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DEPARTMENT OF THE INTERIOR

Final Preliminary Assessment/Site Inspection Report

Additional and Uncharacterized Sites Operable Unit
Crab Orchard National Wildlife Refuge NPL Site
Marion, Illinois (Williamson County)

June 2003

This Final PA/SI Report is identical to the "Draft-Final" Report issued in September 2001.

VOLUME XIV

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95% UCL	95 percent upper confidence limit of the mean
ANOIL	Ammonium Nitrate Fuel Oil
ASTER	Assessment Tools for the Evaluation of Risk
ATSDR	Agency for Toxic Substances and Disease Registry
AUS OU	Additional and Uncharacterized Sites Operable Unit
BCF	Bioconcentration Factor
BNA	Base/Neutral/Acid-extractable Compound
BSAF	Biota-sediment Accumulation Factor
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Crab Orchard Cemetery
COI	Chemical of Interest
COL	Crab Orchard Lake
COPEC	Chemical of Potential Ecological Concern
CSC	Commercial Solvent Corporation
DOC	Dissolved Organic Carbon
ECOTOX	Ecological Toxicity Database
EEC	Environmental Exposure Concentration
EPA	Environmental Protection Agency
EqP	Equilibrium partitioning
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERA	Ecological Risk Assessment
ERL	Effect Range Low
ERM	Effect Range Medium
ERT	Emergency Response Team
FDEP	Florida Department of Environmental Protection
HQ	Hazard Quotient
HSDB	Hazardous Substances Data Bank
HWIR	Hazardous Waste Identification Rule
LD_{50}	Dose lethal to 50% of test organisms
LOEC	Lowest Observed Effect Concentration
MATC	Maximum Acceptable Toxic Concentrations
MAOU	Metals Area Operable Unit
MCL	Maximum Contaminant Level
MHSPE	Ministry of Housing, Spatial Planning, and the Environment
NG	Nitroglycerin
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observed Effect Concentration
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polycyclic Aromatic Hydrocarbons

PCBs	Polychlorinated biphenyl(s)
PEL	Probable Effect Level
PETN	Pentaerythritol tetranitrate
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RDX	Cyclonite
RI	Remedial Investigation
RRTC	Railroad Tank Car
SERA	Screening Ecological Risk Assessment
SMDP	Scientific Management Decision Point
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
SWDC	Sherwin Williams Defense Corporation
TACO	Tiered Approach to Corrective Action
TCE	Trichloroethylene
TEL	Threshold Effect Level
TEQ	Toxicity Equivalency
TNT	2,4,6-Trinitrotolune
TOC	Total Organic Carbon
TRPH	Total recoverable petroleum Hydrocarbons
TRV	Toxicity Reference Value
UMC	Universal Match Corporation
URSGWC	URS Greiner Woodward Clyde
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UST	Underground Storage Tank
UXO	Unexploded ordnance
VOC	Volatile Organic Compound
WWII	World War II

Unitary Abbreviations

ATM	atmosphere
cc	cubic centimeter
d	day
ft^2	square feet
g	gram
km	kilometer

K_{ow}	octanol-water partitioning coefficient
K_{oc}	organic carbon partitioning coefficient
L	liter
m^3	cubic meter
mg	milligram
mg/kgBW/day	milligrams per kilogram body weight per day
mg/L	milligrams per liter
n	number
ppb	parts per billion, equivalent to ug/kg or ug/L
ppm	parts per million, equivalent to mg/kg or mg/L
pH	negative logarithm of the hydrogen ion concentration
μg/kg	micrograms per kilograms
yr or y	year

Absorption – penetration of a substance into the body of another.

Anoxic – A lack of oxygen, no oxygen.

Arthropogenic – resulting from the influence of human beings.

Assessment endpoint - An explicit expression of an environmental value that is to be protected, operationally defined by an ecological entity and its attributes. For example, salmon are valued ecological entities; reproduction and age class structure are some of their important attributes. Together "salmon reproduction and age class structure" form an assessment endpoint.

Aufwuchs – All small, attached (except macrophytes) free-moving organisms forming a living film on aquatic substrate such as rock, snags, and plants; included are some macroinvertebrates, fungi, algae, and bacteria.

Autotroph – An organism that utilizes solar or chemical energy to fix elements from simple nonliving inorganic material into complex life molecules that compose living organisms.

Bioaccumulation – The net accumulation of a contaminant in and on an organism from all sources including water, air, and solid phases of the environment. Solid phases include food sources.

Bioconcentration – The net accumulation in and on an organism or a contaminant from water only.

Biological Half-Life ($t_{1/2}$) – The time required for the amount or concentration of a contaminant in a biological compartment to decrease by 50%.

Biomagnification – An increase in concentration from one trophic level (e.g., prey) to the next (e.g., predator) due to accumulation of contaminants from food.

Carnivore – Any flesh-eating or predatory organism, such as a bird of prey or an insectivorous plant.

Community - An assemblage of populations of different species within a specified location in space and time.

Complexation – to complex with other compounds present.

Conceptual model - A conceptual model in problem formulation is a written description and visual representation of predicted relationships between ecological entities and the stressors to which they may be exposed.

Demersal – Living near, deposited on, or sinking to the bottom of a body of water.

Detritivore – Organisms that feed on decaying or disintegrated matter or debris.

Diffusion - the process whereby dissolved substances move from a region of higher to one of lower concentration.

Dissolution - separation into component parts.

EC_{50} - A statistically or graphically estimated concentration that is expected to cause one or more specified effects in 50% of a group of organisms under specified conditions (ASTM, 1996).

Ecological relevance - One of the three criteria for assessment endpoint selection. Ecologically relevant endpoints reflect important characteristics of the system and are functionally related to other endpoints.

Ecological risk assessment - The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.

Ecosystem - The biotic community and abiotic environment within a specified location in space and time.

Epilimnion – The distinct top or surface layer of a non-flowing body of water. This surface layer is heated by solar radiation and has a relatively high dissolved oxygen content.

Eutrophication – Designating a body of water in which the increase of mineral and organic nutrients has reduced the dissolved oxygen, producing an environment that favors plant over animal life.

Exposure - The contact or co-occurrence of a stressor with a receptor.

Exposure scenario - A set of assumptions concerning how an exposure may take place, including assumptions about the exposure setting, stressor characteristics, and activities that may lead to exposure.

Food web – Network of crossing, interlinked food chains in an ecosystem, encompassing primary producers, consumers, and decomposers.

Herbivore – A plant-eating animal.

Heterotrophic – An organism that utilizes the organic substances produced by autotrophic organisms as energy sources and as the raw materials for the synthesis of their own biomass.

Hypolimnion – The bottom layer of a non-flowing body of water. Typically this layer is anaerobic and chemical species tend to predominate in a relatively reduced form.

Hypoxic – A low level of oxygen.

Insectivore – An organism that feeds on insects.

LC_{50} - A statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions (ASTM, 1996).

Lentic – Standing, non-flowing water environment.

Limnetic – Open water, deeper areas of a lake or pond and away from the shoreline littoral zone.

Lines of evidence - Information derived from different sources or by different techniques that can be used to describe and interpret risk estimates. Unlike the term "weight of evidence", it does not necessarily imply assignment of quantitative weightings to information.

Littoral – A shore or coastal region shallow enough for growth of rooted aquatic vegetation.

Lotic – Running or flowing water environment.

Lowest-observed-effect Concentration (LOEC) - The lowest level of a stressor evaluated in a test that results in a statistically significant difference from controls.

Maximum acceptable toxic concentration (MATC) - For a particular ecological effects test, this term is used to mean either the range between the NOAEL and the LOAEL or the geometric mean of the NOAEL and the LOAEL. The geometric mean is also known as the chronic value.

Measure of ecosystem and receptor characteristics - Measures that influence the behavior and location of ecological entities of the assessment endpoint, the distribution of a stressor, and life-history characteristics of the assessment endpoint or its surrogate that may affect exposure or response to the stressor.

Measure of effect - A change in an attribute of an assessment endpoint or its surrogate in response to a stressor to which it is exposed.

Measure of exposure - A measure of stressor existence and movement in the environment and its contact or co-occurrence with the assessment endpoint.

Migration – movement from the original location.

Neuston – Organisms living at or very near the air/water interface of a water body.

No-observed- -effect concentration (NOEC) - The highest level of a stressor evaluated in a test that does not result in a statistically significant difference from controls.

Occlusion - the inclusion or sorption of gas trapped during solidification of a material.

Pelagic – Organisms living in open water areas rather than waters adjacent to land.

Piscivore – A fish-eating organism.

Population - An aggregate of individuals of a species within a specified location in space and time.

Receptor - The ecological entity exposed to the stressor.

Risk characterization - A phase of ecological risk assessment that integrates the exposure and stressor response profiles to evaluate the likelihood of adverse ecological effects associated with exposure to a stressor. Lines of evidence and the adversity of effects are discussed.

Sorption - A general term for the processes of absorption, adsorption, chemisorption and persorption.

Stressor - Any physical, chemical, or biological entity that can induce an adverse response (synonymous with agent).

Tetrapods – A term literally meaning organisms with two pairs of limbs, that is used to refer collectively to amphibians, reptiles, birds and mammals.

Trophic levels - A functional classification of taxa within a community that is based on feeding relationships (e.g., aquatic and terrestrial green plants make up the first trophic level and herbivores make up the second).

Volatilization – conversion from a solid to a vapor.

Definitions in this glossary were obtained from *Guidelines for Ecological Risk Assessment* (USEPA 1998a); *Fundamentals of Ecotoxicology* (Michael C. Newman, Ann Arbor Press 1998); *The American Heritage Dictionary of the English Language* (Houghton Mifflin Company 1981); and *Environmental Chemistry, 4th edition* (Stanley E. Manahan author, Lewis Publishing 1990)

The Additional and Uncharacterized Sites Operable Unit (AUS OU) is located in the Sangamo Electric/Crab Orchard National Wildlife Refuge NPL Site (Crab Orchard NWL NPL Site) near Marion, Illinois. There are 35 AUS OU sites located within a 20,000-acre former industrial-use area of the Crab Orchard National Wildlife Refuge (the Refuge). The sites vary in size from less than one acre to 550 acres. A quality assurance project plan (QAPP) was developed in February 2000 (URS 2000a) to present the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with an investigation of the AUS OU. This document presents approaches for conducting screening-level ecological and human health evaluations using data collected as part of the AUS OU investigation.

1.1 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT METHODOLOGY

Ecological risk assessment is:

> *... the process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.* (USEPA 1992, USEPA 1998).

In the present context, "adverse ecological effects" are understood to be anthropogenic changes considered undesirable because they alter valued structural or functional characteristics of ecological systems (USEPA 1997, 1998). The "stressors" at issue are chemical contaminants.

There is no formally promulgated, official state guidance for performance of screening-level ecological risk assessments (SERAs) at potentially contaminated sites in Illinois. USEPA has released guidance for conducting ecological risk assessments, specifically USEPA (1992, 1998). The latter of these two references is EPA/630/R-95/002F, *Guidelines for Ecological Risk Assessment*, replaces the 1992 EPA *Framework for Ecological Risk Assessment* (EPA/630/R-92-001) by expanding upon and modifying the framework concepts to "reflect Agency [EPA] experience" since 1992 and is "intended as internal guidance for EPA." These guidelines, "set forth current scientific thinking and approaches for conducting and evaluating ecological risk assessments." However USEPA (1998) does not provide detailed guidance in specific areas and is not intended to be highly prescriptive. One of its stated purposes is to provide a basis or framework for individual EPA programs and regions to develop more specific guidance "suited to their particular needs."

The EPA Emergency Response Team (ERT, Edison, New Jersey), under the authority of OSWER Directive No. 9285.7-17 of August 12, 1994, has developed guidance for ecological risk application at Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, otherwise known as Superfund) sites, which is directly applicable for SERAs within the Refuge. The external review draft of *Ecological Risk Assessment Guidance for Superfund* was released in August of 1996 and the interim final was released in June of 1997. Additional information was released in October of 1999. The Superfund guidance is widely referred to as "ERAGS". Supplemental guidance has also been issued from the EPA Emergency Response team as Intermittent Bulletins (ECO Updates) beginning in 1991 and will be consulted as appropriate and relevant.

Although not specifically labeled "guidance," several other documents are relevant, and will be consulted as appropriate. The first example is RTI (1995), a technical support document for the proposed hazardous waste identification rule (HWIR; USEPA 1995) that outlines a rationale and approach for estimating exposures and effects of high-volume, low-toxicity wastes and constituents. A second example is USEPA (1994), a compendium of "issue papers" commissioned by EPA's Risk Assessment Forum to highlight important principles and approaches to be considered in developing ERA guidance. Additionally, certain books and the peer-reviewed scientific literature will be consulted when relevant and appropriate (e.g., Newman 1999; Ingersoll et al. 1996; Rand 1995; Cockerham and Shane 1994; Suter 1993).

1.2 SCREENING-LEVEL HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The overall guidance for the human health evaluation will follow the structure presented in *Risk Assessment Guidance for Superfund* (RAGS) (USEPA 1989). The evaluation will use published screening concentrations for soils and surface water. However, there are no published values for evaluating sediments. Because sediments are expected to comprise a minor portion of media applicable to the AUS OU, soil screening concentrations will be used to evaluate sediments in lieu of deriving sediment screening concentrations for all chemicals of interest.

1.3 MANAGEMENT GOALS

Refuge management goals provide guidance for conducting the risk evaluation. The Refuge resources are managed so that the wildlife, agricultural, recreational and industrial purposes of the Refuge are accomplished in concert with each other and in full compliance with a long term natural resource stewardship responsibility (Berry 1993). The following goals have been developed for Crab Orchard National Wildlife Refuge.

- Protect, enhance, and manage natural resources and ecosystems to sustain optimum fish and wildlife populations.
- Emphasize the preservation, enhancement, and restoration of viable populations of animal and plant species whose existence is considered by federal or state authorities to be endangered or threatened.
- Wetlands, forests, agricultural lands and other habitat programs are managed to provide food and resting areas for migratory waterfowl with special emphasis on Canada geese (*Branta canadensis*).
- Manage specific areas primarily for non-game migratory birds.
- Create and maintain an interspersion of biologically diverse habitat types including wetlands, uplands, forests, water, and agricultural lands.

1.4 DOCUMENT ORGANIZATION

The remainder of this document presents the components of the screening level risk evaluation for the AUS OU. These sections are:

Section Two – Site History and Suspected Contaminants

This section discusses the sites located within the AUS OU and the suspected contaminants that formed the foundation for specific additional investigation in each of the areas.

Section Three – Ecological Risk Screening Approach

Section Three summarizes the ecological risk screening process. Habitat types, relevant media, and development of screening concentrations are presented. Data collected from the AUS OU areas will be evaluated using the process outlined in this section to assist in decision making as to whether additional evaluation of potential ecological risks may be warranted.

Section Four - Human Health Screening Approach

Section Four summarizes the human health risk screening process that will be applied when data become available from the AUS OU sites. Data collected from the AUS OU areas will be compared to the screening concentrations developed in this section to assist in decision making as to whether additional evaluation of potential human health risks may be warranted.

Section Five - Scientific Management Decision Point (SMDP)

Section Five discusses the Scientific Management Decision Point (SMDP). In the SMDP, the risk managers decide whether the information available is adequate to make a risk management decision.

Section Six - References

This section presents a list of references used in preparation of the body of the report.

Tables and Figures

Tables and figures are presented at the end of each respective section in which they are introduced.

This section presents information on site history and suspected contaminants as obtained from the Historic Search Report (URSGWC 1999) for the AUS OU. Each of the areas of the AUS OU is presented, with a background description, and discussion of suspected or known chemicals that may have been associated with the site.

2.1 AREA 2

Area 2 consists of four IOP load lines in close proximity to each other just north of Crab Orchard Lake. These load lines are the Booster Load Line labeled as Area 2B, the Detonator Load Line labeled as Area 2D, the Fuse Load Line labeled as Area 2F, and the Primer Load Line labeled as Area 2P. Each of these areas is described in the sections below.

AREA 2B – IOP BOOSTER LOAD LINE (AUS-0A2B)

This site is the former IOP Booster Load Line. The facility was designed and built for the purpose of loading boosters, involving the preparation, mixing, and loading of tetryl. Since World War II, ordnance manufacturers have used the facility for their production operations. Post war production activities at Area 2B included explosive fuse trains, pyrotechnics, large explosives, propellant mixes, and gas generators.

The southern and eastern portions of the load line were razed in the 1980s. The remaining buildings at the site are part of General Dynamics' ongoing production operations at the Refuge. Visual inspection of the site revealed building debris, abandoned drums and ordnance waste scattered at the southern end of the site outside the current fence line. Aerial photo interpretation identified a suspicious pond to the southwest of the load line and excavation activity to the east of the load line. Previous sampling at the site indicated the presence of elevated levels of metals and several base/neutral/acid-extractable (BNA) compounds[1].

Building B-2-13 in the northeast section of Area 2B is a propellant mix house. The southern end of the building has propellant mixing machines in the east and west bays and propellant has been identified on the ground outside both of these bays in the past. In addition, to the east of this building is a hexane tank which supplies solvent to the mixing bays for use in propellant mixes.

In the southern portion of Area 2B several buildings were involved in the screening, pressing and loading of high explosives and pyrotechnic mixes. These buildings have all been flashed and razed. Because volatile solvents like methylene chloride ($MeCl_2$) and trichloroethylene (TCE) were used extensively in production operations by the industrial tenants, dioxin is a chemical of interest (COI) in these locations. It is also a COI at the burn pad in the southwest corner of this load line. Other COIs in this area include trinitrotoluene (TNT) and tetryl (explosives), $MeCl_2$ (volatile solvents), hexane, lead (metals), and burn site residues (BNAs).

AREA 2D – IOP DETONATOR LOAD LINE (AUS-0A2D)

This site is the former IOP Detonator Load Line. The facility was designed and built for the purpose of loading detonators, involving the preparation, mixing, and loading of primary

[1] The BNA group is also referred to as semivolatile organic compounds.

explosives. Since World War II, ordnance manufacturers have used the facility for their production operations. Post war production activities at Area 2D included explosive fuse trains, pyrotechnics, large explosives, propellant products, gas generators and ammunition mixes (e.g. tracers and igniters). Currently, General Dynamics is using the load line for its ongoing production activities.

On the southeast corner of the load line, a small building pad was used for several years as a burning ground for ignitable wastes. In addition, several of the production buildings previously contained open sumps that were emptied out on to the ground in the area of the sumps during cleaning activities. Other cleaning activities at the site included sweeping of wash waters in production buildings to the ground just outside the building on a weekly basis. These wash waters reportedly ended up flowing into the ditches near the buildings. Previous sampling at the site indicated the presence of elevated levels of mercury, zinc and several BNA compounds.

In the southeast portion of the load line, the chemicals of interest include mercury fulminate and lead (reactivity and metals), burn site residues (dioxin and BNAs), and propellant and pyrotechnic mixes (explosives, metals, volatile organic compounds [VOCs], and BNAs). On the southwest portion of the load line COIs include lead azide (metals), acetone (VOCs), and propellant and pyrotechnic mixes (explosives, metals, VOCs, and BNAs). On the north end of the load line COIs include propellant and pyrotechnic mixes (explosives, metals, VOCs, and BNAs), TNT, tetryl, Cyclonite (RDX), and Nitroglycerin (NG) (explosives), and lead azide (metals).

AREA 2F – IOP FUSE LOAD LINE (AUS-0A2F)

Area 2F is the former IOP Fuse Load Line. The facility was designed and built for the purpose of loading fuses, including the preparation and loading of black powder, lead azide, potassium chlorate, and tetryl. Since World War II, ordnance manufacturers have used the facility for their production operations. Post war production activities at Area 2F included pyrotechnics, gas generators, and artillery projectiles. Currently, General Dynamics is using the facility for its ongoing production operations.

Visual inspection of the site revealed the northern portion of the load line has been used as a dumping ground for construction debris over the years. In addition, several areas of stressed vegetation were observed around production buildings. Previous sampling at the site indicated the presence of elevated levels of metals.

Fuse production involved the use of tetryl (explosives), lead azide (metals), and nitrocellulose. Other activities at the load line include the use of volatile solvents for metal cleaning activities. It is believed that the disposal of these chemicals was via dumping in the areas around the building involved (F-2-2).

AREA 2P – IOP PRIMER LOAD LINE (AUS-0A2P)

Area 2P is the former IOP Primer Load Line. The facility was designed and built for the purpose of loading primers and the preparation and loading of black powder. Since World War II, an ordnance manufacturer has used the facility for its research and development and production operations. Post war production activities at Area 2P included solid propellants, pyrotechnics, gas generators, and ammunition mixes. General Dynamics is currently using the facility for its ongoing operations at the Refuge.

Previous sampling at the site indicated the presence of RDX in surface water effluents as well as elevated levels of metals and BNA compounds. Surface water at the site is transported off the site either to the northwest or the southeast by numerous ditches at the site. In addition, building P-1-1 formerly contained an open sump from which water was discharged to the ground during cleaning operations.

2.2 AREA 4 EAST – IOP AUTOMOTIVE AND EQUIPMENT SHOP AREA (AUS-0A4E)

Area 4 East is the former IOP Automotive and Equipment Shop. The facility was designed and built for the purpose of maintaining the trucks and equipment needed to support ordnance manufacturing operations. Since World War II, the facility has been used by various tenants for purposes such as truck and mining equipment maintenance and repair, storage, and manufacturing. To the southeast of Area 4, a disposal area was remediated as part of the Metals Area Operable Unit (MAOU). The area was referred to as the Fire Station Landfill. The contaminant of interest at the Fire Station Landfill was lead. An IOP vehicle refueling station once stood in the middle of the site adjacent to Highway 148. The building has been razed; however, it is suspected that the underground fuel storage tanks may have been left in place during the building demolition. Surface water at the site is transported via storm sewers to the north and then east via ditches off the site. Potential COIs are metals, explosives, nitroglycerin, PAHs, volatile organics, and BNAs.

2.3 AREA 4 WEST – IOP WEST SHOP AREA (AUS-0A4W)

Area 4 West originally housed the construction and mechanical trades buildings along with a laboratory and laundry facility. After the end of WWII several of the buildings were leased by businesses of all types. Printing companies occupied building S-1-3. A lumber company occupied buildings S-3-2, S-3-3, and S-3-4. Most notably, however, Supreme Plating Company (a plating operation) occupied buildings S-2-4 and S-2-5. The remediation of the MAOU included the area adjacent to former building S-2-4, and the ditches along the roadsides in the center of Area 4 West as well as the northern drainage swale where the storm sewers discharge their waters. Buildings S-2-1, S-2-2, S-2-3, and S-2-4 are no longer standing. Building S-2-5 has never been investigated. Buildings S-2-1 and S-2-2 building pads are currently being used as compounds for vehicle storage. In addition, aerial photo interpretations of the 1951 and 1960 aerial photos revealed evidence of disposal activities in a remote section of Area 4 to the southwest of building S-1-3. Potential COIs are metals, BNAs, explosives, and volatiles.

2.4 AREA 6 – IOP AMMONIUM NITRATE HIGH EXPLOSIVE AND SMOKELESS POWDER STORAGE AREA (AUS-0A06)

Area 6 is the former IOP Ammonium Nitrate High Explosive and Smokeless Powder Storage Area. The site has 84 explosive storage igloos in 7 rows and has been used for storage since WWII. Samples at the railroad loading docks on the north and south have exceeded screening levels. The analytes indeno[1,2,3-cd]pyrene and dibenz[a,h]anthracene exceeded USEPA soil screening levels (SSLs) in a sample at the south railroad loading dock. The analytes benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene exceeded USEPA SSLs in a sample at the northern railroad loading dock. Barium also exceeded USEPA SSLs and Refuge background values in one sample.

In addition to the northern and southern railroad loading docks each igloo has a truck loading dock. One row of igloos sits adjacent to the former rail line and had both truck loading docks and railroad loading docks.

2.5 AREA 7 – IOP INERT STORAGE AREA (AUS-0A07)

Area 7 was originally built as the IOP Inert Storage complex, which warehoused metal parts and other inert materials used in the production of artillery shells, tank mines and 500-lb bombs and their component parts.[2] The building complex was constructed in 6 rows of buildings (5 to 7 buildings per row originally). Only 26 of the original buildings in Area 7 remain standing. After the end of WWII several industries began leasing space in Area 7.[3] Information on the known leasing history for Area 7 is detailed in the AUS Historic Search Report Section 7. Only one business is known to have stored hazardous materials in Area 7: Great Lakes Terminal and Transport stored pesticides in buildings IN-1-5 and IN-1-6. All other businesses, which would have handled hazardous materials, used the buildings for purposes other than storage. Since the buildings in Area 7 were built strictly for storage, other uses required occupants to modify the buildings. One of the most important modifications required in the Area 7 buildings to make them capable of housing production operations was an upgrade of the electrical service. Production operations require that three-phase power be supplied to a building so that equipment and machinery can be used.[4] Only eight of the remaining 26 buildings in Area 7 have the equipment necessary for supplying three-phase power. These buildings are IN-1-1, IN-1-5, IN-1-6, IN-2-1, IN-2-5, IN-2-6, IN-3-4, and IN-6-5.

Buildings IN-3-5, IN-4-4, IN--5-2 and IN-5-3 were used for production activities for several years. Subsequently these buildings were demolished and buried at the site.

It is possible that other buildings razed in Area 7 were also involved in production activities. However, the remaining building debris is buried under 2 feet of soil and the original landscape and drainage profiles have been changed as a result. Therefore identifying areas impacted from production activities must rely on observations of current site conditions. Potential COIs are pesticides, metals, BNAs, volatiles, PCBs, and explosives.

2.6 AREA 8 SOUTH – IOP LOAD LINE III (AUS-0A8S)

Area 8 South was formerly a bomb loading line for the IOP where TNT was screened, melted, and loaded. After World War II, several different industrial tenants leased the site for various

[2] U.S. ACE, 1944, Part I Sect. 7 page 28.
[3] Techlaw, 1992, pages 59-63b.
[4] Large motors used in pumps, lathes, metal working equipment, etc. require three phase power be supplied to the motor. Three-phase power cannot be supplied using the same electrical service that was installed to supply the single-phase power the IOP used for lighting. Therefore additional equipment had to be installed to support activities other than lighting.

production operations. Products manufactured at the site after World War II included fiberglass canoes, propellants, pyrotechnics, and ground nitrocellulose. After a fire at the site in 1981, the entire site was razed and buried. No industrial activity has taken place at Area 8 South since that time.

A visual inspection of the site revealed several mounded areas in the former production buildings locations. Two drums were identified at the site to the northwest of the former IOP TNT Cooling building. In addition, a sump pit was observed to the west of the former TNT Melting building, which also was the site of the American Fiber Lite production operations. Aerial photo interpretations at the site indicated ground scarring at one location to the southeast of the northern change house. No supplementary information has been found indicating a cause for the ground scarring, however, it was observed in aerial photography from 1943 to 1993. Three other features identified by aerial photo interpretations were southwest of the eastern TNT Cooling building. One was a trench like feature more than 190 feet long and 8 feet wide. The other two were identified as pits. Potential COIs are metals, BNAs, explosives, dioxin, perchlorates, volatile organics, and nitroglycerin.

2.7 AREA 9 – IOP LOAD LINE I (AUS-0A09)

Area 9 was formerly an artillery and bomb loading line for the IOP where TNT was screened, melted, and loaded. After World War II, several different industrial tenants leased the site for various production operations. Products manufactured at the site after World War II included capacitors, wrapping paper, gloves, boats, and industrial finishes. Industrial tenants in Area 9 included Sangamo Electric Co., Technical Tape Corp., Good Luck Glove Co., Mark Twain Marine Industries, Pyramid Industrial Finishes, and Olin Corp. Olin Corp. (now Primex) is currently the sole tenant in Area 9.

In 1982 the Service identified PCB and lead contamination in the portion of Area 9 known as the Sangamo Dump. O'Brien & Gere (1988) investigated Area 9 as Sites 32 and 33. It was subsequently designated as part of the PCB Areas Operable Unit (PCB OU) and a Record of Decision on a remedial action was issued on August 1, 1990.[5] In 1996 and 1997, a large area in and near Area 9 was remediated as a part of the PCB OU.[6] An Explanation of Significant Differences was issued in June 2000 to remediate groundwater contaminated with chlorinated volatile organics compounds.

2.8 AREA 10 – IOP FUSE AND BOOSTER STORAGE MAGAZINES (AUS-0A10)

Area 10 was formerly a group of storage magazines for the explosive components of anti-tank mines, bombs and artillery being produced at the load lines. From 1967 to 1970 the site was used for the incineration of ignitable wastes from the production operations of an ordnance manufacturer. The burning of the wastes was done in large pits called burning pits. In 1970,

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[5] U.S. EPA, 1990, Declaration for the Record of Decision, Crab Orchard National Wildlife Refuge, PCB Areas Operable Unit.

[6] International Technology Corporation, 1997, Acceptance Report for Closure of PCB Areas Operable Unit Landfill, Crab Orchard National Wildlife Refuge, Marion, IL.

open burning was banned on the Refuge and the pits were covered. Since that time the site has been used by local law enforcement personnel for small arms practice.

2.9 AREA 11

Area 11 contains a group of buildings comprising the IOP Group II Melt Loading Line. It originally consisted of 31 buildings located just south of Ogden Road to the west side of Highway 148. Load Line II was designed and built for the loading of 105 or 155mm shells. Several corporations have had operations within Area 11 including:

- The Sherwin Williams Defense Corporation (SWDC) operated the Group II Melt Loading Line (Load Line II) in Area 11 during World War II, from August 1942 through September 1945. Sherwin Williams loaded shells, bombs and mines on Load Line II. They occupied all of the buildings along Load Line II in conjunction with operating the area for IOP.
- Hoosier Cardinal Corporation and the Ordill Machine Works operated in Area 11 from approximately August 1948 through 1954. Hoosier Cardinal Corporation manufactured and finished decorative metal and plastic parts. Ordill Machine Works did tool and dye workings. It is unknown what buildings they occupied.
- From January 1956 through April 1964, Olin conducted operations in Area 11. Olin occupied all of the former IOP buildings and expanded the plant into the vacant property located between Areas 11 and 12. For the purposes of this report, this expanded area will be considered part of Area 11. Olin produced various types of commercial explosives in Area 11.
- Commercial Solvents Corporation (CSC) occupied Area 11 from April 1964 through 1982. CSC (and its successors, including U.S. Powder who initially operated the plant for CSC) also produced explosives in Area 11. CSC occupied some of the same buildings that Olin had previously occupied. Explosives were manufactured in Area 11 until June 1971, when decontamination procedures began. By 1986, there were no tenants in Area 11.[7]

AREA 11 ACID AND AMMONIUM NITRATE PRODUCTION AREA (AUS-A11A)

The area 11 Acid and Ammonium Nitrate Production Area has been occupied by all of the above-mentioned occupants of Area 11 (this area may or may not have been occupied by Hoosier Cardinal/Ordill Machine Company, since it is unknown what buildings these companies occupied).

This area was used during IOP operations as a part of the Melt Loading Line – mostly for TNT and ammonium nitrate storage and screening. Both Olin and CSC used this area as an acid and ammonium nitrate production facility. This production facility was in operation from late 1957 through April 1969, when it was eliminated. The processes used in this area are not known, however it is possible that Olin used chromates in their production of ammonium nitrate. Potential COIs are explosives, semivolatiles organics, metals, TRPH, and sulfates.

[7] CRO 185 – According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Page 75.

AREA 11 HIGH EXPLOSIVES AREA (AUS-A11H)

The majority of the Area 11 High Explosives Area was built by Olin and was occupied by both Olin and CSC. This area has been used for the production and packaging of high explosives. Contaminants identified in this area by CSC include the following: dynamite, RDX, pentaerythritol tetranitrate (PETN), nitroglycerin, nitrocellulose, TNT and ammonium nitrate fuel oil (ANOIL). Several buildings were also used by SWDC for IOP operations at the Melt Loading Line. These buildings were Building 7, 8, 24, 67 and 69 and the most likely explosive contaminant in these buildings would be TNT.

