	7.8E-02

Notes:

*The soil exposure point concentration for this scenario is represented by the mean of detected results, and the site use factor is estimated using the receptor-specific home range (Table 5-3).

$$ADD = \frac{\{[(IR_f \times C_f) + (IR_s \times C_s)] \times SUF\}}{BW}$$

Where:

ADD	=	Average daily dose of COPEC (mg/kg-day)
C_f	=	Concentration of a COPEC in food (mg/kg)
IR_f	=	Daily ingestion of food (kg/day)
C_s	=	Concentration of a COPEC in soil (mg/kg)
IR_s	=	Daily incidental ingestion rate of soil/sediment (kg/day)
SUF	=	Site use factor (unitless)
BW	=	Body weight (kg)

ADDf = average daily dose from bioaccumulation of COPEC through food intake
ADDs = average daily dose from incidental soil ingestion
COPEC = constituent of potential ecological concern
H = high molecular weight
kg = kilogram
mg/kg = milligrams per kilogram

Table 6-1
Ecological Communities Screening
John Deere Dubuque Works
Dubuque, Iowa

COPEC [a]		CASN	Exposure Scenario Max (mg/kg)	Exposure Scenario UCL [b] (mg/kg)	Exposure Scenario Mean (mg/kg)	Plants [c] ESV (mg/kg)		Plants [c] Max HQ	Plants [c] UCL HQ	Plants [c] Mean HQ	Invertebrate [c] ESV (mg/kg)		Invertebrate [c] Max HQ	Invertebrate [c] UCL HQ	Invertebrate [c] Mean HQ
Semi Volatile Organic Compounds															
Benzo(a)anthracene	H,d	56-55-3	3.3	1.3	0.31	1.2	(4)	3E+00	1E+00	3E-01	18		2E-01	7E-02	2E-02
Benzo(a)pyrene	H	50-32-8	2.8	1.1	0.27	1.2	(4)	2E+00	9E-01	2E-01	18		2E-01	6E-02	1E-02
Benzo(b)fluoranthene	H,d	205-99-2	4.8	1.9	0.48	1.2	(4)	4E+00	2E+00	4E-01	18		3E-01	1E-01	3E-02
Benzo(k)fluoranthene	H,d	207-08-9	4.3	1.7	0.43	1.2	(4)	4E+00	1E+00	4E-01	18		2E-01	9E-02	2E-02
Benzo(g,h,i)perylene	H,d	191-24-2	2.2	0.90	0.23	1.2	(4)	2E+00	7E-01	2E-01	18		1E-01	5E-02	1E-02
Bis(2-ethylhexyl) phthalate		117-81-7	0.094	0.075	0.065	100	(3)	9E-04	7E-04	6E-04	200	(3)	5E-04	4E-04	3E-04
Carbazole		86-74-8	0.72	0.72 m	0.39	NA		NSV	NSV	NSV	NA		NSV	NSV	NSV
Chrysene	H,d	218-01-9	3.3	1.3	0.35	1.2	(4)	3E+00	1E+00	3E-01	18		2E-01	7E-02	2E-02
Dibenzofuran		132649	0.22	0.22 m	0.090	NA		NSV	NSV	NSV	NA		NSV	NSV	NSV
Fluoranthene	H,d	206-44-0	5.8	2.2	0.53	1.2	(4)	5E+00	2E+00	4E-01	18		3E-01	1E-01	3E-02
Indeno(1,2,3-cd)pyrene	H,d	193-39-5	2.3	0.94	0.26	1.2	(4)	2E+00	8E-01	2E-01	18		1E-01	5E-02	1E-02
Phenol		108-95-2	0.41	0.13	0.051	70	(3)	6E-03	2E-03	7E-04	100	(3)	4E-03	1E-03	5E-04
Pyrene	H,d	129-00-0	6.1	2.3	0.44	1.2	(4)	5E+00	2E+00	4E-01	18		3E-01	1E-01	2E-02
Inorganics															
Cadmium		7440-43-9	1.5	0.61	0.43	32		5E-02	2E-02	1E-02	140		1E-02	4E-03	3E-03
Chromium		7440-47-3	280	117	45	1.0	(3)	3E+02	1E+02	5E+01	0.4	(2)	7E+02	3E+02	1E+02
Copper		7440-50-8	79	29	21	70		1E+00	4E-01	3E-01	80		1E+00	4E-01	3E-01
Iron		7439-89-6	29,000	12,820	10,800	NA		NSV	NSV	NSV	NA		NSV	NSV	NSV
Lead		7439-92-1	1,100	436	139	120		9E+00	4E+00	1E+00	1700		6E-01	3E-01	8E-02
Mercury		7439-97-6	0.140	0.076	0.040	0.30	(3)	5E-01	3E-01	1E-01	0.1	(2)	1E+00	8E-01	4E-01
Selenium		7782-49-2	1.0	1.0 m	0.90	0.52		2E+00	2E+00	2E+00	4.1		2E-01	2E-01	2E-01
Zinc		7440-66-6	160	87	46	160		1E+00	5E-01	3E-01	120		1E+00	7E-01	4E-01

Notes:
HQ > 1
CASN = Chemical abstracts registry number
COPEC = Constituent of Potential Ecological Concern
EPC = exposure point concentration
ESV = ecological screening value
H = High molecular weight
HQ = Hazard quotient
mg/kg = milligrams per kilograms
NA = No screening value available
NSV = no screening value
Max = Maximum detected concentration
UCL = Upper confidence limit
Mean = Mean of detected concentrations

a. Only COPECs identified in Table 3-3 are presented.
b. The upper confidence levels on the mean (UCLs) were calculated using ProUCL 4.1.00. The UCLs presented are the values recommended by the ProUCL software. EPCs marked with "m" are based on the maximum detected concentratior
c. The ecological screening values were selected from the following sources:
(1) USEPA 2005
(2) USEPA 2003
(3) Efroymson 1997a,b
(4) USEPA 1999
d. Benzo(a)pyrene used as a surrogate for high molecular weight PAHs.

References:
Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Prepared for the Oak Ridge Laboratory. November.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997b. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Prepared for the Oak Ridge Laboratory. November.

USEPA. 1999. Screening Level Ecological Risk Assessment Protocol, Appendix E: Toxicity Reference Values. August.

USEPA. 2003. Ecological Screening Levels. Region 5, Resource Conservation and Recovery Act.

USEPA. 2005. Guidance for Developing Ecological Soil Screening Levels. November 2003, Revised February 2005.

USEPA. 2010. ProUCL Version 4.1. Technical Guide (Draft) May. EPA/600/R-07/041.

Table 6-2
Toxicity Reference Values for Wildlife Receptors
John Deere Dubuque Works
Dubuque, Iowa

COPEC [a]		Toxicity Reference Values (mg/kg-day)					
		Birds			Mammals		
		NOAEL	LOAEL[c]	Source	NOAEL	LOAEL[c]	Source
Semi Volatile Organic Compounds							
Benzo(a)anthracene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Benzo(a)pyrene	H	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Benzo(b)fluoranthene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Benzo(k)fluoranthene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Benzo(g,h,i)perylene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Bis(2-ethylhexyl) phthalate		1.1	11.1	Sample et al (1996)[b]	18.3	183	Sample et al (1996)
Carbazole		--	--	--	--	--	--
Chrysene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Dibenzofuran		--	--	--	--	--	--
Fluoranthene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Indeno(1,2,3-cd)pyrene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Phenol		--	--	--	--	--	--
Pyrene	H,d	10	100	Trust et al. (1994)	0.615	3.07	USEPA 2005
Inorganics							
Barium		20.8	41.7	Sample et al. (1996)	51.8	121	USEPA 2005
Cadmium		1.47	5.88	USEPA 2005	0.77	7.7	USEPA 2005
Chromium		2.66	2.78	USEPA 2005	2.4	9.62	USEPA 2005
Copper		4.05	12.1	USEPA 2005	5.6	9.34	USEPA 2005
Iron		--	--	--	--	--	--
Lead		1.63	3.3	USEPA 2005	4.7	8.90	USEPA 2005
Mercury		0.032	0.16	Sample et al. (1996)[e]	0.45	0.9	Sample et al. (1996)[f]
Nickel		6.71	21.0	USEPA 2005	1.7	3.4	USEPA 2005
Selenium		0.29	0.579	USEPA 2005	0.143	0.215	USEPA 2005
Zinc		66.1	87.1	USEPA 2005	75.4	87.1	USEPA 2005

Notes:
COPEC = Constituent of potential ecological concern
LOAEL = Lowest observed adverse effect level
mg/kg-day = Milligrams per kilogram per day
NOAEL = No-observed adverse effect level
TRV = toxicity reference value

a. Only COPECs identified in Table 3-3 are presented.
b. Uncertainty factor of 10 was applied to estimate a LOAEL TRV from the NOAEL TRV.
c. LOAEL TRVs from USEPA (2005) were selected as follows:
- If the recommended NOAEL-based TRV was bounded, the LOAEL from the same study and endpoint was selected;
- If the recommended NOAEL-based TRV was unbounded, the lowest reproduction, growth, and survival LOAEL greater than the NOAEL-based TRV was selected;
- If the recommended NOAEL-based TRV was a geometric mean of the reproduction and growth NOAELs, the lower value from the following two methods was selected as the LOAEL TRV:
  (1) the geometric mean of bounded reproduction and growth LOAELs was calculated, and if no bounded NOAELs or LOAELs were contained in the dataset, the lowest reproduction or growth LOAEL greater than the NOAEL-based TRV was conservatively selected as the LOAEL-based TRV, and
  (2) the lowest bounded LOAEL for survival endpoints.

d. Benzo(a)pyrene values used as surrogate for high molecular weight PAHs.
e. Mercury avian TRV based on reproductive effects for Japanese Quail exposed to mercuric chloride.
f. Mercury mammalian TRV based on reproductive effects for rats exposed to methyl mercury chloride.

References:
Sample, BE, DM Opresko, GW Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3
Trust, K.A., A. Fairbrother, and M.J. Hooper. 1994. Effects of 7,12-dimethylbenz(a)anthracene on immune function and missed-function oxygenase activity in the European starling. Environ. Toxicol. Chem. 13(5): 821-830
USEPA. 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs), Interim Eco-SSL Documents. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response, Washington D.C.

Table 7-1a
Hazard Quotient Summary for Wildlife Receptors - Maximum Concentration Exposure
John Deere Dubuque Works
Dubuque, Iowa

COPEC	Wildlife Receptors							
	Avian Omnivores		Mammalian Omnivores		Avian Carnivores		Mammalian Carnivores	
	American Robin		Short-tailed Shrew		Red-tailed Hawk		Fox	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Semi Volatile Organic Compounds								
Benzo(a)anthracene	5E-02	5E-03	1E+00	3E-01	0E+00	0E+00	1E-02	2E-03
Benzo(a)pyrene	4E-02	4E-03	9E-01	2E-01	0E+00	0E+00	1E-02	2E-03
Benzo(b)fluoranthene	1E-01	1E-02	**3E+00**	6E-01	0E+00	0E+00	3E-02	6E-03
Benzo(k)fluoranthene	1E-01	1E-02	**3E+00**	5E-01	0E+00	0E+00	2E-02	4E-03
Benzo(g,h,i)perylene	6E-02	6E-03	**2E+00**	3E-01	0E+00	0E+00	1E-02	3E-03
Bis(2-ethylhexyl) phthalate	2E-03	2E-04	2E-04	2E-05	0E+00	0E+00	6E-06	6E-07
Carbazole	--	--	--	--	--	--	--	--
Chrysene	6E-02	6E-03	**2E+00**	4E-01	0E+00	0E+00	2E-02	3E-03
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	2E-01	2E-02	**4E+00**	9E-01	0E+00	0E+00	4E-02	8E-03
Indeno(1,2,3-cd)pyrene	6E-02	6E-03	**2E+00**	3E-01	0E+00	0E+00	1E-02	3E-03
Phenol	--	--	--	--	--	--	--	--
Pyrene	1E-01	1E-02	**3E+00**	6E-01	0E+00	0E+00	4E-02	7E-03
Inorganics								
Barium	6E-01	3E-01	2E-01	1E-01	9E-04	4E-04	9E-03	4E-03
Cadmium	7E-01	2E-01	**2E+00**	2E-01	2E-02	5E-03	3E-02	3E-03
Chromium	**5E+00**	**4E+00**	**7E+00**	**2E+00**	4E-01	4E-01	4E-01	9E-02
Copper	1E+00	4E-01	1E+00	8E-01	3E-01	9E-02	1E-01	7E-02
Iron	--	--	--	--	--	--	--	--
Lead	**2E+01**	**1E+01**	**1E+01**	**6E+00**	1E+00	6E-01	5E-01	2E-01
Mercury	**2E+00**	3E-01	2E-01	8E-02	2E-02	4E-03	2E-03	1E-03
Nickel	3E-01	1E-01	**2E+00**	1E+00	6E-02	2E-02	1E-01	7E-02
Selenium	4E-01	2E-01	1E+00	8E-01	2E-01	9E-02	2E-01	1E-01
Zinc	7E-01	5E-01	9E-01	8E-01	1E-01	1E-01	6E-02	5E-02

Notes:
HQ = hazard quotient
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
HQs > 1

Table 7-1b
Hazard Quotient Summary for Wildlife Receptors - Upper Confidence Limit Exposure
John Deere Dubuque Works
Dubuque, Iowa

COPEC	Wildlife Receptors							
	Avian Omnivores		Mammalian Omnivores		Avian Carnivores		Mammalian Carnivores	
	American Robin		Short-tailed Shrew		Red-tailed Hawk		Fox	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Semi Volatile Organic Compounds								
Benzo(a)anthracene	2E-02	2E-03	5E-01	1E-01	0E+00	0E+00	1E-04	2E-05
Benzo(a)pyrene	1E-02	1E-03	4E-01	8E-02	0E+00	0E+00	8E-05	2E-05
Benzo(b)fluoranthene	5E-02	5E-03	1E+00	2E-01	0E+00	0E+00	2E-04	4E-05
Benzo(k)fluoranthene	4E-02	4E-03	1E+00	2E-01	0E+00	0E+00	2E-04	3E-05
Benzo(g,h,i)perylene	2E-02	2E-03	6E-01	1E-01	0E+00	0E+00	1E-04	2E-05
Bis(2-ethylhexyl) phthalate	2E-03	2E-04	1E-04	1E-05	0E+00	0E+00	9E-08	9E-09
Carbazole	--	--	--	--	--	--	--	--
Chrysene	3E-02	3E-03	7E-01	1E-01	0E+00	0E+00	1E-04	2E-05
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	6E-02	6E-03	**2E+00**	3E-01	0E+00	0E+00	3E-04	6E-05
Indeno(1,2,3-cd)pyrene	2E-02	2E-03	6E-01	1E-01	0E+00	0E+00	1E-04	2E-05
Phenol	--	--	--	--	--	--	--	--
Pyrene	5E-02	5E-03	1E+00	2E-01	0E+00	0E+00	3E-04	5E-05
Inorganics								
Barium	2E-01	1E-01	1E-01	4E-02	4E-06	2E-06	8E-05	3E-05
Cadmium	3E-01	8E-02	1E+00	1E-01	1E-04	4E-05	3E-04	3E-05
Chromium	**2E+00**	**2E+00**	**3E+00**	8E-01	3E-03	3E-03	4E-03	9E-04
Copper	5E-01	2E-01	5E-01	3E-01	3E-03	1E-03	2E-03	1E-03
Iron	--	--	--	--	--	--	--	--
Lead	**1E+01**	**5E+00**	**5E+00**	**3E+00**	9E-03	4E-03	5E-03	2E-03
Mercury	1E+00	2E-01	1E-01	6E-02	1E-04	2E-05	3E-05	1E-05
Nickel	1E-01	4E-02	7E-01	4E-01	4E-04	1E-04	1E-03	7E-04
Selenium	4E-01	2E-01	1E+00	8E-01	2E-03	1E-03	4E-03	2E-03
Zinc	5E-01	4E-01	7E-01	6E-01	1E-03	1E-03	1E-03	1E-03

Notes:
HQ = hazard quotient
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
HQs > 1

Table 7-1c
Hazard Quotient Summary for Wildlife Receptors - Mean Concentration Exposure
John Deere Dubuque Works
Dubuque, Iowa

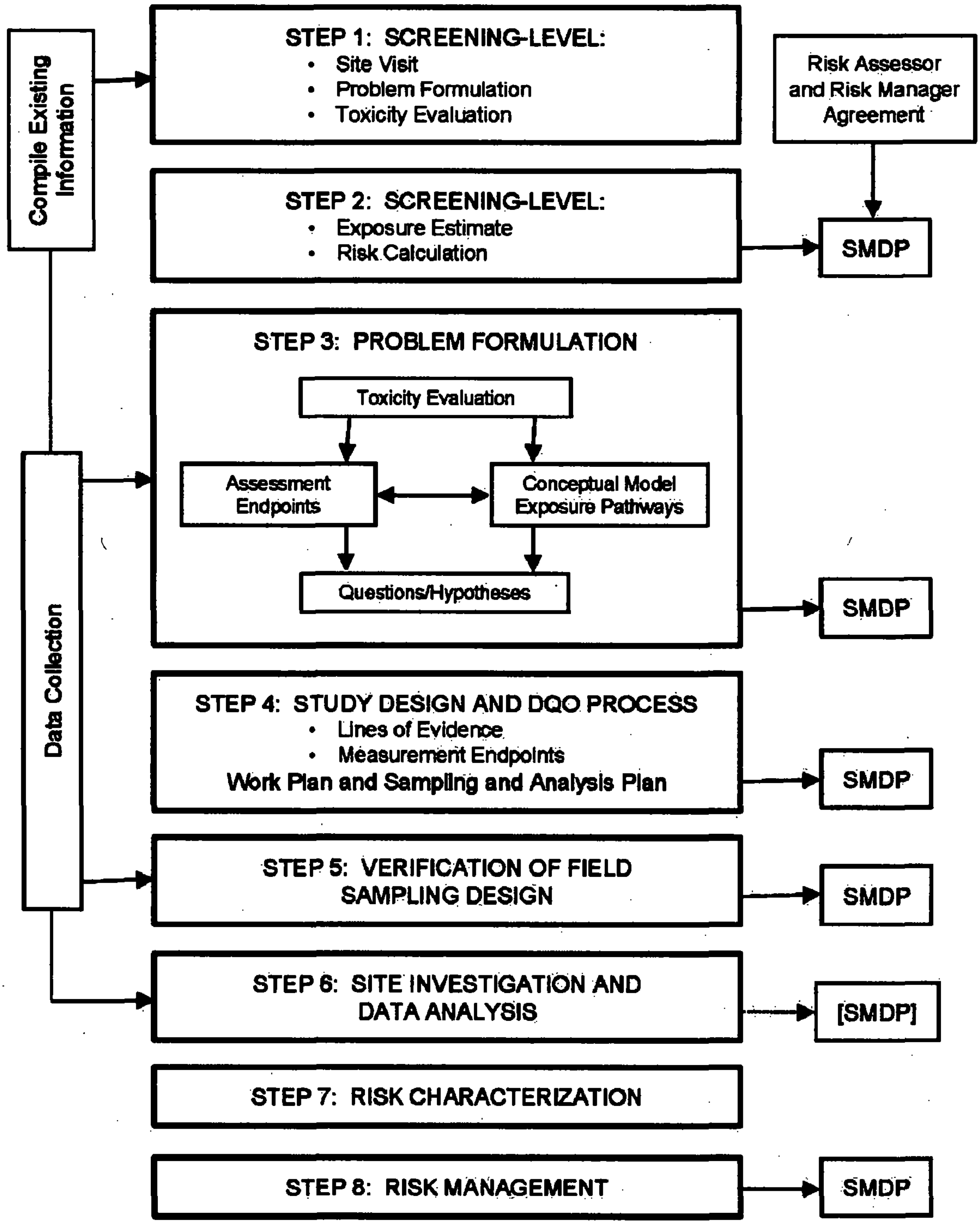
COPEC	Wildlife Receptors							
	Avian Omnivores		Mammalian Omnivores		Avian Carnivores		Mammalian Carnivores	
	American Robin		Short-tailed Shrew		Red-tailed Hawk		Fox	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Semi Volatile Organic Compounds								
Benzo(a)anthracene	--	5E-04	1E-01	2E-02	0E+00	0E+00	2E-05	5E-06
Benzo(a)pyrene	3E-03	3E-04	9E-02	2E-02	0E+00	0E+00	2E-05	4E-06
Benzo(b)fluoranthene	1E-02	1E-03	3E-01	6E-02	0E+00	0E+00	5E-05	1E-05
Benzo(k)fluoranthene	1E-02	1E-03	3E-01	5E-02	0E+00	0E+00	4E-05	9E-06
Benzo(g,h,i)perylene	6E-03	6E-04	2E-01	3E-02	0E+00	0E+00	3E-05	6E-06
Bis(2-ethylhexyl) phthalate	1E-03	1E-04	1E-04	1E-05	0E+00	0E+00	8E-08	8E-09
Carbazole	--	--	--	--	--	--	--	--
Chrysene	7E-03	7E-04	2E-01	4E-02	0E+00	0E+00	3E-05	7E-06
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	2E-02	2E-03	4E-01	8E-02	0E+00	0E+00	7E-05	1E-05
Indeno(1,2,3-cd)pyrene	6E-03	6E-04	2E-01	4E-02	0E+00	0E+00	3E-05	6E-06
Phenol	--	--	--	--	--	--	--	--
Pyrene	9E-03	9E-04	2E-01	4E-02	0E+00	0E+00	5E-05	1E-05
Inorganics								
Barium	1E-01	6E-02	4E-02	2E-02	2E-06	1E-06	4E-05	2E-05
Cadmium	2E-01	6E-02	8E-01	8E-02	1E-04	3E-05	3E-04	3E-05
Chromium	7E-01	7E-01	1E+00	3E-01	1E-03	1E-03	2E-03	4E-04
Copper	4E-01	1E-01	4E-01	2E-01	3E-03	9E-04	2E-03	1E-03
Iron	--	--	--	--	--	--	--	--
Lead	**4E+00**	**2E+00**	**2E+00**	1E+00	5E-03	3E-03	2E-03	1E-03
Mercury	9E-01	2E-01	1E-01	5E-02	6E-05	1E-05	2E-05	1E-05
Nickel	1E-01	3E-02	6E-01	3E-01	4E-04	1E-04	1E-03	6E-04
Selenium	4E-01	2E-01	1E+00	7E-01	2E-03	1E-03	3E-03	2E-03
Zinc	4E-01	3E-01	6E-01	5E-01	1E-03	1E-03	1E-03	9E-04

Notes:
HQ = hazard quotient
LOAEL = Lowest observed adverse effect level
NOAEL = No observed adverse effect level
HQs > 1

FIGURES

ARCADIS

Figures

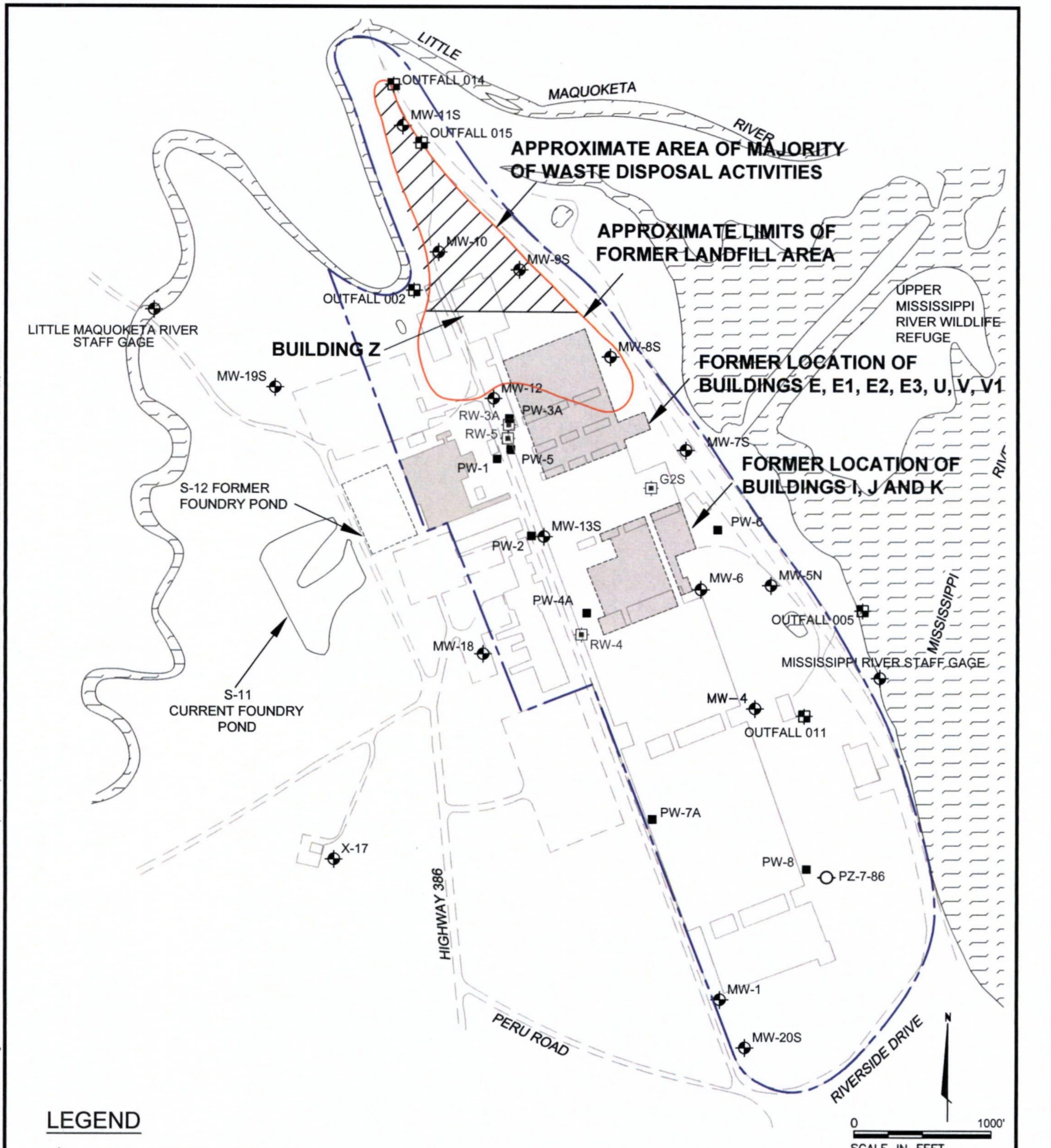


JOHN DEERE DUBUQUE WORKS
DUBUQUE, IOWA
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

EIGHT STEP ECOLOGICAL RISK ASSESSMENT PROCESS FOR SUPERFUND

ARCADIS

FIGURE
1-1



LEGEND

- SHALLOW MONITORING WELL
- PRODUCTION WELLS
- PIEZOMETER
- RECOVERY WELL
- OUTFALL
- AREA OF DEMOLISHED BUILDINGS
- APPROXIMATE EXTENT OF CONSENT DECREE SUPERFUND SITE BOUNDARY

NOTE:
THE LOCATIONS PRESENTED FOR STORMWATER OUTFALL-014 AND OUTFALL-015 ARE APPROXIMATED BASED ON SITE VISIT.

JOHN DEERE DUBUQUE WORKS
DUBUQUE, IOWA
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

FORMER LANDFILL AREA LOCATION MAP

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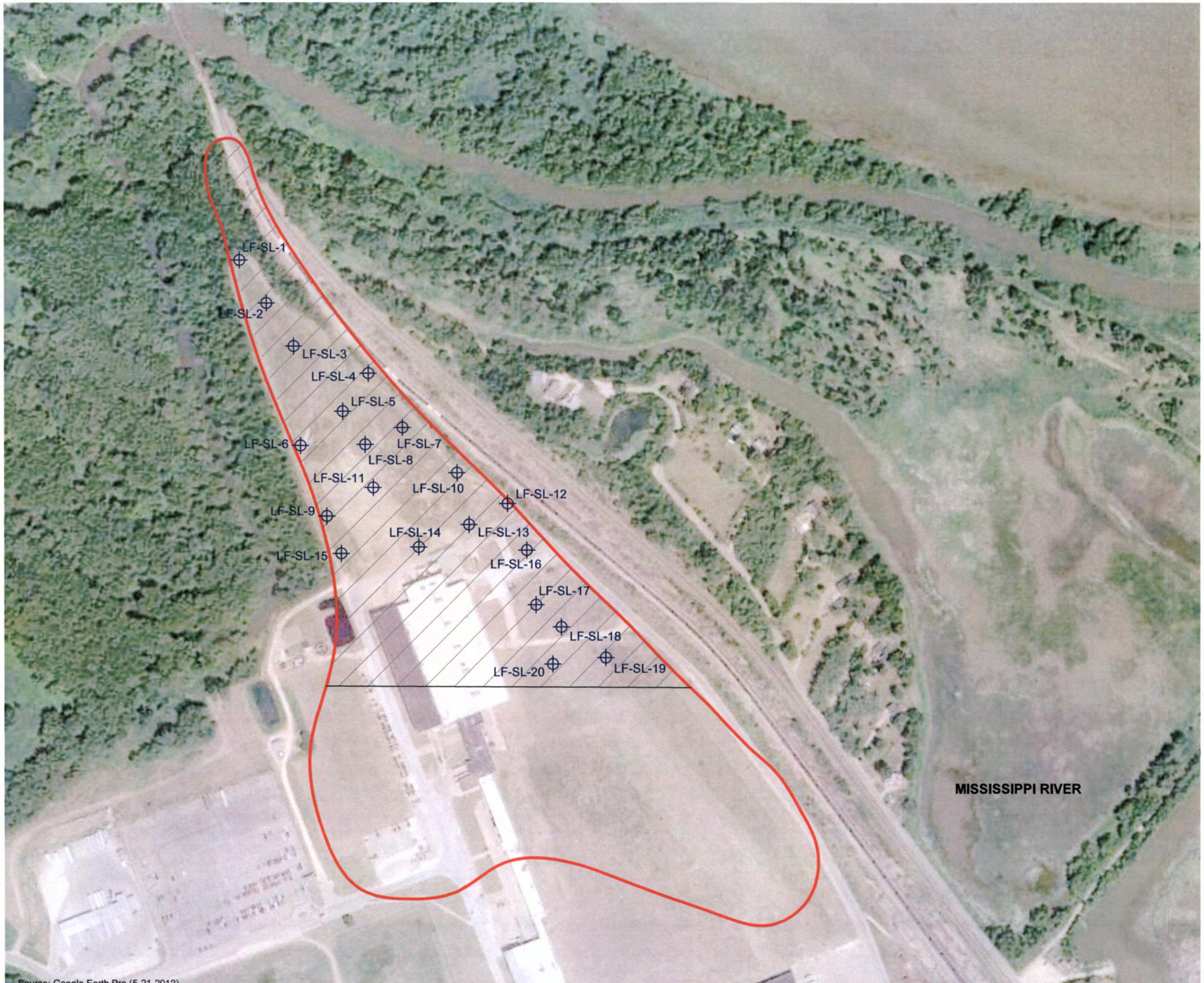
FIGURE
2-1

CITY:Tampa DIV/GROUP:(Reqd) DB:M. Vives LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\TAMPA\ACT\TF\TF001034\2014\Aug_14\TF001034_28_1 John Deere SLERA WP.dwg LAYOUT: 2-1 SAVED: 9/19/2014 4:30 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: ENVIRONMENTAL-PCP.CTB PLOTTED: 9/22/2014 9:43 AM BY: VIVES, MARTIN