AREA 11 NITROGLYCERIN AREA (AUS-A11N)

The Area 11 Nitroglycerin Area was built by Olin and was occupied by both Olin and CSC. This area has been used for the production of nitroglycerin using the Biazzi process. The only explosive contaminant identified in this area by CSC was nitroglycerin. There are numerous ditches and ponded areas in this area that will be investigated in addition to the areas around the buildings.

A previous investigation was done in AUS-A11N in the East Holding Pond (Site COP-2). Metals and nitrates were the only elevated compounds detected in this area. There were eight possible burning trenches located in AUS-A11N that were identified in historical aerial photographs, though there is currently no evidence of these trenches on site. Two were identified in the location of former Building 10, and six were identified in an open area located just east of former Building 9. The former use of these trenches is not known.

There were two railroad tank cars (RRTCs) located just west of the former Nitrator (Building 9). One of these two RRTCs had an access port and has been previously sampled. It has been reported that the ditches and holding pond in this area may have been flashed; however, the potential for contamination still exists. Potential COIs are metals, explosives, nitroglycerin, acids (nitric and sulfuric), PETN, volatiles, perchlorates, BNAs, picric acid and dioxin.

AREA 11 PILOT PROPELLANT PLANT/CAP PRODUCTION AREA (AUS-A11P)

The Area 11 Pilot Propellant Plant/Cap Production Area has been occupied by all of the above-mentioned occupants of Area 11 (this area may or may not have been occupied by Hoosier Cardinal/Ordill Machine Company, since it is not known what buildings these companies occupied).

This area was used by SWDC during IOP operations as a part of the Melt Loading Line for some TNT pouring operations and drilling and boostering operations. Olin used this area as a Pilot Propellant Plant that was used for research and development of propellants. Olin also manufactured gas generators and tested some explosives in this area. CSC used this area for Big Inch Cap Production that involved the use of RDX, lead azide and/or lead styphnate and possibly mercury fulminate. Testing of Big Inch Caps was also done in this area and there were numerous storage facilities also. This area was in operation during most of the time that Olin and CSC had possession of the property. There are numerous ditches and ponded areas in this area. Potential COIs are BNAs, metals, explosives, nitroglycerin, perchlorates, volatiles, PCBs and dioxin.

AREA 11 SUPPORT AREA (AUS-A11S)

The Area 11 Support Area has been occupied by all of the above-mentioned occupants of Area 11. This area was used during IOP operations as a part of the Melt Loading Line, mostly for storage and for cleaning and painting operations (Buildings 56 and 66). The IOP Boiler House along with four associated underground storage tanks (USTs) was also located in this area. It has been reported that the USTs were removed from near the boiler house, there is no evidence of their presence at the site, nor has documentation been found to confirm their removal. The building has been razed; however, it is possible that the underground fuel storage tanks may have been left in place during the building demolition. Both Olin and CSC used this area as a support area for their explosives manufacturing operations in Areas 11 and 12. This portion of the facility was in use for the duration of Olin and CSC's tenure at the site – from January 1956 through the mid-1970s when decontamination procedures began at the site. The following buildings were located in this area: Carpenter, Maintenance and Machine Shop (Building 55), Welding Shop (Building 57), Oil Stores (Building 68), Administration Buildings (various buildings), Laboratories (Buildings 75-1 and 80), Garage/Wash Room (Building 56), Boiler House (Building 60), Scrap Yard (Location 58) and other miscellaneous buildings. There are numerous ditches and ponded areas in this area.

The USEPA previously collected samples from near the cleaning and painting building and near the boiler house; both semivolatile organics and metals were detected at elevated levels in samples from these locations. Potential COIs are BNAs, metals, explosives, nitroglycerin, perchlorates, volatiles, and PAHs.

2.10 AREA 12 FORMER AMMONIUM NITRATE PLANT (AUS-0A12)

Area 12 consists of the IOP Ammonium Nitrate Plant. It originally consisted of 12 buildings located just south of Ogden Road to the west side of Highway 148 – south of Area 11. The Ammonium Nitrate Plant was designed and built for the production of explosive-grade ammonium nitrate. Several corporations have had operations within Area 12 including:

- SWDC used Area 12 for explosive-grade ammonium nitrate production during World War II from August 1942 through May 1943.
- Silas Mason produced fertilizer-grade ammonium nitrate in this area from 1947 through 1950.
- Universal Match Corporation (UMC) tested photo flash signals in this area for approximately six months during 1955.[8]
- Olin leased this area from January 1956 through April 1964. According to John Miller, a former Olin employee, it was used mostly for storage and burning.[9] According to Mr. Robert Meyers[10] (a former Olin truck driver) and Mr. Harry Stiles[11] (former USFWS project manager for entire Refuge), Area 12 was also used to make explosives for a brief time.

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[8] ACO 39 and ACL 670 - According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Pages 6, 25.
[9] Testimony of Mr. John Miller taken on April 9, 1998, Page 31.
[10] Testimony of Mr. Robert Meyers taken on April 10, 1998, Page 20.

- CSC occupied Area 12 from April 1964 through 1982. CSC (and its successors) used Area 12 for cyclonite (RDX) production and for storage, according to the U.S. Powder Map. Additionally, according to the U.S. Powder Map the burning grounds were also still present on the western side of the property. CSC occupied the same buildings that Olin had previously occupied and they built several new buildings.

Decontamination of Area 12 began after 1971.[12] By 1986, there were no tenants in Area 12.[13]

As mentioned above, SWDC, Silas Mason, UMC, Olin and CSC all occupied Area 12. SWDC operated the explosive-grade ammonium nitrate plant for the IOP. Silas Mason then operated the ammonium nitrate plant to produce fertilizer-grade ammonium nitrate. UMC was reported to have used the area to test photo flash signals. Olin used the area for storage, burning and to manufacture explosives. Olin originally manufactured ammonium nitrate in this area until the ammonium nitrate facility in Area 11 was completed. CSC used this area for storage, burning and RDX production.

There were also eight storage ponds present in Area 12. These were used for storage of double-base propellants, smokeless powder, and possibly other explosive materials. A few metals were detected at elevated levels in a previous investigation at the powder storage ponds (Site COP-3). However, all soil samples were collected from depths of at least four feet and no surficial soil samples were collected. The area south of the burning ground was also previously investigated (Site COP-4). Volatile and semivolatile organics, metals, explosives, total recoverable petroleum hydrocarbons (TRPH), nitrates and sulfates were all detected levels in this area. COP-4 was remediated as part of the Explosive/Munition Manufacturing Areas Operable Unit. Other potential COIs are dioxin, PCBs, nitroglycerin, and perchlorates.

2.11 IOP FINISHED AMMUNITION IGLOOS (AUS-0A13)

The site was formerly a group of storage magazines for finished ammunition. Since World War II, the igloos have been used by various manufacturers to store raw materials and products. Each igloo has a truck loading dock for material transfers. In addition, one row of igloos had an additional dock adjacent to the railroad line running through the site. Potential COIs are metals, BNAs, explosives, and nitroglycerin.

2.12 COC AREA SITES (AUS-0062 TO AUS-0069 AND AUS-0109)

The original Crab Orchard Cemetery (COC) sites were identified as having been impacted by ordnance disposal activities in a 1998 unexploded ordnance (UXO) investigation by Parsons Engineering. The AUS sites in the COC Area consist of dumpsites and other sites, which because of their location, may be connected to ordnance disposal activities.

[11] Testimony of Mr. Harry Stiles taken on November 18, 1997, Page 67.

[12] CRO185 – According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Page 76.

[13] CRO185 – According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Page 75.

Ordnance scrap was identified on all of the COC sites that are part of this investigation except for AUS-0066 and AUS-0109. AUS-0066 was not investigated during Parson's 1998 UXO investigation. AUS-0109 is a previously unidentified site. AUS-0109 was identified by aerial photo interpretations as resembling other ordnance disposal sites previously identified and characterized at the site. UXO is a concern at all COC area sites. Potential COIs are metals, explosives, volatiles, and BNAs.

2.13 IOP FIRE AND POLICE HEADQUARTERS (AUS-0001)

AUS-0001 formerly housed the Fire and Police Headquarters for the Illinois Ordnance Plant and later the Refuge. It is less than an acre in size. The Headquarters included an administration building, and a fire station as well as a small boiler house. To the west of these buildings was a long structure with a trough running through it. Its purpose is unknown. Though all of the buildings at the site were razed, their foundations remain. Evidence of underground storage tanks at the site was observed near the former boiler house. Potential COIs are metals, BNAs, explosives, and volatiles.

2.14 IOP WASTEWATER TREATMENT PLANT (AUS-0002)

This site is the former location of the Wastewater Treatment Plant for the Illinois Ordnance Plant's administration area and may have served portions of Area 2. The building was razed, however the settlement lagoons still exist. The site encompasses less than an acre. Potential COIs are metals, explosives, and volatiles.

2.15 IOP RAILROAD CLASSIFICATION YARD (AUS-0018)

AUS-0018 was formerly the railroad classification yard for the Illinois Ordnance Plant. Railroad cars were ordered at the site for efficient transport to their final destinations. The site was not used for long-term storage; however, train cars may have waited at the yard for a few days awaiting dispensation. According to an engineering drawing contained in the War Departments' 1944 Facilities Inventory of the Illinois Ordnance Plant, the classification yard had a fuel oil column, which may have been used for refueling of locomotives. The tracks at the site were removed along with the ballast and railroad ties. Previous sampling at the site revealed the presence of elevated levels of cadmium, mercury, lead, and zinc. The overall size of the site is approximately 30 acres. Other potential COIs are additional metals, explosives, and volatile organics.

2.16 IOP FIRE STATION FOR AREA 7 (AUS-0021)

This site formerly housed a fire station that serviced Area 7 and other nearby IOP facilities. The building has been razed and only parts of the foundation are visible. A walkover survey of the site revealed ordnance/explosive waste at the site to the north of the former fire station building. The site footprint is less than an acre. Potential COIs are metals, BNAs, explosives, and volatile organics.

2.17 AREAS 11 AND 12 FIRE STATION (AUS-0043)

This site formerly housed a fire station that serviced Areas 11 and 12 as well as other nearby IOP facilities and is less than an acre in size. The building has been razed and only the foundation and debris remain at the site. A walkover survey of the site revealed sumps and a burner stack as well as abandoned farm equipment. Potential COIs are metals, BNAs, explosives, and volatiles.

2.18 IOP FULMINATE STORAGE IGLOOS (AUS-0060)

This site was originally designed, built and used for the storage of mercury fulminate for use in detonators. After World War II, the storage igloos were used to store other compounds including lead azide, TNT, tetryl, and nitrocellulose. The storage igloos have been unoccupied for about 30 years. In 1996, igloo number FS 2-2 was found to contain boxes with some nitrocellulose. Previous sampling at the site showed elevated levels of metals at the site. Volatile organics are also suspected at this site. Visual inspection of the site revealed the presence of numerous drums abandoned at the site. The previous contents are unknown. The site encompasses approximately 30 acres.

2.19 CONCRETE STRUCTURES WEST OF WOLF CREEK ROAD (AUS-0061)

AUS-0061 was built for the testing of ordnance and propellant systems. The site contains two structures that were used as test pits and one structure used to initiate the testing. The disposal portion of this site is located adjacent to the former Job Corps Landfill (JCLF). Trenches, and subsequently fill material, were observed in the disposal portion of the site in historical aerial photographs. The site area is less than an acre. Previous sampling at the site showed elevated levels of BNAs. Other potential COIs are metals and explosives.

2.20 DRUM DISPOSAL AREA IDENTIFIED DURING SITE RECONNAISSANCE EAST OF AREA 11 (AUS-106A)

The history of this site is unknown. There appeared to be a road leading to this disposal area as seen in 1951 aerial photographs, which did not appear in the 1960 aerial photograph. There is also an oven hood and two former smokestacks located near a soil mound. The size of the unit is approximately one acre.

During a site reconnaissance, it was estimated that 50 to 100 drums might be disposed in this area. These drums are partially buried and are located along a creek bed that usually contains water only during precipitation events. There is a grayish-bluish solid substance present in several of the exposed drums. It is speculated by the service that this may be old paint; however there is no evidence to support this. Potential COIs are volatile organics, BNAs, metals, and explosives.

2.21 POSSIBLE DISPOSAL AREA IDENTIFIED BY AERIAL PHOTO INTERPRETATIONS (AUS-0107)

This site is located north of Area 8 and just south of Ogden Rd. It was identified by aerial photography interpretations as a possible disposal area. Potential COIs are metals, BNAs, explosives, and volatile organics.

2.22 POSSIBLE SURFACE DISPOSAL AREA IDENTIFIED BY AERIAL PHOTO INTERPRETATIONS (AUS-0108)

This site is located north of Ogden Rd. and north of Area 11. It was identified by aerial photography interpretations as a possible surface disposal area near COC 10. Potential COIs are metals, BNAs, explosives, and volatile organic compounds.

The *Ecological Risk Assessment Guidance for Superfund* (USEPA 1997), hereafter referred to as ERAGS, will be used as the primary guidance for evaluating the potential for ecological risk at the AUS OU. The overall process consists of a series of eight steps as outlined in Figure 3-1. The first two steps correspond to a preliminary or screening level assessment. Step 1 consists of a screening level problem formulation and ecological effects evaluation. Step 2 is the screening-level exposure estimate and preliminary risk calculation.

3.1 SCREENING-LEVEL PROBLEM FORMULATION AND ECOLOGICAL EFFECTS EVALUATION (STEP 1 – ERAGS)

During the screening-level problem formulation, a conceptual model is developed for the site that addresses five issues (USEPA 1997), as follows:

1. Environmental setting and contaminants known or suspected to exist at the site;
2. Contaminant fate and transport mechanisms;
3. Mechanisms of ecotoxicity associated with contaminants and likely categories of receptors that could be effected;
4. What complete exposure pathways exist;
5. Selection of endpoints to screen for ecological risk

3.1.1 Environmental Setting and Suspected Contaminants

The Refuge is located in the temperate deciduous forest region occupying the northeastern portion of North America. Geographically the Refuge lies between the Ozarks and the Appalachians; this area serves as a link in the North American vegetation gradient due to overlap of distinctive vegetation patterns. There are plants of the eastern U.S. that generally range throughout the eastern half of North America, plants of the central U.S. with southern Illinois being near the center of distribution, and plants of the southeastern U.S. which have advanced northward and westward. Thus, the available habitat and species associated with the habitats are diverse throughout the Refuge.

Contaminants suspected to exist at the AUS OU were identified for each of the sites based on historical use and site reconnaissance as discussed in Section 2. A summary of these chemicals and their physiochemical properties is provided in Table 3-1a (organic chemicals) and 3-1b (inorganic chemicals). These chemicals formed the foundation for development of a sampling plan for the AUS OU site investigation, as presented in the *Field Sampling Plan Site Inspection Additional and Uncharacterized Sites Operable Unit* (URS 2000b).

The following subsections discuss the preliminary habitat characterizations at each of the AUS OU subareas. This information was obtained from previous descriptions of the sites and area reconnaissance by biological personnel located at the Refuge.

3.1.1.1 Area 2

Area 2 contains about 595 acres of which about one-third is occupied by the load lines as described in Section 2.1. A 6-foot chain-link fence surrounds each of the four active industrial sub-units in Area 2. Areas within the sub-units are highly industrial, unlike the remaining area between the sub-units within Area 2. The unfenced, non-industrial portion between the sub-units is composed of patches of mixed wetland, old-field, woodland habitats and active agricultural fields. When planted in winter wheat, the agriculture fields serve as habitat for geese. Both geese and raccoon use the agricultural fields when planted in corn. Surrounding the site to the north is state owned land and the Southern Illinois University Coal Research Center. The surrounding habitat to the south consists of mixed wetland, woodland, old-field habitats, and agricultural land. Agricultural land is located to the west of Area 2. Mixed agricultural fields, woodland, and old-field habitat surrounds the east of Area 2. Of particular interest to this area is a designated refuge natural area approximately 22 acres in size that is located partially in the non-industrial portion of Area 2 and east, north-east of sub-unit 2D. The Post Oak Flats Natural Area has a unique forest community of post oak and hickory. The area is relatively undisturbed and the Refuge is preserving the native forest community typical of the glacial till flats geology.

All of the sub-units, 2B, 2D, 2F, and 2P, have a number of drainage ditches that are wet during rain events. The drainage ditches that are along the fences are vegetated with brush and trees aged about 10 to 20 years old. Each of the sub-units is described below.

Area 2B – IOP Booster Load Line (AUS-0A2B)

Very little natural habitat exists within this sub-unit. The total area of the sub-unit is approximately 47 acres. The landscape consists primarily of mowed fescue among the buildings, driveways, and roads. Drainage ditches along the fence are vegetated with brush and young trees. Woodland habitat exists to the south of Area 2B. A 6-foot chain link fence surrounding the area limits accessibility to the site by some organisms.

Area 2D – IOP Detonator Load Line (AUS-0A2D)

This 57-acre sub-unit has little, if any, native habitat. The sub-unit consists primarily of mowed fescue with a few ornamental trees around the buildings, roads, and driveways. Drainage ditches along the fence are vegetated with brush and trees.

Area 2F – IOP Fuse Load Line (AUS-0A2F)

Area 2F is approximately 26 acres in size and is east of Area 2B. Little natural habitat exists in this sub-unit. The habitat is mostly mowed fescue with a few solitary large trees. Drainage ditches along the fence are vegetated with brush and trees. Agricultural fields surround the sub-unit. Geese from the agricultural fields have been observed within Area 2F.

Area 2P – IOP Primer Load Line (AUS-0A2P)

Area 2P is located south of Areas 2D, 2B, and 2F and is approximately 60 acres in size. Vegetation consists mostly of mowed fescue. Vegetated ditches are found along the fence that borders the sub-unit. Fescue that is mowed annually surrounds the east of Area 2P. There is mature woodland (oak/hickory forest) habitat surrounding the north and west sides of the sub-unit. A mixture of fescue field and brushy woodlands exists south of the sub-unit. There is a swampy area, just along Crab Orchard Lake, approximately ¼ mile west of Area 2P.

3.1.1.2 Area 4 East – IOP Automotive and Equipment Shop Area (AUS-0A4E)

Very little native habitat occurs within Area 4 East. Two buildings remain on site, one is scheduled for demolition and the other is used for shipping and receiving activities. An old building foundation from the IOP vehicle refueling station lies adjacent to the existing buildings. There is a gravel parking lot directly to the east of Route 148. Mixed woodland habitat (cedar, maple, and oak) surround the north and east part of the site. Also to the east is a shallow drainage ditch in the trees. A small (approximately 3-acre) fescue field is found south of the existing building. An open field to the south of Area 4 East contains fescue, cedar, and autumn olive, an invasive bush. A walkover survey at the site revealed several areas of stressed vegetation, industrial debris, and debris related to the maintenance of vehicles to the north of the remaining buildings. Surface water at the site is transported via storm sewers to the north and then east via ditches off the site.

3.1.1.3 Area 4 West – IOP West Shop Area (AUS-0A4W)

Little available habitat exists within Area 4 West; however, there are a variety of habitats adjacent to the site. Several buildings still exist in the area and are used as office space and as shipping and receiving buildings. Three buildings have been razed since the war. There are some small patches (100 ft x 100 ft) of overgrown wild rose bushes, blackberry, sumac, and small trees within the area. Drainage ditches on-site leading to off-site drainage ditches are wet during rain events. Pigeon Creek and a moist soil unit are approximately ¼ mile west of this area. A fescue field adjacent to the south of Area 4 West has an early intrusion of autumn olive. Adjacent to the westside is a mature pine plantation, a mature oak/hickory forest, and newly planted hardwoods (approximately two years old). There are mixed hardwoods adjacent to the north. During a walkover survey of the Area 4 West buildings, several areas of stressed vegetation were observed around the S-2-5 building (Building S-2-4 was razed).

3.1.1.4 Area 6 – IOP Ammonium Nitrate High Explosive and Smokeless Powder Storage Area

This 500-acre site is actively used as a storage facility and some of the area is fenced. The habitat immediately surrounding the igloos within the site is old-field and active crop field. The old-field habitat consists of open areas with mowed fescue and some brushy growth of sumac, autumn olive, and other invasives. There are a few agriculture fields between the magazine roads where winter wheat, soybeans, and corn are grown. Most of the igloos have mature trees (30 to 40 years old) growing on them. Roadside ditches with poor drainage contain standing water following rainfall. There is an off-site shallow impoundment of Little Creek that receives runoff from Area 6. Waterfowl and bald eagles have been observed feeding from the impoundment. Cattle graze in a fescue field adjacent to the north of Area 6 in the summer months. The field contains watering ponds for the cattle, and is bordered by mature oak/hickory forest. There are also mature woodlands to the south and west of Area 6. Open field habitat exists adjacent to the east of Area 6. Some agricultural fields (corn) also exist around the borders.

3.1.1.5 Area 7 – IOP Inert Storage Area (AUS-0A07)

Area 7 is located 0.5 miles north of Ogden Road on Chamness Road in a remote area of the Refuge. The site is actively used as a storage area and is approximately 60 acres in size. During the site walkover of Area 7, none of the typical signs of environmental impacts were observed in the areas of the razed buildings. The site is composed mainly of mowed fescue. Interspersed wet drainages hold shallow water after rainfall. Mixed woodland habitat exists to the west of the site. This woodland is in a middle successional stage. A 200-foot corridor of brush and mature oaks, adjacent to the south leads to an open field that is mowed annually. The Refuge is planning to reforest this field with hardwoods. Adjacent to the south is habitat along ditches containing mature trees. Mixed (successional) woodland exists to the north and east of Area 7. A pond attracts feeding blue heron; however, the birds do not visit Area 7. Raccoons regularly use Area 7, and turkey and bobcat have also been observed in the area.

3.1.1.6 Area 8 South – IOP Load Line III (AUS-0A8S)

Area 8 South is approximately 190 acres and consists of intermixed habitat with no industrial activities occurring within the area. There is old-field habitat consisting of fescue, broom sedge, goldenrod, small cedars, and sumac. The old-field habitat is also spotted with large cedars, black locust, and some thick brushy areas (early successional). The brushy areas are young woodlands of about 20 years with a dense under-story and few older trees. There are a few areas of older trees (greater than 50 years) with a clear under-story. Little to no standing water exists on site. There is an adjacent pond to the south side of the area. Some older woodlands exist adjacent to the south, east, and west. Wolf Creek is southwest of the area.

3.1.1.7 Area 9 – IOP Load Line I (AUS-0A09)

Area 9 is approximately 70 acres and is composed primarily of mowed fescue. Some ditches and flooded areas hold water after a rain event. There is an area containing cattails. Some areas, spanning approximately ¼ acre, have trees. Woodland habitat is adjacent to the west of the site and an agricultural field exists to the east. Crab Orchard Lake is to the north. Deer, turkey, and geese have been observed within Area 9. Piscivorous birds, along with mink and raccoon may be transient visitors to Area 9, as the ditches may contain crayfish and other food items.

3.1.1.8 Area 10 – IOP Fuse and Booster Storage Magazines (AUS-0A10)

Area 10 is composed of successional woodland and is approximately 40 acres in size. The habitat contains primarily young, dense woodland with a few large, mature trees. There are areas of thick saplings and vines and a few patches of unmowed fescue. The northern portion of Area 10 is part of a 40 acre designated natural area. The Area 10 natural area extends north, off-site and is a unique forest community designated by the occurrence of a black willow forest. Area 10 is bounded on all sides by mature woodland (oak/hickory/willow forest).

3.1.1.9 Area 11(AUS-A11A, AUS-A11H, AUS-A11N, AUS-A11P, AUS-A11S)

Area 11 has been divided into five sub-units according to the specific activities that were conducted in particular areas. While this is functional for the sampling investigation and derivation of the chemicals of interest, the area is basically a continuous habitat patch of approximately 180 acres. Though relic building foundations are present, the entire area has been left untouched for 20 to 30 years. The habitat consists of thick patches of invasive vines, autumn olive, and sassafras. Roadbeds cross the site. Some patches of woodland are found throughout the area. There are numerous ditches and small ponds. Most of the ponds are ephemeral and too small to support fish. Wood ducks and other dabbling ducks occasionally use Area 11. There is evidence of beavers, probably associated with Wolf Creek and its tributaries that feed within Area 11. Area 11 subareas were discussed in Section 2.

3.1.1.10 Area 12 Former Ammonium Nitrate Plant (AUS-0A12)

Area 12 is approximately 80 acres. Though similar in habitat and physically adjacent to Area 11, this site is less open and more consistently wooded with less fescue. The eastend of Area 12 has mature (40 to 50 years old) woodlands. There are not many large trees, however the canopy is closed. Numerous ditches and ponded areas exist within the site. Area 12 is surrounded on the east, west, and south by woodlands.

3.1.1.11 IOP Finished Ammunition Igloos (AUS-0A13)

AUS-0A13 encompasses approximately 500 acres. The design of Area 13 is similar to that of Area 6, in that both sites are storage areas with igloos and parallel roads. The habitat of Area 13 consists of mowed fescue with patches of woodland, brush, and vegetation. Hayfields and agricultural fields exist on site. The hayfields within the Refuge are usually red clover or fescue. The hay is cut once or twice per year. The hayfields usually receive more visitations by animals than the agricultural fields because the hayfields are not as disturbed. Area 13 contains wetland habitat. Ponds within this site are capable of supporting fish. Herons and ducks use one large pond that borders Area 13. Ditches within the site that are poorly drained contain standing water following rainfall. Area 13 is bound on all sides by woodlands. The Big Grassy Creek Natural Area borders the site to the southwest. This natural area supports a mature white/red oak and sassafras/persimmon forest community. The natural area also supports wood duck nesting and bald eagle use.

3.1.1.12 COC Area Sites (AUS-0062 to AUS-0069 and AUS-0109)

The Crab Orchard Cemetery (COC) sites are all in remote areas. Some of the sites are near Crab Orchard Lake (AUS-0069 and AUS-0066) while others border open fields or woodlands.

AUS 0062

This site is an old field. The site is brushy with young saplings (5 to 10 feet tall), vines, and invasive thorny bushes such as autumn olive, sassafras, and blackberry. A ditch runs through the site and there is ponding water in a couple of locations. AUS 0062 is surrounded on all sides by cropland. An abandoned road runs along the north side of the site.

AUS 0063

This site is an old field, within mixed woodland habitat of approximately 50 to 70 years of age. There are a number of small water-filled depressions from past munitions detonations throughout the site. There is a small intermittent drainage stream that runs through the site. There is an abandoned road on the north and west perimeters of the site. An agricultural field to the south and mature woodlands to the north border the site.

AUS 0065

This site is composed of small, open mature woodland with a dense canopy. This area contains several mounds of soil, a brick structure, two building foundations, and three ground depressions. One depression contains building debris and another has ponded water. A fence runs along the southern perimeter of the site. Fallow field surrounds AUS 0065. The field has early pioneer weeds and small hardwood saplings that have been planted. It will take approximately 50 years until this field is a mature hardwood forest.

AUS 0066

This site, like AUS 0065, is open mature woodland with a dense canopy. A pond of about 60 feet in diameter exists on the site. A red clay brick berm is located on the south side of the pond. An abandoned road and barbwire fence borders the north side of this site. Mixed mature woodlands surround the area. AUS 0066 is approximately 200 feet from Grassy Bay of Crab Orchard Lake.

AUS 0067

The habitat of this site is like that of AUS 0065. There is a soil pile and a sunken area containing concrete slabs, brick, and old foundation pieces. A road runs along the western perimeter of the site with an adjacent barbwire fence. ASU 0067 is completely surrounded by old-field habitat.

AUS 0069

This site is a small wooded area. Approximately 5 acres of the site are located on the Crab Orchard Lake shore. Scattered debris exists in three different locations within the site. Hay fields are adjacent to the west, east, and south.

AUS 0109

This site is an agricultural field that is currently planted and completely surrounded by corn. Woodland exists several hundred feet to the northwest.

3.1.1.13 IOP Fire and Police Headquarters (AUS-0001)

There are two ditches and a gravel parking lot within this site. Brushy woodland growth exists directly around, and is beginning to overtake the foundations of the former site buildings. The site is bounded on the east by Wolf Creek Road. A fescue hay field is on the other side of the road. Cedar and maple woodlands (20 to 30 years old) surround the site on the north, south, and west.

3.1.1.14 IOP Wastewater Treatment Plant (AUS-0002)

Site AUS-0002 is in a stand of trees just west of a pond. New vegetation, including intrusives such as cedar, autumn olive, and sassafras, are directly around the area. A fescue hay field exists to the east and south. A corridor of mature trees leads north from the site to a reforested field. A cool-season native grassland buffer planted around the site leads to this woodland. The treatment building was razed, however settling lagoons still exist. Dense vegetation now exists all around the area of the settling lagoons. The settling lagoons are seasonally wet.

3.1.1.15 IOP Railroad Classification Yard (AUS-0018)

Site 0018 is composed primarily of woodland habitat and brushy overgrown areas. Periodically, there is shallow standing water in ditches. A parking lot exists within the site. Adjacent to the north of the site is an old field. There are some oaks on the south side of the site. One building still stands at the site.

3.1.1.16 IOP Fire Station for Area 7 (AUS-0021)

Young woodlands (20 years) of cedar and autumn olive comprise the habitat of this site. The site is bound on the south by the PCB OU landfill and on the east by Chamness Road. Older woodland exists to the north of this site and leads to AUS Area 7. A fescue field proposed for reforestation borders the west side of this site. The building has been razed and only parts of the foundation are visible.

3.1.1.17 Areas 11 and 12 Fire Station (AUS-0043)

The habitat of this site is mainly early successional woodland. A ditch runs through the site. The foundation of one building still exists. The site is bound on the south by Ogden Road and on the east and west by mature poplar, cedar, and maple woodlands. To the north is an agricultural field. This site is presently used as a staging area by tenant farmers.

3.1.1.18 IOP Fulminate Storage Igloos (AUS-0060)

All of the igloos located at Site AUS-0060 are intact and accessible, however, overgrowth in the area of the compound's fence gate limits access through the gate. There are a few areas of seasonally ponded water within the site. Ditches surround the igloos and road. The site is composed of woodland with larger trees. Crab Orchard Lake is west of the compound and open fields surround the compound on the north south and east. The storage igloos have been unoccupied for approximately 30 years.

3.1.1.19 Concrete Structures West of Wolf Creek Road (AUS-0061)

The concrete structures of AUS-0061 are approximately 0.1 miles west of Wolf Creek Road in a thin row of trees. The site is overgrown and difficult to see from Wolf Creek Road. A road runs through the site. There are ditches on either side of the road that are seasonally wet. Adjacent to the site are woodlands on the east and west and open fields on the north and south.

3.1.1.20 Drum Disposal Area Identified During Site Reconnaissance East of Area 11(AUS-106A)

AUS-106A is located on the northern side of a former roadway (which is now impassable to vehicular traffic) that heads east from the roadway just east of former Building 9. The habitat of this site is mainly early successional woodland. A 3,000 ft^2 mounded area covers 50 to 100 partially buried drums. The mounded area is located along a creek bed that contains water only during precipitation events. This site is completely surrounded by woodland.

3.1.1.21 Possible Disposal Area Identified by Aerial Photo Interpretation (AUS-0107)

The habitat of Site AUS-0107 is mature woodland. Area 8 is located southeast of the site. There is a grassy field immediately adjacent to the east. Mature woodland exists to the south and west. Ogden Road and a grassy field are to the north.

3.1.1.22 Possible Surface Disposal Area Identified by Arial Photo Interpretations (AUS-0108)

AUS-0108 is located north of Ogden Road and north of Area 11. The area is partially agricultural field currently planted in corn and beans, with the remainder a mature woodland. The woodland has older trees (50 years) and brushy undergrowth. There is fairly contiguous mature woodland to the east and north. A patchy woodland/agricultural mix is located to the west. A buffer of younger woodland and a road borders the site to the south.