LEGEND

- Surface Soil Sample Location
- Approximate limits of Former Landfill (LF2) Area

N

0 300'
SCALE IN FEET

JOHN DEERE DUBUQUE WORKS
DUBUQUE, IOWA
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

SOIL SAMPLE LOCATIONS

ARCADIS

FIGURE
3-1

APPENDIX A

ARCADIS

Appendix A

Historical Information: Foundry Ponds and NPDES Outfalls

ARCADIS

Table of Contents

ARCADIS

Table A-1

Summary of Chemical Analyses for RI/FS Former Foundry Pond Surficial Soil Samples

Table A-1
Summary of Chemical Analyses for RI/FS Former Foundary Pond Surficial Soil Samples
John Deere Dubuque Works
Dubuque, Iowa

Sample ID: / Lab ID: / Collection Date:	SL-F1 / 87130506 / 12/2/1987	SL-F2 / 87130507 / 12/2/1987	NOPY3006* / NOPY3006 / 12/2/1987
USEPA TCL METALS (mg/kg):			
Aluminum	10200	9220	10900
Barium	375	325	410 J
Cadmium	ND(2)	2.5	I
Calcium	23400	21400	27900
Chromium	59	36	50 J
Copper	133	45	50J
Iron	15400	10100	12900
Lead	235	345	190 J
Magnesium	12200	12000	14200
Manganese	2250	2080	3000 J
Nickel	ND(12)	14	10 J
Potassium	ND(700)	ND(700)	1040 U
Vanadium	ND (10)	ND(10)	10 U
Zinc	1500	1540	970 J
USEPA TCL VOLATILE ORGANIC COMPOUNDS (µg/kg):			
Methylene chloride	ND(5.0)	16	5.3 U
MISCELLANEOUS (mg/kg)			
Cyanide	0.6	1.9	5.2 U

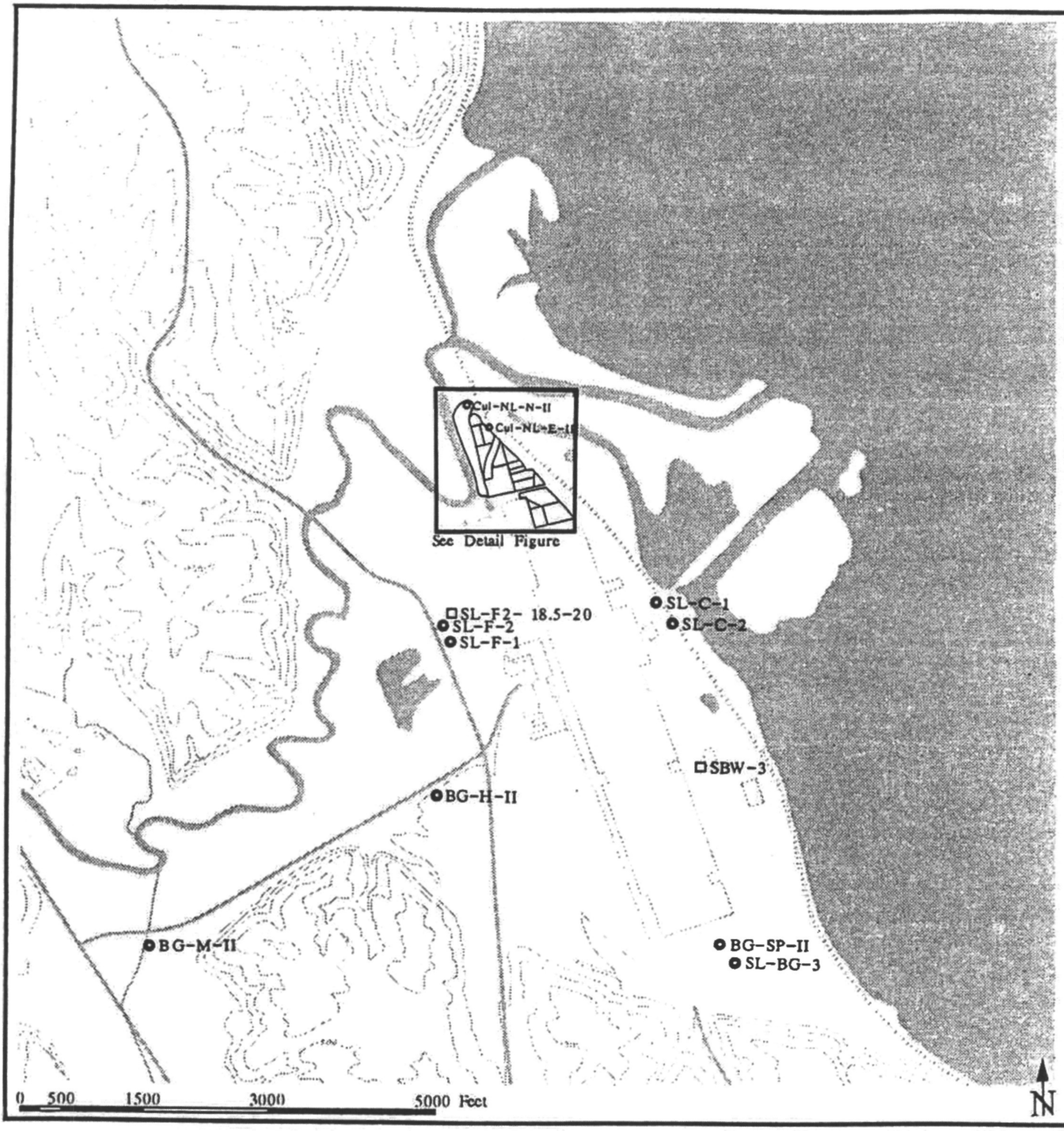
Notes:
I = Invalid data
J = Compound qualitatively identified at a value greater than limit of quantitation
µg/kg = microgram per kilogram
mg/kg = milligrams per kilogram
ND = not detected above method detection limit, indicated by "( )"
RI/FS = remediation investigation/feasibility study
TCL = target compound list
U = Not detected above quantitation limit
USEPA = United States Environmental Protection Agency
* Field duplicate for SL-F1

Source: Geraghty and Miller, Inc. (G&M). 1988. Remedial Investigation Report, Table 4-6. Prepared for John Deere Dubuque Works, Dubuque, Iowa. August 1988

ARCADIS

Figure A-1

Surficial Soil and Soil Boring Sample Locations: Figure 2-2 (Remedial Investigation Report)



SURFICIAL SOIL AND SOIL BORING SAMPLE LOCATIONS

- Water
- Building
- Topographic Contour Line
  Contour Interval: 50 Feet
- □ Soil Boring
- ● Surficial Soil Sample

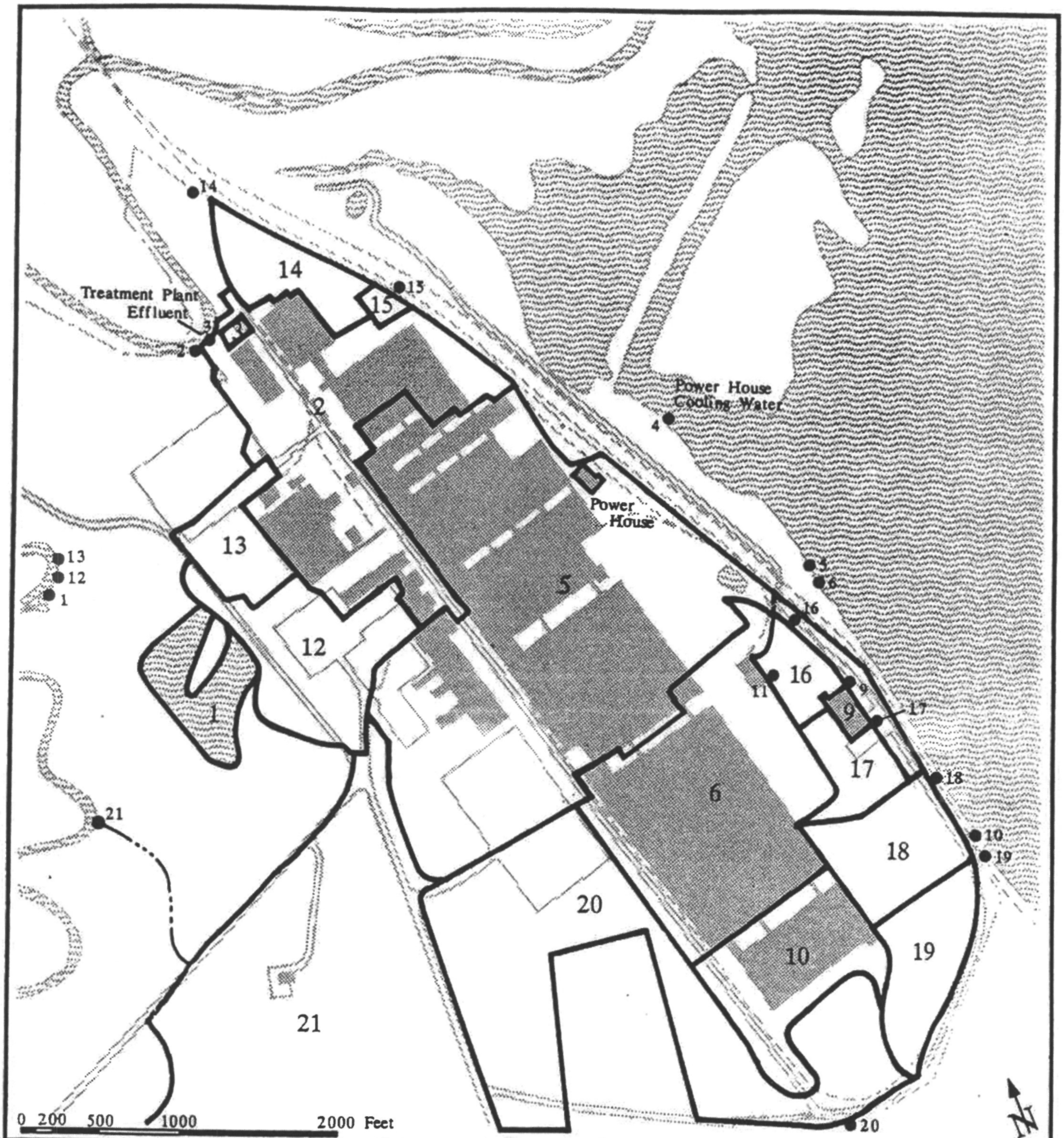
Prepared for: John Deere Dubuque Works | 23JUL88ADF | Project Manager: Steven D. Chatman

ARCADIS

Figure A-2

NPDES Outfalls Map-

Remedial Investigation Report



NPDES OUTFALLS AND SURFACE AREA DRAINAGE

Water
Building
Railroad
Property Line

12 Surface Drainage Area

● NPDES Discharge Point
Prepared from JDDW NPDES Permit, Mar. 1986

Prepared for: John Deere Dubuque Works 28JUL88ADF Project Manager: Steven D. Chatman

ARCADIS

Acute Toxicity Results for Outfall 002 and Outfalls 005/006

THE UNIVERSITY OF IOWA

STATE HYGIENIC LABORATORY
Iowa's Environmental and Public Health Laboratory
www.shl.uiowa.edu

September 20, 2013

Chris Habers
John Deere Dubuque Works
18600 South John Deere Rd.
Dubuque, IA 52001

RE: SHL Sample Number: 122963

Dear Mr. Habers:

Analytical and toxicity test results for the sample listed above are enclosed. This sample was received by our Laboratory for effluent toxicity testing on September 10, 2013.

As required by the Iowa Department of Natural Resources, statistical analyses were performed on the 48 hour mortality data. These statistical analyses determined there was no significant difference in survival between the effluent dilution and the control.

As a result, your sample, SHL Lab No. 122963, "passed" the toxicity tests.

The State Hygienic Laboratory appreciates this opportunity to provide you with our services. Questions regarding the test or results should be directed to David Schelling, Tim Blake, or Jim Luzier. Test analysts can be contacted on the dedicated WETT program phone line, (515) 725-1648.

The charge for these tests is $446.00. Following the end of the month a statement of this charge will be directed to the above address.

Sincerely,

John G. Miller III
Environmental Manager

JM/dms

Enclosure
c: Accounting

University of Iowa Research Park
2490 Crosspark Road
Coralville, Iowa 52241-4721
319-335-4500 *Fax* 319-335-4555
1-800-421-IOWA

Iowa Laboratories Complex
2220 South Ankeny Boulevard
Ankeny, Iowa 50023-9093
515-725-1600 *Fax* 515-725-1642

Iowa Lakeside Laboratory
1838 Highway 86
Milford, Iowa 51351-7267
712-337-3669 *Fax* 712-337-0227

Iowa Department of Natural Resources
Effluent Toxicity Testing Report Form
48-Hour Acute Test

FACILITY DATA

Facility Name: John Deere Dubuque Works	NPDES # IA: 31-26-1-07
Address: 18600 South John Deere Rd.	
City/State/Zip: Dubuque, IA 52001	
Lab Sample #: 122963	Date Collected: 9/9/2013 12:00:00 PM
Sampling Location: Outfall #002	
Diluted effluent sample ratio (from permit): 91.8%	
Date Received: 9/10/2013 10:20:00 AM	Temperature Upon Receipt: 1.0 °C

ORGANISM DATA

Pimephales promelas age:	12 Days	Ceriodaphnia dubia age:	< 24 Hours
Reference Toxicant:	Sodium Chloride	Reference Toxicant:	Sodium Chloride
Reference LC50 (95% Conf. Interval):	7.97 (7.53-8.44) gm/L	Reference LC50 (95% Conf. Interval):	2.06 (1.92-2.21) gm/L

SAMPLE DATA (100% EFFLUENT)

Temperature	24	°C	Ammonia Nitrogen (as N)	<0.05	mg/L
Initial D.O.	9.2	mg/L	D.O. (end of test)	7.1	mg/L
pH (start of test)	8.0	Units	pH (end of test)	8.7	Units
Total Ammonia (as NH3)	<0.06	mg/L	Unionized Ammonia (calculated as NH3)	<0.01	mg/L
Total Residual Chlorine	<0.1	mg/L	Specific Conductance	1200	µmhos

MORTALITY DATA

Laboratory (Name): State Hygienic Laboratory at the University of Iowa	
Test begun (Date): 9/10/2013 2:10:00 PM	Test ended (date): 9/12/2013 2:10:00 PM

Conc.	Pimephales promelas Mortality (Number Dead/Number Tested)						Ceriodaphnia dubia Mortality (Number Dead/Number Tested)					
	Bk. 1	Bk. 2	Bk. 3	Bk. 4	Pass	Fail	Bk. 1	Bk. 2	Bk. 3	Bk. 4	Pass	Fail
Control	0/5	0/5	0/5	0/5			0/5	0/5	0/5	0/5		
91.8%	0/5	0/5	0/5	0/5	(☒)	(☐)	0/5	0/5	0/5	0/5	(☒)	(☐)
100%	0/5	0/5	0/5	0/5	(☒)	(☐)	0/5	0/5	0/5	0/5	(☒)	(☐)

EFFLUENT TOXICITY TESTING RESULTS: PASS (☒) FAIL (☐)

Comments: Total Residual Chlorine analyzed by Hach Colorimeter.