3.1.1.23 Summary of Habitats Associated with the AUS OU

An area habitat matrix is provided in Table 3-2 that summarizes the types of habitats and onsite and adjacent features associated with the AUS OU. Considering the areas presently characterized, there appear to be eight general habitat types presented within the areas under investigation:

- Early succession woodland
- Mid-succession woodland
- Agricultural field
- Agricultural pasture
- Urban grassland with treelines
- Urban grassland with brush
- Agricultural pasture with tree stands (savannah type habitat)

- Old field

The term "urban" grassland is used to indicate the presence of active industrial activity, with maintained lawn present.

3.2 CONTAMINANT FATE AND TRANSPORT

The largest medium in terms of areal extent associated with the AUS OU sites is soil. Windblown dust in most of the areas is not expected to be a significant pathway since most areas are vegetated. However, windblown dust may be a potential transport mechanism in areas where cultivated agricultural fields are present. The same is true for erosion. Some erosion may occur, particularly on the agricultural fields or portions of active industrial sites.

Some of the sites also contain ditches and ponds. There is the potential that offsite transport could occur during periods of rainfall. For many of the COIs, sediments in the ponds and ditches may act as contaminant sinks or reservoirs. Sediments could then sequester chemicals, and may be important to benthic invertebrates or semiaquatic receptors where sediment-dwelling organisms form a component of the food chain.

The COIs in Table 3-1 have been organized in general chemical categories (for example, alkanes, alkenes, polycyclic aromatic hydrocarbons [PAHs], inorganics, etc.), along with their physical/chemical properties. The migration and persistence of a chemical within the environment is controlled by the physical/chemical attributes of the chemical, the physical attributes of the system, and finally by the biota within the environment. All of these attributes affect the ultimate fate of the chemical. Such interactions are site-specific, but certain generalizations can be made. This section reviews the following in general terms:

- the importance of the soil/water/sediment matrices and their character;
- the chemical attributes of the constituent in the context of fate and transport, *e.g.*, lipophilicity, solubility, and sorption phenomena; and
- relative importance of dissolution, volatilization, complexation, photolysis, advection, and biodegradation as transport processes for the chemicals.

An understanding of how a chemical stressor behaves in the environment and how it can elicit stress in an ecosystem is an important component of the ecological risk evaluation process.

3.2.1 General Chemical/Physical Properties of Organic Chemicals

One of the most illuminating properties of an organic chemical's fate and transport within the environment is its relative solubility in water and octanol (Table 3-1A). The ratio between chemical concentrations in water versus octanol is represented by the octanol-water-partitioning coefficient, the K_{ow}. The K_{ow} of a chemical is a useful indication of the chemical's lipophilicity or propensity for sequestering into lipid stores within biota, the chemical's propensity towards adsorption onto organic carbon and, its ability to cross biological membranes. Empirical relationships between a chemical's K_{ow}, water solubility, organic carbon partitioning coefficient (K_{oc}), bioconcentration factor (BCF), and assimilation coefficient for biota have been drawn by numerous authors (*e.g.*, Clark *et al.* 1988, Donnelly *et al.* 1994, Lyman 1995, Mackay *et al.*

1995, Trapp and McFarlane 1995). For example, a chemical's K_{ow} is closely correlated to its affinity for organic carbon, expressed as the K_{oc}. In general, the greater the K_{ow} or K_{oc} the lower the water solubility and greater relative adsorption onto organic carbon. Donnelly *et al.* (1994) suggested relative mobility in soils based on a chemical's K_{oc}.

Soil Mobility Defined by Affinity for Organic Carbon

K_{oc}	*Log K_{oc}*	*Mobility Class*
> 2000	>3.3	Immobile
500 – 2000	2.7-3.3	Low Mobility
150 – 500	2.2-2.7	Intermediate Mobility
50 – 150	1.7-2.2	Mobile
< 50	<1.7	Very Mobile

In general, volatile organic compounds (VOCs) range from intermediate mobility to very mobile. In general, the majority of the semivolatile organic compounds (SVOCs)[14] that have log K_{oc}'s in excess of 3.3 and are considered essentially immobile in soil (unless the soil itself becomes mobile through *advected transport* or *biological assimilation*).

The octanol-water partitioning (K_{oc}) of an organic chemical is also a key property affecting the environmental behavior of an organic chemical in an aquatic system. This process has a direct bearing on ecological risk assessment as it impacts exposure pathways and especially the bioavailability of a chemical.

The process and/or degree of sorption with organic carbon, whether particulate or dissolved, has been shown to reduce the apparent (effective) bioavailability of both organic and inorganic compounds (Knulst 1992; Dewitt *et al.* 1992; Goodrich *et al.* 1992). Most sorption studies used to estimate or calculate partitioning coefficients for organic chemicals involve short exposure periods (hours to days) followed by desorption periods (USEPA 1986). These studies have been performed, for the most part, under the assumption that the sediment sorption process follows first-order thermodynamic kinetics. DiToro (1985), Landrum *et al.* (1992), USACE (1985), and others have shown that this assumption is invalid. Sorption is more accurately described as a biphasic process, in which the initial phase involves the chemical sorbing onto the surface of a sediment particle, followed by a second phase in which the chemical is absorbed into the particle. This biphasic process has a greater impact on predictions of desorption than adsorption, since the contribution of the secondary absorption of a chemical within particles does not have a great influence on the overall mass or concentration. Desorption, however, can be greatly overestimated since contact time and "degree" of adsorption will affect the rate of desorption (Landrum *et al.* 1992; USACE 1985). There is evidence that, given sufficient time, desorption essentially will not occur (Karrickhoff and Morris 1985; DiToro 1985). This phenomenon is

[14] The SVOCs as a group comprise the BNA compounds.

reflected in several recent articles that demonstrate reduced bioavailability (and toxicity) with the "age" of contamination in sediments (*e.g.*, Landrum *et al.* 1992).

An uncertainty in the prediction of bioavailability of sediment associated chemicals of interest is the inherent assumption of the equilibrium partitioning (EqP) approach that sorption of organic chemicals is dominated by the total organic carbon (TOC) content of the sediment. In fact, pore-water concentrations of dissolved organic carbon (DOC) also have a significant impact on the apparent bioavailability predicted by EqP (Williams *et al.* 1995).

Certain site-specific features such as soil structure have profound effects on the sorption, volatilization, and/or degradation processes of any chemical. In general, VOCs are susceptible to volatilization and degradation, and do not readily adsorb to sediments. PAHs can undergo photolysis, oxidation, and biodegradation (USEPA 1979). Some pesticides can undergo some volatilization from soils (*e.g.*, aldrin and endrin [USEPA 1979]). Others, such as chlordane and heptachlor are very resistant to degradation processes.

The significance of these processes is highly dependent on the environmental conditions to which the materials are exposed. The absorbents present in the soil, the type of soil cover, and size of macropores are highly significant site-specific considerations for most organic chemicals due to their impact on/interaction with the process of photolysis, volatilization, and oxidation/reduction.

Volatilization of organic chemicals from soils has been measured empirically and experimentally but can be considered highly site-specific. Volatilization is hampered by sorption to the soil and entrapment by overlying moisture. Lyman (1995) provides a generalization that is useful in qualitatively describing a chemical's propensity towards volatilization using its Henry's constant where:

Volatilization Potential

H (atm m^3/mol)	*Volatilization Potential*
$< 3 \times 10^{-7}$	Chemical is less volatile than water.
3×10^{-7} to 10^{-5}	Chemical volatilizes slowly.
$> 10^{-5}$ to $<10^{-3}$	Volatilization is significant.
$> 10^{-3}$	Volatilization is rapid.

Rates of chemical biodegradation vary widely due to variations in microbial composition, nutrient concentration, chemical soil concentration (non-toxic levels), and other environmental factors (*e.g.*, temperature, anaerobic or aerobic conditions). The most significant microbial degradation PAHs occurs aerobically in acclimated populations (USEPA 1979, Lyman 1995). While strong evidence exists that significant biodegradation occurs under anaerobic conditions the best evidence is still found for aerobic degradation. Because most soils within the units under consideration here are believed to be fairly aerobic, anaerobic degradation is probably not a significant fate process.

3.2.2 General Chemical/Physical Properties of Inorganic Chemicals

The fate of metals and metalloids depends on a myriad of processes best generalized as follows (according to Kabata-Pendias and Pendias 1992):

- dissolution;
- sorption;
- complexation;
- migration;
- precipitation;
- occlusion;
- diffusion (into minerals);
- binding by organic substances;
- absorption/fixation and/or sorption by microbiota; and
- volatilization.

The most important soil parameters involved with these processes are pH and redox potential. Other factors, such as cation exchange capacity (CEC), iron and manganese hydrous oxides, humics, chlorides, and clay minerals, are all known to impact these processes as well (Kabata-Pendias and Pendias 1992). Physiochemical parameters for inorganic COIs are presented in Table 3-1B.

3.3 POTENTIAL ECOLOGICAL RECEPTORS

3.3.1 Biological Characteristics and Ecological Structure

The following subsections describe the study area in the context of habitat, biological composition (structure), and system function. Habitat and composition are presented in the context of aquatic and terrestrial, or semiaquatic, *communities*. Understanding the biological characteristics and ecological structure enable the risk assessor to focus the evaluation through selection of assessment endpoints specific to the sites. *Assessment endpoints* represent ecologically relevant values based on fundamental ecological principles that consider the structure, function and dynamics of the ecological systems at risk.

Brief discussions of general community groups are presented below.

3.3.1.1 Plant Communities (Autotrophs)

Plants or plant communities are relevant in defining ecological assemblages by providing vegetative cover and shelter. Overall, eight vegetative cover types or assemblages are present at the AUS OU as described in Section 3.1:

- Early succession woodland

- Mid-succession woodland
- Agricultural field
- Agricultural pasture
- Urban grassland with treelines
- Urban grassland with brush
- Urban grassland with tree stands
- Old field

3.3.1.2 Soil Communities

Soil communities, comprised primarily of microorganisms (bacteria, fungi, molds, algae and protozoa) and invertebrates (*e.g.*, earthworms, nematodes), can be rich and diverse, both in terms of species diversity and biomass per unit area or volume (Spurr 1964, Owen 1975). Some play a significant role in the decomposition of fallen vegetation (Owen 1975), whereas some are predaceous on other soil invertebrates. At industrial areas, soil communities are important as potential contaminant transport pathways to organisms that may periodically forage within the boundaries of the site. The soil invertebrates in particular are prey items of consumers that will be considered as assessment endpoints. Through assimilation of bioaccumulative chemicals, these invertebrates represent a source of ingestion-pathway exposure to higher level consumers. Earthworms are a good example of a key pathway organism, in that they can account for up to 80% of the total macrobiotic biomass in soil (Kabata-Pendias and Pendias 1992).

3.3.2 Aquatic Microorganism and Invertebrate Communities

Several of the AUS OU sites contain ephemeral water habitats such as ditches or pools. These areas are seasonal or associated only with rainfall. Though they may be small in size and ephemeral in nature, they could potentially represent seasonal breeding areas for amphibians in the nonindustrial areas.

Several of the AUS OU sites contain permanent water (ponds) or wetlands. In permanent standing water, the aquatic microorganism and invertebrate communities may be significant in providing decomposition and nutrient cycling, and for food for higher level consumers. Because wetland sediments are anoxic, infaunal invertebrates are probably not significant. However, epifaunal invertebrates may play an important function role in decomposition and nutrient cycling. Some of the ponds contain fish, and though others do not, they may be important amphibian reproductive areas. Wetlands can also provide breeding habitat for a number of potential ecological receptors.

3.3.3 Fish

Fish are not believed to be associated with the ephemeral ditches and pools at the site since there are no direct connections to other surface water bodies that could provide recruitment. However, there are several permanent ponds, as noted in Table 3-2, which could potentially contain fish. A list of fish potentially present at the Refuge is presented in Table 3-3. Based on the preliminary types of surface water present, (ponds) likely common fish are centrarchids (i.e., sunfish and bass), and ictalurids (catfish and bullheads), as well as numerous species of minnows. Catfish and bullheads are bottom dwelling fish, and also have higher lipid content than the centrarchids and bass. Because of these characteristics, as well as an outer "skin" rather than scales, ictalurids may be more likely to contain sediment-associated contaminants.

3.3.4 Amphibians

Amphibians that may occur in the vicinity of the Refuge are presented in Table 3-4. As a group, the amphibians are the most primitive of the so-called higher vertebrates. As adults, frogs are basically terrestrial in the sense that they breathe air, but all have strictly aquatic larvae, or tadpoles. All except the tree frog and chorus frog remain in or near water most of the time. When there are temperature extremes (*e.g.*, in winter or on sunny summer days), frogs generally hibernate or aestivate in the warmest or coolest available locations. For the *Rana* sp., whose skin must remain moist, this usually means burrowing in soft aquatic sediments or riparian soils. Amphibians at the AUS OU will generally be associated with creeks, ponds, wetlands and adjacent riparian areas.

Adult frogs are essentially sedentary in the spatial context of relevance to this investigation. All are carnivores, and their normal way of feeding is waiting in ambush. Adult frogs normally eat anything alive that is small enough to ingest, which usually means some type of crawling or flying insect, but for the bullfrog includes crayfish, fish, other frogs, mice, and small birds. The tadpoles are basically herbivorous, feeding mainly on algae and vegetable detritus.

At industrial areas with associated water bodies, amphibians are considered as potential contaminant transport pathways to higher organisms that may forage along ponds and ditches. For non-industrial areas, amphibians represent potential assessment endpoints. Though the forage biomass may be limited, amphibians are potentially components of the diets of many predatory semiaquatic vertebrates (*e.g.*, wading birds and raccoons).

3.3.5 Reptiles

Based on geographical ranges and historical information, about 31 species of reptiles could conceivably occur in the vicinity of the Refuge (Table 3-4). Reptiles like the amphibians are cold-blooded, but all are strictly air breathing.[15] All reptiles that may be associated with the AUS OU sites, with the exception of the box turtle, are primarily carnivorous as adults, but will take other foods at times. Most are omnivorous as juveniles. All of the snakes are carnivores, with diets depending largely upon the most prevalent prey within the respective snakes' preferred habitats. Specific individuals of any of these species are unlikely to stray from relatively confined areas (i.e., a few tens or hundreds of square meters [DeGraaf and Rudis 1986; Dundee and Rossman 1989]). Snakes are potential prey items of various vertebrates, especially wading birds, some raptors, raccoons, and other snakes.

[15] Many amphibians are capable of and extensively utilize "dermal" respiration via their skin. Terrestrial reptiles, for the most part, are incapable of dermal or buccal respiration and have fully developed lungs.

3.3.6 Birds

Many birds forage over large areas, or are seasonal migrants that are federally protected. A total of 230 species of birds are listed with at least a potential to occur in the vicinity of the Refuge based on zoogeographic information and accounts (Table 3-5). Many of these are only transient visitors that pass through the Refuge during migration and have very limited exposures. Others are present only seasonally, and some are residents of the Refuge throughout the year. For the purposes of selecting candidate ecological receptors for the screening evaluation (Section 3.6.1), focus is placed on birds believed to be relatively common and either resident or seasonally resident. This does not indicate that transient birds are not a consideration as part of this evaluation. Rather, because resident or seasonally resident birds will be more susceptible to contaminant exposures, risks estimated based on these receptors should also be protective of birds with lower exposure[16].

3.3.7 Mammals

A total of 38 species of mammals have a potential to occur at the Refuge (Table 3-6). There are several herbivorous ground-grazing mammals potentially present at the Refuge. These include the eastern cottontail rabbit, the white-tailed deer, the prairie vole, the woodchuck and several species of squirrels. Several mice species may be common to the area. With the exception of the golden mouse (which is arboreal), these mice are herbivorous ground foragers but will consume insects and soil invertebrates on occasion (Martin *et al.* 1951, DeGraaf and Rudis 1986, USEPA 1993).

Among the carnivores, the mink is semiaquatic in nature, feeding on small mammals, birds, amphibians and fish. The weasel, though it also is generally not found far from water, feeds on small mammals, birds and insects. Six species of bat may occur at Crab Orchard. All of these species are entirely insectivorous feeding exclusively on flying insects caught in flight (air hawkers, DeGraaf and Rudis 1986). The largest carnivores potentially associated with the site are the coyote and bobcat.

The remaining mammals expected to be common or abundant within the landscape-scale ecosystem are omnivorous ground foragers. The opossum, raccoon and striped skunk are expected to be relatively common. The red fox is more carnivorous than the other common mammalian omnivores and feeds heavily on rabbits and small rodents (DeGraaf and Rudis 1986). However, the fox will also consume significant quantities of fruits when available.

3.3.8 Species of Special Value or Concern

Federally listed and State of Illinois listed threatened or endangered species potentially found on Crab Orchard National Wildlife Refuge are summarized in Table 3-7.

[16] Susceptibility is a function of both sensitivity to the chemical and degree of exposure (dose or concentration). Unless certain receptors are known to have greater sensitivity to a chemical, then identifying receptors with greater exposure is a reasonable approach to selecting those at greatest risk.

3.4 ECOTOXICITY

As pointed out in ERAGS, understanding the toxic mechanisms of a contaminant helps to evaluate the importance of potential exposure pathways and to focus selection of assessment endpoints. It is not the intent of this Work Plan to provide a great level of detail on the toxic mode of action of the each of the COIs listed in Table 3-1. Rather, a broader approach will be used for screening. For example, in a detailed evaluation, or where COIs are limited, it may be appropriate to limit the evaluation of PCBs to reproductive endpoints in higher level consumers because of the tendency of PCBs to biomagnify and act as a reproductive toxin in mammals. In this screening evaluation, conservative toxicity reference values will be selected using the most sensitive of reproductive, growth or survival endpoints based on information available from the readily available toxicological literature for all trophic levels for both direct and ingestion pathway exposures.

3.5 EXPOSURE PATHWAYS

The predominant source of potential contaminants at the AUS OU sites are wastes historically disposed at the sites, or releases occurring as a result of historic handling practices or spills. The primary medium associated with the AUS Sites is soils. However, transport of chemicals to other media (e.g., surface water, sediment or groundwater) may have occurred.

In the context of ecological receptors, exposure can occur via direct contact and ingestion. A diagrammatic conceptual exposure model for potential exposure pathways associated with the AUS OU sites is shown in Figure 3-2. Direct exposures are defined as direct contact between a contaminated medium and a receptor. Examples include roots of vegetation or invertebrates in direct contact with soils or sediment; or fish, amphibians or invertebrates in direct contact with surface water. Potential exposure pathways for vertebrate receptors include: (1) inhalation, dermal contact and direct ingestion of contaminated media; and/or (2) ingestion of dietary items containing chemicals as a result of bioconcentration/accumulation (i.e., food chain exposures). Although some of the COIs are volatile constituents, the inhalation exposure pathway is not considered a significant exposure pathway and is not included in the overall evaluation. There are also limitations in estimating the potential release of these chemicals from soil to subsurface soil pores or channels. However, none of the areas being evaluated represent confined areas where a "concentrated" exposure to volatile constituents may occur. Nevertheless, fossorial or burrowing organisms could potentially be exposed to volatile chemicals in soil. Though not considered significant, this remains an uncertainty in the risk evaluation.

"Direct" dermal contact with soil could potentially occur via digging for food or "dusting" (e.g., sand bathing). However, most soil generally does not reach the epidermis because of the presence of fur or feathers and is discarded (e.g., shaken off) or ingested through preening and grooming behaviors (USEPA 1993). Semiaquatic birds and mammals can also be exposed via dermal contact to chemicals in sediment or surface water. However, as with the inhalation pathway, there is a paucity of information regarding dermal exposures to wildlife. Though inhalation and dermal pathways are considered of relatively low importance compared to direct ingestion, they contribute to uncertainty in the risk assessment.

3.6 SELECTION OF ASSESSMENT ENDPOINTS

As noted previously, assessment endpoints represent ecologically relevant values based on fundamental ecological principles that consider the structure, function and dynamics of the ecological systems at risk. They represent the focus of the ecological risk assessment. Screening level assessment endpoints are dependent upon the presence of exploitable habitat for each of the AUS OU sites. Based on the foregoing discussion, identification of potential terrestrial and aquatic assessment endpoints for the AUS Units are presented in the following subsections.

3.6.1 Aquatic and Riparian Habitat Assessment Endpoints

3.6.1.1 Assessment Endpoint #1: Viability and Function of the Benthic Macroinvertebrate Community

Benthic invertebrate communities comprise a large portion of the base of the food chain for aquatic ecosystems. Impacts to benthic invertebrate communities may have direct effects (e.g., loss or reduction of forage) and indirect effects (transfer of bioaccumulative compounds) on higher trophic-level organisms. Benthic macroinvertebrates process organic material in water bodies and are important in nutrient and energy transfer as well as to the overall ecosystem function.

Hypothesis

Are the levels of site contaminants in surface water and sediment sufficient to cause adverse alterations to the structure and function of aquatic invertebrate communities?

Measurement Endpoint

One line of evidence will be used to assess the effects of contamination within the creeks and ponds associated with the AUS OU on the benthic invertebrate communities. Sediment and water samples collected from the various water bodies will be analyzed for contaminants. The results of these analyses will be compared with screening concentrations developed from toxicity reference values (TRVs) reported in the literature. If the maximum concentration of a chemical exceeds the screening value, it will be retained for further evaluation as a chemical of potential ecological concern (COPEC).

3.6.1.2 Assessment Endpoint #2: Viability and Function of the Periphyton Community

The periphyton community is comprised of algae, bacteria, fungi, and meiofauna attached to the substrate in a stream. Benthic algae are generally the dominant group of organisms within the periphyton community. Stream periphyton communities can be affected by nutrient or sediment loading, light, temperature, water velocity and grazing pressure. Impacts to the periphyton community are of concern due to its role in energy flow, their potential for exposure to contaminants, and their role as a food source for higher trophic level organisms.

Hypothesis

Are levels of site contaminants in surface water and sediment sufficient to cause adverse alterations to the structure and function of the periphyton community?

Measurement Endpoint

One line of evidence will be used to assess the effects of contamination within the creeks and ponds associated with the AUS OU on the periphyton community. Sediment and water samples collected from the various water bodies will be analyzed for contaminants. The results of these analyses will be compared with screening concentrations developed from TRVs reported in the literature. If the maximum concentration of a chemical exceeds the screening value, it will be retained for further evaluation as a COPEC.

3.6.1.3 Assessment Endpoint #3: Viability and Function of the Amphibian and Reptile Communities

Amphibians and some reptiles may rely on ponds associated with the Crab Orchard National Wildlife Refuge. Amphibians and reptiles are important to energy transfer in the terrestrial systems as they provide a link between the aquatic and terrestrial systems and act as both predators and prey. Predation by and of amphibians and reptiles contributes to balanced populations of other aquatic and terrestrial organisms, which are essential for normal ecosystem functioning.

Hypothesis

Are levels of site contaminants sufficient to cause adverse alterations to the development, growth or reproductive capacity of the amphibian and reptile communities?

Measurement Endpoint

There are insufficient data with which to develop screening concentrations for evaluation of amphibians and reptiles. Therefore, this assessment endpoint will not be assessed directly, but will be acknowledged as an uncertainty in the risk evaluation. For decision-making purposes, it will be assumed that screening of chemicals relative to other assessment endpoint will be sufficiently protective of this assessment endpoint as well.

3.6.1.4 Assessment Endpoint #4: Viability and Function of the Fish Community

The fish community in a stream plays a key role in ecosystem functions such as energy flow, nutrient cycling and organic matter accumulation, and is an important food resource for higher trophic level species.

Hypothesis

Are levels of site contaminants sufficient to adversely effect the survival, growth or reproduction of fish that inhabit the AUS OU?

Measurement Endpoint

One line of evidence will be used to assess the effects of contamination within the creeks and ponds associated with the AUS OU on the fish community. Water samples collected from the various water bodies will be analyzed for the contaminants. The results of these analyses will be compared with screening concentrations developed from TRVs reported in the literature. If the maximum concentration of a chemical exceeds the screening value, it will be retained for further evaluation as a COPEC.

3.6.1.5 Assessment Endpoint #5: Survival, Growth and Reproduction of Omnivorous Birds

Omnivorous birds have diverse methods of foraging (e.g., dabbling). Omnivorous birds can also have high soil/sediment ingestion rates. Soil/sediment ingestion often accounts for the majority of the contaminant uptake in ingestion models. Omnivorous birds also help to regulate the growth of aquatic vegetation, algae, and benthic invertebrates. Omnivorous birds are important pathways by which nutrient and energy in the stream may be transferred between the aquatic and terrestrial environment.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth or reproduction in omnivorous birds that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For omnivorous birds, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.1.6 Assessment Endpoint #6: Survival, Growth, and Reproduction of Omnivorous Mammals

Omnivorous mammals help to regulate benthic invertebrate and fish populations. Omnivorous mammals are important pathways by which nutrient and energy are transferred between the terrestrial and aquatic environment. In many urban and/or suburban ecosystems, these species typically represent the highest trophic levels and therefore, for contaminants that biomagnify, would be receiving the greatest doses of contaminants from their forage.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in omnivorous mammals that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For omnivorous mammals, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.1.7 Assessment Endpoint #7: Survival, Growth and Reproduction of Herbivorous Mammals

Herbivorous mammals are organisms that rely primarily on vegetation as forage. The role of herbivores is essential to an ecosystem as they transfer the energy available in plant tissue (primary producers) to animal tissue. In addition to contributing to energy pathways in an aquatic system, herbivores foraging on vegetation regulate vegetation density, species abundance, and diversity. Herbivorous mammals may also serve as prey items for upper trophic level predators. Therefore, herbivorous mammals contribute to a balanced vegetative community, in terms of species diversity and abundance, while regulating upper trophic level terrestrial organisms.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in herbivorous mammals that use the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For herbivorous mammals, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.1.8 Assessment Endpoint #8: Survival Growth and Reproduction of Insectivorous Mammals

Insectivorous mammals are important in the population regulation of potentially harmful aquatic insects, such as mosquitoes. Impacts to insectivorous mammals would allow species of potentially harmful aquatic insects to obtain higher population levels than would typically occur in a system that was not impacted. Insectivores are important in nutrient processing and energy transfer between the aquatic and terrestrial environment.

Hypotheses

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in insectivorous mammals that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For insectivorous mammals, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.1.9 Assessment Endpoint #9: Survival, Growth and Reproduction of Insectivorous Birds

Insectivorous birds are important in the population regulation of potentially harmful aquatic insects, such as mosquitoes. Impacts to insectivorous birds would allow species of potentially harmful aquatic insects to obtain higher population levels than would typically occur in a system that was not impacted. Insectivores are important in nutrient processing and energy transfer between the aquatic and terrestrial environment.

Hypotheses

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in insectivorous birds that use the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For insectivorous birds, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.1.10 Assessment Endpoint # 10: Survival, Growth, and Reproduction of Piscivorous Birds

Piscivorous birds are upper trophic-level organisms that feed primarily on fish. Piscivorous birds selectively feed on fish of a specific size, thereby helping to regulate fish populations. The foraging behavior of piscivorous birds represents a pathway by which energy is transferred between aquatic and terrestrial ecosystems. Predators also are often required to keep prey in check, and impacts to predators could cause detrimental population explosions in prey species.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in piscivorous birds that utilize the water bodies associated with the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For piscivorous birds, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.1.11 Assessment Endpoint #11: Survival, Growth, and Reproduction of Piscivorous Mammals

Piscivorous mammals are upper trophic-level organisms that selectively forage on fish. Foraging behavior of piscivorous mammals represents a pathway by which energy is transferred to higher trophic levels within the terrestrial ecosystem. Predators also are often required to keep prey in check, and impacts to predators could cause detrimental population explosions in prey species.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth or reproduction in piscivorous mammals that use the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For piscivorous mammals, the results of water and sediment analyses will be reviewed for the presence of bioaccumulative chemicals. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.2 Terrestrial Assessment Endpoints

3.6.2.1 Assessment Endpoint #12: Viability and Function of the Soil Invertebrate Community

The soil invertebrate community of a terrestrial ecosystem plays a key role in ecosystem functions such as nutrient cycling and organic matter processing. Soil invertebrates can be an important food resource for upper trophic level species such as insectivorous small mammals and birds. Therefore, soil community function and viability was selected as an assessment endpoint for this screening risk assessment.

Hypothesis

Are levels of site contaminants in soil sufficient to cause adverse alterations to the structure and function of terrestrial invertebrate communities?

Measurement Endpoint

One line of evidence will be used to assess the effects of contamination within the soil associated with the AUS OU on the terrestrial invertebrate communities. Soil samples collected from the various sites will be analyzed for the contaminants. The results of these analyses will be compared with screening concentrations developed from TRVs reported in the literature. If the maximum concentration of a chemical exceeds the screening value, it will be retained for further evaluation as a COPEC.

3.6.2.2 Assessment Endpoint #13: Viability and Function of the Vascular Plant Community

The terrestrial rooted vascular plant community provides many functions within the ecosystem. Included within these functions are: erosion prevention (both water and wind caused erosion), promotion of rainwater percolation, restriction of sheet water flow leading to reduced flooding potential, reduction of surface wind velocity, providing nesting and cover habitat for wildlife, primary production via photosynthesis, and a source of organic mater input (energy) to streams and soil systems. Because the terrestrial plant community is critical to the overall function of the terrestrial ecosystem, a viable terrestrial plant community was selected as an assessment endpoint for this screening risk assessment.

Hypothesis

Are levels of site contaminants in soil sufficient to cause adverse alterations to the structure and function of terrestrial vascular plant communities?

Measurement Endpoint

One line of evidence will be used to assess the effects of contamination within the soil associated with the AUS OU on the terrestrial plant communities. Soil samples collected from the various sites will be analyzed for contaminants. The results of these analyses will be compared with screening concentrations developed from TRVs reported in the literature. If the maximum concentration of a chemical exceeds the screening value, it will be retained for further evaluation as a COPEC.

3.6.2.3 Assessment Endpoint #14: Survival, Growth, and Reproduction of Herbivorous Birds

Herbivorous birds were selected for evaluation because they feed mostly on plant tissue (whether it be stems or fruits and seeds). Herbivorous birds also help to regulate the growth of vascular plants, and are an important pathway by which nutrient and energy in the terrestrial system may be transferred.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in herbivorous birds that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For herbivorous birds, the results of soil analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.2.4 Assessment Endpoint #15: Survival, Growth and Reproduction of Herbivorous Mammals

Herbivorous mammals are organisms that rely primarily on vegetation as forage. The role of herbivores is essential to an ecosystem as they transfer the energy available in plant tissue (primary producers) to animal tissue, and make it available to upper trophic level organisms. In addition to contributing to energy pathways in a terrestrial system, herbivore foraging on vegetation regulates vegetation density, species abundance, and diversity. In addition, herbivorous small mammals serve as prey items for upper trophic level predators. Therefore, herbivorous small mammals contribute to a balanced vegetative community, in terms of species diversity and abundance, while regulating upper trophic level terrestrial organisms.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in herbivorous mammals that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For herbivorous mammals, the results of soil analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.2.5 Assessment Endpoint #16: Survival, Growth, and Reproduction of Insectivorous Birds

Insectivorous birds are organisms that rely primarily on insects as forage. The foraging behavior of insectivorous birds represents a pathway by which nutrients and energy are transferred from lower to higher links in the food chain. For example, insects are consumed by mid-level insectivorous birds, which are in turn consumed by an upper level consumer. Insectivores may also transfer energy from the detrital food chain to the predator food chain in that insectivores may consume detritivores (e.g., millipedes) thereby providing a link between the two chains.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in insectivorous birds that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For insectivorous birds, the results of soil analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.2.6 Assessment Endpoint #17: Survival, growth, and Reproduction of Insectivorous Mammals

Insectivorous mammals are important in the population regulation of terrestrial insects, such as grubs and earthworms. Impacts to insectivorous mammals would allow species of terrestrial insects to obtain higher population levels than would typically occur in a system that was not impacted. Insectivores are important in nutrient processing and energy transfer in the terrestrial environment.