Date Reported: SEP 20 2013

Fathead Minnow 48-h Acute Survival Test | **University of Iowa-Hygienic Laboratory**

Analysis ID:	00-6575-7688	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:34	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	14-2168-9021	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:10	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:10	**Species:**	Pimephales promelas	**Brine:**	
Duration:	48h	**Source:**	Environmental Consulting & Testing, WI	**Age:**	12
Sample ID:	16-6057-5916	**Code:**	122963	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		91.8	18	NA	1	6	1.0000	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
91.8		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
91.8		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
91.8		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
91.8		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
91.8		5/5	5/5	5/5	5/5

Fathead Minnow 48-h Acute Survival Test — **University of Iowa-Hygienic Laboratory**

Analysis ID:	11-9795-5333	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:34	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	14-2168-9021	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:10	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:10	**Species:**	Pimephales promelas	**Brine:**	
Duration:	48h	**Source:**	Environmental Consulting & Testing, WI	**Age:**	12
Sample ID:	16-6057-5916	**Code:**	122963	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water	100	18	NA	1	6	1.0000	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
100		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
100		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
100		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
100		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
100		5/5	5/5	5/5	5/5

Ceriodaphnia 48-h Acute Survival Test — University of Iowa-Hygienic Laboratory

Analysis ID:	20-2148-5956	Endpoint:	48h Survival Rate	CETIS Version:	CETISv1.8.4
Analyzed:	13 Sep-13 13:35	Analysis:	Nonparametric-Two Sample	Official Results:	Yes
Batch ID:	16-9079-8492	Test Type:	Survival (48h)	Analyst:	
Start Date:	10 Sep-13 14:10	Protocol:	EPA/821/R-02-012 (2002)	Diluent:	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:10	Species:	Ceriodaphnia dubia	Brine:	
Duration:	48h	Source:	Aquatic Biosystems, CO	Age:	<24h
Sample ID:	16-6057-5916	Code:	122963	Client:	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	Material:	Industrial Effluent	Project:	Iowa WET Test
Receive Date:	10 Sep-13 10:20	Source:	NPDES Permit #		
Sample Age:	26h (1 °C)	Station:	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		91.8	18	NA	1	6	1.0000	Exact	Non-Significant Effect

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
91.8		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
91.8		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
91.8		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
91.8		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
91.8		5/5	5/5	5/5	5/5

Ceriodaphnia 48-h Acute Survival Test — **University of Iowa-Hygienic Laboratory**

Analysis ID:	21-1509-8644	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:35	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	16-9079-8492	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:10	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:10	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	48h	**Source:**	Aquatic Biosystems, CO	**Age:**	<24h
Sample ID:	16-6057-5916	**Code:**	122963	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		100	18	NA	1	6	1.0000	Exact	Non-Significant Effect

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
100		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
100		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
100		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
100		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
100		5/5	5/5	5/5	5/5

THE UNIVERSITY OF IOWA

STATE HYGIENIC LABORATORY
Iowa's Environmental and Public Health Laboratory
www.shl.uiowa.edu

September 20, 2013

Chris Habers
John Deere Dubuque Works
18600 South John Deere Rd.
Dubuque, IA 52001

RE: SHL Sample Number: 122964

Dear Mr. Habers:

Analytical and toxicity test results for the sample listed above are enclosed. This sample was received by our Laboratory for effluent toxicity testing on September 10, 2013.

As required by the Iowa Department of Natural Resources, statistical analyses were performed on the 48 hour mortality data. These statistical analyses determined there was no significant difference in survival between the effluent dilution and the control.

As a result, your sample, SHL Lab No. 122964, "passed" the toxicity tests.

The State Hygienic Laboratory appreciates this opportunity to provide you with our services. Questions regarding the test or results should be directed to David Schelling, Tim Blake, or Jim Luzier. Test analysts can be contacted on the dedicated WETT program phone line, (515) 725-1648.

The charge for these tests is $446.00. Following the end of the month a statement of this charge will be directed to the above address.

Sincerely,

John G. Miller III
Environmental Manager

JM/dms

Enclosure
c: Accounting

University of Iowa Research Park
2490 Crosspark Road
Coralville, Iowa 52241-4721
319-335-4500 *Fax* 319-335-4555
1-800-421-IOWA

Iowa Laboratories Complex
2220 South Ankeny Boulevard
Ankeny, Iowa 50023-9093
515-725-1600 *Fax* 515-725-1642

Iowa Lakeside Laboratory
1838 Highway 86
Milford, Iowa 51351-7267
712-337-3669 *Fax* 712-337-0227

Iowa Department of Natural Resources
Effluent Toxicity Testing Report Form
48-Hour Acute Test

FACILITY DATA

Facility Name: John Deere Dubuque Works — NPDES # IA: 31-26-1-07

Address: 18600 South John Deere Rd.

City/State/Zip: Dubuque, IA 52001

Lab Sample #: 122964 — Date Collected: 9/9/2013 12:00:00 PM

Sampling Location: Outfall #801

Diluted effluent sample ratio (from permit): 79.0%

Date Received: 9/10/2013 10:20:00 AM — Temperature Upon Receipt: 1.9 °C

ORGANISM DATA

Pimephales promelas age:	12 Days		Ceriodaphnia dubia age:	< 24 Hours	
Reference Toxicant:	Sodium Chloride		Reference Toxicant:	Sodium Chloride	
Reference LC50 (95% Conf. Interval):	7.97 (7.53-8.44)	gm/L	Reference LC50 (95% Conf. Interval):	2.06 (1.92-2.21)	gm/L

SAMPLE DATA (100% EFFLUENT)

Temperature	24	°C	Ammonia Nitrogen (as N)	<0.05	mg/L
Initial D.O.	8.9	mg/L	D.O. (end of test)	7.0	mg/L
pH (start of test)	8.0	Units	pH (end of test)	8.7	Units
Total Ammonia (as NH3)	<0.06	mg/L	Unionized Ammonia (calculated as NH3)	<0.01	mg/L
Total Residual Chlorine	<0.1	mg/L	Specific Conductance	1200	µmhos

MORTALITY DATA

Laboratory (Name): State Hygienic Laboratory at the University of Iowa

Test begun (Date): 9/10/2013 2:30:00 PM — Test ended (date): 9/12/2013 2:30:00 PM

Conc.	Pimephales promelas Mortality (Number Dead/Number Tested)						Ceriodaphnia dubia Mortality (Number Dead/Number Tested)					
	Bk. 1	Bk. 2	Bk. 3	Bk. 4	Pass	Fail	Bk. 1	Bk. 2	Bk. 3	Bk. 4	Pass	Fail
Control	0/5	0/5	0/5	0/5			0/5	0/5	0/5	0/5		
79.0%	0/5	0/5	0/5	0/5	(☒)	(☐)	0/5	0/5	0/5	0/5	(☒)	(☐)
100%	0/5	0/5	0/5	0/5	(☒)	(☐)	0/5	0/5	0/5	0/5	(☒)	(☐)

EFFLUENT TOXICITY TESTING RESULTS: PASS (☒) FAIL (☐)

Comments: Total Residual Chlorine analyzed by Hach Colorimeter.

Date Reported: SEP 20 2013

CETIS Analytical Report

Fathead Minnow 48-h Acute Survival Test — **University of Iowa-Hygienic Laboratory**

Analysis ID:	21-3115-0121	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:39	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	16-3581-2903	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:30	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:30	**Species:**	Pimephales promelas	**Brine:**	
Duration:	48h	**Source:**	Environmental Consulting & Testing, WI	**Age:**	12
Sample ID:	19-9428-2534	**Code:**	122964	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1.9 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water	79	18	NA	1	6	1.0000	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
79		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
79		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
79		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
79		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
79		5/5	5/5	5/5	5/5

Fathead Minnow 48-h Acute Survival Test — **University of Iowa-Hygienic Laboratory**

Analysis ID:	03-7887-4891	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:39	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	16-3581-2903	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:30	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:30	**Species:**	Pimephales promelas	**Brine:**	
Duration:	48h	**Source:**	Environmental Consulting & Testing, WI	**Age:**	12
Sample ID:	19-9428-2534	**Code:**	122964	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1.9 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		100	18	NA	1	6	1.0000	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
100		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
100		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
100		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
100		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
100		5/5	5/5	5/5	5/5

Ceriodaphnia 48-h Acute Survival Test — **University of Iowa-Hygienic Laboratory**

Analysis ID:	02-0062-8722	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:40	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	20-3118-9699	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:30	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:30	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	48h	**Source:**	Aquatic Biosystems, CO	**Age:**	<24h
Sample ID:	19-9428-2534	**Code:**	122964	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1.9 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		79	18	NA	1	6	1.0000	Exact	Non-Significant Effect

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
79		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
79		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
79		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
79		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
79		5/5	5/5	5/5	5/5

Ceriodaphnia 48-h Acute Survival Test — **University of Iowa-Hygienic Laboratory**

Analysis ID:	18-2120-6202	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	13 Sep-13 13:40	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	20-3118-9699	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	10 Sep-13 14:30	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Hard-Mod. Hard Synthetic Water
Ending Date:	12 Sep-13 14:30	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	48h	**Source:**	Aquatic Biosystems, CO	**Age:**	<24h
Sample ID:	19-9428-2534	**Code:**	122964	**Client:**	John Deere Dubuque Works
Sample Date:	09 Sep-13 12:00	**Material:**	Industrial Effluent	**Project:**	Iowa WET Test
Receive Date:	10 Sep-13 10:20	**Source:**	NPDES Permit #		
Sample Age:	26h (1.9 °C)	**Station:**	31-26-1-07		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Angular (Corrected)	NA	C > T	NA	NA	Sample passes 48h survival rate endpoint

Wilcoxon Rank Sum Two-Sample Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		100	18	NA	1	6	1.0000	Exact	Non-Significant Effect

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0	0	1	65540	<0.0001	Significant Effect
Error	0	0	6			
Total	0		7			

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1	1	1	1	1	1	0	0.0%	0.0%
100		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
100		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
100		1	1	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.345	1.345	1.345	1.345
100		1.345	1.345	1.345	1.345

48h Survival Rate Binomials

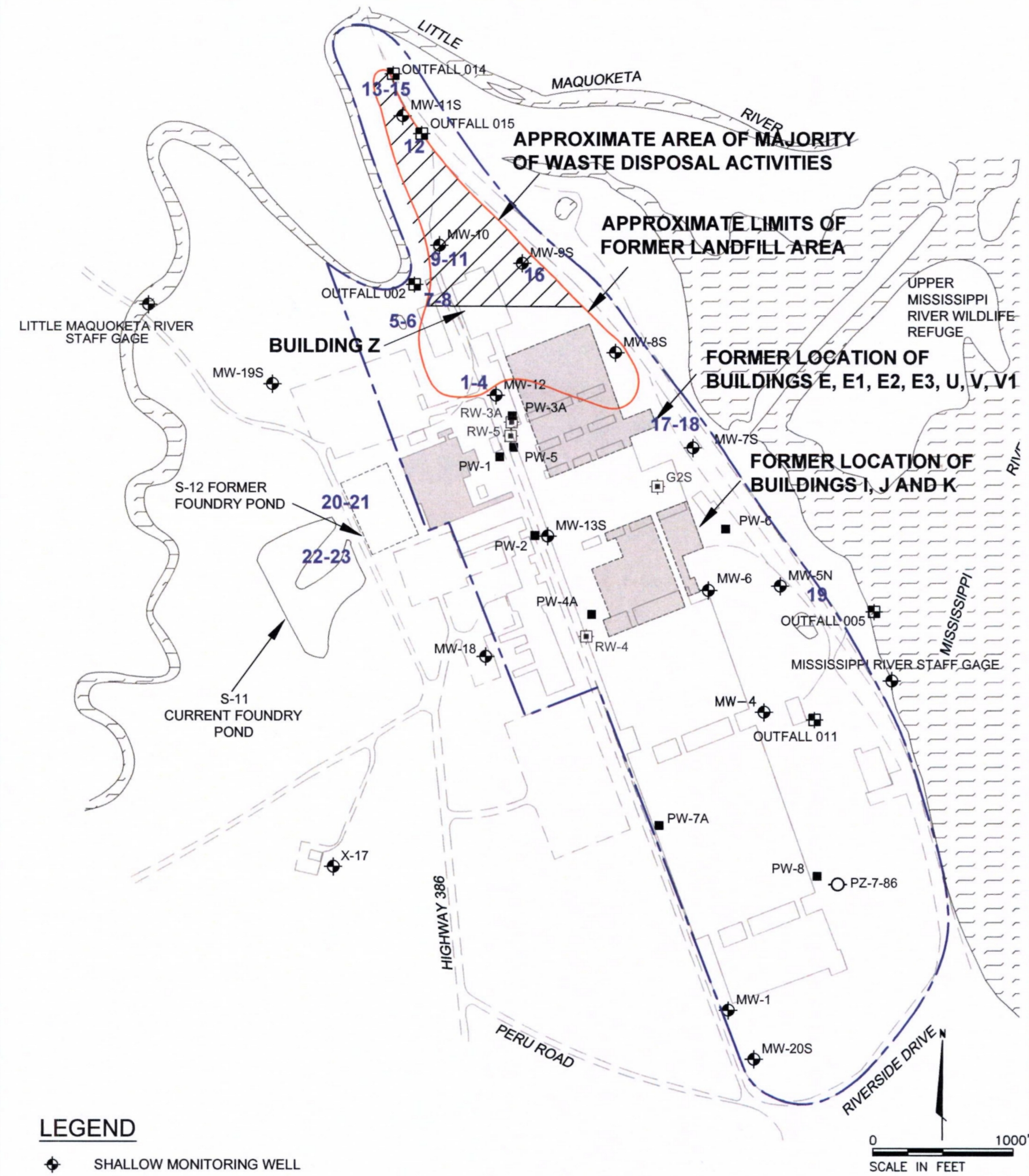
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	5/5	5/5	5/5	5/5
100		5/5	5/5	5/5	5/5

APPENDIX B

ARCADIS

Appendix B

Site Reconnaissance Summary



LEGEND

- SHALLOW MONITORING WELL
- PRODUCTION WELLS
- PIEZOMETER
- RECOVERY WELL
- OUTFALL
- AREA OF DEMOLISHED BUILDINGS
- 15 PHOTO LOCATIONS
- APPROXIMATE EXTENT OF CONSENT DECREE SUPERFUND SITE BOUNDARY

NOTE:
THE LOCATIONS PRESENTED FOR STORMWATER OUTFALL-014 AND OUTFALL-015 ARE APPROXIMATED BASED ON SITE VISIT.

JOHN DEERE DUBUQUE WORKS
DUBUQUE, IOWA
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

SITE RECONNAISSANCE PHOTO LOCATIONS

ARCADIS

FIGURE
B-1

Appendix B
Photo Log: Site Ecological Reconnaissance – May 29, 2014
Screening Level Ecological Risk Assessment
John Deere Dubuque Works
Dubuque, Iowa

Ecological Site Reconnaissance Summary

The site visit was conducted during the morning of May 29, 2014. Sara Selden (ARCADIS) met with Jack Dallal and Russ Eberlin (John Deere) at the main visitor entrance of John Deere Dubuque Works located at 18600 South John Deere Road, Dubuque, Iowa. Weather was approximately 70 degrees Fahrenheit, little to no wind, and initially overcast, becoming partly cloudy/sunny mid-morning. Photos and descriptions for the landfill, outfalls, site border adjacent to the wildlife refuge, general site characteristics and habitat, and foundry ponds are included below.

Photo 1: Southern portion of landfill area (maintained lawn) west of Building Z. Facing south.

Photo 2: Southern portion of landfill area (maintained lawn) west of Building Z. Facing north.

Photo 3: Southern portion of landfill area (maintained lawn) west of Building Z. Facing northwest.

Photo 4: Southern portion of landfill area (maintained lawn) west of Building Z. Facing west.

Photos 5: Pond north of Outfall-002. Facing south.

Photo 6: Pond north of Outfall-002. Facing west.

Photo 7: Pond west of Building Z, east of Outfall-002. Facing north.

Photo 8: East of pond in Photo 7. Facing south towards southern portion of delineated landfill area and west of Building Z.

Photo 9: Northern portion of landfill area, north of Building Z, facing north. Vegetation approximately 0.5 to 2 feet tall.

Photo 10: Northern portion of landfill area, north of Building Z, facing east.

Photo 11: Close-up of typical vegetation found throughout northern portion of landfill area, north of Building Z. Taken at same location as Photos 9 and 10.

Photo 12: Outfall #15 on eastern portion of landfill, north of Building Z. Facing east towards railroad tracks.

Photo 13: Outfall #14 located at northern portion of landfill, north of Building Z, facing north.