Hypotheses

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in insectivorous mammals that utilize the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For insectivorous mammals, the results of soil analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.2.7 Assessment Endpoint #18: Survival, Growth, and Reproduction of Carnivorous Birds

Carnivorous birds are upper trophic level organisms that rely primarily on animal tissue, such as small mammals, as forage. This foraging behavior represents a pathway by which nutrients and energy are transferred from lower to higher links in the food chain. In addition, foraging on small mammals regulates small mammal density, species abundance, and diversity. Carnivorous birds are susceptible to exposure to contaminants because certain contaminants can bioaccumulate in the organisms upon which they feed.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in carnivorous birds that use AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures.

For carnivorous birds, the results of soil analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.6.2.8 Assessment Endpoint #19: Survival, Growth, and Reproduction of Carnivorous Mammals

Carnivorous mammals are upper trophic-level organisms that selectively forage on lower trophic-level organisms such as small mammals. Foraging behavior of carnivorous mammals represents a pathway by which energy is transferred to higher trophic levels within the terrestrial ecosystem. Predators also are often required to keep prey in check, and impacts to predators could cause detrimental population explosions in prey species.

Hypothesis

Are levels of site contaminants sufficient to adversely effect survival, growth, or reproduction in carnivorous mammals that use the AUS OU?

Measurement Endpoint

For the screening stage of the risk process, the presence of potentially bioaccumulative compounds will be used to indicate a need for further evaluation of ingestion pathway exposures. For carnivorous mammals, the results of soil analyses will be reviewed for the presence of bioaccumulative chemicals. For organic chemicals, the potential for bioaccumulation will be based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. Organic chemicals that have a log K_{ow} greater than 3.5 will be considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium will be considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected will be retained as a COPEC for further evaluation.

3.7 SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK CHARACTERIZATION (STEP 2 – ERAGS)

3.7.1 Estimates of Exposure

The types and numbers of analyses varies among each of the AUS OU sites depending on the historical activities at the site as outlined in the *Field Sampling Plan Site Inspection Additional and Uncharacterized Sites Operable Unit* (URS 2000b) and as discussed in this report. For the purposes of exposure estimation at the screening level, only the maximum concentration of a constituent identified at each site will be evaluated. This is consistent with the overall conservative nature of the screening process to ensure that constituents that could potentially contribute to risk are not eliminated early in the process.

3.7.2 Effects Assessment

To develop chemical-specific screening concentrations, it is necessary to understand the level at which a chemical may affect ecological receptors via direct contact or ingestion. For the purposes of developing screening concentrations for direct exposures, effects in this screening evaluation are based on identification of relevant toxicity reference values. TRVs are concentrations or doses above which ecologically relevant effects might occur following chronic exposures. The ratio of the maximum concentration to the screening concentration is expressed as a screening hazard quotient (HQ). If the screening HQ exceeds 1, that is, if the maximum concentration of the chemical measured at a specific AUS OU site exceeds the screening concentration, then the constituent is characterized as a COPEC, and additional evaluation of the AUS OU site may be warranted. Direct Exposure TRVs are discussed in the following subsections.

For ingestion pathway exposures, as discussed previously, it will be assumed that there is a potential for risk if a potentially bioaccumulative chemical is detected in soil, surface water or sediment. Potentially bioaccumulative chemicals as used herein, include mercury, selenium, or any organic chemical with a log K_{ow} greater than 3.5. The K_{ow} provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. If a potentially bioaccumulative chemical is detected in soils, surface water or sediment, it will be characterized as a COPEC, and additional evaluation of the AUS OU site may be warranted.

3.7.2.1 TRVs for Soil-Associated Organisms

Soil organisms are those organisms in intimate contact with the soil. These include invertebrates such as earthworms and insects, plants such as soil algae or vascular plant roots, and soil microbes (bacteria and fungi).

There are multiple TRVs available for soil-associated organisms as shown in Table 3-8. The goal was to identify a single ecological screening value (ESV) from among the many TRVs to apply in the AUS OU ecological screening evaluation of direct exposures to soil-associated organisms. It is recognized that some of the available TRVs within the scientific literature are below typical soil and sediment concentrations considered "natural," undisturbed or background levels. Reasons for this include the reliance on laboratory-based "spiking" experiments to derive the TRVs. Additional problems are encountered when experimenters and those using experimental results to derive TRVs fail to account for the existing level of chemical within soil and/or sediment. This is common among the soil TRVs for the naturally occurring inorganics disseminated by the Oak Ridge National Laboratory (e.g., Efroymson *et al.* 1997a and 1997b). Still other soil screening concentrations disseminated consider ecological ingestion pathway effects (e.g., Region V ecological data quality levels [EDQLs]) and/or human health (e.g., Canada Environmental Quality Guidelines, Netherlands Intervention Values and EPA Region IV Screening Values), which are not directly relevant to direct exposures to soil organisms. Considering the attributes and limitations of the various sources of TRVs, the following prioritization scheme was developed for selecting a single ESV for direct exposures to soil organisms.

Prioritization Level	Source	Rationale
Level A	USEPA (2000) draft ecological soil screening levels Environment Canada (1995) NOEC values for seed emergence and worm survival Talmage et al. (1999)	The draft USEPA (2000) guidance incorporates a rigorous review of available studies on the toxicity in soils of various constituents. The Environment Canada (1995) values are empirically derived no effect levels directly related to plants and invertebrates. Talmage et al. (1999) is essentially the sole source for information on explosives compounds.
Level B	Efroymson *et al.* (1997a) Efroymson *et al.* (1997b)	These sources present screening levels directly relevant to plants, invertebrates and microbial communities. However, they are limited since many of the data relate to added concentrations, rather than total concentration present. This is a substantial limitation for inorganics, though should not be significant for organics.
Level C	EPA Region V EDQLs	The Region V EDQLs are broad screening values that may not be directly relevant to direct exposures in soils because they include ingestion pathway exposures to higher trophic levels.
Level D	Canadian Environmental Quality Guidelines (CCME 1999) Netherlands Intervention Values (MHSPE 1994) EPA Region IV screening values (1999)	Values from these sources take into consideration human health as well as ecological considerations, and may not be directly relevant to direct exposures in soils.

The approach for selection of a single ESV for direct exposures in soils was to select the lowest value from Level A sources as the ESV. If no value was available from Level A sources, then the lowest level among the reported values in Level B was selected. This process was repeated as necessary for Levels C and D. Using this approach, the single ESV selected for each chemical from among the multiple potential soil screening concentrations is presented in Table 3-8.

3.7.2.2 TRVs for Sediment-Associated Invertebrates, Periphyton and Vascular Plants

TRVs specific to freshwater sediment were obtained from a number of sources and are summarized in Table 3-9. None of the TRVs are specific to periphyton or vascular plants; therefore, evaluation of these receptor groups represents an uncertainty.

With respect to effects levels, there are a number of potential sources and endpoints. There are also multiple endpoints from some sources. For example, threshold effects levels (TELs) as reported by Ingersoll et al. (1996) are the geometric mean of the 15th percentile in the effects data set and the 50th percentile in the no-effects data set. The effects-range low (ERL) and effects-range medium (ERM) are the 15^{th} percentile and 50^{th} percentile values in the effects datasets, respectively. The Probable Effects Level (PEL) is the geometric mean of the 50^{th} percentile in the effects data set and the 85^{th} percentile in the no-effects data set, and the effects range medium is the 50^{th} percentile value of the effects dataset. A TEL or ERL is assumed to represent a concentration below which toxic effects are rarely observed. The range between the TEL and PEL is assumed to represent the range in which effects are occasionally observed. MacDonald et al. (1999) developed "consensus-based" freshwater sediment screening concentrations. Threshold effect concentrations (TECs) were developed as concentrations below which adverse effects are not expected to occur. Probable effect concentrations (PECs) were levels above which effects are frequently expected to occur. Among other potential screening values, no effect concentrations (NECs – Ingersoll et al. 1996) and upper effect thresholds (UETs – NOAA 1999) are also levels above which effects are frequently or always observed.

In deriving an ESV, preference was given to the TEC, TEL and ERL values since these are the most conservative (i.e., levels below which effects are rarely observed). Preference was also given to freshwater-derived values (MacDonald et al. [1999], Ingersoll et al. [1996], Ontario [1995] and NOAA [1999]) as opposed to estuarine or saltwater (Long et al. 1995).

If screening values were unavailable from the sources noted above, the "equilibrium-partitioning" (EqP) approach was used. This used the lowest surface water ESV (Table 3-10) and the expected partitioning between sediment and sediment pore water as described in USEPA (1993). EqP-based sediment screening values were derived using the following relationship:

$$SC = Cw * f_{oc} * K_{oc}$$

where:

SC = EqP based screening concentration in sediment

Koc = organic carbon to water partitioning coefficient (from Table 3-1)

foc = fraction organic carbon (0.01 assuming an organic carbon concentration of 1%)

Cw = screening value in water (from Table 3-10)

The equilibrium partitioning approach is applicable to nonionic organic compounds. There is uncertainty associated with application of the equilibrium partitioning approach to organics that may ionize, thereby representing a limitation to the approach.

Region V values were only used in the absence of direct exposure screening concentrations, or EqP-derived values, since the Region V values also take into consideration ingestion pathway exposures. In terms of published screening concentrations, Region IV screening values were used only in the absence of other screening values, since many of the values were based on reporting limit considerations rather than effects levels.

The overall prioritization for selection of an ESV for direct exposures in sediments is summarized in the following table.

Prioritization Level	Source	Rationale
Level A	MacDonald et al. (1999) TEC Ingersoll et al. (1996) TEL, ERL NOAA TEL (1999) Ontario Low (1995)	The TEC, TEL and ERL represent the most conservative screening values. TECs were selected preferentially, since they represent "consensus"-based values, and are also the most recently published values. The lower of the Ingersoll *et al.* (1996) TELs and ERLs were selected next in priority, as they are based on well-document freshwater data. NOAA TELs were prioritized next; they are for freshwater but lack the derivation documentation of the Ingersoll values. Ontario values are the last among the Level A values that are based solely on freshwater endpoints.
	ECOTOX Threshold Values (USEPA 1996) Long et al. ERL (1995)	The ECOTOX threshold values are recommendations from a compilation of other values (including EqP and Long et al. [1995]) The Long et al. (1995) data were selected last among the Level A sources, since they are based on marine, as opposed to freshwater data.
Level B	Ingersoll et al. (1996) ERM Long et al. (1995) ERM	ERMs are less conservative than the Level A values. Ingersoll *et al.* (1996) values were selected preferentially because they are based on freshwater data.
Level C	MacDonald et al. (1999) PEC Ingersoll et al. (1996) PEL and NEC NOAA PEL and UET	These values are less conservative than Level A or B data, generally representing concentrations above which effects have been observed in sediments. The PEC was selected in order of preference since it is a "consensus"-based concentration and the

Prioritization Level	Source	Rationale
		most recently published. Ingersoll *et al.* (1996) PELs and NECs were selected next in order of preference since the data are well-documented. NOAA values were selected last in order of preference, since only summary tables are available without derivation documentation.
Level D	Equilibrium Partitioning	Screening concentrations estimated using equilibrium partitioning were selected next since they are based on conservative direct effect screening concentrations in surface water expressed, based on EqP, in sediment.
Level E	EPA Region V EDQL	EPA Region V EDQLs are broad screening values that may not be directly relevant to direct exposures in sediments because they include ingestion pathway exposures to higher trophic levels.
	EPA Region IV	EPA Region IV values were selected next in preference. Many of these values are based on reporting limit considerations rather than effects levels.

Table 3-9 is presented in a format consist with the selection rationale presented in the above table. Values in the left-most columns were selected in preference to values from other sources. Note that this is slightly different from the general approach using for surface water and soils, in which the lowest value within each level was selected. This is because the sources used in sediments, even within a specific level, could be prioritized using the rationale presented in the above table. For example, though both were placed within the Level A category, freshwater-based values were selected in preference to marine values, since only freshwater systems will be encountered at the Refuge.

For equilibrium partitioning calculations, the water ESVand log K_{oc} used to calculate a screening concentration are also presented. For purposes of calculating screening concentrations, the organic carbon concentration was assumed to be 1%. The single ESV selected from among the multiple potential sediment screening concentrations is presented in Table 3-9.

3.7.2.3 TRVs for Direct Water Exposure

TRVs for direct exposure by aquatic organisms in surface water are relevant to invertebrates, fish and larval amphibians. A summary of TRVs for direct exposures to surface water is provided in

Table 3-10. As with soils and sediments, a prioritization scheme was developed to select a single ESV among the many values available. The Illinois water quality standards are believed to be the most relevant, followed by national recommended ambient water quality criteria. ECOTOX reports values based on ambient water quality criteria, and Tier II water quality criteria have been developed in the absence of sufficient information to support a national recommended water quality criterion using guidelines outlined in the Great Lakes Water Quality Initiative. Remaining sources were prioritized based on relevance to the area and professional judgment. The approach for selecting a single ESV from among the multiple sources is presented in the following table.

Prioritization Level	Source	Rationale
Level A	Illinois General Use Water Quality Standards	The Illinois General Use water quality standards are believed to be the most relevant because they relate directly to Illinois waters. Pursuant to Illinois Title 35 Environmental Protection, Subtitle C Water Pollution, Chapter 1 Pollution Control Board, Part 302.202, the General Use standards will protect the State's water for aquatic life… [and] wildlife.
Level B	National Recommended Water Quality Criteria (USEPA 1999)	A rigorous review and screening of toxicity data are used to develop National Recommended Water Quality Criteria, for which minimum data requirements spanning a number of aquatic families is a requirement.
Level C	ECOTOX (1996) Suter and Tsao (1997) USEPA Region IV Freshwater Screening Values (USEPA 2001) NOAA Chronic Values (1999) ASessment Tools for The Evaluation of Risk (ASTER): (ASTER 2000)	There is a great deal of overlap among these sources (with the exception of ASTER). These include Tier II values developed when there are insufficient data to develop a value using the approach outlined for the national recommended water quality criteria, or lowest reported chronic values. ASTER also contains Maximum Acceptable Toxicant Concentrations (MATCs) derived using quantitative structure activity relationship (QSAR) models.
Level D	EPA Region V EDQLs	EPA Region V EDQLs are broad screening values that may not be directly relevant to direct exposures in surface water because

Prioritization Level	Source	Rationale
		they include ingestion pathway exposures to higher trophic levels. Therefore, these values were selected only in the absence of information from other sources.

Using the approach presented in the above table, the single ESV selected from among the multiple potential surface water screening concentrations is presented in Table 3-10.

Table 3-10 is presented in a format consistent with the selection rationale presented in the above table. Illinois Water Quality Standards (Level A) were selected first in order of preference, followed by National Recommended Water Quality Criteria (Level B). If no data were available from Levels A or B, the lowest value among the several sources in Level C was selected. If still no data were available, the value from Level D, if available, was selected as the ESV. The single ESV selected from among the multiple potential sediment screening concentrations is presented in Table 3-10.

3.7.3 Selection of Chemicals of Potential Ecological Concern

Screening concentrations developed using the approaches outlined above are applied by comparing them to the maximum concentration of a COI at each of the AUS OU sites. The goal of this process is to identify COPECs. A COPEC is a chemical, based on an initial screening of its maximum concentration in applicable media (i.e., surface soil, surface water, and/or surficial sediment[17]), where there is a potential that the chemical may adversely interact with the environment. The ultimate decision for considering a chemical for further evaluation is up to the risk managers. Even though a chemical may exceed an ESV in the screening process, the risk managers may decide, based on such factors as frequency of detection, the degree of exceedance, chemical-specific attributes, and uncertainty in assumptions, that further evaluation is not warranted (see Section 5).

The following criteria will be used in selecting COPECs for each site in the AUS OU.

- If a chemical is not detected, and there is no screening concentration, then the chemical will not be selected as a COPEC.
- If the maximum concentration of a chemical exceeds the screening concentration, then the chemical will be classified as a COPEC.
- If the maximum concentration of a chemical is less than the screening concentration, then the chemical will not be classified as a COPEC.
- If a chemical is not detected, but the reporting limit exceeds the screening concentration, then the chemical will be carried forward as an uncertainty to the Scientific Management Decision Point (SMDP – Section 5).

[17] Subsurface media are not directly considered here as there is no complete exposure pathway for the subsurface to ecological receptors.

- If an organic chemical is detected and has a log K_{ow} greater than 3.5, it will be classified as a COPEC.
- If mercury or selenium is detected, it will be classified as a COPEC.
- If a chemical is detected, and there is no screening concentration, then the chemical will be characterized as an uncertainty for evaluation in the Scientific Management Decision Point (SMDP).

This process of COPEC selection corresponds to Step 2 within the ERAGS Screening-Level Ecological Risk Assessment (Screening-Level Exposure Estimate and Risk Calculation). If no COPECs are identified, it is concluded that the COIs are not of potential ecological concern and no further investigation for ecological concerns would be deemed warranted. COPECs identified will be carried forward to the Scientific/Management Decision Point (SMDP) where a decision is made for further evaluation, or to eliminate the chemical from further evaluation.

3.7.4 Uncertainties

There are basically three types of uncertainties associated with the process of selecting COPECs: a lack of knowledge (what we do not know); a lack of data (what we can know but do not presently); and a lack of technology (the limits of our ability to measure or predict). In the context of screening for chemicals that deserve a comprehensive evaluation of potential ecological impact, not all uncertainties are equal. For example, the lack of credible oral toxicity values for amphibians and reptiles is a significant uncertainty in that the potential risks for these receptors cannot be fully characterized. A lack of organic carbon data for soils (for example) would not be nearly as significant. While the foregoing examples are fairly clear, others are less so.

In the present context, an often encountered uncertainty is that of a lack of technology -- analytical sensitively for detection of chemicals in environmental media. The approach used to evaluate the significance of such an uncertainty is on a case-by-case basis using a line-of-evidence approach. Where a chemical is never detected in any media, in any area, at any time, even though the reporting limit may exceed the screening concentration, then the uncertainty is not believed to be significant. Conversely, if a chemical is routinely detected in multiple media but not detected in one media where the reporting limit exceeds the screening concentration, the associated uncertainty may be significant.

Assumptions made during the screening process are conservatively applied to ensure that chemicals that warrant further consideration are not eliminated early in the process. These assumptions include use of a NOEC TRVs (i.e., a TRV where it is assumed there is no risk); application of an area use factor of 1 (receptors obtain all food intake from the study area); and 100% chemical bioavailability.

TABLE 3-1A
PHYSIOCHEMICAL PARAMETERS FOR ORGANIC CHEMICALS OF INTEREST
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Molecular Wt (g/mol)	Melting Point (°C)	Vapor Pressure (torr)	Solubility (mg/L) @20-25°C	log K_{oc} ASTER[1]	log K_{oc} HSDB	K_{oc}[2]	log K_{ow}	Henry's constant (atm/m³/mole)
Halogenated Methanes/Alkanes									
Bis(2-chloroethoxy) methane	173	NA	4.00E-05	120000	1.74	1.32	7-61	0.75	1.70E-07
Bromodichloromethane	163.8	-57	50	6700	2.48	2.06	53-251	2.1	0.0016
Bromoform (Tribromomethane)	252.7	8	5.5	3100	2.63			2.4	0.00053
Bromomethane	94.94	-93.7	1600	15000	1.92	1.19		1.2	0.0062
Carbon tetrachloride (Tetrachloromethane)	153.8	-23	120	790	2.9		71	2.7	0.03
Chloroform (Trichloromethane)	119.4	-63.6	200	7900	2.4		34	1.9	0.0037
Chloromethane	50.49	-97.7	4300	5300	1.85			0.91	0.0088
Dibromochloromethane	208.3	-20	4.9	2600	2.55	2.32	95-468	2.2	0.00078
Methylene chloride	84.93	-95.1	430	13000	2.02	1.68		1.3	0.0022
Halogenated Ethanes									
1,1-Dichloroethane	98.96	-96.9	230	5100	2.3		43	1.8	0.0056
1,1,1-Trichloroethane	133.4	-30.4	120	1300	2.69	1.28	2-183	2.5	0.017
1,1,2-Trichloroethane	133.4	-36.6	23	4400	2.45	2.05	70-183	2	0.00091
1,1,2,2-Tetrachloroethane	167.8	-43.8	4.6	3000	2.78		79	2.4	0.00034
1,2-Dichloroethane	98.96	-35.5	79	8500	2.13		33	1.5	0.00098
Chloroethane (Ethyl Chloride)	64.51	-138.7	1000	5700	2.13	1.84	33-143	1.4	0.0088
Hexachloroethane	236.7	187	0.21	50	3.84	2.84	220-2188	4	0.0039
Halogenated Propanes									
1,2-Dichloropropane	113	-70	52	2800	2.42		47	2	0.0028
2,2'-Oxybis (1-chloropropane)	171.1	-122.8[a]	0.88	1700		1.75	56	2.5	0.00012
Halogenated Alkenes									
1,1-Dichloroethene	96.94	-122.5	600	2300	2.63		150	2.1	0.026
1,2-Dichloroethene (total)	96.95[a]	-50[a]	324[a]			1.62	36-49		
1,2-Dichloroethene (cis)	96.94	-80	200	3500	2.3		49	1.9	0.0041
1,2-Dichloroethene (trans)	96.94	-49.8	330	6300	2.3		36	2.1	0.0094
1,3-Dichloropropene (total)	111	<-50[a]	34	2800				2	0.018
1,3-Dichloropropene (cis)	111		33	2700		2.65	450	2	0.0024[a]
1,3-Dichloropropene (trans)	111		23	2700	2.3		740	2	0.0018[a]
Tetrachloroethylene	165.8	-22.3	19	200	3.23	2.80	238-1685	2.7	0.018
Trichloroethylene	131.4	-84.7	73	1100	2.77	2	87-150	2.7	0.01
Vinyl chloride	62.5	-153.7	3000	2800	2.16		56	1.5	0.027
Amines									
2-Nitroaniline	138.1	71.2	1.40E-04	290	2.32		53	1.9	1.81E-08[a]
3-Nitroaniline	138.1	114	9.60E-05	1200	2.02	1.94		1.4	1.40E-07
3,3'-Dichlorobenzidine	253.1	132.5	3.70E-08	3.1	3.28			3.5	4.00E-09
4-Chloroaniline	127.6	72.5	0.012	5300	2.37	2.86	96-5550	1.9	3.30E-07
4-Nitroaniline	138.1	147	8.30E-06	730	2.02	1.89	52-117	1.4	2.1E-09
4,4'-Methylenebis (2-chloroanaline)	267.2	110[a]	1.30E-08	14		3.68	4810	1.4	4.1E-11
N-Nitrosodiphenylamine	198.2	66.5	0.00067	35	3.06	3.08	1200	3.2	5.00E-06
N-Nitroso-di-n-propylamine	130.2		0.13	9900	2.15	2.11	130	1.4	2.30E-06
Benzene and Derivatives									
Benzene	78.11	5.5	95	1800	2.5	1.82	31-143	2.1	0.0056
Chlorobenzene	112.6	-45.2	12	470	2.89	1.59	4.8-313.1	2.9	0.0037
1,2-Dichlorobenzene	147	-16.7	1.4	160	3.21	4	280-320	3.4	0.0019
1,2,4-Trichlorobenzene	181.4	17	0.43	35	3.6	3.1-5		4	0.0014
1,3-Dichlorobenzene	147	-24.8	2.1	130	3.28	2.48	300	3.5	0.0031
1,4-Dichlorobenzene	147	52.7	1	74	3.28	4.8	273-390	3.4	0.0024
Hexachlorobenzene	284.8	231.8	1.80E-05	0.005	4.7	4.55		5.9	0.0013
Methylated Benzenes									
Toluene	92.14	-94.9	28	530	2.77	1.873589		2.8	0.0066
Xylenes (total)	106.16[a]		7.99[a]			2.08	39-365		0.007[a]
Other Substituted Benzenes									
Ethylbenzene	106.2	-94.9	9.6	170	3.06	2.94	164	3.1	0.0079

TABLE 3-1A
PHYSIOCHEMICAL PARAMETERS FOR ORGANIC CHEMICALS OF INTEREST
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Molecular Wt (g/mol)	Melting Point (°C)	Vapor Pressure (torr)	Solubility (mg/L) @20-25°C	log K_{oc} ASTER[1]	log K_{oc} HSDB	K_{oc}[2]	log K_{ow}	Henry's constant (atm/m^3/mole)
Styrene	104.2	-31	6.1	310	2.9	2.73	520-555	2.9	0.0027
Nitrobenzene	123.1	5.7	0.24	2100	2.36	2.34	1.27-370	1.8	2.40E-05
Arenes									
2,4-Dinitrotoluene	182.1	71	1.50E-04	270	2.45	2.450249	282	2	9.30E-08
2,6-Dinitrotoluene	182.1	66	5.70E-04	180	2.41	2.31	204	1.9	7.50E-07
Chlorinated Dienes									
Hexachlorobutadiene	260.8	-21	0.22	3.2	4	3.71	5181	4.8	0.0081
Hexachlorocyclopentadiene	272.8	-9	0.06	1.8	4.08	3.63	4265	5.4	0.027
Ethers									
4-Bromophenyl phenyl ether	249.1	18.72	0.0015	4.6	4.19	4.28	17000	5	0.00012
4-Chlorophenyl phenyl ether	204.7	-8[a]	0.0027[a]	1.4	4.11	3.48	2260-3950	5	0.00146[b]
Bis (2-chloroethyl) ether	143	-51.9	1.6	17000	1.88	2.08	120	1.2	1.80E-05
Phenols and Substituted Phenols									
2-Chlorophenol	128.6	9.8	2.3	22000	2.51	2.70		2.1	3.90E-04
2-Methylphenol (o-Cresol)	108.1	29.8	0.3	26000	2.41	1.55		2	1.20E-06
2-Nitrophenol	139.1	44.8	0.11	2200	2.35	1.97	32-266	1.8	9.50E-06
2,4-Dichlorophenol	163	45	0.067	4500	2.95	3	200-5000	3.1	3.20E-06
2,4-Dimethylphenol	122.2	24.5	0.098	7900	2.68	2.33	105-430	2.4	2.00E-06
2,4-Dinitrophenol	184.1	112-114[a]	0.0051	2800	2.31	2.30	200	1.6	4.40E-07
2,4,5-Trichlorophenol	197.4	69	0.02	1200	3.35	3.36	2300	3.9	4.30E-06
2,4,6-Trichlorophenol	197.4	69	0.024	800	3.17	2.76	150-2200	3.7	7.80E-06
4-Chloro-3-methylphenol	142.6	67	0.0082	3800	2.96	1.70	50	3.1	4.00E-07
4-Methylphenol (p-Cresol)	108.1	35.5	0.11	22000	2.41	2.25		1.9	7.90E-07
4-Nitrophenol	139.1	113.8	4.10E-05	12000	2.35	1.7	55	1.9	4.20E-10
4,6-Dinitro-2-Methylphenol	198.1	86.5	3.20E-04	200	2.58	2.56	225-590	2.1	4.30E-07
Pentachlorophenol	266.3	174	3.20E-05	2000	3.44	2.69	2-121681	5.1	2.40E-08
Phenol	94.11	40.9	0.28	83000	2.14	1.34	16-30	1.5	4.00E-07
Ketones (Carbonyl Compounds)									
2-Butanone (Methyl Ethyl Ketone)	72.11	-86.6	95	220000	1.51	1.50	29-34	0.28	0.000056
2-Hexanone	100.2	-55.5	12	18000	2.09	2.13	134	1.4	0.000093[a]
4-Methyl-2-pentanone (MIBK)	100.2	-84	20	19000		2.09	123	1.2	1.40E-04
Acetone	58.08	-94.8	230	1.00E+06	1.22	0	1	-0.24	3.90E-05
Isophorone	138.2	-8.1	0.44	12000	2.47	1.99	25-384	1.7	6.60E-06
Low Molecular Weight PAHs									
2-Chloronaphthalene	162.6	61	0.008	12	3.53	3.05	1130	4.1	3.10E-04
2-Methylnaphthalene	142.2	34.4	0.055	25	3.41	3.93	8500	3.9	5.20E-04
Acenaphthene	100	93.4	0.0025	4.2	3.39	3.41	2065-3230	3.9	1.60E-04
Acenaphthylene	152.2	92.5	0.00091	16	3.3	3.25	950-3315	3.5	1.10E-04
Anthracene	178.2	215	2.70E-06	0.043	3.78	5.30	70000-130000	4.5	6.50E-05
Carbazole	167.2	246.2	5.20E-07	7.5	3.25	2.56	114-1180	3.6	1.50E-08
Dibenzofuran	168.2	86.5	1.80E-04	10	3.56	3.67	2000-11000	4.2	1.30E-05
Fluorene	166.2	114.8	0.00063	2	3.55	3.96		4.2	6.40E-05
Naphthalene	128.2	80.2	0.085	31	3.14	3.26	812-4100	3.4	4.80E-04
Phenanthrene	178.2	99.2	0.00011	1.1	3.78	4.36		4.5	2.30E-05
High Molecular Weight PAHs									
Benzo(a)anthracene	228.3	84	1.10E-07	0.0094	4.42	4.49	545000-1870000	5.7	3.40E-06
Benzo(a)pyrene	252.3	176.5	5.5E-09	0.0016	4.67	6.14	930-1700000	6.1	1.10E-06
Benzo(ghi)perylene	276.3	277[a]	1.00E-10	0.00026	4.92	4.98	96000	6.7	1.40E-07
Benzo(b,k)fluoranthene	252.3	217	2.00E-09	0.0008	4.67	5.82	330000-1300000	6.2	8.30E-07
Chrysene	228.3	258.2	6.2E-09	0.0016	4.42	5.13	31000-580000	5.7	9.50E-05
Dibenzo(a,h)anthracene	278.4	269.5	1E-10	0.0025	5.06	6.12	570000-3100000	6.7	1.50E-08
Fluoranthene	202.3	107.8	7.80E-06	0.21	4.03	4.97		5.1	1.60E-05
Indeno(1,2,3-cd)pyrene	276.3	161.5	1.00E-10	0.000022	4.92	6.82	110000	6.7	1.60E-06
Pyrene	202.3	151.2	4.60E-06	0.14	4.03	5.2	59675-169000	5.1	1.10E-05

TABLE 3-1A
PHYSIOCHEMICAL PARAMETERS FOR ORGANIC CHEMICALS OF INTEREST
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Molecular Wt (g/mol)	Melting Point (°C)	Vapor Pressure (torr)	Solubility (mg/L) @20-25°C	log K_{oc} ASTER[1]	log K_{oc} HSDB	K_{oc}[2]	log K_{ow}	Henry's constant (atm/m³/mole)
Phthalates									
Bis (2-ethylhexyl) phthalate	390.6	-55	6.50E-06	0.34	6.03	4-5	87420	7.3	1.00E-07
Butylbenzylphthalate	312.4	-35[a]	8.30E-06	2.7	3.35	4		4.8	1.30E-06
Diethyl phthalate	222.2	-40.5	0.0016	1100	2.72	1.99	69-1726	2.5	4.50E-07
Dimethyl phthalate	194.2	5.5	0.0016	4000	2.14	5.2	80-50000	1.6	1.10E-07
Di-n-butyl phthalate	278.4	-35	7.30E-05	11	3.87	2.195		4.6	9.40E-10
Di-n-octyl phthalate	390.6	25	2.60E-06	0.02	6.17	5	610000	8.1	6.70E-05
Miscellaneous Solvents									
Carbon disulfide	76.14	-115	360	1200		2.43	270	2	0.03
Pesticides (mg/kg)									
4,4'-DDD	320	109.5	6.70E-07	0.09		4.91	80500	6.1	4.00E-06
4,4'-DDE	6.1	89	6.00E-06	0.12		3.92	8300	6.8	2.10E-05
4,4'-DDT	354.5	108.5	1.60E-07	0.025		5.30	113000-350000	6.5	8.10E-06
DDT (Total)									
Aldrin	364.9	104	6.00E-06	0.18		3.53		6.5	1.70E-04
a-BHC (hexachlorocyclohexane)	290.85[a]	159-160[a]	4.50E-05	2		3.28	1780-1995	3.8	1.10E-05
b-BHC (hexachlorocyclohexane)	290.8		4.70E-07	0.24		3.75		3.8	7.40E-07
d-BHC (hexachlorocyclohexane)	290.8	141.5	3.50E-05	31		3.14	700-2700	4.1	4.30E-07
g-BHC (Lindane)	290.8	112.5	4.10E-04	6.8	3.38	3.53	1080.9-4800	3.7	1.40E-05
a-Chlordane				0.044				6	0.00086[a]
g-Chlordane				0.019				6.4	0.0013[a]
Chlordane (Technical)	409.8	106	9.80E-06	0.056		3.71	1720-15500	6.3	4.90E-05
Dieldrin	380.9	175.5	5.90E-06	0.2		3.87		5.4	1.50E-05
alpha Endosulfan									
beta Endosulfan									
Endosufan	406.9	106	1.00E-05	0.51		3.30	2000	4.1	1.10E-05
Endosulfan sufate	422.9	181[a]	1.6	6.4		3.76	2330-14200	3.7	0.0021
Endrin	380.9	<200[a]	3.00E-06	0.25	3.31	4.53	34000	5.1	7.50E-06
Endrin aldehyde	380.89[a]	235[a]	2.00E-07[a]	3.1		4.29	8500-45000	4	2.90E-09[a]
Endrin ketone									
Heptachlor	373.3	95.5	0.0004	0.18		4.48		6.3	1.5
Heptachlor epoxide	389.3	160	1.90E-05	0.2		4.10	7800-20000	5	9.50E-06
Isodrin	364.9[a]	240-242[a]	0.000006[a]	0.2[a]		3.52	400-28000		0.000496[a]
Methoxychlor	345.6	87	6.00E-07	0.045	4.15	3.90	620-100000	5.1	1.60E-05
Toxaphene	413.2	65-90[a]	9.80E-07	0.74	3.69	4.59	7200-210000	5.5	6.00E-06
PCBs (mg/kg)									
PCBs (total)			7.70E-05	0.07				6	0.0026
Aroclor 1016			0.0004[a]	0.225-0.25[a]		4.97	52100-171000	4.38[a]	0.000343[a]
Aroclor 1221	192[a]	1[a]	0.0067[a]	2[a]		4.46		4.09[a]	0.000228[a]
Aroclor 1248	288[a]		0.000494a	0.054[a]				6.11[a]	
Aroclor 1254	327[a]		0.000077[a]	0.012[a]		5.58	110000-1330000	6.3[a]	0.000283[a]
Aroclor 1260	375.7[a]		0.0000405[a]	0.027[a]		5.83	61000-7400000	6.8[a]	0.000336[a]
Explosives (mg/kg)									
1,3-Dinitrobenzene (DNB)	168.1	90	0.0009	860	1.56	1.39		1.5	2.30E-07
1,3,5-Trinitrobenzene (TNB)	213.1	121.5	0.00002	350	1.3	2.13	104-178	1.2	1.60E-08
2-Amino-4,6-Dinitrotoluene (2-ADNT)	197.17[c]	173-176[c]	0.00004[c]	2800[c]				0.5-1.94[c]	0.003[c](L-torr)/mol
2-Nitrotoluene (ONT)	137.13[a]	-9.5[a]	0.1[a]	652[a]		2.36	124-425	2.3[a]	0.000056[a]
2,4,6-Trinitrotoluene (TNT)	227.1	80.1	0.000002	120	2.72	3.16	1100-1900	1.6	4.9E-09
3-Nitrotoluene	137.15[a]	15.5[a]	0.207[a]	498[a]		2.16	143	2.45[a]	0.000075[a]
4-Amino-2,6-Dinitrotoluene	197.15[d]		0.00002[d]	2800[d]				0.6[d]	0.001[d]
4-Nitrotoluene (PNT)	137.1	51.6	0.0048	94		2.43	153-464	2.4	2.10E-07
Cyclonite (RDX)	222.1	205.5		60	2	1.92	42-167	0.87	6.30E-08[a]

TABLE 3-1A
PHYSIOCHEMICAL PARAMETERS FOR ORGANIC CHEMICALS OF INTEREST
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Molecular Wt (g/mol)	Melting Point (°C)	Vapor Pressure (torr)	Solubility (mg/L) @20-25°C	log K_{oc} ASTER[1]	log K_{oc} HSDB	K_{oc}[2]	log K_{ow}	Henry's constant (atm/m³/mole)
Cyclotetramethylenetetranitramine (HMX)	296.2[d]	286[d]	3.33E-14[d]	5[d]	0.54			0.06-0.26[d]	2.6E-15[c]
Nitroglycerin (NG)	227.1	13.5	0.0002	1400	2.215			1.6	4.30E-08
Pentaerythritol tetranitrate (PETN)	316.15[a]	140[a]	1.035E-10[a]	43[a]	3.39	2.74	179-1720	1.61[a]	1.20E-11[a]
Tetryl	287.15[a]	130-132[a]	1.00E-08[a]	75[a]	1.69	2.61	406	1.65-2[c]	1.00E-11[c]
Dioxins/Furans (mg/kg)									
1,2,3,7,8-PeCDD	356.4			0.012				6.6	
1,2,3,4,6,7,8-HpCDD	425.3			0.00042				8.2	
1,2,3,4,6,7,8-HpCDF	409.3			0.00076				7.9	
1,2,3,4,7,8-HxCDD	390.9			0.001				7.8	
1,2,3,4,7,8,8-HpCDF									
1,2,3,4,7,8-HxCDF	374.9			2.50E-05				9.5	
1,2,3,6,7,8-HxCDD	390.9	285-286[a]	3.60E-11[a]			5.6-7.6		7.8[a]	2.56E-05[a]
1,2,3,6,7,8-HxCDF	374.9								
1,2,3,7,8-PeCDF	340.4			0.0064				6.9	
1,2,3,7,8,9-HxCDD	390.9	243-244[a]							
1,2,3,7,8,9-HxCDF	374.9								
2,3,4,6,7,8-HxCDF	374.9								
2,3,4,7,8-PeCDF									
2,3,7,8-TCDD	322	295	1.5E-09	7.90E-06		7.39		6.5	7.90E-05
2,3,7,8-TCDF	306			0.015			35000-400000	6.5	5.35E-05[a]
OCDD	459.8[a]	330[a]	8.25E-13[a]	7.40E-08[a]		7-7.9	50000-350000	8.78-13.37[a]	6.74E-06[a]
OCDF									
Total Petroleum Hydrocarbons (mg/kg)									
TPH-Gasoline range organics									
TPH-Diesel range organics									

Note:

All physical parameter are obtained from the EPA Superfund Chemical Data Matrix except as noted.

1=Values for all explosives are obtainted from Rosenblatt et al. 1991, Army Biomedical Research and Development Laboratory.

2=All k_{oc} values are obtained from HSDB

a= Value obtained from HSDB

b= Value obtained from ASTER

c= Value obtained from Talmage et al. 1999

d= Value obtained from Rosenblatt et al. 1991, Army Biomedical Research and Development Laboratory.

TABLE 3-1B
PHYSIOCHEMICAL PARAMETERS FOR INORGANIC CHEMICALS OF INTEREST
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Molecular Wt (g/mol)[1]	Density (g/cc)[1]	Melting Point (°C)[1]	Soil / Sediment Kd	Invertebrate BSAF	Water BCF	Plant - Soil BCF	Soil - Invertebrate BCF	Herbivore Soil BCF	Invertivore Soil BCF
Metals (mg/kg)										
Aluminum	2.70E+01	2.70E+00	660.37	1.50E+03		136a	5.00E-03	1.18E-01	3.10E-02	9.30E-02
Antimony	1.22E+02	6.70E+00	630.5	4.50E+01		10.8d	1.14E-02		8.00E-03	8.00E-03
Arsenic	7.49E+01	5.70E+00		2.00E+02	6.90E-01	2.9q	1.10E+00	5.23E-01	1.60E-02	1.30E-03
Barium	1.37E+02	3.50E+00	725	4.10E+01		150f	4.77E-01	1.60E-01	2.53E-01	1.12E-01
Beryllium	9.01E+00	1.80E+00	1278	7.90E+02		95e	1.00E-02	1.18E+00	3.20E-01	3.20E-01
Boron										
Cadmium	1.12E+02	8.70E+00	321	7.50E+01	7.99E+00	713t	3.25E+00	4.07E+01	4.48E-01	7.02E+00
Calcium	4.01E+01	1.50E+00	850	4.00E+00			6.03E+00		1.73E+01	9.72E+00
Chromium III	5.20E+01	7.10E+00	1900	1.80E+06	4.68E-01	3e	8.39E-02	3.16E+00	3.09E-01	9.50E-02
Chromium VI	5.20E+01	7.10E+00	1900	1.90E+01						
Cobalt	5.89E+01	8.90E+00	1493	4.50E+01		0.98p	2.48E-02	2.91E-01	1.40E-01	1.00E-01
Copper	6.36E+01	8.90E+00	1083	4.30E+02	5.25E+00	469g	6.25E-01	1.53E+00	1.29E+00	1.12E+00
Iron	5.59E+01	7.90E+00	1535	2.50E+01			1.00E-02	7.80E-02	2.40E-02	1.71E-02
Lead	2.07E+02	1.10E+01	328	9.00E+02	6.07E-01	331h	4.68E-01	1.52E+00	1.87E-01	3.39E-01
Magnesium	2.43E+01	1.70E+00	649	4.50E+00			2.06E+00		1.15E+00	7.43E-01
Manganese	5.49E+01	7.20E+00	1244	6.50E+01		73r	2.31E-01	1.24E-01	7.90E-02	3.70E-02
Mercury	2.01E+02	1.40E+01	-38.87	5.20E+01	2.87E+00		5.00E+00	2.06E+01	2.40E-02	1.05E+00
Nickel	5.87E+01	8.90E+00	1455	6.50E+01	2.32E+00	35.1k	1.41E+00	4.73E+00	8.98E-01	5.78E-01
Potassium	3.91E+01	8.60E-01	63.25	5.50E+00			1.13E+01		7.73E+00	5.52E+00
Selenium	7.90E+01	4.80E+00	217	3.00E+02		94m	3.01E+00	1.34E+00	1.55E-01	8.13E-01
Silver	1.08E+02	1.00E+01	962	8.30E+00		21.8n	3.67E-02	1.53E+01	7.00E-03	8.10E-01
Sodium	2.30E+01	9.70E-01	97.82	1.00E+02			8.20E-01		1.00E+02	8.01E+01
Thallium	2.04E+02	1.20E+01	303.5	1.50E+03		67e	4.00E-03		1.23E-01	1.23E-01
Vanadium	5.09E+01	6.10E+00	1917	1.00E+03		100s	9.70E-03	8.80E-02	1.90E-02	1.31E-02
Zinc	6.54E+01	7.10E+00	419.5	6.20E+01	7.53E+00	682o	1.82E+00	1.29E+01	2.32E+00	2.90E+00
Total Cyanide				9.90E+00						

Note:

1= obtained from the EPA Superfund Chemical Data Matrix
a = obtained from USEPA (1988)
c = obtained from USEPA Region IV (1999)
d = geometric mean of values presented by MOEE (1996) - No data in AQUIRE
e = obtained from RTI (1995)
f = obtained from OHM/TADS - No data in AQUIRE
g - geometric mean from values obtained from USEPA 1985a
h - geometric mean from values obtained from USEPA 1985b
k - geometric mean from values obtained from USEPA 1986b
m = obtained from USEPA 1980a
n - geometric mean from values obtained from USEPA 1980b

g/cc= gram/cubic centimeter
Kd = soil/sediment - water partitioning coefficient
BASF = biota/sediment accumulation factor
BCF = Bioconcentration factor
o - geometric mean from values obtained from USEPA 1987
p = only marine BCFs avaiable geometric mean obtained from ASTER Database
q - geometric mean from values obtained from USEPA 1984a
r = obtained from USEPA ASTER database
s = obtained from OHM/TADS for plants (50 for invertebrates and 10 for fish)
t - geometric mean from values obtained from USEPA 1984b

TABLE 3-2
AREA HABITAT MATRIX FOR THE ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Area	Habitat Classification	Area Size - Arces (approximate)	Industrial Activity (Y / N?)	Agricultural Activity (Y / N?)	Primary Vegetative Cover	Secondary Vegetative Cover	Tertiary Vegetative Cover	Ephemeral Water (Ditches / Pools)	Permenant Water (Ponds / Creeks)	Fenced (Y / N?)	Active Buildlings (Y / N?)	Abandoned Buildlings (Y / N?)	Building Foundations (Y / N?)	Adjacent Water Body*	Adjacent Old-Filed*	Adjacent Woodland*	Adjacent Open Field*	Adjacent Road*	Adjacent Cropland*
2	Woodland Patch and Agricultural Fields	405	N	Y	W	AG (w,c)	---	D		N	N	Y	Y		S	N,W	E		
2B	Urban Grassland with Tree Line	47	Y	N	F	B,T	---	D		Y	Y	N	N						
2D	Urban Grassland with Tree Line	57	Y	N	F	B,T	---	D		Y	Y	Y	Y						
2F	Urban Grassland with Tree Line	26	Y	N	F	B,T	---	D		Y	Y	Y	N						All
2P	Urban Grassland with Tree Line	60	Y	N	F	B,T	---	D		Y	Y	?	N		S	N,W	E		
4 East	None		Y	N	F	---	---	D		N	Y	Y	Y			N	S,E	W	
4 West	Urban Grassland with Brush		Y	N	F	B	---	D		N	Y	N	Y	W-C		W,N	S	E	
6	Old Field and Agriculture Field	500	Y	Y	OF	Ag (w,c,s)	MIT	D,PL		PF	Y	N	Y			N,W,S	N,E		
7	Urban Grassland	60	Y	N	F	---	---	D		N	Y	Y	Y	NE-PNF		N,W,E	S		
8 South	Old Field and Early Woodland	190	N	N	OF	B	W	D	PNF	N	N	N	Y buried	SW-C		S,E,W			
9	Urban Grassland with Tree Stands	70	Y	N	F	T	---	D	W	Y	Y	Y	Y	SW-W		W			E
10	Old Field and Early Woodland	40	N(o)	N	OF	W	---	P		Y	N	Y	N			All			
11	Old Field and Early Woodland	180	N	N	OF	W	---	D,PL	PN	PF	N	N	Y			W,E			N
12	Early Woodland and Woodland	80	N	N	W	---	---	D,PL	PN	N	N	N	Y			W,E,S			

TABLE 3-2
AREA HABITAT MATRIX FOR THE ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Area	Habitat Classification	Area Size - Arces (approximate)	Industrial Activity (Y / N?)	Agricultural Activity (Y / N?)	Primary Vegetative Cover	Secondary Vegetative Cover	Tertiary Vegetative Cover	Ephemeral Water (Ditches / Pools)	Permenant Water (Ponds / Creeks)	Fenced (Y / N?)	Active Buildlings (Y / N?)	Abandoned Buildlings (Y / N?)	Building Foundations (Y / N?)	Adjacent Water Body*	Adjacent Old-Filed*	Adjacent Woodland*	Adjacent Open Field*	Adjacent Road*	Adjacent Cropland*
13	Agricultural Grassland and Old Field	500	Y	Y	OF	Ag (h)	W	D	PNF	PF	Y	N	Y buried			All			
AUS 0062	Old Field		N	N	OF	---	---	D,PL		N	N	N	N					N-AR	All
AUS 0063	Old Field		N	N	OF	---	---	D		N	N	N	N			All		N,W-AR	
AUS 0065	Mid/Late Succession Woodland		N	N	W	B	---	PL		PF	N	Y	Y		All				
AUS 0066	Mid/Late Succession Woodland		N	N	W	B	---		PN	PF	N	N	N	N-COL		All		N-AR	
AUS 0067	Mid/Late Succession Woodland		N	N	W	B	---			PF	N	N	Y		All			W	
AUS 0069	Mid/Late Succession Woodland		N	N	W	B	---			N	N	N	N	N-COL					W,E,S-(h)
AUS 0109	Agriculture Field		N	N	AG (c)	—	—			N	N	N	N						All-(c)
0001	Early Succession Woodland		N	N	W	B	---	D		N	N	N	Y			N,S,W		E	E-(h)
0002	Mid-succession Woodland and Native Grassland		N	N	W	B	F		PN	N	N	N	N			N			E, S-(h)
0018	Early Succession Woodland		N	N	W	B	---	D		N	N	Y	N		N	S		W	
0021	Early Succession Woodland		N	N	W	B	---			N	N	N	Y			N	W	E	
0043	Early Succession Woodland		N	Y	W	B	---	D		N	N	N	Y			W,E		S	N
0060	Mid-succession Woodland		N	N	W	B	---	D,PL		Y		Y		W-COL			N,S,E		

TABLE 3-2
AREA HABITAT MATRIX FOR THE ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Area	Habitat Classification	Area Size - Arces (approximate)	Industrial Activity (Y / N?)	Agricultural Activity (Y / N?)	Primary Vegetative Cover	Secondary Vegetative Cover	Tertiary Vegetative Cover	Ephemeral Water (Ditches / Pools)	Permenant Water (Ponds / Creeks)	Fenced (Y / N?)	Active Buildings (Y / N?)	Abandoned Buildings (Y / N?)	Building Foundations (Y / N?)	Adjacent Water Body*	Adjacent Old-Filed*	Adjacent Woodland*	Adjacent Open Field*	Adjacent Road*	Adjacent Cropland*
0061	Mid-succession Woodland		N	N	W	---	---	D		N	N	Y,CS	N			W,E	N,S	through site	
106A	Early Succession Woodland		N	N	W	---	---	D		N	N	N	N			All			
0107	Mid/Late Succession Woodland		N	N	W	—	---			N	N	N	N			W,S	N,E	N	
0108	Mid-succession Woodland and Agriculture Field		N	N	W	AG (c)	B			PF	N	N	N			E,S			N,W

Vegetative Cover

W	Woodland
F	Grass Field
OF	Old Field (brush, forbs)
T	Trees (open)
MIT	Mature Isolated Trees
AG	Agricultural Field
(h)	hay crop
(w)	wheat crop
(c)	corn crop
(s)	soybean crop
B	Brush

Fenced

PF	Partially Fenced

Abandoned Buildings

CS	Concrete Structures

Adjacent Road

AR	Abandoned Road

Water Resources

PL	Pools
PN	Pond
PNF	Pond with fish
W	Wetland
D	Ditch
C	Creek
COL	Crab Orchard Lake

* = Direction followed by applicable codes

Direction

N	North
S	South
E	East
W	West
SW	Southwest
NE	Northeast

TABLE 3-3
FISH KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Polyodon spathula	paddlefish	slow-moving waters rich in microscopic life; spawning needs access to large, free-flowing river with gravel bars	Mic/Ins	Fil
Lepisosteus platostomus	shortnose gar	quiet pools, backwaters and oxbow lakes of major rivers, also permanent pools of prairie creeks	Pis	Amb/Pur
Amia calva	bowfin	swamps, sloughs, borrow pits, ditches, abandoned stream channels and pools of sluggish streams	Pis	Amb/Pur
Dorosoma cepedianum	gizzard shad	quiet-water habitats in lowland lakes and ponds, man-made impoundments, and pools and backwaters of streams	Mic/Ins	Fil
Dorosoma petenense	threadfin shad	quiet-water habitats in lowland lakes and ponds, man-made impoundments, and pools and backwaters of streams; more often found in waters with a noticeable current	Mic	Fil
Oncorhynchus mykiss	rainbow trout	variety of habitats including streams, lakes, and reservoirs	Ins	Amb/Pur
Salmo trutta	brown trout	streams and lakes; found around dense cover or deep water below riffles	Ins/Pis	Amb/Pur
Labidesthes sicculus	brook silverside	clear, warm waters with no noticeable current	Ins	Gle/Pur
Cyprinus carpio	common carp	not native; large streams, lakes and man-made impoundments that are highly productive	Omn	Ben Gle
Ctenopharyngodon idella	grass carp	not native; large streams and rivers	Omn	Ben Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Notemigonus crysoleucas	golden shiner	sloughs, ponds, lakes, impoundments, quiet pools of low-gradient streams and ditches, and permanent pools of intermittent upland creeks	Omn	Gle
Semotilus atromaculatus	creek chub	small headwater creeks	Ins/Pis	Gle/Pur
Lythrurus fumeus	ribbon shiner	quiet, turbid, mud or sand-bottomed pools of headwaters, creeks and small rivers	Ins	Amb/Pur
Notropis lutrensis	red shiner	streams of all sizes, most abundant in large creeks and rivers	Ins	Amb/Pur
Notropis umbratilis	redfin shiner	prairie region-permanent pools of rocky or gravelly creeks having high gradient and low or intermittent flow; Ozark uplift-weedy backwaters and overflow pools	Ins	Amb/Pur
Cyprinella whipplii	steelcolor minnow	rocky and sandy runs, less often pools of creeks and small to medium rivers	Ins	Amb/Pur
Campostoma anomalum	central stoneroller	streams with moderate or high gradients, well-defined gravel, rubble or bedrock riffles and permanent flow	Her	Ben Gle
Pimephales promelas	fathead minnow	streams of all sizes but is abundant only in pools of small, intermittent prairie creeks	Omn	Gle
Pimephales notatus	bluntnose minnow	quiet pools and backwaters of medium to moderately large streams with clear, warm waters, permanent flow and moderate amounts of aquatic vegetation	Omn	Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Pimephales vigilax	bullhead minnow	quiet pools and runs over sand, slit, gravel in small to large rivers	Ins	Amb/Pur
Ictiobus cyprinellus	bigmouth buffalo	deeper pools of large streams, lowland lakes, and man-made impoundments	Ins	Fil
Ictiobus niger	black buffalo	deeper pools of large streams, lowland lakes, and man-made impoundments, but occurs more often in strong currents	Unknown	Unknown
Ictiobus bubalus	smallmouth buffalo	pools, backwaters and main channels of small to large rivers; impoundments; lakes	Ins	Fil
Catostomus commersoni	white sucker	small headwater creeks	Ins	Ben Gle
Minytrema melanops	spotted sucker	clear, warm water having no noticeable current, and abundance of submerged aquatic vegetation, and soft bottoms containing large quantities of organic debris	Inv	Ben Gle (?)
Erimyzon oblongus	creek chubsucker	clear, quiet waters with thick growths of submergent vegetation and bottoms composed of sand or silt mixed with organic debris	Ins	Ben Gle (?)
Ictalurus melas	black bullhead	turbid water, a silt bottom, no noticeable current or strong flow, and a lack of diversity in fish fauna	Omn	Ben Gle
Ictalurus natalis	yellow bullhead	less turbid water, no noticeable current or strong flow	Omn	Ben Gle
Ictalurus punctatus	channel catfish	large streams with low or moderate gradients; larger pools, in deep water or near submerged logs or other cover	Omn/Det	Ben Gle

TABLE 3-3
FISH KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Pylodictis olivaris	flathead catfish	variety of streams with low gradients; pools, near submerged logs, piles of drift or other cover	Inv/Pis	Ben Gle
Noturus gyrinus	tadpole madtom	clear to moderately turbid waters with little current but with abundance of cover	Inv	Ben Gle
Aphredoderus sayanus	pirate perch	clear, warm water, absence of current and abundant cover	Inv/Pis	Amb/Pur
Fundulus notatus	blackstripe topminnow	slightly warmer, more turbid water permanent-flowing streams in quiet water along the margins of pools, near thick stands of emergent aquatic plants	Inv	Gle
Fundulus olivaceus	blackspotted topminnow	clear, permanent-flowing streams in quiet water along the margins of pools, near thick stands of emergent aquatic plants	Inv	Gle
Gambusia affinis	mosquitofish	Standing to slow-flowing water; most common in vegetated ponds and lakes	Inv	Gle
Rhinichthys atratulus	blacknose dace	Rocky runs and pools or headwaters, creeks and small rivers		
Morone mississippiensis	yellow bass	quiet pools and backwaters of large streams and reservoirs	Inv/Pis	Pur/Amb
Morone saxatilis	striped bass	reservoirs	Ins/Pis	Pur/Amb
Morone saxatilis x M. chrysops	Hybrid striped bass	Deep pools of stream and open water of lakes	Ins/Pis	Pur/Amb
Morone chrysops	white bass	deeper pools of streams and open water of lakes and reservoirs	Inv/Pis	Gle
Micropterus salmoides	largemouth bass	warm, moderately clear waters with no noticeable current	Pis/Inv	Amb/Pur

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FISH KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Micropterus dolomieu	smallmouth bass	Clear, gravel-bottom runs and flowing pools of small to medium rivers; shallow rocky areas of lakes	Pis/Inv	Amb/Pur
Micropterus punctulatus	Spotted bass	Clear, gravelly flowing pools and runs in creeks a small to medium rivers; also impoundments	Pis/Inv	Amb/Pur
Lepomis cyanellus	green sunfish	tolerates extremes of turbidity, dissolved oxygen, temperature, and flow; survives in fluctuating environment of small prairie streams	Inv/Pis	Amb/Pur
Lepomis gibbosus	pumpkinseed	clear, quiet waters with much aquatic vegetation	Inv	Gle
Lepomis gulosus	warmouth	streams with clear water and thick growths of submergent vegetation	Inv/Pis	Amb/Pur
Lepomis humilis	orangespotted sunfish	tolerant of siltation and high turbidity, commonly found in streams with low or intermittent flow	Inv	Gle
Lepomis macrochirus	bluegill	warm, clear waters with aquatic plants for cover; deeper pools and backwaters of streams; most abundant in overflow ponds, oxbow lakes and impoundments	Inv/Pis	Amb/Gle
Lepomis megalotis	longear sunfish	clear, permanent-flowing streams with sandy or rocky bottoms	Inv	Gle
Lepomis microlophus	redear sunfish	warm, clear waters with no noticeable current and an abundance of aquatic plants	Inv	Gle
Pomoxis annularis	white crappie	reservoirs with standing timber or other cover; deeper pools of streams, overflow ponds and lakes away from any stream channel	Pis/Inv	Amb/Pur

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FISH KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Pomoxis nigromaculatus	black crappie	clear water, absence of noticeable current and abundant cover in for of submerged timber or aquatic vegetation	Pis/Inv	Amb/Pur
Centrarchus macropterus	flier	clear, heavily vegetated waters without noticeable current	Inv/Pis	Gle
Stizostedion vitreum	walleye	open water of lakes and reservoirs and pools of streams	Pis	Amb/Pur
Stizostedion vitreum x S. canadense	Walleye-sauger hybrid	Open water of lakes and reservoirs and pool of streams	Pis	Amb/Pur
Perca flavescens	yellow perch	lakes and reservoirs	Inv/Pis	Gle/Pur
Percina caprodes	logperch	deeper, more sluggish sections of riffles; pools if the bottoms is free of silt; reservoirs along gravelly wave-swept shores	Inv	Gle
Etheostoma nigrum	Johnny darter	Sandy and muddy pools of headwaters, creeks, small to medium rivers, sandy shores of lakes	Inv	Gle
Percina shumardi	river darter	Rocky riffles of small to large rivers	Inv	Gle
Etheostoma chlorosomum	bluntnose darter	sluggish streams; pools and backwaters without noticeable current and bottom is sand and organic debris	Ins	Gle
Etheostoma gracile	slough darter	oxbows and overflow waters along floodplains of streams; pools of sluggish streams and ditches of lowlands and upland prairies; moderately clear, warm water without current and with soft bottoms including much organic debris	Inv	Gle
Etheostoma spectabile	orangethroat darter	small creeks and spring branches over gravelly or rocky bottom on sluggish riffles, or in pools with enough current to prevent silt deposition	Inv	Gle

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FISH KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Aplodinotus grunniens	freshwater drum	large rivers, lakes and impoundments	Pis/Inv	Ben Gle

[1]Trophic Level Codes: Her = herbivore; Det = detritivore; Omn = omnivore; Mic = microscopic animals/plants; Pis = piscivore; Ins = insectivore; Inv = invertivore; Unknown = life history has not been studied. Note that "predators", "insectivores", and "invertivores" are all carnivores (consumers of other animals). Note further that the designations refer to the "typical" or predominant composition of the diet and should not be interpreted as representing the overall diets.

[2]Foraging Behavior Codes: Ben = benthic; Par = parasitic; Fil = filter feeder/strainer; Gle = glean, Amb = ambush; Pur = pursuit; Unknown = life history has not been studied. Note that these foraging behaviors are "typical" and do not reflect the potential full range of possible foraging behaviors.

Pflieger, W.L. 1975. The Fishes of Missouri. M. Sullivan, ed. Missouri Department of Conservation.