Photo 14: Area leading up to Outfall #14 located at northern portion of landfill, north of Building Z.

Photo 15: Photo taken from Outfall #14 located at northern portion of landfill (same as Photos 13 and 14), facing south.

Photo 16: Photo taken from near MW-9S, facing south. Vegetation is approximately 0.5 to 1 foot tall.

Photo 17: Photo taken from road on eastern portion of site just south of delineated landfill extent. Facing west across railroad tracks towards wildlife refuge. Eight feet tall fence with barbed wire surrounds site.

Photo 18: Facing west across railroad tracks towards wildlife refuge, same location to Photo 17.

Photo 19: Photo taken from access road on eastern portion of site facing Pond 5 (facing west), near MW-4.

Photo 20: Former Foundry Pond. Photo taken west of Herber Road (facing east). Vegetation mainly grasses, no standing water.

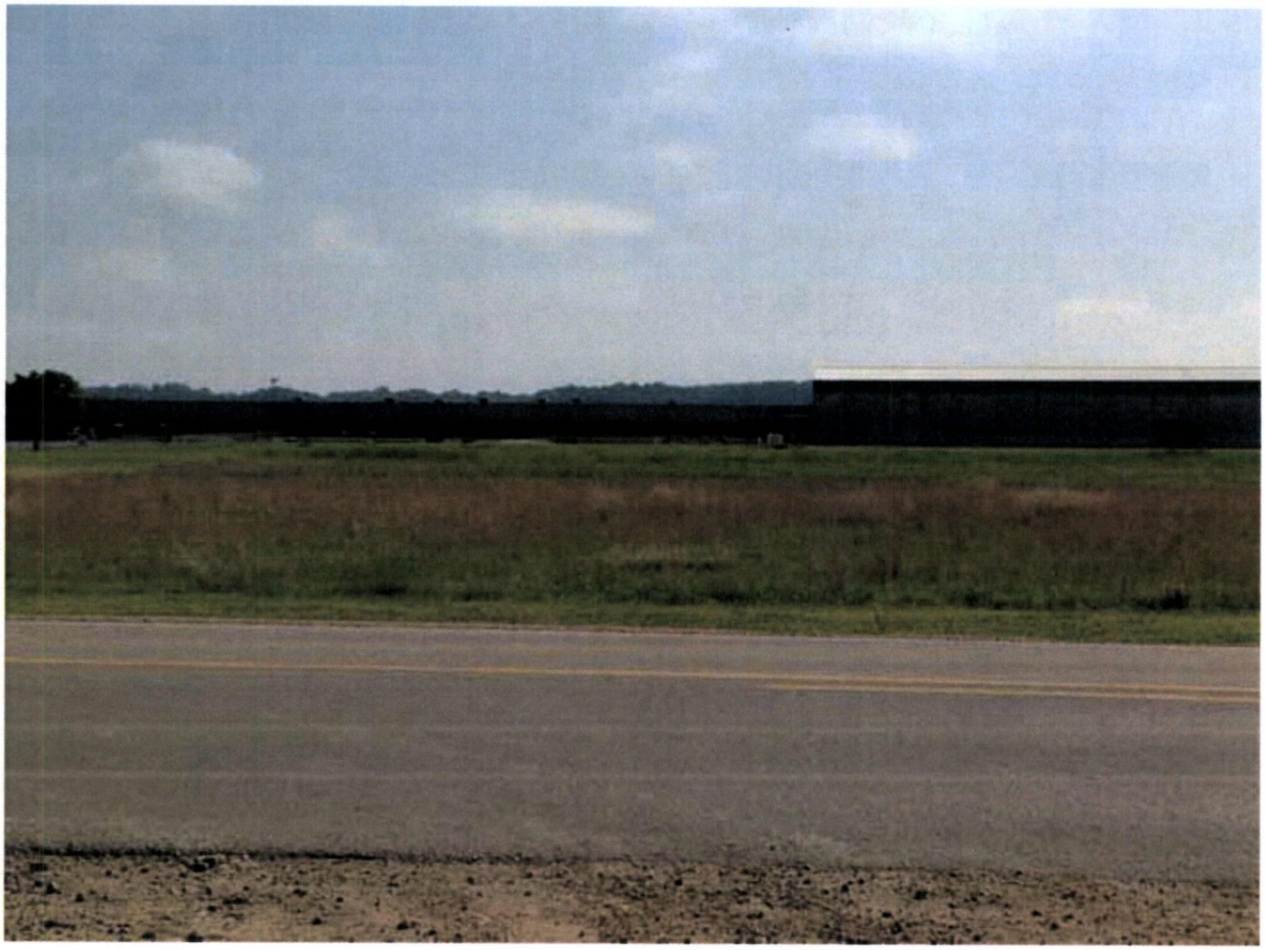


Photo 21: Former Foundry Pond. Same location as Photo 20, facing east.

Photo 22: Former Foundry Pond located west of Herber Road (facing west).

Photo 23: Close-up of vegetation found at Former Foundry Pond located west of Herber Road. Same location as Photo 22.

APPENDIX C

ARCADIS

Appendix C

ProUCL Data Sheets

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	For ProUCL wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Result (aluminum)

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	640	Minimum of Log Data	6.461
Maximum	7200	Maximum of Log Data	8.882
Mean	2896	Mean of log Data	7.813
Geometric Mean	2471	SD of log Data	0.619
Median	3150		
SD	1551		
Std. Error of Mean	346.7		
Coefficient of Variation	0.535		
Skewness	0.883		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.906	Shapiro Wilk Test Statistic	0.908
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	3496	95% H-UCL	4060
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4845
95% Adjusted-CLT UCL (Chen-1995)	3539	97.5% Chebyshev (MVUE) UCL	5661
95% Modified-t UCL (Johnson-1978)	3507	99% Chebyshev (MVUE) UCL	7262
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.848	**Data appear Normal at 5% Significance Level**	
Theta Star	1017		
MLE of Mean	2896		
MLE of Standard Deviation	1716		
nu star	113.9		
Approximate Chi Square Value (.05)	90.27	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	3466
Adjusted Chi Square Value	88.6	95% Jackknife UCL	3496
		95% Standard Bootstrap UCL	3455
Anderson-Darling Test Statistic	0.76	95% Bootstrap-t UCL	3593
Anderson-Darling 5% Critical Value	0.747	95% Hall's Bootstrap UCL	3758
Kolmogorov-Smirnov Test Statistic	0.198	95% Percentile Bootstrap UCL	3447
Kolmogorov-Smirnov 5% Critical Value	0.195	95% BCA Bootstrap UCL	3500
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	4407
		97.5% Chebyshev(Mean, Sd) UCL	5061
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	6346
95% Approximate Gamma UCL (Use when n >= 40)	3654		
95% Adjusted Gamma UCL (Use when n < 40)	3723		
Potential UCL to Use		Use 95% Student's-t UCL	3496

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (anthracene)

	General Statistics		
Number of Valid Data	20	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	15
		Percent Non-Detects	75.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	17	Minimum Detected	2.833
Maximum Detected	1200	Maximum Detected	7.09
Mean of Detected	269.6	Mean of Detected	4.223
SD of Detected	520.3	SD of Detected	1.671
Minimum Non-Detect	310	Minimum Non-Detect	5.737
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 5 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.581	Shapiro Wilk Test Statistic	0.808
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	263.4	Mean	4.988
SD	407.1	SD	1.029
95% DL/2 (t) UCL	420.8	95% H-Stat (DL/2) UCL	468.1
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.776
		SD in Log Scale	1.147
		Mean in Original Scale	108.7
		SD in Original Scale	260.6
		95% t UCL	209.5
		95% Percentile Bootstrap UCL	221.2
		95% BCA Bootstrap UCL	290.3
		95% H-UCL	178.5
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.32	**Data appear Lognormal at 5% Significance Level**	
Theta Star	841.9		
nu star	3.202		
A-D Test Statistic	0.86	**Nonparametric Statistics**	
5% A-D Critical Value	0.716	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.716	Mean	98.21
5% K-S Critical Value	0.373	SD	260.1
Data not Gamma Distributed at 5% Significance Level		SE of Mean	67.13
		95% KM (t) UCL	214.3
Assuming Gamma Distribution		95% KM (z) UCL	208.6
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	205.5
Minimum	0.000001	95% KM (bootstrap t) UCL	883
Maximum	1200	95% KM (BCA) UCL	252.8
Mean	161.5	95% KM (Percentile Bootstrap) UCL	225.1
Median	35.33	95% KM (Chebyshev) UCL	390.8
SD	296.2	97.5% KM (Chebyshev) UCL	517.4
k star	0.132	99% KM (Chebyshev) UCL	766.1
Theta star	1224		
Nu star	5.275	**Potential UCLs to Use**	
AppChi2	1.281	97.5% KM (Chebyshev) UCL	517.4
95% Gamma Approximate UCL (Use when n >= 40)	664.7		
95% Adjusted Gamma UCL (Use when n < 40)	750.8		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Result (arsenic)

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	16
Raw Statistics		**Log-transformed Statistics**	
Minimum	1.6	Minimum of Log Data	0.47
Maximum	13	Maximum of Log Data	2.565
Mean	3 99	Mean of log Data	1.254
Geometric Mean	3.503	SD of log Data	0.491
Median	3 15		
SD	2.52		
Std. Error of Mean	0 564		
Coefficient of Variation	0.632		
Skewness	2 61		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.729	Shapiro Wilk Test Statistic	0.95
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	4.964	95% H-UCL	4.955
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5 869
95% Adjusted-CLT UCL (Chen-1995)	5.268	97 5% Chebyshev (MVUE) UCL	6.711
95% Modified-t UCL (Johnson-1978)	5.019	99% Chebyshev (MVUE) UCL	8.363
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.433	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	1.162		
MLE of Mean	3.99		
MLE of Standard Deviation	2 154		
nu star	137.3		
Approximate Chi Square Value (.05)	111.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	4.917
Adjusted Chi Square Value	109.4	95% Jackknife UCL	4.964
		95% Standard Bootstrap UCL	4.901
Anderson-Darling Test Statistic	0 637	95% Bootstrap-t UCL	5.762
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	8.925
Kolmogorov-Smirnov Test Statistic	0 151	95% Percentile Bootstrap UCL	4.98
Kolmogorov-Smirnov 5% Critical Value	0.195	95% BCA Bootstrap UCL	5.175
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	6.446
		97.5% Chebyshev(Mean, Sd) UCL	7.509
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9.597
95% Approximate Gamma UCL (Use when n >= 40)	4.925		
95% Adjusted Gamma UCL (Use when n < 40)	5.009		
Potential UCL to Use		Use 95% Approximate Gamma UCL	4.925

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (barium)

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	17
Raw Statistics		**Log-transformed Statistics**	
Minimum	12	Minimum of Log Data	2.485
Maximum	340	Maximum of Log Data	5.829
Mean	65.65	Mean of log Data	3.82
Geometric Mean	45.59	SD of log Data	0.763
Median	40		
SD	79.27		
Std. Error of Mean	17 73		
Coefficient of Variation	1.207		
Skewness	2.818		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0 556	Shapiro Wilk Test Statistic	0.841
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	96.3	95% H-UCL	91.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	107.9
95% Adjusted-CLT UCL (Chen-1995)	106.7	97.5% Chebyshev (MVUE) UCL	128.6
95% Modified-t UCL (Johnson-1978)	98.16	99% Chebyshev (MVUE) UCL	169.4
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.322	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	49.65		
MLE of Mean	65.65		
MLE of Standard Deviation	57.09		
nu star	52.9		
Approximate Chi Square Value (05)	37.19	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	94.81
Adjusted Chi Square Value	36.15	95% Jackknife UCL	96.3
		95% Standard Bootstrap UCL	93.97
Anderson-Darling Test Statistic	2.347	95% Bootstrap-t UCL	152
Anderson-Darling 5% Critical Value	0.758	95% Hall's Bootstrap UCL	193 4
Kolmogorov-Smirnov Test Statistic	0 344	95% Percentile Bootstrap UCL	96.65
Kolmogorov-Smirnov 5% Critical Value	0.197	95% BCA Bootstrap UCL	110.5
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	142.9
		97.5% Chebyshev(Mean, Sd) UCL	176.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	242
95% Approximate Gamma UCL (Use when n >= 40)	93 38		
95% Adjusted Gamma UCL (Use when n < 40)	96.07		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	142.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (benzo[a]anthracene)

General Statistics

Number of Valid Data	20	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	6
		Percent Non-Detects	30.00%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	23	Minimum Detected	3.135
Maximum Detected	3300	Maximum Detected	8.102
Mean of Detected	312.4	Mean of Detected	4.406
SD of Detected	862.5	SD of Detected	1.302
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8 102