TABLE 3-4
AMPHIBIANS AND REPTILES KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
AMPHIBIANS				
Siren intermedia nettingi	western lesser siren	shallow waters such as ditches and ponds	Inv	Ben Amb
Ambystoma opacum	marbled salamander	variety of habitats ranging from moist sandy areas to dry hillsides	Inv	Grd Amb
Ambystoma texanum	smallmouth salamander	under debris near ponds or swamps, in river bottoms, or other areas where moisture is abundant	Inv	Rip/Foss Amb
Ambystoma maculatum	spotted salamander	hardwood forests around pools and flooded swampy areas	Inv	Rip/Foss Amb
Ambystoma tigrinum tigrinum	eastern tiger salamander	small ponds	Inv	Wt Amb
Plethodon glutinousus	northern slimy salamander	moist woodland ravines or hillsides	Inv	Grd/Rip Amb
Notophthalmus viridescens	red-spotted newt	Ponds, lakes, marshes or other shallow permanent or semi-permanent body of water	Inv	Wt/Grd Amb
Bufo americanus charlesmithi	dwarf American toad	need soil to burrow in, water to soak in and breed, and plenty of live insects	Ins	Grd/Foss Amb
Bufo woodhousii fowleri	fowler's toad	sandy areas, around shores of lakes or in river valleys	Inv	Rip/Wt Amb
Acris crepitans blanchardi	blanchard's cricket frog	permanent bodies of shallow water with vegetation	Ins	Rip/Wt Amb
Hyla cinerea	green tree frog	Swamps, borders of lakes and streams; most freshwater habitats	Inv	Rip/Grd Amb
Hyla versicolor/chrysoscelis	gray treefrog	mainly arboreal along woodlot edges	Ins	Amb
Hyla crucifer	spring peeper	woodlands; brushy areas near small temporary and semipermanent ponds or swamps	Inv	Rip/Grd Amb
Pseudacris triseriata feriarum	upland chorus frog	grassy swales, moist woodlands, river-bottom swamps, ponds, bogs, and marshes	Inv	Grd/Rip Amb
Rana catesbeiana	bullfrog	often in/near water	Pre	Rip/Wt Amb

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Rana areolata	crayfish frog	old crayfish holes containing water, small mammal burrows, storm or drainage sewers	Inv	Rip/Wt Amb
Rana utricularia	southern leopard frog	All types of shallow, freshwater habitats	Inv	Rip/Wt Amb
Rana clamitans	green frog	Shallow fresh water; springs, rills, creeks, ditches, along edges of ponds and lakes.	Inv	Rip/Wt Amb
Rana sylvatica	wood frog	Moist wooded areas	Inv	Rip/Wt Amb
REPTILES				
Chelydra serpentina	snapping turtle	quiet, slow moving waters with muddy bottom and ample vegetation	Omn	Wt Gle
Sternotherus odoratus	stinkpot	found in streams, ditches, ponds, and lakes; permanent water	Omn	Ben Gle
Kinosternon flavescens	yellow mud turtle	bodies of water with muddy bottoms	Omn	Ben Gle
Terrapene carolina carolina	eastern box turtle	open woods	Omn	Grd Gle
Chrysemys scripta elegans	red-eared slider	quiet water with a muddy bottom and profusion of vegetation	Omn	Ben Gle
Chrysemys picta picta	eastern painted turtle	soft-bottomed streams, lakes, ponds with ample vegetation	Omn	Wt Gle
Trionyx spinifera spinifera	eastern spiny softshell	rivers and lakes with sand and mud bars	Omn	Wt Gle
Sceloporus undulatus	eastern fence lizard	treed areas; seen on rail fences or rotting logs or stumps	Ins	Grd Amb
Scincella lateralis	ground skink	woodlands	Ins	Grd Amb
Cnemidophorus sexlineatus	six-lined racerunner	Open well drained areas; sand or loose soil; fields, open woods rocky outcrops, river floodplains	Ins	Grd Amb
Eumeces fasciatus	five-lined skink	damp cutover woodlots with many rotting stumps and logs, rock piles, decaying debris	Ins	Grd Amb

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Eumeces laticeps	broadhead skink	extensively arboreal; swamp forests to empty urban lots with debris	Ins	Grd Amb
Nerodia rhombifera rhombifera	diamondback water snake	many types of aquatic habitat; big lakes and rivers to ditches	Pre	Wt Amb
Nerodia erythrogaster flavigaster	yellowbelly water snake	in or near larger, more permanent bodies of water	Pre	Wt Amb
Nerodia sipedon pleuralis	midland water snake	utilizes wide variety of habitats; streams, ponds, swales, marshes	Pre	Wt Amb
Storeria occipitomaculata	redbelly snake	in or near open woods	Pre	Grd Amb
Thamnophis proximus proximus	western ribbon snake	streams, ditches, edges of lakes and ponds	Pre	Rip Amb
Heterodon platirhinos	eastern hognose snake	sandy areas	Pre	Grd Amb
Diadophis punctatus arnyi	prairie ringneck snake	rocky hillsides in open woods	Pre	Grd Amb
Carphophis amoenus helenae	midwest worm snake	under stones or boards, rotting logs; partial to moist earth	Ins	Grd/Foss Amb
Farancia abacura reinwardti	western mud snake	swamps and lowlands	Pre	Rip Amb/Pur
Coluber constrictor flaviventris	eastern yellowbelly racer	fields, grasslands, brushy areas, and open woods	Pre	Grd Amb/Pur
Opheodrys aestivus	rough green snake	dense growth of vegetation overhanging a stream or lake border	Ins	Rip Amb
Storeria dekayi	brown snake	Environs of bogs, swamps, marshes, moist woods and hillsides	Ins	Grd Amb/Pur
Virginia valeriae	smooth earth snake	Abandoned fields, trails in or near deciduous forest	Ins	Grd Amb/Pur
Elaphe obsoleta obsoleta	black rat snake	rocky, timbered hillsides to flat farmlands	Pre	Grd Amb
Lampropeltis getulus niger	black kingsnake	dry, rocky hills, open woods, dry prairies, and stream valleys	Pre	Grd Amb
Lampropeltis getula holbrooki	speckled kingsnake	river swamps, upland wooded areas, stream valleys across the open plains and prairies	Pre	Rip Amb

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Lampropeltis calligaster calligaster	prairie kingsnake	grassland and prairies, open woodlands, patches of prairie and savannah in the midst of essentially forested country	Pre	Grd Amb
Agkistrodon contortrix mokasen	northern copperhead	rocky, wooded hillsides and mountainous areas	Pre	Grd Amb
Crotalus horridus	timber rattlesnake	in south, lowlands, favoring cane thickets and swamplands	Pre	Grd Amb/Pur

[1]Trophic Level Codes: Her = herbivore; Det = detritivore; Omn = omnivore; Pre = predator; Ins = insectivore; Inv = invertivore. Note that "predators", "insectivores", and "invertivores" are all carnivores (consumers of other animals). Note further that the designations refer to the "typical" or predominant composition of the diet and should not be interpreted as representing the overall diets.

[2]Foraging Behavior Codes: Grd = ground; Wt = Water; Ben = benthic; Rip = riparian; Foss = fossorial; Gle = glean, Amb = ambush; Pur = pursuit. Note that these foraging behaviors are "typical" and do not reflect the potential full range of possible foraging behaviors.

Conant, R. and J.T. Collins. 1998. A field guide to reptiles and amphibians, eastern/central North America. 3rd edition. Houghton Mifflin Company, New York, NY.

TABLE 3-5
BIRDS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Gavia immer	common loon	forested lakes and rivers; winters on oceans and bays	Pre	Wt Dvr
Podilymbus podiceps	pied-billed grebe*	marshes, ponds; sinter in salt marshes if freshwater habitats freeze	Pre	Wt Dvr
Podiceps auritus	horned grebe	marshes and lakes; winters on salt water and the Great Lakes	Pre	Wt Dvr
Phalacrocorax auritus	double-crested cormorant	lakes, rivers, swamps, and coasts	Pre	Wt Dvr
Botaurus lentiginosus	American bittern	freshwater and brackish marshes and marshy lake shores	Pre	Wt Stk
Ardea herodias	great blue heron	lakes, ponds, rivers and marshes	Pre	Wt Stk
Casmerodius alba	great egret	freshwater and salt marshes, marshy ponds, and tidal flats	Pre	Wt Stk
Egretta thula	snowy egret	marshes, swamps, ponds, and shores	Inv	Wt Stk
Florida caerulea	little blue heron	freshwater swamps and lagoons in the south; coastal thickets on islands in the north	Pre	Wt Stk
Bubulcus ibis	cattle egret	dry land in open fields where it feeds alongside livestock, but breeds near water with other herons	Ins	Grd Gle
Butorides striatus	green heron*	lake margins, streams, ponds, and marshes	Pre	Wt Stk
Nycticorax nycticorax	black-crowned night heron*	marshes, swamps, and wooded streams	Pre	Wt Stk
Nycticorax violaceus	yellow-crowned night heron*	wooded swamps and coastal thickets	Pre	Wt/Grd Stk
Anser albifrons	greater white-fronted goose	marshy tundra; winters on marshes and bays	Her	Grd Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Chen caerulescens	snow goose	tundra; winters in salt marshes and marshy coastal bays, less commonly in freshwater marshes and adjacent grain fields	Her	Grd Gle
Branta canadensis	Canada goose*	lakes, bays, rivers, and marshes, often feeds in open grassland and stubble fields	Her	Grd Gle
Aix sponsa	wood duck*	wooded rivers, ponds and swamps; freshwater marshes in late summer and fall	Omn	Wt Gle
Anas crecca	green-winged teal	marshes, ponds, and marshy lakes	Omn	Wt Gle
Anas rubripes	American black duck	marshes, lakes, streams, coastal mud flats and estuaries	Omn	Wt Gle
Anas platyrhynchos	mallard*	ponds, lakes, and marshes	Omn	Wt Gle
Anas acuta	common pintail	marshes, prairie ponds, and tundra; salt marshes in winter	Omn	Wt Gle
Anas discors	blue-winged teal*	marshes, shallow ponds, and lakes	Her	Wt Gle
Anas clypeata	northern shoveler	marshes and prairie potholes	Omn	Wt Gle
Anas strepera	gadwall	freshwater marshes, ponds, and rivers; winter in salt marshes	Her	Wt Gle
Anas americana	American widgeon	marshes, ponds, and shallow lakes	Her	Wt/Grd Gle
Aythya valisineria	canvasback	nests on marshes; winters on lakes, bays and estuaries	Her	Wt Gle
Aythya americana	redhead	nests in marshes, other times found on lakes and bays; winters on salt water	Omn	Wt Dvr
Aythya collaris	ring-necked duck	wooded lakes, ponds, and rivers; seldom winters on salt water except in the southern states	Omn	Wt Dvr

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Aythya affinis	lesser scaup	ponds and marshes; migration and winter occurs on lakes, rivers, and ponds	Omn	Wt Dvr
Bucephala clangula	common goldeneye	nests on lakes and ponds in the north; winters mainly along the coast in bays and inlets	Inv	Wt Dvr
Bucephala albeola	bufflehead	northern lakes and ponds; winters on salt bays and estuaries	Ins	Wt Dvr
Lophodytes cucullatus	hooded merganser	wooded ponds, lakes and rivers	Pre	Wt Dvr
Mergus merganser	common merganser	wooded rivers and ponds; winters on salt bays	Pre	Wt Dvr
Mergus serrator	red-breasted merganser	northern lakes and tundra ponds; winters on the ocean and in salt bays	Pre	Wt Dvr
Oxyura jamaicensis	ruddy duck	freshwater marshes, marshy lakes and ponds; shallow salt bays and rivers in winter	Omn	Wt Dvr
Coragyps atratus	black vulture	open lowland areas, garbage dumps, avoids forested areas	Det	S/Grd Gle
Cathartes aura	turkey vulture*	open habitat in both lowlands and mountains	Det	S/Grd Gle
Pandion haliaetus	osprey	lakes, rivers, and seacoasts	Pre	Ar Ha
Haliaeetus leucocephalus	bald eagle*	lakes, rivers, marshes, and sea coasts	Pre/ Det	PSw
Circus cyaneus	northern harrier	marshes and open grasslands	Pre	Ar Ha
Accipeter striatus	sharp-shinned hawk	woodland and mountains	Pre	Ar Ha
Accipter cooperii	Cooper's hawk*	forests and woodlands prefers riparian areas	Pre	Ar Ha

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BIRDS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Buteo lineatus	red-shouldered hawk*	deciduous woodlands, especially near standing water	Pre	PSw
Buteo platypterus	broad-winged hawk*	deciduous woodland	Pre	PSw
Buteo jamaicensis	red-tailed hawk*	woodland and open country with scattered trees, desert	Pre	S/Grd Pou
Buteo lagopus	rough-legged hawk	tundra; winters on open plains, agricultural areas, and marshes	Pre	H/PSw
Aquila chrysaetos	golden eagle	open habitat, especially in mountains and hilly areas	Pre	S/Grd Pou
Falco sparverius	American kestrel*	open or partly opened habitats with scattered trees, also cultivated and urban areas	Ins	H/Grd Pou
Meleagris gallopavo	wild turkey*	mixed forest and open woodland	Omn	Grd Gle
Colinus virginianus	northern bobwhite*	tall grassland, brushy fields, open woodland, cultivated fields	Omn	Grd Gle
Rallus limicola	Virginia rail	freshwater and brackish marshes	Inv	Grd Gle/Pur
Porzana carolina	sora	freshwater marshes and marshy ponds; winters in rice fields and salt marshes	Omn	Grd Gle
Fulica americana	American coot	open ponds and marshes, winter in saltwater bays and inlets	Omn	Wt Gle/Dvr
Pluvialis asuatarola	black-bellied plover	tundra; winter on beaches and coastal marshes, inland marshes, lakeshores, and plowed fields	Inv	Wt/Grd Prb
Pluvialis dominica	American golden-plover	tundra; migration coastal beaches and mudflats and inland prairies and plowed fields	Ins	Wt/Grd Prb

TABLE 3-5
BIRDS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Charadrius semipalmatus	semipalmated plover	beaches and tidal flats, shallow pools in salt marshes; lakeshores in the interior during migration	Inv	Wt/Grd Prb
Charadrius vociferus	killdeer*	variable; fields, meadows, pastures, mud flats, urban and rural areas	Ins	Grd Gle
Recurvirostra americana	American avocet	freshwater marshes and shallow marshy lakes	Inv	Wt Prb/Gle
Tringa melanoleuca	greater yellowlegs	open wet tundra and marshy ground; migration and winter in pools, lakeshores, and tidal mud flats	Pre	Wt Gle/Pur
Tringa flavipes	lesser yellowlegs	marshy ponds, lake and river shores, mudflats	Pre	Wt Gle
Tringa solitaria	solitary sandpiper	inland ponds and bogs, wet swampy places and woodland streams	Inv	Wt Prb/Gle
Catoptrophorus semipalmatus	willet	coastal beaches, freshwater and slat marshes, lakeshores, and wet prairies	Inv	Wt Prb
Actitis macularia	spotted sandpiper*	almost anyplace with water nearby, both in open country and in wooded areas	No	Wt Prb/Stk
Bartramia longicauda	upland sandpiper	grassy prairies, open meadows, and fields	Omn	Grd Gle
Calidris alba	sanderling	ocean beaches, sandbars, occasionally mud flats, inland lake and river shores	Inv	Wt Prb
Calidris pusilla	semipalmated sandpiper	coastal beaches, lake and river shores, flats, and pools in salt marshes	Inv	Wt Prb/Gle
Calidris minutilla	least sandpiper	grassy pools, bogs, and marshes with open areas, also flooded fields and mud flats	Inv	Wt Prb/Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Calidris fuscicollis	white-rumped sandpiper	tundra; winter on flats, grassy pools, wet meadows, and shores	Inv	Wt./Grd Prb/Gle
Calidris bairdii	Baird's sandpiper	tundra; winter in inland areas with grassy pools, wet meadows, and lake and river shores	Ins	Wt Gle
Calidris melanotos	pectoral sandpiper	wet, short-grass areas, grassy pools, golf courses and airports after heavy rains	Ins	Wt/Grd Prb/Gle
Calidris alpina	dunlin	beaches, extensive mud and sand flats, tidal inlets and lagoons, also inland lake and river shores	Inv	Wt Prb
Calidris himantopus	stilt sandpiper	grassy pools and shores of ponds and lakes	Inv	Wt Prb
Limnodromus griseus	short-billed dowitcher	mud flats, creeks, salt marshes and tidal estuaries	Inv	Wt Prb
Limnodromus scolopaceus	long-billed dowitcher	muskeg; migration and winter occurs on mud flats, marshy pools, and margins of freshwater ponds	Inv	Wt Prb
Gallinago gallinago	common snipe	freshwater marshes, ponds, flooded meadows, and fields	Ins	Grd/Wt Prb
Philohela minor	American woodcock*	moist woodland and thickets near open fields	Ins	Grd/Wt
Phalaropus tricolor	Wilson's phalarope	prairie pools and marshes, lake and river shores, marshy pools along the coast	Inv	Wt Prb/Gle
Larus pipixcan	Franklin's gull	prairie marshes and sloughs, often feeds in plowed fields	Ins	Grd/Ar Scr
Larus philadelphia	Bonaparte's gull	forested lakes and rivers; winters along the coast, in estuaries and at the mouth of large rivers	Pre	Ar Pur

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Larus delawarensis	ring-billed gull	lakes and rivers; winter in salt water	Omn	Ar/Grd Gle/Scr
Larus argentatus	herring gull	lakes, rivers, estuaries, and beaches	Omn	Ar/Grd Gle/Scr
Sterna caspia	Caspian tern	sandy or pebbly shores of lakes and large rivers and along seacoasts	Pre	Ar H/Pou
Sterna hirundo	common tern	lakes, ponds, rivers, coastal beaches and islands	Pre	Ar H/Pou
Sterna forsteri	Forster's tern	salt marshes in the east; freshwater marshes in the west	Pre/Ins	Ar H/Pou
Chlidonias niger	black tern	freshwater marshes and marshy lakes; winters on sandy coasts	Pre/Ins	Ar Gle/Pur
Columba livia	rock dove*	cities, towns, rural areas, always near human habitation	Her	Grd Gle
Zenaida macroura	mourning dove*	variable; generally open areas, common in agricultural areas	Her	Grd Gle
Coccyzus erythropthalmus	black-billed cuckoo	moist thickets in low, overgrown pastures and orchards	Ins	Lca Gle
Coccyzus americanus	yellow-billed cuckoo*	open woodland, especially with dense undergrowth, parks, riparian woodland and thickets	Ins	Lca/Grd Gle
Otus asio	eastern screech owl*	woodland, especially oak and riparian, scrub, orchards, woodlots	Pre	PSw/Grd Pou
Bubo virginianus	great horned owl*	dense conifer and mixed forests, wooded swamps, and river valleys	Pre	PSw/Grd Pou
Strix varia	barred owl*	low, wet woods and swamp forest	Pre	PSw/H Pou

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Asio flammeus	short-eared owl	prairie, meadow, tundra, marsh, and savanna	Pre	H/Grd Pou
Chorodeiles minot	common nighthawk*	open and semi-open habitats, especially savanna, grassland, fields, cities and towns	Ins	Ar Scr
Caprimulgus carolinensis	Chuck-will's-widow*	open woodland and clearings near agricultural country	Ins	Ar Scr
Caprimulgus vociferus	whip-poor-will*	dry open woodland near fields	Ins	Ar Scr
Chaetura pelagica	chimney swift*	breeds and roosts in chimneys	Ins	Ar Scr
Archilochus colubris	ruby-throated hummingbird*	suburban gardens, parks, and woodlands	Her	H Fl
Megaceryle alcyon	belted kingfisher*	rivers, lakes, and saltwater estuaries	Pre	PSw Pou
Melanerpes erythrocephalus	red-headed woodpecker*	open country, farms, rural roads, open park-like woodland, and golf courses	Omn	Ar/Ba Gle/Pur
Melanerpes carolinus	red-bellied woodpecker*	open and swamp woodland	Omn	Ba Gle
Sphyrapicus varius	yellow-bellied sapsucker	mixed forests and parks	Omn	Ba Gle
Picoides pubescens	downy woodpecker*	wood lots, parks and gardens	Ins	Ba Gle
Dicoides villosus	hairy woodpecker*	conifer forests, occasionally mixed or riparian forests	Omn	Ba Gle
Colaptes auratus	common flicker*	open country with trees, parks and rural estates	Ins	Grd/Ba Gle
Dryocopus pileatus	pileated woodpecker*	dense forest and borders	Omn	Ba Prb

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Contopus borealis	olive-sided flycatcher	boreal spruce and fir forests, near openings, burns, ponds and bogs	Ins	PSw Pur
Contopus virens	eastern wood-pewee*	forest, open woodland, orchards, and shade trees in parks and along roadsides	Ins	PSw Pur
Empidonax flaviventris	yellow-bellied flycatcher	thickets of alder and will in northern coniferous forests; migration second-growth forests	Ins	PSw/Lca Pur
Empidonax virescens	Acadian flycatcher*	beech-maple or hemlock forest, usually under the canopy but also in clearings, often in wooded ravines	Ins	PSw/Lca Pur
Empidonax alnorum	alder flycatcher	alder swamps, streamside and lakeside thickets and second growth	Ins	PSw/Lca Pur
Empidonax traillii	willow flycatcher	swampy thickets, upland pastures, and old abandoned orchards	Ins	PSw Pur
Empidonax minimus	least flycatcher	widely distributed in open country, nests in shade trees, orchards, villages, city parks, rural roadsides and woodland borders	Ins	PSw Pur
Sayornis phoebe	eastern phoebe*	open woodland near streams, cliffs, bridges, and buildings with ledges	Omn	PSw Pur
Myiarchus crinitus	great crested flycatcher*	open forest, orchards, and large trees in farm country	Ins	PSw Pur
Tyrannus tyrannus	eastern kingbird*	open country, farms, orchards, roadsides, and lake and river shores	Omn	PSw/H Pur
Eremophila alpestris	horned lark*	plains, fields, airports, and beaches	Omn	Grd Gle
Progne subis	purple martin*	open woodland, residential areas, and agricultural land	Ins	Ar Scr

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Tachycineta bicolor	tree swallow*	lake shores, flooded meadows, marshes, and streams	Omn	Ar Scr
Stelgidopteryx ruficollis	northern rough-winged swallow*	streams and rivers, especially in the vicinity of steep banks and man-made structures for nesting sites	Ins	Ar Scr
Riparia riparia	bank swallow	rivers and streams, especially near sandbanks; more widespread during migration	Ins	Ar Scr
Petrochelidon pyrrhonota	cliff swallow*	open country, savanna, especially near running water	Ins	Ar Scr
Hirundo rustica	barn swallow*	agricultural land, suburban areas, marshes, and lake shores	Ins	Ar Scr
Cyanocitta cristata	blue jay*	chiefly oak forest, but now also city parks and suburban yards	Omn	Lca/Grd Gle
Corvus brachyrhynchos	American crow*	woodland, farmland, orchards, and tidal flats; riparian woodland in arid regions	Omn	Grd Gle
Parus carolinensis	Carolina chickadee*	deciduous woodlands and residential areas	Omn	Lca Gle
Parus bicolor	tufted titmouse*	swampy or moist woodland and shade trees in villages and city parks; at feeders in winter	Omn	Lca/Grd Gle
Sitta canadensis	red-breasted nuthatch*	coniferous forests; widespread during winter	Omn	Ba Gle
Sitta carolinensis	white-breasted nuthatch*	deciduous forests (especially mature), mixed forests, woodland, forest edge	Ins	Ba Gle
Certhia familiaris	brown creeper	woodlands, groves, shade trees	Ins	Ba Gle
Thryothorus ludovicianus	Carolina wren*	woodland thickets, ravines, and rocky slopes covered with brush	Ins	Ba/Grd Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Thryomanes bewickii	Bewick's wren*	open woodland, scrub land, farms, and suburbs	Ins	Grd Gle
Troglodytes aedon	house wren*	residential areas, city parks, farmlands, and woodland edges	Ins	Ba/Grd Gle/Prb
Troglodytes troglodytes	winter wren	dense tangles and thickets in coniferous and mixed forests	Ins	Grd/Ba Gle
Cistothorus platensis	sedge wren	grassy freshwater marshes and sedges; winter brackish marshes and wet meadows	Ins	Grd Gle
Cistothorus palustris	marsh wren	fresh and brackish marshes with cattails, reeds, bulrushes, or sedges	Ins	Grd Gle
Regulus satrapa	golden-crowned kinglet	open conifer forests	Ins	Ca Gle
Regulus calendula	ruby-crowned kinglet	conifer and mixed forests	Ins	Ca Gle
Polioptila caerula	blue-gray gnatcatcher*	variable; forests, woodlands, swamps, scrub, desert	Ins	Ca Gle
Sialia sialis	eastern bluebird*	open farmlands with scattered trees	Omn	PSw/H Pur
Catharus fuscescens	veery	moist deciduous woodlands	Omn	Grd Gle
Catharus minimus	gray-checked thrush	coniferous forests; widespread during migration	Omn	Grd Gle
Catharus ustulatus	Swainson's thrush	coniferous forests and willow thickets	Omn	Grd/Lca Gle
Hylocicla guttata	hermit thrush	conifer or mixed forests and forest edges	Ins	Grd Gle
Hylocichla mustelina	wood thrush*	moist, deciduous woodlands with a thick understory	Omn	Grd/Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Turdus migratorius	American robin*	habitat generalist; forests, woodlands, garden, parks	Ins	Grd Gle
Dumetella carolinensis	gray catbird*	thickets and brush, residential areas and gardens	Omn	Grd Gle
Mimus polyglottos	northern mockingbird*	residential areas, city parks, farmlands, open country with thickets, and desert brushland	Omn	Grd Gle
Toxostoma rufum	brown thrasher*	brush and scrub lands, forest edges and clearings	Omn	Grd Gle
Anthus rubescens	American pipit	arctic and alpine tundra; migration and winter on beaches, barren fields, agricultural land and golf courses	Omn	Grd/Wt Gle
Bombycilla cedorum	cedar waxwing*	woodlands, forests edges, well-planted suburbs	Her	Ca Gle
Lanius ludovicianus	loggerhead shrike*	open fields with scattered trees, open	Pre	PSw/Grd
Sturnus vulgaris	European starling*	variable; open fields, woodlots, suburbs and cities	Omn	Grd Gle
Vireo griseus	white-eyed vireo*	dense swampy thickets and hillsides with blackberry and briar tangles	Omn	Lca Gle
Vireo bellii	Bell's vireo*	dense bottomland thickets, willow scrub, and mesquite	Ins	Lca H/Gle
Vireo solitaris	solitary vireo	mixed woodlands	Ins	Ca Gle
Vireo flavifrons	yellow-throated vireo*	tall deciduous trees at the edge of forests, along streams, roadsides, orchards, parks and estates	Omn	Ca Gle
Vireo gilvus	warbling vireo*	open woodlands, riparian forests and thickets	Ins	Ca Gle
Vireo alivaceus	red-eyed vireo*	deciduous forest, and shade trees in residential areas	Omn	Lca H/Gle

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Vermivora pinus	blue-winged warbler	abandoned fields and pastures grown up to saplings, forest clearings and edges with clumps of catbrier, blackberry, and various bushes and young trees	Ins	Lca Gle
Vermivora chrysoptera	golden-winged warbler	abandoned fields and pastures grown up to saplings but usually in moister situations	Ins	Ca Gle
Vermivora peregrina	Tennessee warbler	open mixed woodlands; trees and bushes during migration	Omn	Lca Gle
Vermivora celata	orange-crowned warbler	thickets and brushy woodlands	Omn	Lca Gle/Fl
Vermivora ruficapilla	Nashville warbler	woodland edges; thickets in open mixed forest or brushy borders of swamps	Ins	Lca Gle
Parula americana	northern parula*	wet, coniferous woods, swamps, and along lakes and ponds; widespread during migration	Ins	Lca H
Dendroica petechia	yellow warbler*	second-growth woodlands, gardens, scrub, riparian thickets	Ins	Ca Gle
Dendroica pensylvanica	chestnut-sided warbler	young, open second-growth woodland and scrub	Ins	Ba Gle/H
Dendroica magnolia	magnolia warbler	open stands of young spruce and fir; migration any place where shrubbery or trees occur	Ins	Ba Gle
Dendroica tigrina	Cape May warbler	open spruce forests; migration, in evergreen or deciduous woodlands and often in parks or suburban yards	Omn	Ca Gle
Dendroica coronata	yellow-rumped warbler	coniferous and mixed forests; wide spread during winter	Omn	Grd/Lca Gle/H
Dendroica virens	black-throated green warbler	open stands of hemlock or pine; migration variety of habitats	Ins	Lca Gle/H

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Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Dendroica fusca	Blackburian warbler	most numerous in mixed forests or hemlock, spruce, and various hardwoods; high in the trees	Ins	Ca Gle
Dendroica dominica	yellow-throated warbler*	forests of pine, cypress, sycamore and oak, in both swampy places and dry upland	Ins	Ba Gle
Dendroica pinus	pine warbler*	pine forests	Omn	Ba Gle
Dendroica discolor	prairie warbler*	in north, mixed pine-oak barrens, old pastures and on hillsides with scattered red cedar; in south, open scrub	Ins	Lca/Ba Gle
Dendroica palmarum	palm warbler	bogs; during migration in open places, weedy fields, borders of marshes	Omn	Grd Gle
Dendroica castanea	bay-breasted warbler	open spruce forests; migration deciduous forests as well	Omn	Lca Gle
Dendroica striata	blackpoll warbler	coniferous forests; migration found in tall trees	Omn	Ca Gle
Dendroica cerulea	cerulean warbler*	open woodland, often near streams and rivers	Ins	Ca Gle
Mniotilta varia	black-and-white warbler	primary and secondary forest; during migration parks, gardens and lawn areas with trees and shrubs	Ins	Ba Gle
Setophaga ruticilla	American redstart	second-growth woodlands, thickets with saplings	Ins	Ar H/Pur
Protonotaria citrea	prothonotary warbler*	wooded swamps, flooded bottomland forest, and streams with dead trees	Inv	Lca/Wt Gle
Helmitheros vermivorus	worm-eating warbler*	dry wooded hillsides	Ins	Ba Gle
Limnothlypis swainsonii	Swainson's warbler	wooded swamps and southern canebrakes	Ins	Grd Gle
Seiurus aurocapillus	ovenbird	mature, dry forest with little undergrowth	Ins	Grd Gle

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Seiurus noveboracensis	northern waterthrush	cool bogs, wooded swamps, and lake shores in breeding season; wooded habitat during migration	Ins	Grd/Wt Gle
Seiurus motacilla	Louisiana waterthrush*	swift-moving brooks on hillsides, occurs in river swamps and along sluggish streams	Inv	Grd/Ar Gle
Oporornis formosus	Kentucky warbler*	low, moist, rich woodland with luxuriant undergrowth, ravines	Ins	Grd Gle
Geothlypis trichas	common yellowthroat*	moist thickets and grassy marshes	Ins	Lca H/Gle
Wilsonia citrina	hooded warbler	mature, moist forest with luxuriant undergrowth, especially in ravines, wood swamps	Ins	Grd/Lca Gle
Wilsonia pusilla	Wilson's warbler	moist thickets in woodland and along streams; alder and willow thickets and bogs	Ins	Grd/Lca Gle
Wilsonia canadensis	Canada warbler	cool, moist woodland that is nearly mature and has thick undergrowth	Ins	Grd/Lca Pur/Gle
Icteria virens	yellow-breasted chat*	dense thickets and brush, often with thorns, streamside tangles and dry brushy hillsides	Omn	Lca Gle
Piranga rubra	summer tanager*	deciduous forests, open and riparian woodland, pine-oak woodlots, parks	Ins	Ca Gle
Piranga olivacea	scarlet tanager*	mature woodland, especially oak and pine	Omn	Ca Gle
Cardinalis cardinalis	northern cardinal*	woodland edges, thickets, brushy swamps and gardens	Omn	Grd/Lca Gle
Pheucticus ludovicianus	rose-breasted grosbeak	moist woodland adjacent to open fields with tall shrubs, old and overgrown orchards	Omn	Lca Gle

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Guiraca caerulea	blue grosbeak*	riparian thickets, overgrown fields, open woodland, hedgerows, orchards	Omn	Grd Gle
Passerina cyanea	indigo bunting*	brushy slopes, abandoned farmland, old pastures and fields grown up to scrub, woodland clearings and forest edge adjacent to fields	Omn	Grd/Lca Gle
Spiza americana	dickcissel*	open country in grain or hay fields and in weed patches	Omn	Grd Gle
Pipilo erythrophthalmus	eastern towhee*	forest edges, chaparral, riparian thickets, woodlands	Omn	Grd Gle
Spizella arborea	American tree sparrow	arctic willow and birch thickets; fields, weedy woodland edges and roadside thickets in winter	Omn	Grd Gle
Spizella passerina	chipping sparrow*	open conifer forests, forest edges, oak and pine-oak woodlands, thickets, and parks	Omn	Grd Gle
Spizella pusilla	field sparrow*	abandoned fields and pastures grown up to seeds, scattered bushes and small saplings	Omn	Grd Gle
Pooecetes gramineus	vesper sparrow	grassland, prairie, savanna, old fields, arid scrub, open woodlands	Her	Grd Gle
Passerculus sandwichensis	savannah sparrow	grassland, meadows, marsh, grassy areas	Omn	Grd Gle
Ammodramus savannarum	grasshopper sparrow*	grassland, cultivated fields, prairie, old fields, open savanna	Omn	Grd Gle
Ammodramus henslowii	Henslow's sparrow	moist or dry grassland with scattered weeds and small shrubs	Omn	Grd Gle
Ammodramus leconteii	Le Conte's sparrow	moist grassland and boggy meadows; dry fields in winter	Omn	Grd Gle
Passerella iliaca	fox sparrow	coniferous forest undergrowth in summer; winter dense woodland thickets, weedy pastures and brushy roadsides	Omn	Grd Gle

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Melospiza melodia	song sparrow*	dense vegetation along watercourses, forest edges, clearings, bogs, gardens	Omn	Grd Gle
Melaspiza lincolnii	Lincoln's sparrow	bogs, wet meadows, riparian thickets	Omn	Grd Gle
Melospiza georgiana	swamp sparrow	freshwater marshes and open wooded swamps; in migration in weedy fields, parks and brush piles	Omn	Grd Gle
Zonotrichia albicollis	white-throated sparrow	mixed forests, edges, thickets, and open woodlands	Omn	Grd Gle
Zonotrichia leucophrys	white-crowned sparrow	stunted woody vegetation, coastal scrub, wet meadows, thickets, chaparral, parks	Omn	Grd Gle
Junco hyemalis	dark-eyed junco	coniferous or mixed forests; winters in fields, gardens, city parks and roadside thickets	Omn	Grd Gle
Calcarius lapponicus	lapland longspur	arctic tundra; winters in open windswept fields and on grassy coastal dunes	Omn	Grd Gle
Dolichonyx oryzivorus	bobolink	prairies and meadows; marshes during migration	Omn	Grd Gle
Agelaius phoeniceus	red-winged blackbird*	marshes, riparian habitats agricultural fields	Omn	Grd Gle
Sturnella magna	eastern meadowlark*	grassland, savanna, fields	Omn	Grd Gle
Euphagus carolinus	rusty blackbird	boreal bogs; wooded swamps and damp woods with pools during migration	Omn	Grd/Wt Gle
Quiscalus quiscula	common grackle*	lawns, parks, fields, open woodland	Omn	Grd/Wt Gle
Molothrus ater	brown-headed cowbird*	woodland, forest, forest edge, grassland	Her	Grd/Ca Gle

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Icterus spurius	orchard oriole*	orchards, shade trees in parks and gardens, and scattered trees along lakes and streams	Omn	Lca Gle/Fl
Icterus galbula	Baltimore oriole*	deciduous woodland and shade trees	Omn	Lca Gle/Fl
Carpodacus purpureus	purple finch	mixed and coniferous woodlands, ornamental conifers in gardens	Omn	Lca/Grd Gle
Carduelis pinus	pine siskin	coniferous and mixed woodlands, alder thickets, and brushy pastures	Omn	Ca Gle
Carduelis tristis	American goldfinch*	weedy and cultivated fields, deciduous open forests, riparian woodlots	Her	Ca Gle
Hesperiphona vespertina	evening grosbeak	conifer and mixed forests, second growth woodlots and parks	Omn	Grd Gle
Passer domesticus	house sparrow*	cultivated lands, woodland and edges, generally around human habitation	Omn	Grd Gle

*Birds that nest on the Refuge.

[1] Trophic Level Codes: Her = herbivore; Det = detritivore; Omn = omnivore; Pre = predator; Ins = insectivore; Inv = invertivore. Note that "predators", "insectivores", and "invertivores" are all carnivores (consumers of other animals). Note further that the designations refer to the "typical" or predominant composition of the diet and should not be interpreted as representing the overall diets.

[2] Foraging Behavior Codes: S = soars; PSw = swoops from a perch; H = hovers; Grd = ground; Wt = Water; Ar = air; Lca = lower tree canopy; Ba = bark; Ca = tree canopy, Gle = glean, Ha = hawk; Pou = pounce; Pur = pursuit; Dvr = dive; Prb = Probe; Stk = stalk; Scr = screen; Fl = floral. Note that these foraging behaviors are "typical" and do not reflect the potential full range of possible foraging behaviors.

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Kaufman, K. 1996. Lives of North American birds. Roger Tory Peterson Institute. New York, NY.

TABLE 3-6
MAMMALS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Didelphis marsupialis	Virginia opossum	variable, but prefers woodlands	Omn & Det	Grd/Lca Gle
Sorex longirostris	southeastern shrew	found in many kinds of vegetation; prefers moist areas	Ins	Grd Amb
Blarina brevicauda	short-tailed shrew	found nearly all land habitats	Omn	Foss Gle
Cryptotis parva	least shrew	open, grassy fields	Pre	Grd Amb
Scalopus aquaticus	eastern American mole	well-drained soil in fields, meadows, pastures, and open woodlands	Ins	Foss Gle
Myotis lucifugus	little brown bat	fields, forests, wood edges or over water	Ins	Ar Scr
Myotis sodalis	Indiana bat	winter found in caves and mines; summer found in wooded and riparian areas	Ins	Ar Scr
Lasionycteris noctivagans	silver-haired bat	streams and rivers in wooded areas; mainly a tree dweller	Ins	Ar Scr
Pipistrellus subflavus	eastern pipistrelle	open woods near water; roosts in rock crevices	Ins	Ar Scr
Eptesicus fuscus	big brown bat	forest dweller, using hollow trees for roosting in warmer months and hibernating in caves in winter, also uses buildings	Ins	Ar Scr

TABLE 3-6
MAMMALS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Lasiurus borealis	red bat	wooded areas, roost in foliage or buildings	Ins	Ar Scr
Sylvilagus floridanus	eastern cottontail	fields, woodlands, swamps, prairies, hardwood forests	Her	Grd Bro
Tamias striatus	eastern American chipmunk	deciduous forests and bushy areas near broken rocky ground, stone fences, and fallen logs	Omn	Grd Gle
Marmota monax	woodchuck	pastures and forest edge	Her	Grd Bro
Sciurus carolinensis	gray squirrel	deciduous and coniferous forests	Her	Lca/Grd Gle
Sciurus niger	fox squirrel	deciduous and coniferous forests	Her	Lca/Grd Gle
Glaucomys volans	southern flying squirrel	wooded areas	Omn	Uca/Lca Gle
Castor canadensis	beaver	semiaquatic; streams and small lakes with willow, aspen, poplar, birch or alder growing near	Her	Rip Bro
Oryzomys palustris	marsh rice rat	wet swampy fields and marshes; along ditches, lowland meadows, and wet areas of woods and grass	Omn	Grd Gle
Peromyscus maniculatus	deer mouse	woodlands, grasslands, brushlands	Omn	Grd Gle
Peromyscus gossypinus	cotton mouse	bottomland hardwood forest and swamp	Omn	Grd Gle
Peromyscus leucopus	white-footed mouse	deep woodlands or brushy areas	Omn	Grd Gle

TABLE 3-6
MAMMALS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Ochrotomys nuttalli	golden mouse	brushy and wooded areas, often found in thickets of honeysuckle and greenbrier	Her	Grd Gle
Microtus ochrogaster	prairie vole	dry grasslands	Her	Grd Bro
Microtus pinetorum	pine vole	fossorial, seldom comes above ground	Her	Foss Bro
Ondatra zibethicus	muskrat	semiaquatic; marshes, lakes, ponds, rivers, and sloughs	Omn	Rip Gle
Zapus hudsonius	meadow jumping mouse	wooded areas and grassy fields, common in thick vegetation bordering streams, ponds or marshes	Omn	Grd Gle
Rattus norvegicus	Norway rat	buildings, grain bins, and cultivated fields	Omn	Grd Gle
Mus musculus	house mouse	buildings and fields	Omn	Grd Gle
Vulpes vulpes	red fox	deep forest to open prairie and farmland, prefers areas of highly diverse vegetation	Omn	Grd Amb-Pou
Urocyon cinereoargenteus	gray fox	wooded and brushy country	Omn	Grd Amb-pou
Canis latrans	coyote	open grassland, brush country and broken forests	Pre	Grd Amb-Pou
Procyon lotor	raccoon	timbered and brushy areas near water	Omn	Rip Gle

TABLE 3-6
MAMMALS KNOWN OR EXPECTED TO OCCUR WITHIN THE VICINITY OF THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE, MARION, ILLINOIS

Scientific Name	Common Name	Habitat	Trophic Level[1]	Foraging Behavior[2]
Mustela frenata	long-tailed weasel	open, brushy or grassy areas near water	Pre	Grd Pur
Mustela vison	American mink	densely vegetated areas along streams, lakes, swamps and marshes	Pre	Grd Pur
Mephitis mephitis	striped skunk	woods and grasslands	Omn	Grd Gle
Lynx rufus	bobcat	forests, mountainous areas, and brushlands	Pre	Grd Pou-Pur
Odocoileus virginianus	white-tailed deer	low mixed woodlands, forest edges, and second growth	Her	Grd/Lca Bro

[1] Her = herbivore; Det = detritivore; Omn = omnivore; Gen = generalist; Pre = predator; Ins = insectivore; Inv = invertivore. Note that "predators", "insectivores", and "invertivores" are all carnivores (consumers of other animals). Note further that the designations refer to the "typical" or predominant composition of the diet and should not be interpreted as representing the overall diets.

[2]Ar = Air; Grd = ground; Foss = fossorial; Rip = riparian; Lca = lower canopy; Uca = upper canopy; Amb = ambush; Gle = glean; Bro = browse; Scr = screen; Pou = pounce; Pur = pursuit. Not that these foraging behaviors are "typical" and do not reflect the potential full range of possible foraging behaviors.

TABLE 3-7
FEDERALLY LISTED AND STATE OF ILLINOIS LISTED THREATENED OR ENDANGERED SPECIES POTENTIALLY FOUND ON CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Common Name	Scientific Name	State Listed	Federally Listed	Habitat
Little blue heron	*Egretta caerulea*	E[1]	-	Little blue herons use stands of young trees, forming dense thickets; feeding takes place in shallow waters of lagoons, marshes and swampy areas
Great egret	*Ardea alba*	E	-	Great egret rookeries are shared with great blue herons and occasionally other herons in floodplain forests; foraging occurs in floodplain lagoons of major rivers
Snowy egret	*Egretta thula*	E	-	Snowy egrets use lowland thickets or forest for nesting; foraging is generally restricted to floodplain lagoons of rivers and marshes
Black-crowned night heron	*Nycticorax nycticorax*	E	-	Black-crowned night herons use bottomland forests
Upland sandpiper	*Bartramia longicauda*	E	-	Upland sandpipers use prairies, pastureland and hayfields with an average grass height less than 30 cm
Sharp-shinned hawk	*Accipiter striatus*	E	-	Sharp-shinned hawks use deciduous and coniferous forests and open woodlands
American bittern	*Botaurus lentiginosus*	E	-	The American bittern is found in freshwater marshes and marshy, lake shores
Least bittern	*Ixobrychus exilis*	E	-	Least bitterns use shallow freshwater lakes and marshes with tall dense vegetation for nesting
Double-crested cormorant	*Phalacrocorax auritus*	T	-	Double-crested cormorants are found near lakes, rivers, swamps and coasts
Osprey	*Pandion haliaetus*	E	-	Ospreys are found near lakes, rivers, and seacoasts
Cooper's hawk	*Accipiter cooperii*	E	-	The Cooper's hawk uses mature deciduous forests, open woodlands and forest edges

TABLE 3-7
FEDERALLY LISTED AND STATE OF ILLINOIS LISTED THREATENED OR ENDANGERED SPECIES POTENTIALLY FOUND ON CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Common Name	Scientific Name	State Listed	Federally Listed	Habitat
Northern harrier	*Circus cyaneus*	E	-	Northern harries occur in large undisturbed grasslands and marshes
Red-shouldered hawk	*Buteo lineatus*	E	-	The red-shouldered hawk is found in moist and riparian forests including wooded swamps
Bald eagle	*Haliaeetus leucocephalus*	E	T	Bald eagles are found within undisturbed areas near large rivers and lakes
Barn owl	*Tyto alba*	E	-	Barn-owls occur in open to partly open areas often near human habituation
Brown creeper	*Certhia americana*	T	-	The brown creeper uses deciduous and mixed woodlands, with cypress swamps and floodplain forests
Bewick's wren	*Thryomanes bewickii*	E	-	The Bewick's wren uses thickets, brushy areas, hedgerows in farming country, and open and riparian woodlands
Bachman's sparrow	*Aimophila aestivalis*	E	-	Bachman's sparrows occur in open oak woods with adjoining grass; also neglected fields with old dead trees
Golden mouse	*Ochrotomys nuttalli*	T	-	Golden mice use dense thickets in a variety of wooded habitats including bottomland hardwood forests, pines, drainage-ways, abandoned upland fields, roadside right-of-ways, and successional sites dominated by cedar. This species appears to be dependent on the presence of a dense understory including honeysuckle, catbrier, and grape.
Marsh rice rat	*Oryzomys palustris*	T	-	Marsh rice rats use wet swampy fields and marshes in areas of the Shawnee Hills or Ozark Uplift. They have been found along drainage ditches, farm ponds, marshy railroad right-of-ways, cypress swamps, lowland meadows, and wet areas of woods and grass

TABLE 3-7
FEDERALLY LISTED AND STATE OF ILLINOIS LISTED THREATENED OR ENDANGERED SPECIES POTENTIALLY FOUND ON CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Common Name	Scientific Name	State Listed	Federally Listed	Habitat
Bobcat	*Lynx rufus*	T	-	Bobcats use heavily wooded areas near rocky outcrops, brushy hollows, and timbered swamps
Indiana bat	*Myotis sodalis*	E	E	The Indiana bat's winter habitat includes caves and mines; summer habitat includes a variety of wooded and riparian settings
Pallid shiner	*Notropis amnis*	E	-	The pallid shiner is found in pools with negligible current in medium to large rivers having clear water and a sand-silt substrate
Least brook lamprey	*Lampetra aepyptera*	T	-	The adult least brook lamprey is found in clean, clear, gravelly riffles, runs of creeks and small rivers; the larval stage occurs in spring-fed wetlands, quiet pools and backwaters of small sand or mud bottom streams
Indiana crayfish	*Orconectes indianensis*	E	-	Indiana crayfish use rocky riffles and pools of small to medium-sized streams in the southern part of the state
Timber rattlesnake	*Crotalus horridus*	T	-	Timber rattlesnakes use forested areas with bluffs and rock outcrops, and occasionally upland forests or crop fields
Bellow's beak sedge	*Carex physorhyncha*	E	-	The bellow's beak sedge occurs in sand or chert outcrops in forests in the Ozark Natural Division of southwestern Illinois
Bent sedge	*Carex styloflexa*	E	-	The bent sedge occurs in mesic floodplain forests
Eryngo	*Eryngium prostratum*	E	-	The eryngo occurs in muddy and sandy shores
Turk's cap lily	*Lilium superbum*	E	-	Turk's-cap lilies occur in mesic woods and stream banks

TABLE 3-7
FEDERALLY LISTED AND STATE OF ILLINOIS LISTED THREATENED OR ENDANGERED SPECIES POTENTIALLY FOUND ON CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Common Name	Scientific Name	State Listed	Federally Listed	Habitat
Bead grass	*Paspalum dissectum*	E	-	The bead grass is found in disturbed sites and shallow water
Hairy synandra	*Synandra hispidula*	E	-	The hairy synandra occurs in rich mesic forests
Climbing milkweed	*Matelea decipiens*	E	-	Climbing milkweed occurs in floodplain forests
Spring ladies' tresses	*Spiranthes vernalis*	E	-	The spring ladies' tresses occur in acidic soils in prairies and old fields
Green trillium	*Trillium vifide*	T	-	In southern Illinois, green trilliums occur in forested bottomlands, talus slopes, blufftops, and prairies

[1]E=endangered, T=threatened.

References:
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Illinois Endangered Species Protection Board, 1991, Endangered and Threatened Species of Illinois: Status and Distribution, Volume I-Plants, Volume II-Animals, Williamson County.
Illinois Endangered Species Protection Board, 1994, Checklist of Endangered and Threatened Animals and Plants of Illinois.

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Level A								Level B			Level C	Level D			
Constituent	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values [8]	ESV
Halogenated Methanes/Alkanes (mg/kg)																
Bis(2-chloroethoxy) methane												0.3029				0.3029
Bromodichloromethane												0.53978				0.53978
Bromoform												15.9				15.9
Bromomethane												0.23516				0.23516
Carbon tetrachloride (Tetrachloromethane)										1000		2.98		1	1000	1000
Chloroform (Trichloromethane)												1.19		10	0.001	1.19
Chloromethane												10.4				10.4
Dibromochloromethane												2.05				2.05
Methylene chloride												4.05		20	2	4.05
Halogenated Ethanes (mg/kg)																
1,1-Dichloroethane												20.1				20.1
1,1,1-Trichloroethane												29.8				29.8
1,1,2-Trichloroethane												28.6				28.6
1,1,2,2-Tetrachloroethane												0.12722				0.12722
1,2-Dichloroethane												21.2			0.4	21.2
Chloroethane																NA
Hexachloroethane												0.59634				0.59634
Halogenated Propanes (mg/kg)																
1,2-Dichloropropane									700			32.7			700	700
2,2'-Oxybis (1-chloropropane)																NA
Halogenated Alkenes (mg/kg)																
1,1-Dichloroethene												8.28				8.28
1,2-Dichloroethene (total) [1]																0.7873
1,2-Dichloroethene (cis) [1]																0.7873

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (NHSPE 1994)	EPA Region 4 Screening Values [6]	ESV
1,2-Dichloroethene (trans)												0.7873				0.7873
1,3-Dichloropropene (total) [2]																0.39786
1,3-Dichloropropene (cis)												0.39786				0.39786
1,3-Dichloropropene (trans)												0.39786				0.39786
Tetrachloroethylene			13	84								992	0.1	4	0.01	13
Trichloroethylene			9	60								12.4	0.1	60	0.001	9
Vinyl chloride												0.64614		0.1	0.01	0.64614
Amines (mg/kg)																
2-Nitroaniline												74.1				74.1
3-Nitroaniline												3.16				3.16
3,3'-Dichlorobenzidine												0.64636				0.64636
4-Chloroaniline												1.1				1.1
4-Nitroaniline												21.9				21.9
4,4'-Methylenebis (2-chloroanaline)																NA
N-Nitrosodiphenylamine									20			0.54514			20	20
N-Nitroso-di-n-propylamine												0.54368				0.54368
Benzene and Derivatives (mg/kg)																
Benzene			16	133								0.25462		1	0.05	16
Chlorobenzene									40			13.1		30	0.05	40
1,2-Dichlorobenzene												2.96				2.96
1,2,4-Trichlorobenzene									20			11.1			0.01	20
1,3-Dichlorobenzene												37.7				37.7
1,4-Dichlorobenzene									20			0.54559				20
Hexachlorobenzene										1000		0.19878		30	0.0025	1000

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values [8]	ESV
Methylated Benzenes (mg/kg)																
Toluene			<3	34							200	5.45		130	0.05	3
Xylenes (total)			0.6	33								10		25	0.05	0.6
Other Substituted Benzenes (mg/kg)																
Ethylbenzene			5	73								5.16	0.1	50	0.05	5
Styrene											300	4.69		100	0.1	300
Nitrobenzene									40	1000		1.31			40	40
Arenes (mg/kg)																
2,4-Dinitrotoluene												1.28				1.28
2,6-Dinitrotoluene												0.03283				0.03283
Chlorinated Dienes (mg/kg)																
Hexachlorobutadiene												0.03976				0.03976
Hexachlorocyclopentadiene											10	0.75537			10	10
Ethers (mg/kg)																
4-Bromophenyl phenyl ether																NA
4-Chlorophenyl phenyl ether																NA
Bis (2-chloroethyl) ether												23.7				23.7
Phenols and Substituted Phenols (mg/kg)																
2-Chlorophenol												0.24266				0.24266
2-Methylphenol												40.4				40.4
2-Nitrophenol												1.6				1.6
2,4-Dichlorophenol												87.5			0.003	87.5
2,4-Dimethylphenol												0.01				0.01
2,4-Dinitrophenol											20	0.06086			20	20
2,4,5-Trichlorophenol									9		4	14.1			4	4

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
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CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values [8]	ESV
2,4,6-Trichlorophenol									10			9.94			10	10
4-Chloro-3-methylphenol												7.95				7.95
4-Methylphenol												163				163
4-Nitrophenol									7			5.12			7	7
4,6-Dinitro-2-Methylphenol																NA
Pentachlorophenol			6	44					6	400	3	0.11927	7.6	5	0.002	6
Phenol			40	160					30	100	70	120	3.8	40	0.05	40
Ketones (Carbonyl Compounds) (mg/kg)																
2-Butanone												89.6				89.6
2-Hexanone												12.6				12.6
4-Methyl-2-pentanone (MIBK)												443				443
Acetone												2.5				2.5
Isophorone												139				139
Polynuclear Aromatic Hydrocarbons (PAHs) (mg/kg)																
PAH (Total)																NA
Low Molecular Weight PAHs (mg/kg)																
2-Chloronaphthalene												0.01218		10	1	0.01218
2-Methylnaphthalene												3.24				3.24
Acenaphthene												682.5			20	682.5
Acenaphthylene												682.5				682.5
Anthracene												1480			0.1	1480
Carbazole																NA
Dibenzofuran												–				NA
Fluorene									30			122			30	30
Naphthalene			430	249								0.09939			0.1	249

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ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Level A								Level B			Level C	Level D			
Constituent	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values [8]	ESV
Phenanthrene												45.7			0.1	45.7
High Molecular Weight PAHs (mg/kg)																
Benzo(a)anthracene												5.21	0.05			5.21
Benzo(a)pyrene			4400	26000								1.52			0.1	4400
Benzo(ghi)perylene												119				119
Benzo(b,k)fluoranthene												59.8				59.8
Chrysene												4.73				4.73
Dibenzo(a,h)anthracene												18.4				18.4
Fluoranthene												122			0.1	122
Indeno(1,2,3-cd)pyrene												109				109
Pyrene												78.5		40	0.1	78.5
Phthalates (mg/kg)																
Bis (2-ethylhexyl) phthalate												0.92594				0.92594
Butylbenzylphthalate												0.23889				0.23889
Diethyl phthalate											100	24.8			100	100
Dimethyl phthalate									200			734			200	200
Di-n-butyl phthalate											200	0.14979				200
Di-n-octyl phthalate												709				709
Miscellaneous Solvents (mg/kg)																
Carbon disulfide												0.09412				0.09412
Pesticides (mg/kg)																
4,4'-DDD												0.75815				0.75815
4,4'-DDE												0.59587				0.59587
4,4'-DDT												0.0175	0.7	4		0.0175
DDT (Total)																NA
Aldrin												0.00332			0.0025	0.00332
a-BHC												0.09939			0.0025	0.09939

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC[3]	Environment Canada (1995) Worm Survival NOEC[3]	Talmage et al. (1999) Earthworm Screening Concentration[4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration[4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration[4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration[4]	Efroymson et al. (1997a) Earthworm Screening Concentration[1]	Efroymson et al. (1997a) Micro-organism Screening Concentration[1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[2]	EPA Region V EDQL[7]	Canadian Environmental Quality Guidelines[5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values[8]	ESV
b-BHC												0.00398			0.0001	0.00398
d-BHC												9.94				9.94
g-BHC (Lindane)												0.005			0.00005	0.005
a-Chlordane [3]																0.224
g-Chlordane [3]																0.224
Chlordane (Technical)												0.224				0.224
Dieldrin												0.00238			0.0005	0.00238
alpha Endosulfan												0.11927				0.11927
beta Endosulfan												0.11927				0.11927
Endosulfan sulfate												0.03578				0.03578
Endrin												0.0101				0.0101
Endrin aldehyde												0.0105				0.0105
Endrin ketone																NA
Heptachlor												0.00598				0.00598
Heptachlor epoxide												0.15188				0.15188
Isodrin												0.00332				0.00332
Methoxychlor												0.01988				0.01988
Toxaphene												0.11927				0.11927
PCBs (mg/kg)																
PCB(total)											40	0.000332		1	0.02	40
Aroclor 1016																NA
Aroclor 1221																NA
Aroclor 1248																NA
Aroclor 1254																NA
Aroclor 1260																NA
Explosives (mg/kg)																
1,3-Dinitrobenzene (DNB)												0.6547				0.6547

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values [8]	ESV
1,3,5-Trinitrobenzene (TNB)												0.37615				0.37615
2-Amino-4,6-Dinitrotoluene (2-ADNT)							80	80								80
2-Nitrotoluene(ONT)																NA
2,4,6-Trinitrotoluene (TNT)					140	200		30								30
3-Nitrotoluene																NA
4-Amino-2,6-Dinitrotoluene																NA
4-Nitrotoluene (PNT)																NA
Cyclonite (RDX)								100								100
Cyclotetramethylenetetranitramine (HMX)								25								25
Nitroglycerin (NG)																NA
Pentaerythritol tetranitrate (PETN)																NA
Tetryl																NA
Dioxins/Furans (mg/kg)																
2,3,7,8-TCDD				5[10]								0.000000199				5
Total Petroleum Hydrocarbons (mg/kg)																
TPH-Gasoline range organics																
TPH-Diesel range organics																
Metals (mg/kg)																
Aluminum	soil pH < 5.5	soil pH < 5.5								600	50				50	soil pH < 5.5
Antimony											5				3.5	5
Arsenic		37	9	83					60	100	10	5.7	12	34	10	9
Barium										3000	500	1.04	750	165	165	500
Beryllium											10	1.06	1.4	1.1	1.1	10

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates[9]	USEPA (2000) Ecological Soil Screening Level: Plants[9]	Environment Canada (1995) Seed Emergence NOEC[3]	Environment Canada (1995) Worm Survival NOEC[3]	Talmage et al. (1999) Earthworm Screening Concentration[4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration[4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration[4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration[4]	Efroymson et al. (1997a) Earthworm Screening Concentration[1]	Efroymson et al. (1997a) Micro-organism Screening Concentration[1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[2]	EPA Region V EDQL[7]	Canadian Environmental Quality Guidelines[5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values[8]	ESV
Boron										20	0.5				0.5	0.5
Cadmium	110	29	44	433					20	20	4	0.00222	1.4	1.6	1.6	29
Calcium																NA
Chromium (Total)		5	56	323					0.4	10	1	0.4	64	100	0.4	5
Chromium VI			117	900									0.4			117
Cobalt										1000	20	0.14033		33	20	20
Copper	61		31	210					60	100	100	0.3132	63	40	40	31
Iron															200	200
Lead			433	1433					500	900	50	0.05373	70	140	50	433
Magnesium																NA
Manganese										100	500				100	100
Mercury			7	96					0.1	30	0.3	0.1	6.6	2.2	0.1	7
Nickel									200	90	30	13.6	50	38	30	30
Potassium																NA
Selenium									70	100	1	0.02765		0.81	0.81	1
Silver										50	2	4.04			2	2
Sodium																NA
Thallium											1	0.05692			1	1
Vanadium			46	207						20	2	1.59		43	2	46
Zinc	120	190	153	400					100	100	50	6.62		160	50	120
Total Cyanide			0.9	12								1.33	0.9	50	5	0.9

Note:

NA= Screening concentration not available

[1] ESVs for 1,2-Dichloroethene (total) and 1,2-Dichloroethene (cis) based on 1,2-Dichloroethene (trans)

[2] ESV for 1,3-Dichloropropene (total) based on trans and cis isomers

[3] ESVs for a-Chlordane and g-chlordane based on chlordane (Technical)

TABLE 3-8
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SOIL
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A								Level B			Level C	Level D			
	USEPA (2000) Ecological Soil Screening Level: Invertebrates [9]	USEPA (2000) Ecological Soil Screening Level: Plants [9]	Environment Canada (1995) Seed Emergence NOEC [3]	Environment Canada (1995) Worm Survival NOEC [3]	Talmage et al. (1999) Earthworm Screening Concentration [4]	Talmage et al. (1999) Soil Invertebrate Screening Concentration [4]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration [4]	Talmage et al. (1999) Terrestrial Plant Screening Concentration [4]	Efroymson et al. (1997a) Earthworm Screening Concentration [1]	Efroymson et al. (1997a) Micro-organism Screening Concentration [1]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration [2]	EPA Region V EDQL [7]	Canadian Environmental Quality Guidelines [5]	Netherlands Intervention Values (MHSPE 1994)	EPA Region 4 Screening Values [8]	ESV

1 Efroymson, R.A., M.E. Will, G.W. Suter II. 1997a. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory. ES/ER/TM-126/R2.

2 Efroymson, R.A., M.E. Will, G.W. Suter II. 1997b. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory. ES/ER/TM-126/R2.

3 Environment Canada. 1995. Toxicity testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Prepared by HydroQual Laboratories, Calgary, Alberta for Guidelines Division, Evaluation and Interpretation Br

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6 MHSPE (Ministry of Housing Physical Planning and Environment). 1994. Intervention Values and Target Values - Soil Quality Standards. Directorate General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. IN Friday, G.

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TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C					Netherlands Limit Values	Equilibrium Partitioning Level D			EPA Regional Level E		Screening ESV Selected
	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)		K_{oc} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDLs	EPA Region 4 Sediment Screening Value	
Halogenated Methanes/Alkanes (mg/kg)																					
Bis(2-chloroethoxy) methane																1.32	6400	1.3			1.3
Bromodichloromethane																2.06	15215	17.5	0.00113		17.5
Bromoform																2.63	293	1.2	0.99627		1.2
Bromomethane																1.19	67647	10.5			10.5
Carbon tetrachloride (Tetrachloromethane)																2.90	9.8	0.078	0.03573		0.078
Chloroform (Trichloromethane)																2.40	28	0.070	0.027		0.070
Chloromethane																1.85	67467	47.8			47.8
Dibromochloromethane																2.32	14607	30.8	0.26761		30.8
Methylene chloride																1.68	1930	0.92	1.26		0.92
Halogenated Ethanes (mg/kg)																					
1,1-Dichloroethane																2.30	47	0.094	0.00058		0.094
1,1,1-Trichloroethane						0.17										1.28	11	0.002	0.24685		0.17
1,1,2-Trichloroethane																2.05	940	1.06	0.67351		1.06
1,1,2,2-Tetrachloroethane						0.94										2.78	240	1.4	0.02908		0.94
1,2-Dichloroethane																2.13	910	1.23	0.05418		1.23
Chloroethane																1.84	21069	14.5	58.6		14.5
Hexachloroethane																2.84	9.8	0.068	2.23		0.068
Halogenated Propanes (mg/kg)																					
1,2-Dichloropropane																2.42	525	1.38	0.35161		1.38
2,2'-Oxybis (1-chloropropane)																1.75	NA	NA			NA
Halogenated Alkenes (mg/kg)																					
1,1-Dichloroethene																2.63	25	0.11	0.02327		0.11
1,2-Dichloroethene (total)																1.62	590	0.25			0.25
1,2-Dichloroethene (cis)																2.30	590	1.18			1.18
1,2-Dichloroethene (trans)																2.30	590	1.18	0.20894		1.18
1,3-Dichloropropene (total)																NA	NA	NA			NA
1,3-Dichloropropene (cis)																2.65	0.055	0.0002	0.00296		0.0002
1,3-Dichloropropene (trans)																2.30	24.4	0.049	0.00296		0.049
Tetrachloroethylene						0.53									0.01	2.80	84	0.53	0.19583		0.53

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C						Equilibrium Partitioning Level D			EPA Regional Level E		
	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)	Netherlands Limit Values	K_{ow} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDLs	EPA Region 4 Sediment Sreening Value	Screening ESV Selected
Trichloroethylene						1.6									0 001	2.00	47	0.05	0.17956		1.6
Vinyl chloride																2.16	18242	26 4	0.002		26 4
Amines (mg/kg)																					
2-Nitroaniline																2 32	23132	48 3	0.00022		48 3
3-Nitroaniline																1 94	68321	59 5	0 00022		59 5
3,3'-Dichlorobenzidine																3 28	105	2 0	0.02822		2 0
4-Chloroaniline																2.86	2250	16.4	0.14608		16 4
4-Nitroaniline																1.89	46418	36.2	0.00022		36 2
4,4'-Methylenebis (2-chloroanaline)																3 68	NA	NA			NA
N-Nitrosodiphenylamine																3.08	58 5	0 70	0 15524		0 70
N-Nitroso-di-n-propylamine																2.11	NA	NA			NA
Benzene and Derivatives (mg/kg)																					
Benzene						0.057										1.82	46	0.031	0.14157		0 057
Chlorobenzene						0.82										1.59	64	0.02	0.06194		0.82
1,2-Dichlorobenzene						0 34										4.00	14	1.4	0.23132		0.34
1,2,4-Trichlorobenzene						9.2										3.10	44.9	0.6	11.7		9.2
1,3-Dichlorobenzene						1.7										2.48	50.2	0 15	3.01		1.7
1,4-Dichlorobenzene						0.35										4.80	11.2	7.1	1.45		0.35
Hexachlorobenzene														0.1		4.55	3.68	1.3	0.02		0.1
Methylated Benzenes (mg/kg)																					
Toluene						0.67										1.87	9.8	0.01	52.5		0.67
Xylenes (total)						0.025										2.08	1.8	0.002	1.88		0.025
Other Substituted Benzenes (mg/kg)																					
Ethylbenzene						3.6										2 94	7.3	0.06	0.0001		3.6
Styrene																2.73	4020	21.6	0.44496		21.6
Nitrobenzene																2.34	270	0.59	0.4876		0.59
Arenes (mg/kg)																					
2,4-Dinitrotoluene																2.45	230	0.65	0.07513		0.65
2,6-Dinitrotoluene																2.31	42	0.09	0.02062		0.09
Chlorinated Dienes (mg/kg)																					