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.359	Shapiro Wilk Test Statistic	0.825
5% Shapiro Wilk Critical Value	0 874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	342.5	Mean	4 731
SD	779.7	SD	1.285
95% DL/2 (t) UCL	643.9	95% H-Stat (DL/2) UCL	640.9
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4 355
		SD in Log Scale	1.158
		Mean in Original Scale	245.6
		SD in Original Scale	722
		95% t UCL	524.7
		95% Percentile Bootstrap UCL	562
		95% BCA Bootstrap UCL	733
		95% H-UCL	326.4
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.423	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	738 2		
nu star	11 85		
A-D Test Statistic	2.176	**Nonparametric Statistics**	
5% A-D Critical Value	0 798	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.798	Mean	243.5
5% K-S Critical Value	0 242	SD	704.3
Data not Gamma Distributed at 5% Significance Level		SE of Mean	163.7
		95% KM (t) UCL	526.6
Assuming Gamma Distribution		95% KM (z) UCL	512.8
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	523.5
Minimum	0.000001	95% KM (bootstrap t) UCL	2511
Maximum	3300	95% KM (BCA) UCL	567.3
Mean	287	95% KM (Percentile Bootstrap) UCL	558.5
Median	65.07	95% KM (Chebyshev) UCL	957.2
SD	734.9	97.5% KM (Chebyshev) UCL	1266
k star	0.242	99% KM (Chebyshev) UCL	1873
Theta star	1186		
Nu star	9.679	**Potential UCLs to Use**	
AppChi2	3.742	97.5% KM (Chebyshev) UCL	1266
95% Gamma Approximate UCL (Use when n >= 40)	742.3		
95% Adjusted Gamma UCL (Use when n < 40)	804		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Result (benzo[a]pyrene)			
	General Statistics		
Number of Valid Data	20	Number of Detected Data	15
Number of Distinct Detected Data	15	Number of Non-Detect Data	5
		Percent Non-Detects	25.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	20	Minimum Detected	2.996
Maximum Detected	2800	Maximum Detected	7 937
Mean of Detected	265.7	Mean of Detected	4.358
SD of Detected	704.9	SD of Detected	1.274
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.366	Shapiro Wilk Test Statistic	0 849
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	314.8	Mean	4.66
SD	683.1	SD	1.306
95% DL/2 (t) UCL	578.9	95% H-Stat (DL/2) UCL	628.8
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.324
		SD in Log Scale	1.148
		Mean in Original Scale	220.4
		SD in Original Scale	611.1
		95% t UCL	456 6
		95% Percentile Bootstrap UCL	494.7
		95% BCA Bootstrap UCL	647.1
		95% H-UCL	309 7
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0 457	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	580.7		
nu star	13.72		
A-D Test Statistic	2.035	**Nonparametric Statistics**	
5% A-D Critical Value	0 792	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.792	Mean	227.6
5% K-S Critical Value	0.234	SD	610.5
Data not Gamma Distributed at 5% Significance Level		SE of Mean	145.3
		95% KM (t) UCL	478.7
Assuming Gamma Distribution		95% KM (z) UCL	466.5
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	477.3
Minimum	0.000001	95% KM (bootstrap t) UCL	1822
Maximum	2800	95% KM (BCA) UCL	525
Mean	248.3	95% KM (Percentile Bootstrap) UCL	504.5
Median	59	95% KM (Chebyshev) UCL	860.8
SD	617.6	97.5% KM (Chebyshev) UCL	1135
k star	0.249	99% KM (Chebyshev) UCL	1673
Theta star	997.4		
Nu star	9.957	**Potential UCLs to Use**	
AppChi2	3.915	97.5% KM (Chebyshev) UCL	1135
95% Gamma Approximate UCL (Use when n >= 40)	631.4		
95% Adjusted Gamma UCL (Use when n < 40)	682.9		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Result (benzo[b]fluoranthene)			
	General Statistics		
Number of Valid Data	20	Number of Detected Data	15
Number of Distinct Detected Data	15	Number of Non-Detect Data	5
		Percent Non-Detects	25.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	41	Minimum Detected	3.714
Maximum Detected	4800	Maximum Detected	8.476
Mean of Detected	478.9	Mean of Detected	5.034
SD of Detected	1205	SD of Detected	1.255
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.00%
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.382	Shapiro Wilk Test Statistic	0.858
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	474.7	Mean	5.167
SD	1078	SD	1.2
95% DL/2 (t) UCL	891.5	95% H-Stat (DL/2) UCL	808.6
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.92
		SD in Log Scale	1.132
		Mean in Original Scale	387.1
		SD in Original Scale	1047
		95% t UCL	792.1
		95% Percentile Bootstrap UCL	852.5
		95% BCA Bootstrap UCL	1099
		95% H-UCL	542.8
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.485	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	988.2		
nu star	14.54		
A-D Test Statistic	1.856	**Nonparametric Statistics**	
5% A-D Critical Value	0.789	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.789	Mean	387.1
5% K-S Critical Value	0.233	SD	1021
Data not Gamma Distributed at 5% Significance Level		SE of Mean	236.7
		95% KM (t) UCL	796.3
Assuming Gamma Distribution		95% KM (z) UCL	776.4
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	792.8
Minimum	0.000001	95% KM (bootstrap t) UCL	2852
Maximum	4800	95% KM (BCA) UCL	864.3
Mean	402.7	95% KM (Percentile Bootstrap) UCL	831.5
Median	115	95% KM (Chebyshev) UCL	1419
SD	1048	97.5% KM (Chebyshev) UCL	1865
k star	0.25	99% KM (Chebyshev) UCL	2742
Theta star	1613		
Nu star	9.986	**Potential UCLs to Use**	
AppChi2	3.933	97.5% KM (Chebyshev) UCL	1865
95% Gamma Approximate UCL (Use when n >= 40)	1022		
95% Adjusted Gamma UCL (Use when n < 40)	1106		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Result (benzo[g,h,i]perylene)			
General Statistics			
Number of Valid Data	20	Number of Detected Data	14
Number of Distinct Detected Data	13	Number of Non-Detect Data	6
		Percent Non-Detects	30.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	20	Minimum Detected	2.996
Maximum Detected	2200	Maximum Detected	7.696
Mean of Detected	225.5	Mean of Detected	4.239
SD of Detected	571.7	SD of Detected	1.271
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.383	Shapiro Wilk Test Statistic	0.834
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	281 6	Mean	4.614
SD	572 8	SD	1.297
95% DL/2 (t) UCL	503 1	95% H-Stat (DL/2) UCL	587.2
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.193
		SD in Log Scale	1.131
		Mean in Original Scale	180.8
		SD in Original Scale	479
		95% t UCL	366
		95% Percentile Bootstrap UCL	392.3
		95% BCA Bootstrap UCL	517.2
		95% H-UCL	261.4
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.467	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	483.2		
nu star	13.07		
A-D Test Statistic	1.9	**Nonparametric Statistics**	
5% A-D Critical Value	0.79	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.79	Mean	185.5
5% K-S Critical Value	0.241	SD	478.7
Data not Gamma Distributed at 5% Significance Level		SE of Mean	114.3
		95% KM (t) UCL	383.2
Assuming Gamma Distribution		95% KM (z) UCL	373.6
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	381.6
Minimum	0.000001	95% KM (bootstrap t) UCL	1415
Maximum	2200	95% KM (BCA) UCL	426.3
Mean	210.9	95% KM (Percentile Bootstrap) UCL	401.6
Median	66	95% KM (Chebyshev) UCL	683.8
SD	487.7	97.5% KM (Chebyshev) UCL	899.4
k star	0.254	99% KM (Chebyshev) UCL	1323
Theta star	829.3		
Nu star	10.17	**Potential UCLs to Use**	
AppChi2	4 051	97.5% KM (Chebyshev) UCL	899.4
95% Gamma Approximate UCL (Use when n >= 40)	529.8		
95% Adjusted Gamma UCL (Use when n < 40)	572.3		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Result (benzo[k]fluoranthene)

General Statistics			
Number of Valid Data	20	Number of Detected Data	15
Number of Distinct Detected Data	15	Number of Non-Detect Data	5
		Percent Non-Detects	25.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	36	Minimum Detected	3.584
Maximum Detected	4255	Maximum Detected	8.356
Mean of Detected	424.6	Mean of Detected	4.915
SD of Detected	1068	SD of Detected	1.254
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.00%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.382	Shapiro Wilk Test Statistic	0 859
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	434	Mean	5.078
SD	966.1	SD	1.211
95% DL/2 (t) UCL	807.5	95% H-Stat (DL/2) UCL	758 5
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.85
		SD in Log Scale	1.128
		Mean in Original Scale	349.8
		SD in Original Scale	927
		95% t UCL	708.2
		95% Percentile Bootstrap UCL	753.8
		95% BCA Bootstrap UCL	974.9
		95% H-UCL	500.6
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.485	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	875.6		
nu star	14.55		
A-D Test Statistic	1 856	**Nonparametric Statistics**	
5% A-D Critical Value	0.789	Kaplan-Meier (KM) Method	
K-S Test Statistic	0 789	Mean	350.9
5% K-S Critical Value	0.233	SD	904.1
Data not Gamma Distributed at 5% Significance Level		SE of Mean	209.7
		95% KM (t) UCL	713.5
Assuming Gamma Distribution		95% KM (z) UCL	695.9
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	710.5
Minimum	0.000001	95% KM (bootstrap t) UCL	2376
Maximum	4255	95% KM (BCA) UCL	772.2
Mean	380.6	95% KM (Percentile Bootstrap) UCL	750 3
Median	102	95% KM (Chebyshev) UCL	1265
SD	932.2	97.5% KM (Chebyshev) UCL	1661
k star	0.251	99% KM (Chebyshev) UCL	2438
Theta star	1518		
Nu star	10.03	**Potential UCLs to Use**	
AppChi2	3 96	97.5% KM (Chebyshev) UCL	1661
95% Gamma Approximate UCL (Use when n >= 40)	963.9		
95% Adjusted Gamma UCL (Use when n < 40)	1042		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Result (beryllium)

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	14
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.096	Minimum of Log Data	-2.343
Maximum	0.5	Maximum of Log Data	-0.693
Mean	*0.221*	*Mean of log Data*	*-1.61*
Geometric Mean	0.2	SD of log Data	0.455
Median	0.2		
SD	0.104		
Std Error of Mean	0.0233		
Coefficient of Variation	0.472		
Skewness	1.142		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.895	Shapiro Wilk Test Statistic	0.959
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.261	95% H-UCL	0.272
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.321
95% Adjusted-CLT UCL (Chen-1995)	0.265	97.5% Chebyshev (MVUE) UCL	0.365
95% Modified-t UCL (Johnson-1978)	0.262	99% Chebyshev (MVUE) UCL	0.45
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.476	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	0.0493		
MLE of Mean	0.221		
MLE of Standard Deviation	0.104		
nu star	179		
Approximate Chi Square Value (.05)	149.1	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	0.259
Adjusted Chi Square Value	146.9	95% Jackknife UCL	0.261
		95% Standard Bootstrap UCL	0.257
Anderson-Darling Test Statistic	0.424	95% Bootstrap-t UCL	0.27
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	0.275
Kolmogorov-Smirnov Test Statistic	0.179	95% Percentile Bootstrap UCL	0.26
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL	0.261
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.322
		97.5% Chebyshev(Mean, Sd) UCL	0.366
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.452
95% Approximate Gamma UCL (Use when n >= 40)	0.265		
95% Adjusted Gamma UCL (Use when n < 40)	0.269		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.265

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (bis(2-ethylhexyl) phthalate)

General Statistics			
Number of Valid Data	20	Number of Detected Data	7
Number of Distinct Detected Data	6	Number of Non-Detect Data	13
		Percent Non-Detects	65.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	46	Minimum Detected	3.829
Maximum Detected	94	Maximum Detected	4.543
Mean of Detected	64.71	Mean of Detected	4.148
SD of Detected	15.27	SD of Detected	0.225
Minimum Non-Detect	110	Minimum Non-Detect	4.7
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
Warning: There are only 7 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.916	Shapiro Wilk Test Statistic	0.96
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	197.9	Mean	4.826
SD	345.5	SD	0.784
95% DL/2 (t) UCL	331.5	95% H-Stat (DL/2) UCL	258.3
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.148
		SD in Log Scale	0.194
		Mean in Original Scale	64.44
		SD in Original Scale	12.82
		95% t UCL	69.4
		95% Percentile Bootstrap UCL	69.08
		95% BCA Bootstrap UCL	69.23
		95% H-UCL	69.83
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	12.98	**Data appear Normal at 5% Significance Level**	
Theta Star	4.984		
nu star	181.8		
A-D Test Statistic	0.292	**Nonparametric Statistics**	
5% A-D Critical Value	0.707	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.707	Mean	64.71
5% K-S Critical Value	0.311	SD	14.14
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	5.772
		95% KM (t) UCL	74.7
Assuming Gamma Distribution		95% KM (z) UCL	74.21
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	75.22
Minimum	40.26	95% KM (bootstrap t) UCL	79.83
Maximum	94	95% KM (BCA) UCL	74.38
Mean	65.07	95% KM (Percentile Bootstrap) UCL	75.17
Median	66.12	95% KM (Chebyshev) UCL	89.88
SD	12.55	97.5% KM (Chebyshev) UCL	100.8
k star	23.27	99% KM (Chebyshev) UCL	122.1
Theta star	2.796		
Nu star	930.7	**Potential UCLs to Use**	
AppChi2	860.9	95% KM (t) UCL	74.7
95% Gamma Approximate UCL (Use when n >= 40)	70.34	95% KM (Percentile Bootstrap) UCL	75.17
95% Adjusted Gamma UCL (Use when n < 40)	70.78		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Result (cadmium)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	16
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.083	Minimum of Log Data	-2.489
Maximum	1.5	Maximum of Log Data	0.405
Mean	0 432	Mean of log Data	-1.181
Geometric Mean	0.307	SD of log Data	0.833
Median	0.25		
SD	0.394		
Std Error of Mean	0 088		
Coefficient of Variation	0 911		
Skewness	1.564		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.799	Shapiro Wilk Test Statistic	0.956
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0 905
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0 584	95% H-UCL	0.688
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.801
95% Adjusted-CLT UCL (Chen-1995)	0.61	97.5% Chebyshev (MVUE) UCL	0.964
95% Modified-t UCL (Johnson-1978)	0.59	99% Chebyshev (MVUE) UCL	1.283
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.4	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	0.309		
MLE of Mean	0 432		
MLE of Standard Deviation	0.365		
nu star	56		
Approximate Chi Square Value (.05)	39.8	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	0.577
Adjusted Chi Square Value	38.72	95% Jackknife UCL	0.584
		95% Standard Bootstrap UCL	0.575
Anderson-Darling Test Statistic	0.646	95% Bootstrap-t UCL	0.655
Anderson-Darling 5% Critical Value	0 757	95% Hall's Bootstrap UCL	0.641
Kolmogorov-Smirnov Test Statistic	0 191	95% Percentile Bootstrap UCL	0.58
Kolmogorov-Smirnov 5% Critical Value	0.197	95% BCA Bootstrap UCL	0.604
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.816
		97.5% Chebyshev(Mean, Sd) UCL	0.982
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1.308
95% Approximate Gamma UCL (Use when n >= 40)	0.608		
95% Adjusted Gamma UCL (Use when n < 40)	0.625		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.608
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Result (calcium)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	20
Raw Statistics		**Log-transformed Statistics**	
Minimum	2400	Minimum of Log Data	7.783
Maximum	170000	Maximum of Log Data	12.04
Mean	51905	Mean of log Data	9.969
Geometric Mean	21354	SD of log Data	1.517
Median	24000		
SD	59071		
Std. Error of Mean	13209		
Coefficient of Variation	1.138		
Skewness	0.995		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0 796	Shapiro Wilk Test Statistic	0 904
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	74745	95% H-UCL	224526
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	167758
95% Adjusted-CLT UCL (Chen-1995)	76770	97.5% Chebyshev (MVUE) UCL	214147
95% Modified-t UCL (Johnson-1978)	75234	99% Chebyshev (MVUE) UCL	305270
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0 614	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	84573		
MLE of Mean	51905		
MLE of Standard Deviation	66255		
nu star	24.55		
Approximate Chi Square Value (.05)	14.27	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	73631
Adjusted Chi Square Value	13.65	95% Jackknife UCL	74745
		95% Standard Bootstrap UCL	73235
Anderson-Darling Test Statistic	0 768	95% Bootstrap-t UCL	81233
Anderson-Darling 5% Critical Value	0.786	95% Hall's Bootstrap UCL	73927
Kolmogorov-Smirnov Test Statistic	0.177	95% Percentile Bootstrap UCL	73835
Kolmogorov-Smirnov 5% Critical Value	0.202	95% BCA Bootstrap UCL	75285
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	109480
		97.5% Chebyshev(Mean, Sd) UCL	134393
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	183330
95% Approximate Gamma UCL (Use when n >= 40)	89313		
95% Adjusted Gamma UCL (Use when n < 40)	93360		
Potential UCL to Use		Use 95% Approximate Gamma UCL	89313
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Result (chromium)			
	General Statistics		
Number of Valid Observations	20	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	5	Minimum of Log Data	1.609
Maximum	280	Maximum of Log Data	5.635
Mean	45.09	Mean of log Data	3.104
Geometric Mean	22.29	SD of log Data	1.079
Median	20		
SD	73.85		
Std. Error of Mean	16.51		
Coefficient of Variation	1.638		
Skewness	2 733		
	Relevant UCL Statistics		
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.534	Shapiro Wilk Test Statistic	0.905
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	73.64	95% H-UCL	78.87
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	83.78
95% Adjusted-CLT UCL (Chen-1995)	83.04	97.5% Chebyshev (MVUE) UCL	103.5
95% Modified-t UCL (Johnson-1978)	75.33	99% Chebyshev (MVUE) UCL	142 2
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.745	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	60.52		
MLE of Mean	45.09		
MLE of Standard Deviation	52.24		
nu star	29.8		
Approximate Chi Square Value (.05)	18.34	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	72.25
Adjusted Chi Square Value	17.63	95% Jackknife UCL	73.64
		95% Standard Bootstrap UCL	72.67
Anderson-Darling Test Statistic	1.658	95% Bootstrap-t UCL	168.6
Anderson-Darling 5% Critical Value	0.775	95% Hall's Bootstrap UCL	210.6
Kolmogorov-Smirnov Test Statistic	0.256	95% Percentile Bootstrap UCL	74.25
Kolmogorov-Smirnov 5% Critical Value	0.201	95% BCA Bootstrap UCL	88.51
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	117.1
		97.5% Chebyshev(Mean, Sd) UCL	148.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	209.4
95% Approximate Gamma UCL (Use when n >= 40)	73.28		
95% Adjusted Gamma UCL (Use when n < 40)	76 23		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	117 1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (chrysene)			
	General Statistics		
Number of Valid Data	20	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	7
		Percent Non-Detects	35.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	29	Minimum Detected	3.367
Maximum Detected	3300	Maximum Detected	8.102
Mean of Detected	351.4	Mean of Detected	4.669
SD of Detected	889.8	SD of Detected	1.266
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods).		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.00%
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.387	Shapiro Wilk Test Statistic	0.84
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	360.4	Mean	4.937
SD	774.4	SD	1.18
95% DL/2 (t) UCL	659.8	95% H-Stat (DL/2) UCL	613.6
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.604
		SD in Log Scale	1.114
		Mean in Original Scale	269.4
		SD in Original Scale	718.3
		95% t UCL	547.2
		95% Percentile Bootstrap UCL	576.4
		95% BCA Bootstrap UCL	760.1
		95% H-UCL	380.3
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.457	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	768.1		
nu star	11.89		
A-D Test Statistic	1.869	**Nonparametric Statistics**	
5% A-D Critical Value	0.788	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.788	Mean	265.4
5% K-S Critical Value	0.249	SD	700.8
Data not Gamma Distributed at 5% Significance Level		SE of Mean	163.7
		95% KM (t) UCL	548.5
Assuming Gamma Distribution		95% KM (z) UCL	534.7
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	544.7
Minimum	0.000001	95% KM (bootstrap t) UCL	2008
Maximum	3300	95% KM (BCA) UCL	598.1
Mean	323.2	95% KM (Percentile Bootstrap) UCL	583.9
Median	80	95% KM (Chebyshev) UCL	979.1
SD	739	97.5% KM (Chebyshev) UCL	1288
k star	0.205	99% KM (Chebyshev) UCL	1894
Theta star	1579		
Nu star	8.185	**Potential UCLs to Use**	
AppChi2	2.843	97.5% KM (Chebyshev) UCL	1288
95% Gamma Approximate UCL (Use when n >= 40)	930.6		
95% Adjusted Gamma UCL (Use when n < 40)	1018		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Result (cobalt)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	1.4	Minimum of Log Data	0.336
Maximum	5.4	Maximum of Log Data	1.686
Mean	3.58	Mean of log Data	1.176
Geometric Mean	3.242	SD of log Data	0.482
Median	3.8		
SD	1.473		
Std. Error of Mean	0.329		
Coefficient of Variation	0.411		
Skewness	-0.262		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Test Statistic	0.856
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	4.149	95% H-UCL	4.543
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5.376
95% Adjusted-CLT UCL (Chen-1995)	4.101	97.5% Chebyshev (MVUE) UCL	6 136
95% Modified-t UCL (Johnson-1978)	4 146	99% Chebyshev (MVUE) UCL	7 631
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.449	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	0.805		
MLE of Mean	3.58		
MLE of Standard Deviation	1.697		
nu star	178		
Approximate Chi Square Value (.05)	148.1	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	4.122
Adjusted Chi Square Value	146	95% Jackknife UCL	4.149
		95% Standard Bootstrap UCL	4.106
Anderson-Darling Test Statistic	1.056	95% Bootstrap-t UCL	4.129
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	4.089
Kolmogorov-Smirnov Test Statistic	0.186	95% Percentile Bootstrap UCL	4.085
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL	4.06
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5.015
		97.5% Chebyshev(Mean, Sd) UCL	5.637
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	6.857
95% Approximate Gamma UCL (Use when n >= 40)	4.302		
95% Adjusted Gamma UCL (Use when n < 40)	4 365		
Potential UCL to Use		Use 95% Approximate Gamma UCL	4.302

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits
(e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide
adjustments for positively skewed data sets.

Result (copper)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	4.4	Minimum of Log Data	1.482
Maximum	79	Maximum of Log Data	4.369
Mean	20.55	Mean of log Data	2.699
Geometric Mean	14.86	SD of log Data	0.812
Median	15		
SD	18.54		
Std. Error of Mean	4.145		
Coefficient of Variation	0.902		
Skewness	1.898		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.789	Shapiro Wilk Test Statistic	0.953
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	27.71	95% H-UCL	32.18
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	37.65
95% Adjusted-CLT UCL (Chen-1995)	29.24	97.5% Chebyshev (MVUE) UCL	45.18
95% Modified-t UCL (Johnson-1978)	28.01	99% Chebyshev (MVUE) UCL	59.97
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.471	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	13.97		
MLE of Mean	20.55		
MLE of Standard Deviation	16.94		
nu star	58 82		
Approximate Chi Square Value (.05)	42.19	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	27 36
Adjusted Chi Square Value	41.08	95% Jackknife UCL	27 71
		95% Standard Bootstrap UCL	27.31
Anderson-Darling Test Statistic	0.554	95% Bootstrap-t UCL	30.52
Anderson-Darling 5% Critical Value	0.756	95% Hall's Bootstrap UCL	32.65
Kolmogorov-Smirnov Test Statistic	0 164	95% Percentile Bootstrap UCL	27.68
Kolmogorov-Smirnov 5% Critical Value	0.197	95% BCA Bootstrap UCL	29.72
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	38.61
		97.5% Chebyshev(Mean, Sd) UCL	46.43
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	61.79
95% Approximate Gamma UCL (Use when n >= 40)	28.65		
95% Adjusted Gamma UCL (Use when n < 40)	29.42		
Potential UCL to Use		Use 95% Approximate Gamma UCL	28.65

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (fluoranthene)			
	General Statistics		
Number of Valid Data	20	Number of Detected Data	15
Number of Distinct Detected Data	14	Number of Non-Detect Data	5
		Percent Non-Detects	25.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	43	Minimum Detected	3.761
Maximum Detected	5800	Maximum Detected	8.666
Mean of Detected	531 5	Mean of Detected	4.968
SD of Detected	1465	SD of Detected	1.293
Minimum Non-Detect	330	Minimum Non-Detect	5 799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.00%
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.358	Shapiro Wilk Test Statistic	0.824
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	514.1	Mean	5.117
SD	1294	SD	1.236
95% DL/2 (t) UCL	1014	95% H-Stat (DL/2) UCL	836.1
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.877
		SD in Log Scale	1.161
		Mean in Original Scale	427.8
		SD in Original Scale	1271
		95% t UCL	919.3
		95% Percentile Bootstrap UCL	981.9
		95% BCA Bootstrap UCL	1333
		95% H-UCL	554
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.434	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	1223		
nu star	13 03		
A-D Test Statistic	2.233	**Nonparametric Statistics**	
5% A-D Critical Value	0.796	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.796	Mean	426.5
5% K-S Critical Value	0.234	SD	1240
Data not Gamma Distributed at 5% Significance Level		SE of Mean	287 1
		95% KM (t) UCL	922.9
Assuming Gamma Distribution		95% KM (z) UCL	898.7
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	918.6
Minimum	0.000001	95% KM (bootstrap t) UCL	4465
Maximum	5800	95% KM (BCA) UCL	991.3
Mean	453.4	95% KM (Percentile Bootstrap) UCL	990.5
Median	120.9	95% KM (Chebyshev) UCL	1678
SD	1273	97.5% KM (Chebyshev) UCL	2219
k star	0.24	99% KM (Chebyshev) UCL	3283
Theta star	1889		
Nu star	9.601	**Potential UCLs to Use**	
AppChi2	3 694	97.5% KM (Chebyshev) UCL	2219
95% Gamma Approximate UCL (Use when n >= 40)	1178		
95% Adjusted Gamma UCL (Use when n < 40)	1277		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Result (Indeno[1,2,3-cd]pyrene)

General Statistics			
Number of Valid Data	20	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	8
		Percent Non-Detects	40.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	23	Minimum Detected	3.135
Maximum Detected	2300	Maximum Detected	7.741
Mean of Detected	259.6	Mean of Detected	4.337
SD of Detected	644.9	SD of Detected	1.309
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note. Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0 399	Shapiro Wilk Test Statistic	0 828
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	296	Mean	4.759
SD	586.9	SD	1.232
95% DL/2 (t) UCL	522.9	95% H-Stat (DL/2) UCL	579.6
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.257
		SD in Log Scale	1.137
		Mean in Original Scale	190.3
		SD in Original Scale	500.4
		95% t UCL	383.7
		95% Percentile Bootstrap UCL	403.9
		95% BCA Bootstrap UCL	523.6
		95% H-UCL	282 6
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.443	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	585 6		
nu star	10.64		
A-D Test Statistic	1.711	**Nonparametric Statistics**	
5% A-D Critical Value	0.784	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.784	Mean	191.2
5% K-S Critical Value	0 258	SD	499.9
Data not Gamma Distributed at 5% Significance Level		SE of Mean	120.2
		95% KM (t) UCL	399 1
Assuming Gamma Distribution		95% KM (z) UCL	389
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	396.2
Minimum	0.000001	95% KM (bootstrap t) UCL	1553
Maximum	2300	95% KM (BCA) UCL	437.3
Mean	238.8	95% KM (Percentile Bootstrap) UCL	417.9
Median	72.54	95% KM (Chebyshev) UCL	715.3
SD	519.7	97.5% KM (Chebyshev) UCL	942.1
k star	0.207	99% KM (Chebyshev) UCL	1387
Theta star	1153		
Nu star	8.285	**Potential UCLs to Use**	
AppChi2	2.901	97.5% KM (Chebyshev) UCL	942.1
95% Gamma Approximate UCL (Use when n >= 40)	682		
95% Adjusted Gamma UCL (Use when n < 40)	745.4		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Result (Iron)			
	General Statistics		
Number of Valid Observations	20	Number of Distinct Observations	15
Raw Statistics		**Log-transformed Statistics**	
Minimum	5400	Minimum of Log Data	8 594
Maximum	29000	Maximum of Log Data	10.28
Mean	10800	Mean of log Data	9.201
Geometric Mean	9902	SD of log Data	0.407
Median	9950		
SD	5318		
Std. Error of Mean	1189		
Coefficient of Variation	0 492		
Skewness	2.263		
	Relevant UCL Statistics		
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.781	Shapiro Wilk Test Statistic	0.948
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0 905
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	12856	95% H-UCL	12882
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15056
95% Adjusted-CLT UCL (Chen-1995)	13399	97.5% Chebyshev (MVUE) UCL	16937
95% Modified-t UCL (Johnson-1978)	12957	99% Chebyshev (MVUE) UCL	20633
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	5 068	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	2131		
MLE of Mean	10800		
MLE of Standard Deviation	4797		
nu star	202 7		
Approximate Chi Square Value (.05)	170.8	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	12756
Adjusted Chi Square Value	168.5	95% Jackknife UCL	12856
		95% Standard Bootstrap UCL	12735
Anderson-Darling Test Statistic	0.532	95% Bootstrap-t UCL	14007
Anderson-Darling 5% Critical Value	0 745	95% Hall's Bootstrap UCL	21332
Kolmogorov-Smirnov Test Statistic	0 169	95% Percentile Bootstrap UCL	12900
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL	13375
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	15984
		97 5% Chebyshev(Mean, Sd) UCL	18227
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	22632
95% Approximate Gamma UCL (Use when n >= 40)	12820		
95% Adjusted Gamma UCL (Use when n < 40)	12996		
Potential UCL to Use		Use 95% Approximate Gamma UCL	12820

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (lead)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	20
Raw Statistics		**Log-transformed Statistics**	
Minimum	5.5	Minimum of Log Data	1.705
Maximum	1100	Maximum of Log Data	7.003
Mean	139.4	Mean of log Data	3.647
Geometric Mean	38.37	SD of log Data	1.484
Median	37.5		
SD	304.4		
Std. Error of Mean	68.06		
Coefficient of Variation	2.184		
Skewness	2.855		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.458	Shapiro Wilk Test Statistic	0.914
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	257.1	95% H-UCL	367.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	284.4
95% Adjusted-CLT UCL (Chen-1995)	297.7	97.5% Chebyshev (MVUE) UCL	362.4
95% Modified-t UCL (Johnson-1978)	264.3	99% Chebyshev (MVUE) UCL	515.5
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.453	**Data appear Lognormal at 5% Significance Level**	
Theta Star	307.8		
MLE of Mean	139.4		
MLE of Standard Deviation	207.1		
nu star	18 11		
Approximate Chi Square Value (.05)	9.47	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	251.3
Adjusted Chi Square Value	8.978	95% Jackknife UCL	257.1
		95% Standard Bootstrap UCL	248.3
Anderson-Darling Test Statistic	1.857	95% Bootstrap-t UCL	1037
Anderson-Darling 5% Critical Value	0 804	95% Hall's Bootstrap UCL	868.3
Kolmogorov-Smirnov Test Statistic	0.258	95% Percentile Bootstrap UCL	255.9
Kolmogorov-Smirnov 5% Critical Value	0.205	95% BCA Bootstrap UCL	314.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	436
		97.5% Chebyshev(Mean, Sd) UCL	564.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	816 6
95% Approximate Gamma UCL (Use when n >= 40)	266.5		
95% Adjusted Gamma UCL (Use when n < 40)	281.1		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	436
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Result (magnesium)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	1900	Minimum of Log Data	7.55
Maximum	85000	Maximum of Log Data	11.35
Mean	28045	Mean of log Data	9.37
Geometric Mean	11733	SD of log Data	1.492
Median	12450		
SD	30751		
Std Error of Mean	6876		
Coefficient of Variation	1.097		
Skewness	0.785		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.794	Shapiro Wilk Test Statistic	0.85
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0 905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	39935	95% H-UCL	114830
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	88149
95% Adjusted-CLT UCL (Chen-1995)	40645	97.5% Chebyshev (MVUE) UCL	112356
95% *Modified-t* UCL (*Johnson-1978*)	40136	99% Chebyshev (MVUE) UCL	159906
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.624	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	44978		
MLE of Mean	28045		
MLE of Standard Deviation	35516		
nu star	24.94		
Approximate Chi Square Value (.05)	14.57	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	39355
Adjusted Chi Square Value	13.94	95% Jackknife UCL	39935
		95% Standard Bootstrap UCL	39128
Anderson-Darling Test Statistic	1.205	95% Bootstrap-t UCL	41537
Anderson-Darling 5% Critical Value	0.785	95% Hall's Bootstrap UCL	39815
Kolmogorov-Smirnov Test Statistic	0.227	95% Percentile Bootstrap UCL	39785
Kolmogorov-Smirnov 5% Critical Value	0.202	95% BCA Bootstrap UCL	40390
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	58018
		97.5% Chebyshev(Mean, Sd) UCL	70987
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	96462
95% Approximate Gamma UCL (Use when n >= 40)	48019		
95% Adjusted Gamma UCL (Use when n < 40)	50174		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	58018

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (manganese)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	17
Raw Statistics		**Log-transformed Statistics**	
Minimum	87	Minimum of Log Data	4.466
Maximum	630	Maximum of Log Data	6.446
Mean	348.9	Mean of log Data	5.789
Geometric Mean	326.8	SD of log Data	0.409
Median	370		
SD	113.2		
Std. Error of Mean	25.32		
Coefficient of Variation	0.325		
Skewness	0.00487		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Test Statistic	0.841
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	392.6	95% H-UCL	426 2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	498.4
95% Adjusted-CLT UCL (Chen-1995)	390 5	97.5% Chebyshev (MVUE) UCL	561
95% Modified-t UCL (Johnson-1978)	392.6	99% Chebyshev (MVUE) UCL	684
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	6.677	**Data appear Normal at 5% Significance Level**	
Theta Star	52.24		
MLE of Mean	348.9		
MLE of Standard Deviation	135		
nu star	267.1		
Approximate Chi Square Value (.05)	230.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	390.5
Adjusted Chi Square Value	227.5	95% Jackknife UCL	392 6
		95% Standard Bootstrap UCL	388.2
Anderson-Darling Test Statistic	0.744	95% Bootstrap-t UCL	393.8
Anderson-Darling 5% Critical Value	0.743	95% Hall's Bootstrap UCL	397
Kolmogorov-Smirnov Test Statistic	0.182	95% Percentile Bootstrap UCL	390
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL	389.4
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	459.2
		97.5% Chebyshev(Mean, Sd) UCL	506.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	600.7
95% Approximate Gamma UCL (Use when n >= 40)	404.7		
95% Adjusted Gamma UCL (Use when n < 40)	409.5		
Potential UCL to Use		Use 95% Student's-t UCL	392.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (mercury)			
	General Statistics		
Number of Valid Data	20	Number of Detected Data	17
Number of Distinct Detected Data	17	Number of Non-Detect Data	3
		Percent Non-Detects	15.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.005	Minimum Detected	-5.298
Maximum Detected	0.14	Maximum Detected	-1.966
Mean of Detected	0.04	Mean of Detected	-3.796
SD of Detected	0.044	SD of Detected	1.113
Minimum Non-Detect	0.015	Minimum Non-Detect	-4.2
Maximum Non-Detect	0.017	Maximum Non-Detect	-4.075
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	11
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	55.00%
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.77	Shapiro Wilk Test Statistic	0.921
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0352	Mean	-3.951
SD	0.0421	SD	1.089
95% DL/2 (t) UCL	0.0514	95% H-Stat (DL/2) UCL	0.0695
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.00686	Mean in Log Scale	-3.931
SD	0.0699	SD in Log Scale	1.073
95% MLE (t) UCL	0.0339	Mean in Original Scale	0.0353
95% MLE (Tiku) UCL	0.0423	SD in Original Scale	0.0419
		95% t UCL	0.0515
		95% Percentile Bootstrap UCL	0.0512
		95% BCA Bootstrap UCL	0.0533
		95% H UCL	0.0686
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.864	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	0.0462		
nu star	29.38		
A-D Test Statistic	0.807	**Nonparametric Statistics**	
5% A-D Critical Value	0.766	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.766	Mean	0.0353
5% K-S Critical Value	0.215	SD	0.0409
Data follow Appr. Gamma Distribution at 5% Significance Level		SE of Mean	0.00944
.		95% KM (t) UCL	0.0516
Assuming Gamma Distribution		95% KM (z) UCL	0.0508
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0515
Minimum	0.0008181	95% KM (bootstrap t) UCL	0.0578
Maximum	0.14	95% KM (BCA) UCL	0.0511
Mean	0.0344	95% KM (Percentile Bootstrap) UCL	0.0504
Median	0.0145	95% KM (Chebyshev) UCL	0.0764
SD	0.0426	97.5% KM (Chebyshev) UCL	0.0942
k star	0.702	99% KM (Chebyshev) UCL	0.129
Theta star	0.0491		
Nu star	28.08	**Potential UCLs to Use**	
AppChi2	16.99	95% KM (Chebyshev) UCL	0.0764
95% Gamma Approximate UCL (Use when n >= 40)	0.0569		
95% Adjusted Gamma UCL (Use when n < 40)	0.0593		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Result (nickel)

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	14
Raw Statistics		**Log-transformed Statistics**	
Minimum	6	Minimum of Log Data	1.792
Maximum	46	Maximum of Log Data	3 829
Mean	13 23	Mean of log Data	2.468
Geometric Mean	11 8	SD of log Data	0.444
Median	11		
SD	8.465		
Std. Error of Mean	1.893		
Coefficient of Variation	0.64		
Skewness	3 311		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.62	Shapiro Wilk Test Statistic	0.894
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Cntical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	16 5	95% H-UCL	15.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	18.71
95% Adjusted-CLT UCL (Chen-1995)	17.84	97.5% Chebyshev (MVUE) UCL	21.2
95% Modified-t UCL (Johnson-1978)	16.73	99% Chebyshev (MVUE) UCL	26.1
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.886	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	3.403		
MLE of Mean	13 23		
MLE of Standard Deviation	6.709		
nu star	155.4		
Approximate Chi Square Value (.05)	127.6	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	16.34
Adjusted Chi Square Value	125.6	95% Jackknife UCL	16.5
		95% Standard Bootstrap UCL	16.31
Anderson-Darling Test Statistic	1 04	95% Bootstrap-t UCL	20.28
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	29.78
Kolmogorov-Smirnov Test Statistic	0.184	95% Percentile Bootstrap UCL	16.55
Kolmogorov-Smirnov 5% Critical Value	0.195	95% BCA Bootstrap UCL	18.17
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	21.48
		97.5% Chebyshev(Mean, Sd) UCL	25.05
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	32.06
95% Approximate Gamma UCL (Use when n >= 40)	16.11		
95% Adjusted Gamma UCL (Use when n < 40)	16.36		
Potential UCL to Use		Use 95% Approximate Gamma UCL	16 11

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (phenanthrene)			
	General Statistics		
Number of Valid Data	20	Number of Detected Data	15
Number of Distinct Detected Data	13	Number of Non-Detect Data	5
		Percent Non-Detects	25.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	22	Minimum Detected	3.091
Maximum Detected	4300	Maximum Detected	8.366
Mean of Detected	373.8	Mean of Detected	4.409
SD of Detected	1090	SD of Detected	1.401
Minimum Non-Detect	310	Minimum Non-Detect	5.737
Maximum Non-Detect	3300	Maximum Non-Detect	8.102
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.00%
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.348	Shapiro Wilk Test Statistic	0.833
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	395.4	Mean	4.695
SD	985	SD	1 39
95% DL/2 (t) UCL	776.2	95% H-Stat (DL/2) UCL	807.7
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.36
		SD in Log Scale	1.239
		Mean in Original Scale	300
		SD in Original Scale	945.2
		95% t UCL	665.4
		95% Percentile Bootstrap UCL	717.1
		95% BCA Bootstrap UCL	954.3
		95% H-UCL	395
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0 388	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	963.2		
nu star	11.64		
A-D Test Statistic	2.254	**Nonparametric Statistics**	
5% A-D Critical Value	0.808	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.808	Mean	302.6
5% K-S Critical Value	0.236	SD	921.4
Data not Gamma Distributed at 5% Significance Level		SE of Mean	213.6
		95% KM (t) UCL	672
Assuming Gamma Distribution		95% KM (z) UCL	654
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	668.8
Minimum	0.000001	95% KM (bootstrap t) UCL	3214
Maximum	4300	95% KM (BCA) UCL	734.2
Mean	319 8	95% KM (Percentile Bootstrap) UCL	722.4
Median	49.35	95% KM (Chebyshev) UCL	1234
SD	950 6	97 5% KM (Chebyshev) UCL	1636
k star	0.229	99% KM (Chebyshev) UCL	2428
Theta star	1396		
Nu star	9.162	**Potential UCLs to Use**	
AppChi2	3.425	97.5% KM (Chebyshev) UCL	1636
95% Gamma Approximate UCL (Use when n >= 40)	855.5		
95% Adjusted Gamma UCL (Use when n < 40)	929.5		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Result (phenol)			
	General Statistics		
Number of Valid Observations	20	Number of Distinct Observations	16
Raw Statistics		**Log-transformed Statistics**	
Minimum	19	Minimum of Log Data	2 944
Maximum	410	Maximum of Log Data	6.016
Mean	50 65	Mean of log Data	3.536
Geometric Mean	34.34	SD of log Data	0 664
Median	31.5		
SD	85 24		
Std. Error of Mean	19 06		
Coefficient of Variation	1.683		
Skewness	4.359		
	Relevant UCL Statistics		
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.339	Shapiro Wilk Test Statistic	0 688
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	83.61	95% H-UCL	59.82
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	71.3
95% Adjusted-CLT UCL (Chen-1995)	101.9	97.5% Chebyshev (MVUE) UCL	83.86
95% Modified-t UCL (Johnson-1978)	86 71	99% Chebyshev (MVUE) UCL	108.5
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.249	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	40.54		
MLE of Mean	50.65		
MLE of Standard Deviation	45.31		
nu star	49.97		
Approximate Chi Square Value (.05)	34.74	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	82
Adjusted Chi Square Value	33.74	95% Jackknife UCL	83.61
		95% Standard Bootstrap UCL	81 51
Anderson-Darling Test Statistic	3.241	95% Bootstrap-t UCL	262.5
Anderson-Darling 5% Critical Value	0.759	95% Hall's Bootstrap UCL	220 6
Kolmogorov-Smirnov Test Statistic	0.323	95% Percentile Bootstrap UCL	87 25
Kolmogorov-Smirnov 5% Critical Value	0.198	95% BCA Bootstrap UCL	109.3
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	133.7
		97.5% Chebyshev(Mean, Sd) UCL	169.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	240.3
95% Approximate Gamma UCL (Use when n >= 40)	72 86		
95% Adjusted Gamma UCL (Use when n < 40)	75.02		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	133.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (potassium)			
	General Statistics		
Number of Valid Observations	20	Number of Distinct Observations	15
Raw Statistics		**Log-transformed Statistics**	
Minimum	170	Minimum of Log Data	5.136
Maximum	510	Maximum of Log Data	6.234
Mean	335.5	Mean of log Data	5.767
Geometric Mean	319.6	SD of log Data	0.328
Median	320		
SD	102.7		
Std. Error of Mean	22.96		
Coefficient of Variation	0.306		
Skewness	0.0209		
	Relevant UCL Statistics		
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Test Statistic	0.935
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		***Data appear Lognormal at 5% Significance Level***	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	375.2	95% H-UCL	388.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	445.7
95% Adjusted-CLT UCL (Chen-1995)	373.4	97.5% Chebyshev (MVUE) UCL	493.1
95% Modified-t UCL (Johnson-1978)	375.2	99% Chebyshev (MVUE) UCL	586
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	8 919	**Data appear Normal at 5% Significance Level**	
Theta Star	37.62		
MLE of Mean	335.5		
MLE of Standard Deviation	112.3		
nu star	356.8		
Approximate Chi Square Value (05)	314	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	373.3
Adjusted Chi Square Value	310.8	95% Jackknife UCL	375.2
		95% Standard Bootstrap UCL	372.4
Anderson-Darling Test Statistic	0.428	95% Bootstrap-t UCL	375.8
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL	375
Kolmogorov-Smirnov Test Statistic	0.126	95% Percentile Bootstrap UCL	374
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL	373.5
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	435 6
		97.5% Chebyshev(Mean, Sd) UCL	478.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	563.9
95% Approximate Gamma UCL (Use when n >= 40)	381.2		
95% Adjusted Gamma UCL (Use when n < 40)	385.1		
Potential UCL to Use		Use 95% Student's-t UCL	375.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Result (pyrene)

General Statistics

Number of Valid Data	20	Number of Detected Data	19
Number of Distinct Detected Data	17	Number of Non-Detect Data	1
		Percent Non-Detects	5.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	15	Minimum Detected	2.708
Maximum Detected	6100	Maximum Detected	8.716
Mean of Detected	440.1	Mean of Detected	4.61
SD of Detected	1377	SD of Detected	1.378
Minimum Non-Detect	330	Minimum Non-Detect	5.799
Maximum Non-Detect	330	Maximum Non-Detect	5.799

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.312	Shapiro Wilk Test Statistic	0.899
5% Shapiro Wilk Critical Value	0.901	5% Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	426.3	Mean	4.635
SD	1342	SD	1.346
95% DL/2 (t) UCL	945	95% H-Stat (DL/2) UCL	677.5
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	4.595
		SD in Log Scale	1.343
		Mean in Original Scale	421.8
		SD in Original Scale	1343
		95% t UCL	940.9
		95% Percentile Bootstrap UCL	1016
		95% BCA Bootstrap UCL	1337
		95% H-UCL	646.2
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.405	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	1087		
nu star	15.38		
A-D Test Statistic	2.525	**Nonparametric Statistics**	
5% A-D Critical Value	0.815	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.815	Mean	422.4
5% K-S Critical Value	0.212	SD	1309
Data not Gamma Distributed at 5% Significance Level		SE of Mean	300.6
		95% KM (t) UCL	942.2
Assuming Gamma Distribution		95% KM (z) UCL	916.9
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	941.5
Minimum	0.000001	95% KM (bootstrap t) UCL	5920
Maximum	6100	95% KM (BCA) UCL	1028
Mean	418.1	95% KM (Percentile Bootstrap) UCL	1017
Median	83	95% KM (Chebyshev) UCL	1733
SD	1344	97.5% KM (Chebyshev) UCL	2300
k star	0.284	99% KM (Chebyshev) UCL	3414
Theta star	1473		
Nu star	11.35	**Potential UCLs to Use**	
AppChi2	4.804	97.5% KM (Chebyshev) UCL	2300
95% Gamma Approximate UCL (Use when n >= 40)	987.9		
95% Adjusted Gamma UCL (Use when n < 40)	1062		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Result (vanadium)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	3.8	Minimum of Log Data	1.335
Maximum	15	Maximum of Log Data	2.708
Mean	10.28	Mean of log Data	2 238
Geometric Mean	9.374	SD of log Data	0.469
Median	11		
SD	4.012		
Std. Error of Mean	0.897		
Coefficient of Variation	0.39		
Skewness	-0.404		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.882	Shapiro Wilk Test Statistic	0.851
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	11.83	95% H-UCL	12.96
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.31
95% Adjusted-CLT UCL (Chen-1995)	11 67	97.5% Chebyshev (MVUE) UCL	17.43
95% Modified-t UCL (Johnson-1978)	11 82	99% Chebyshev (MVUE) UCL	21.6
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.778	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	2.152		
MLE of Mean	10.28		
MLE of Standard Deviation	4 703		
nu star	191.1		
Approximate Chi Square Value (.05)	160.1	**Nonparametric Statistics**	
Adjusted Level of Significance	0.038	95% CLT UCL	11.76
Adjusted Chi Square Value	157 9	95% Jackknife UCL	11.83
		95% Standard Bootstrap UCL	11.73
Anderson-Darling Test Statistic	1.116	95% Bootstrap-t UCL	11.71
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	11.71
Kolmogorov-Smirnov Test Statistic	0.219	95% Percentile Bootstrap UCL	11.67
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL	11.55
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	14.19
		97.5% Chebyshev(Mean, Sd) UCL	15.88
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	19.21
95% Approximate Gamma UCL (Use when n >= 40)	12.27		
95% Adjusted Gamma UCL (Use when n < 40)	12.44		
Potential UCL to Use		Use 95% Student's-t UCL	11.83
		or 95% Modified-t UCL	11.82
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			
Note: For highly negative-skewed data, confidence limits			
(e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide			
adjustments for positively skewed data sets.			

Result (zinc)			
General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	16
Raw Statistics		Log-transformed Statistics	
Minimum	16	Minimum of Log Data	2.773
Maximum	160	Maximum of Log Data	5.075
Mean	46.2	Mean of log Data	3.579
Geometric Mean	35.84	SD of log Data	0.662
Median	32		
SD	41.41		
Std. Error of Mean	9.26		
Coefficient of Variation	0.896		
Skewness	1.997		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.666	Shapiro Wilk Test Statistic	0.856
Shapiro Wilk Critical Value	0 905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	62.21	95% H-UCL	62.25
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	74.21
95% Adjusted-CLT UCL (Chen-1995)	65.85	97.5% Chebyshev (MVUE) UCL	87.26
95% Modified-t UCL (Johnson-1978)	62.9	99% Chebyshev (MVUE) UCL	112.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.836	Data do not follow a Discernable Distribution (0.05)	
Theta Star	25.17		
MLE of Mean	46.2		
MLE of Standard Deviation	34.1		
nu star	73.43		
Approximate Chi Square Value (.05)	54.69	Nonparametric Statistics	
Adjusted Level of Significance	0.038	95% CLT UCL	61.43
Adjusted Chi Square Value	53.42	95% Jackknife UCL	62.21
		95% Standard Bootstrap UCL	61.31
Anderson-Darling Test Statistic	1.767	95% Bootstrap-t UCL	76 3
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL	69.75
Kolmogorov-Smirnov Test Statistic	0.289	95% Percentile Bootstrap UCL	61.5
Kolmogorov-Smirnov 5% Critical Value	0.196	95% BCA Bootstrap UCL	65.2
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	86.56
		97 5% Chebyshev(Mean, Sd) UCL	104
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	138 3
95% Approximate Gamma UCL (Use when n >= 40)	62 02		
95% Adjusted Gamma UCL (Use when n < 40)	63.51		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	86.56

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.