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A: Consensus-Based TEC (MacDonald, et.al. 1999)	Level A: Ingersoll et.al. TEL (1996)	Level A: Ingersoll et.al. ERL (1996)	Level A: NOAA TEL (1999)	Level A: Ontario Low (1995)	Level A: ECOTOX Threshold (USEPA 1996)	Level A: Long et.al. ERL (1995)	Effects Range Median - Level B: Ingersoll et.al. ERM (1996)	Level B: Long et.al. ERM (1995)	No Effect/Probable Effects Levels - Level C: Consensus-Based PEC (MacDonald, et.al. 1999)	Level C: Ingersoll et.al. PEL (1996)	Level C: Ingersoll et.al. NEC (1996)	Level C: NOAA PEL (1999)	Level C: NOAA UET (1999)	Netherlands Limit Values	Equilibrium Partitioning Level D: K_{ow} (from Table 3-1)	Level D: Water Screening ESV (ug/L) (from Table 3-10)	Level D: Equilibrium Partitioning Screening Value (mg/kg)	EPA Regional Level E: EPA Region V EQDLs	Level E: EPA Region 4 Sediment Sreening Value	Screening ESV Selected
Hexachlorobutadiene																3.71	0.93	0.048	1.38		0.048
Hexachlorocyclopentadiene																3.63	0.07	0.003	0.90074		0.003
Ethers (mg/kg)																					
4-Bromophenyl phenyl ether						1.3										4.28	1.5	0.29	1.55		1.3
4-Chlorophenyl phenyl ether																3.48	46	1.4	0.65612		1.4
Bis (2-chloroethyl) ether																2.08	2380	2.9	0.21196		2.9
Phenols and Substituted Phenols (mg/kg)																					
2-Chlorophenol																2.70	43.8	0.22	0.0117		0.22
2-Methylphenol																1.55	13	0.005	0.00083		0.005
2-Nitrophenol																1.97	3451	3.2	0.00777		3.2
2,4-Dichlorophenol																3.00	36.5	0.37	0.13363		0.37
2,4-Dimethylphenol																2.33	21.2	0.045	0.30453		0.045
2,4-Dinitrophenol																2.30	6.2	0.012	0.00133		0.012
2,4,5-Trichlorophenol																3.36	63	1.45	0.08556		1.45
2,4,6-Trichlorophenol																2.76	3.2	0.018	0.08484		0.018
4-Chloro-3-methylphenol																1.70	0.3	0.0002	0.38818		0.0002
4-Methylphenol																2.25	2251	4.0	0.00081		4.0
4-Nitrophenol																1.70	82.8	0.041	0.00778		0.041
4,6-Dinitro-2-Methylphenol																2.56	2.3	0.008	0.01038		0.008
Pentachlorophenol																2.69	15	0.074	30.1		0.074
Phenol														0.048		1.34	100	0.022	0.02726		0.048
Ketones (Carbonyl Compounds) (mg/kg)																					
2-Butanone																1.50	14000	4.4	0.13696		4.4
2-Hexanone																2.13	99	0.13	1.01		0.13
4-Methyl-2-pentanone (MIBK)																2.09	170	0.21	0.54437		0.21
Acetone																1.22	507	0.08	0.45337		0.08
Isophorone																1.99	1170	1.1	0.4223		1.1
Total Polynuclear Aromatic Hydrocarbons (PAHs) (mg/kg)																					
PAH Total	1.61	0.26	0.24		4		4.022	22	44.8	22.8	3.4	6.2		12						1.684	1.61

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C						Equilibrium Partitioning Level D			EPA Regional Level E		
	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)	Netherlands Limit Values	K_{ow} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDLs	EPA Region 4 Sediment Sreening Value	Screening ESV Selected
Low Molecular Weight PAHs (mg/kg)																					
LMW PAH Total		0.076	0.08				0.552	0.65	3.16		1.2	29		5.3						0.33	0.076
2-Chloronaphthalene																3.05	310	3.5	0.41723		3.5
2-Methylnaphthalene							0.07		0.67							3.93	417	35.4	0.0202	0.33	0.07
Acenaphthene							0.016		0.5					0.29		3.41	17	0.44	0.00671	0.33	0.016
Acenaphthylene							0.044		0.64					0.16		3.25	665	11.801	0.00587	0.33	0.044
Anthracene	0.057	0.01	0.01		0.22		0.0853	0.14	1.1	0.845	0.17	2		0.26	0.05	5.30	6	11.8	0.0469	0.33	0.057
Carbazole																2.56	893	3.3			3.30
Dibenzofuran						2								5.1		3.67	3.7	0.17	1.52		2
Fluorene	0.0774	0.01	0.01		0.19	0.54	0.019	0.14	0.54	0.536	0.15	3		0.3		3.96	3.9	0.35	0.0212	0.33	0.0774
Naphthalene	0.176	0.015	0.013			0.48	0.16	0.098	2.1	0.561	0.14	1.4		0.6	0.015	3.26	12	0.22	0.0346	0.33	0.176
Phenanthrene	0.204	0.019	0.027	0.0419	0.56		0.24	0.35	1.5	1.17	0.41	20	0.515	0.8	0.05	4.36	6.3	1.4	0.0419	0.33	0.204
High Molecular Weight PAHs (mg/kg)																					
HMW PAH Total		0.19	0.17				1.7	1.7	9.6		2.3	33		6.5						0.655	0.19
Benzo(a)anthracene	0.108	0.016	0.019	0.0317	0.32		0.261	0.3	1.6	1.05	0.28	3	0.385	0.5	0.05	4.49	0.027	0.008	0.0317	0.33	0.108
Benzo(a)pyrene	0.15	0.032	0.084	0.0319	0.37		0.43	0.47	1.6	1.45	0.32	1	0.782	0.7	0.05	6.14	0.014	0.19	0.0319	0.33	0.15
Benzo(ghi)perylene		0.016	0.013		0.17			0.28			0.25	1.2		0.3	0.05	4.98	7.64	7.3	0.17		0.016
Benzo(b,k)fluoranthene		0.027	0.037		0.24			0.071			0.16	4		13.4	0.2	5.82	0.0056	0.04	0.24		0.027
Chrysene	0.166	0.027	0.03	0.0571	0.34		0.384	0.5	2.8	1.29	0.41	3	0.862	0.8	0.05	5.13	16	21.5	0.0571	0.33	0.166
Dibenzo(a,h)anthracene	0.033	0.01	0.01		0.06		0.0634	0.015	0.26		0.028	0.87		0.1	0.05	6.12	0.0016	0.021	0.00622	0.33	0.033
Fluoranthene	0.423	0.031	0.033	0.111	0.75		0.6	0.18	5.1	2.23	0.32	10	2.355	1.5	0.3	4.97	8.1	7.6	0.1113	0.33	0.423
Indeno(1,2,3-cd)pyrene		0.017	0.03		0.2			0.25			0.24	0.77		0.33	0.05	6.82	4.31	284.76	0.2		0.017
Pyrene	0.195	0.044	0.04	0.053	0.49		0.665	0.35	2.6	1.52	0.49	9	0.875	1	0.05	5.20	61	96.7	0.053	0.33	0.195
Phthalates (mg/kg)																					
Bis (2-ethylhexyl) phthalate														0.75		5.00	3	3.0	0.182	0.182	0.75
Butylbenzylphthalate						11										4.00	19	1.9	4.19		11
Diethyl phthalate						0.63										1.99	210	0.21	0.00804		0.63
Dimethyl phthalate																5.20	330	523	0.02495		523
Di-n-butyl phthalate						11								0.11		2.20	9.4	0.01	0.1105		11
Di-n-octyl phthalate																5.00	708	708	40.6		708

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C						Equilibrium Partitioning Level D			EPA Regional Level E		
	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)	Netherlands Limit Values	K_{oc} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDL₃	EPA Region 4 Sediment Screening Value	Screening ESV Selected
Miscellaneous Solvents (mg/kg)																					
Carbon disulfide																2.43	0.92	0.002	0.13397		0.002
Pesticides (mg/kg)																					
4,4'-DDD	0.00488			0.00354	0.008					0.028			0.00851	0.06		4.91	0.0064	0.005	0.00553	0.0033	0.00488
4,4'-DDE	0.00316			0.00142	0.005		0.0022		0.027	0.0313			0.00675	0.05		3.92	10.5	0.87	0.00142	0.0033	0.00316
4,4'-DDT	0.00416				0.008					0.0629				0.05		5.30	0.001	0.002	0.00119	0.0033	0.00416
Aldrin					0.002									0.04		3.53	0.3	0.010	0.002		0.002
a-BHC					0.006											3.28	2.2	0.041	0.006		0.006
b-BHC					0.005											3.75	2.2	0.12	0.005		0.005
d-BHC																3.14	2.2	0.030	71.5		0.030
g-BHC (Lindane)	0.00237			0.00094	0.003					0.00499			0.00014	0.09	0.001	3.53	0.08	0.003	0.00094	0.0033	0.00237
a-Chlordane																NA	1.09	NA			NA
g-Chlordane																NA	1.09	NA			NA
Chlordane (Technical)	0.00324			0.0045	0.007					0.0176			0.0089	0.03	0.02	3.71	0.0043	0.0002	0.0045	0.0017	0.00324
Dieldrin	0.0019			0.00285	0.002					0.0618			0.00667	0.3	0.02	3.87	0.056	0.004	0.002	0.0033	0.0019
alpha Endosulfan						0.0029										NA	0.056	NA	0.00018		0.0029
beta Endosulfan						0.014										NA	0.056	NA	0.0001		0.014
Endosulfan						0.0054										3.30	0.051	0.001			0.0054
Endosulfan sufate															0.01	3.76	0.051	0.003	0.0346		0.003
Endrin	0.00222			0.00267	0.003					0.207			0.0624	0.5	0.04	4.53	0.036	0.012	0.0027	0.0033	0.00222
Endrin aldehyde																4.29	NA	NA	3.2		3.2
Endrin ketone																NA	NA	NA			NA
Heptachlor														0.01		4.48	0.0038	0.001	0.0006		0.01
Heptachlor epoxide	0.00247			0.0006	0.005					0.016			0.00274	0.03	0.02	4.10	0.0038	0.0005	0.0006		0.00247
Isodrin																3.52	NA	NA	0.0552		0.0552
Methoxychlor						0.019										3.90	0.03	0.002	0.00359		0.019
Toxaphene						0.028										4.59	0.0002	0.0001	0.00011		0.028
PCBs (mg/kg)																					
Aroclor 1016					0.007											4.97	0.014	0.013			0.007
Aroclor 1221																4.46	0.014	0.004		0.067	0.004
Aroclor 1232																NA	0.014	NA			NA

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C					Netherlands Limit Values	Equilibrium Partitioning Level D			EPA Regional Level E		Screening ESV Selected
	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)		K_{oc} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDLs	EPA Region 4 Sediment Sreening Value	
Aroclor 1242																NA	0.014	NA			NA
Aroclor 1248					0.03											NA	0.014	NA			0.03
Aroclor 1254					0.06											5.58	0.014	0.05			0.06
Aroclor 1260					0.005											5.83	0.014	0.09			0.005
PCBs (total)	0.0598	0.032	0.05	0.0341	0.07		0.0227	0.73	0.18	0.676	0.24	0.19	0.277	0.026					0.0341	0.033	0.0598
Explosives (mg/kg)																					
1,3-Dinitrobenzene (DNB)																1.39	20	0.005	0.00092		0.005
1,3,5-Trinitrobenzene (TNB)																2.13	30	0.041	0.00012		0.041
2-Amino-4,6-Dinitrotoluene (2-ADNT)																NA	20	NA			NA
2-Nitrotoluene (ONT)																2.36	7300	16.8			16.8
2,4,6-Trinitrotoluene (TNT)																3.16	40	0.58			0.58
3-Nitrotoluene																2.16	8300	11.9			11.9
4-Amino-2,6-Dinitrotoluene																NA	540	NA			NA
4-Nitrotoluene (PNT)																2.43	7000	18.7			18.7
Cyclonite (RDX)																1.92	190	0.2			0.2
Cyclotetramethylenetetranitramine (HMX)																0.54	330	0.01			0.01
Nitroglycerin (NG)																2.22	200	0.33			0.33
Pentaerythritol tetranitrate (PETN)																2.74	85000	472			472
Tetryl																2.61	NA	NA			NA
Dioxins/Furans (mg/kg)																					
2,3,7,8-TCDD																7.39	NA	NA	3.3E-06		0.0000033
Total Petroleum Hydrocarbons (mg/kg)																					
TPH-Gasoline range organics																					NA
TPH-Diesel range organics																					NA
Metals (mg/kg)																					
Aluminum		26000	14000					58000			60000	73000									26000
Antimony														3						12	3
Arsenic	9.79	11	13	5.9	6		8.2	50	70	33	48	100	17	17	55				5.9	7.24	9.79
Barium																					NA
Beryllium																					NA

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C						Equilibrium Partitioning Level D			EPA Regional Level E		
Constituent	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)	Netherlands Limit Values	K_{oc} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDLs	EPA Region 4 Sediment Screening Value	Screening ESV Selected
Boron																					NA
Cadmium	0.99	0.58	0 7	0.596	0 6		1.2	3 9	9 6	4.98	3 2	8	3 53	3	2				0 596	1	0.99
Calcium																					NA
Chromium (Total)	43 4	36	39	37 3	26		81	270	370	111	120	95	90	95	380				26	52 3	43 4
Chromium VI																					NA
Cobalt																			50		50
Copper	31 6	28	41	35.7	16		34	190	270	149	100	580	197	86	36				16	18.7	31 6
Iron		190000	200000		20000			280000			250000	290000		40000							190000
Lead	35.8	37	55	35	31		46.7	99	218	128	82	130	91.3	127	530				31	30.2	35.8
Magnesium																					NA
Manganese		630	730		460			1700			1200	4500		1100							630
Mercury	0.18			0.174	0.2		0.15		0.71	1.06			0.486	0.56	0.5				0 174	0.13	0.18
Nickel	22.7	20	24	18	16		20.9	45	51.6	48.6	33	43	35.9	43	35				16	15.9	22.7
Potassium																					NA
Selenium																					NA
Silver							1		3.7					4.5					0.5	2	1
Sodium																					NA
Thallium																					NA
Vanadium																					NA
Zinc	121	98	110	123.1	120		150	550	410	459	540	1300	315	520	480				120	124	121
Total Cyanide																			0.0001		0.0001

Notes:

TEC - Threshold Effect Concentration -

PEC - Probable Effect Concentration

TEL - Threshold Effect Level

PEL - Probable Effect Level

ERL - Effects Range Low

ERM - Effects Range Medium

Low - Ontario Lowest effect level

NEC - No Effect Concentration

TABLE 3-9
ECOTOXICOLOGICAL SCREENING VALUES (ESV) FOR DIRECT EXPOSURES TO SEDIMENTS
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNITCRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Threshold / Lowest Effect Levels - Level A							Effects Range Median - Level B		No Effect/Probable Effects Levels - Level C					Netherlands Limit Values	Equilibrium Partitioning Level D			EPA Regional Level E		Screening ESV Selected
	Consensus-Based TEC (MacDonald, et.al. 1999)	Ingersoll et.al. TEL (1996)	Ingersoll et.al. ERL (1996)	NOAA TEL (1999)	Ontario Low (1995)	ECOTOX Threshold (USEPA 1996)	Long et.al. ERL (1995)	Ingersoll et.al. ERM (1996)	Long et.al. ERM (1995)	Consensus-Based PEC (MacDonald, et.al. 1999)	Ingersoll et.al. PEL (1996)	Ingersoll et.al. NEC (1996)	NOAA PEL (1999)	NOAA UET (1999)		K_{oc} (from Table 3-1)	Water Screening ESV (ug/L) (from Table 3-10)	Equilibrium Partitioning Screening Value (mg/kg)	EPA Region V EQDLs	EPA Region 4 Sediment Screening Value	

AET - Apparent Effects Threshold

UET - NOAA Upper Effects Threshold

* = Based on 1% organic carbon and water ESV as presented in the table

BTAG= Biological Technical Assistance Group

NA= Not Available

for 1,3 dichloropropene (total), the lower value for the cis and trans isomers was selected as the ESV.

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TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Level A	Level B	Level C							Level D	
Constituent	**Illinois General Use Water Quality Standards**	**National Recommended Water Quality Criteria (Chronic)[3]**	**ECOTOX AWQC/FCV[4]**	**ECOTOX Tier II Chronic[4]**	**Suter and Tsao (1997) Tier II Chronic[5]**	**EPA Region IV Freshwater Screening Values[7]**	**Lowest Reported Chronic[6] ORNL (1997) (or other as noted)**	**NOAA Chronic[1]**	**ASTER Chronic[8] (or Other as noted)**	**Region V EDQL**	**ESV**
Halogenated Methanes/Alkanes (ug/L)											
Bis(2-chloroethoxy) methane										6400	6400
Bromodichloromethane									15215		15215
Bromoform						293			13386	466	293
Bromomethane									67647		67647
Carbon tetrachloride (Tetrachloromethane)					9.8	352	1970		2971	5.9	9.8
Chloroform (Trichloromethane)					28	289	1240	1240	2971	79	28
Chloromethane									67467		67467
Dibromochloromethane									14607	6400	14607
Methylene chloride					2200	1930	42667		142000	430	1930
Halogenated Ethanes (ug/L)											
1,1-Dichloroethane				47	47		14680		17251	47	47
1,1,1-Trichloroethane				62	11	528	3493		5678	88	11
1,1,2-Trichloroethane					1200	940	9400	9400	13451	650	940
1,1,2,2-Tetrachloroethane				420	610	240	2400	2400	5152	13	240
1,2-Dichloroethane					910	2000	15200	20000	59000	190	910
Chloroethane									21069	230000	21069
Hexachloroethane				12	12	9.8		540	141	30.5	9.8
Halogenated Propanes (ug/L)											
1,2-Dichloropropane						525		5700	25000	380	525
2,2'-Oxybis (1-chloropropane)											NA
Halogenated Alkenes (ug/L)											
1,1-Dichloroethene					25	303	2800		5114	78	25

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A	Level B	Level C							Level D	
	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
1,2-Dichloroethene (total)					590		9538				590
1,2-Dichloroethene (cis)					590		9538		17036		590
1,2-Dichloroethene (trans)					590	1350	9538		17036	310	590
1,3-Dichloropropene (total)											NA
1,3-Dichloropropene (cis)					0.055	24.4	244			7.9	0.055
1,3-Dichloropropene (trans)						24.4				7.9	24.4
Tetrachloroethylene				120	98	84	750	840	952	8.9	84
Trichloroethylene				350	47		7257	21900	4173	75	47
Vinyl chloride									18242	9.2	18242
Amines (ug/L)											
2-Nitroaniline									23132		23132
3-Nitroaniline									68321		68321
3,3'-Dichlorobenzidine									105	99.75	105
4-Chloroaniline									2250	231.97	2250
4-Nitroaniline									46418		46418
4,4'-Methylenebis (2-chloroanaline)											NA
N-Nitrosodiphenylamine					210	58.5	332			13	58.5
N-Nitroso-di-n-propylamine											NA
Benzene and Derivatives (ug/L)											
Benzene				46	130	53	525000		3100	114	46
Chlorobenzene				130	64	195	1203		2263	10	64
1,2-Dichlorobenzene				14	14	15.8		763	900	11	14
1,2,4-Trichlorobenzene				110	110	44.9			350	69.2	44.9
1,3-Dichlorobenzene				71	71	50.2			1000	87	50.2
1,4-Dichlorobenzene				15	15	11.2		763	570	43	11.2

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A	Level B	Level C							Level D	
	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
Hexachlorobenzene								3.68		0.00024	3.68
Methylated Benzenes (ug/L)											
Toluene				130	9.8	175	1269		6000	253	9.8
Xylenes (total)				1.8	13		62308			117	1.8
Other Substituted Benzenes (ug/L)											
Ethylbenzene				290	7.3	453	440		1135	17.2	7.3
Styrene									4020	56	4020
Nitrobenzene						270			17317	740	270
Arenes (ug/L)											
2,4-Dinitrotoluene						310		230		230	230
2,6-Dinitrotoluene										42	42
Chlorinated Dienes (ug/L)											
Hexachlorobutadiene						0.93		9.3		0.223	0.93
Hexachlorocyclopentadiene						0.07		5.2	7.3	77.04	0.07
Ethers (ug/L)											
4-Bromophenyl phenyl ether				1.5			1.5		42	1.5	1.5
4-Chlorophenyl phenyl ether									46		46
Bis (2-chloroethyl) ether						2380			19000	1140	2380
Phenols and Substituted Phenols (ug/L)											
2-Chlorophenol						43.8			2056	8.8	43.8
2-Methylphenol					13		489		2251		13
2-Nitrophenol						3500			3451	13.5	3451
2,4-Dichlorophenol						36.5		365	103	18	36.5

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A	Level B	Level C							Level D	ESV
	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
2,4-Dimethylphenol						21.2			3110	100.17	21.2
2,4-Dinitrophenol						6.2			594	4.07	6.2
2,4,5-Trichlorophenol								63	297		63
2,4,6-Trichlorophenol						3.2		970	538	2	3.2
4-Chloro-3-methylphenol						0.3			680	34.79	0.3
4-Methylphenol									2251		2251
4-Nitrophenol					300	82.8	481		989	35	82.8
4,6-Dinitro-2-Methylphenol						2.3			183	2.3	2.3
Pentachlorophenol		15	13			13		15	13	5.23	15
Phenol	100					256	200	2560	118	100	100
Ketones (Carbonyl Compounds) (ug/L)											
2-Butanone					14000		282170		233553	7100	14000
2-Hexanone					99		32783		38868	1710	99
4-Methyl-2-pentanone (MIBK)					170		77400			3680	170
Acetone					1500		507		543494	78000	507
Isophorone						1170			19000	900	1170
Low Molecular Weight PAHs (ug/L)											
2-Chloronaphthalene									310	0.396	310
2-Methylnaphthalene									417	329.55	417
Acenaphthene			23			17	74	520	345	9.9	17
Acenaphthylene									665	4840	665
Anthracene									<6	0.029	6
Carbazole									893		893

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Level A	Level B	Level C							Level D	
Constituent	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
Dibenzofuran				20	3.7		1003		286	20	3.7
Fluorene				3.9	3.9				289	3.9	3.9
Naphthalene				24	12	62	620	620	1022	44	12
Phenanthrene				6.3			200	6.3	19a	2.1	6.3
High Molecular Weight PAHs (ug/L)											
Benzo(a)anthracene					0.027		0.65			0.839	0.027
Benzo(a)pyrene				0.014	0.014		0.3			0.014	0.014
Benzo(ghi)perylene										7.64	7.64
Benzo(b,k)fluoranthene										0.0056	0.0056
Chrysene									16	0.033	16
Dibenzo(a,h)anthracene										0.0016	0.0016
Fluoranthene			8.1			39.8	15		61	8.1	8.1
Indeno(1,2,3-cd)pyrene										4.31	4.31
Pyrene									61	0.3	61
Phthalates (ug/L)											
Bis (2-ethylhexyl) phthalate				32	3		912	360	54	2.1	3
Butylbenzylphthalate				19	19	22			280	49	19
Diethyl phthalate				220	210	521	85600		25000	3	210
Dimethyl phthalate						330			11000	73	330
Di-n-butyl phthalate				33	35	9.4	697		100	3	9.4
Di-n-octyl phthalate							708		8300	30	708
Miscellaneous Solvents (ug/L)											
Carbon disulfide					0.92		244			84.1	0.92

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Level A	Level B	Level C							Level D	
Constituent	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
Pesticides (ug/L)											
4,4'-DDD					0.011	0.0064	1.69			0.0011	0.0064
4,4'-DDE						10.5				4.51E-09	10.5
4,4'-DDT		0.001		0.013	0.013	0.001	0.3	0.0005		0.001	0.001
Aldrin						0.3			1.3	0.0309	0.3
a-BHC					2.2	500	95			12.38	2.2
b-BHC					2.2	5000	95			0.495	2.2
d-BHC					2.2		95			666.67	2.2
g-BHC (Lindane)			0.08			0.08	3.3	0.08	40	0.01	0.08
a-Chlordane							1.09				1.09
g-Chlordane							1.09				1.09
Chlordane (Technical)		0.0043				0.0043		0.00215		0.00029	0.0043
Dieldrin		0.056	0.062			0.0019		0.056		0.000026	0.056
alpha Endosulfan		0.056		0.051	0.051	0.056		0.028		0.003	0.056
beta Endosulfan		0.056		0.051	0.051	0.056		0.028		0.003	0.056
Endosulfan					0.051						0.051
Endosulfan sufate					0.051					2.22	0.051
Endrin		0.036	0.061			0.0023		0.036	0.1	0.002	0.036
Endrin aldehyde										0.15	0.15
Endrin ketone											NA
Heptachlor		0.0038		0.0069	0.0069	0.0038	1.26	0.0019		0.00039	0.0038
Heptachlor epoxide		0.0038				0.0038		0.0019		0.00048	0.0038
Isodrin										0.0309	0.0309
Methoxychlor		0.03		0.019	0.019	0.03		0.03	9.2	0.005	0.03
Toxaphene		0.0002		0.011		0.0002		0.0002	0.054	0.0002	0.0002

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

	Level A	Level B	Level C							Level D	
Constituent	**Illinois General Use Water Quality Standards**	**National Recommended Water Quality Criteria (Chronic)[3]**	**ECOTOX AWQC/FCV[4]**	**ECOTOX Tier II Chronic[4]**	**Suter and Tsao (1997) Tier II Chronic[5]**	**EPA Region IV Freshwater Screening Values[7]**	**Lowest Reported Chronic[6] ORNL (1997) (or other as noted)**	**NOAA Chronic[1]**	**ASTER Chronic[8] (or Other as noted)**	**Region V EDQL**	**ESV**
PCBs (ug/L)		0.014									0.014
Aroclor 1016		0.014				0.014					0.014
Aroclor 1221		0.014			0.28	0.014	60				0.014
Aroclor 1232		0.014									0.014
Aroclor 1242		0.014									0.014
Aroclor 1248		0.014			0.081	0.014					0.014
Aroclor 1254		0.014			0.033	0.014					0.014
Aroclor 1260		0.014			94	0.014	1.3			0.000029	0.014
Explosives (ug/L)											
1,3-Dinitrobenzene (DNB)							240a		20a1	2.36	20
1,3,5-Trinitrobenzene (TNB)							100a		30a1		30
2-Amino-4,6-Dinitrotoluene (2-ADNT)									20a1		20
2-Nitrotoluene (ONT)							7300b				7300
2,4,6-Trinitrotolune (TNT)							40a		93a2		40
3-Nitrotoluene							8300b				8300
4-Amino-2,6-Dinitrotoluene							540c				540
4-Nitrotoluene (PNT)							7000b				7000
Cyclonite (RDX)							3200a		190a1		190
Cyclotetramethylenetetranitramine (HMX)							3300a		330a1		330
Nitroglycerin (NG)							200d				200
Pentaerythritol tetranitrate (PETN)							85000b				85000
Tetryl											NA

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT, CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A	Level B	Level C							Level D	
	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
Total Petroleum Hydrocarbons (ug/L)											
TPH-Gasoline range organics									150e		150
TPH-Diesel range organics									150e		150
Metals (ug/L)											
Aluminum		87				87	460	87	87		87
Antimony						160	610	30		31	30
Arsenic	190					190	914	150	188.6	53	190
Barium	5000			3.9	4					5000	5000
Beryllium				5.1	0.66	0.53	5.3	5.3		7.6	0.53
Boron	1000										1000
Cadmium	1.1	2.2	1			0.66	0.15	1.1	1.13	0.66	1.1
Calcium							116000				116000
Chromium (Total)	207	74	180			117.32	44	74		42	207
Chromium VI	11	11	10			11	2	11			11
Cobalt				3	2.3		5.1			5	2.3
Copper	11.8	9	11			6.54	0.23	9		5	11.8
Iron	1000	1000	1000			1000	158	1000			1000
Lead	20.1	2.5	2.5			1.32	12.3	2.5	3.18	1.3	20.1
Magnesium							82000				82000
Manganese	1000			80	120		1100		1000		1000
Mercury	1.3	0.77	1.3		1.3	0.012	0.23	0.012		0.0013	1.3
Nickel	1000	52	160			87.71	5	52		29	1000
Potassium							53000				53000
Selenium	1000	5	5			5	88.3			5	1000

TABLE 3-10
ECOTOXICOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT,
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

Constituent	Level A	Level B	Level C							Level D	
	Illinois General Use Water Quality Standards	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1997) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[7]	Lowest Reported Chronic[6] ORNL (1997) (or other as noted)	NOAA Chronic[1]	ASTER Chronic[8] (or Other as noted)	Region V EDQL	ESV
Silver	5				0.36	0.012	0.12	0.12		1	5
Sodium							680000				680000
Thallium					12	4	57	40		0.56	4
Vanadium				19	20		80			19	19
Zinc	1000	120	100			58.91	30	110		58.9	1000
Total Cyanide	5.2	5.2	5.2			5.2	7.8	5.2		5.2	5.2

1 = NOAA SQuiRT Tables, Chronic Toxicity Value - NOAA 1999. Hazmat Report No. 99-1. Does not include values categorized by general chemical class.
3 = Recommended National Water Quality Criteria - Correction - USEPA 1999
4 = Ecotox Threshold EcoUpdate - USEPA 1996
5 = Suter and Tsao (1996) - Oak Ridge National Laboratory Tier II Chronic Toxicity Values
6 = Lowest chronic toxicity - Suter and Tsao 1996 unless otherwise noted
7 = Freshwater ecotox screening values USEPA Region 4 1999
8 = (ASTER) Assessment Tools for Evaluation of Risk Database, ASTER (2000) unless otherwise noted
9 = Ministry of Housing, Spatial Planning and Environment 1994

a = Talmage et al. 1999
a1 = Tier II chronic value calculated by Talmage et al 1999
a2 = Final Chronic Value value calculated by Talmage et al 1999
b = (AQUIRE) Aquatic Toxicity Information Retrieval Database USEPA 2000
c = Layton et al. 1987: EC50/10
d = Rosenblatt et al 1991
e = Entrix Inc. 1993
NA= Not Available

Notes:

There is also a Region IV FWSV for bis(2-ethylhexyl)phthalate (DEHP) of <0.3 ug/L. However, this is apparently a typo, since the source referenced is the national ambient water quality criterion, for which there is no criterion for DEHP.

The National Recommended Water Quality Criterion is for Total PCBs - this was also used as a default value for individual Aroclors for screening purposes.

Hardness-dependent Cd, Cr, Cu and Pb values for Illinois Water quality criteria are based on a water hardness of 100 mg/L. For region IV, values are based on a hardness of 50 mg/L.

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L	2.5				29800
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L	2.4				127.22
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L	2				28600
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L	1.8				20100
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L	2.1				8280
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L	4				20000
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L	3.4				2960
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L	1.5				21200
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L	2				700000
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L	1.2				376.15
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L	3.5				37700
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L	1.5				654.7
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L	3.4				20000
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L					
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L	6.5				5000
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L	3.9				4000
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L	3.7				10000
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L	1.6				30000
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L	3.1				87500
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L	2.4				10
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L	1.6				20000
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L	2				1280
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L	1.9				32.83
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L	1.94				80000
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L	4.1				12.18
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L	2.1				242.66
591-78-6	2-HEXANONE	UG/KG	UG/L	1.4				12600
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L	3.9				3240

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L	2				40400
88-74-4	2-NITROANILINE	UG/KG	UG/L	1.9				74100
88-75-5	2-NITROPHENOL	UG/KG	UG/L	1.8				1600
88-72-2	2-NITROTOLUENE	UG/KG	UG/L	2.3				
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L	3.5				646.36
99-09-2	3-NITROANILINE	UG/KG	UG/L	1.4				3160
99-08-1	3-NITROTOLUENE	UG/KG	UG/L	2.45				
72-54-8	4,4'-DDD	UG/KG	UG/L	6.1				758.15
72-55-9	4,4'-DDE	UG/KG	UG/L	6.8				595.87
50-29-3	4,4'-DDT	UG/KG	UG/L	6.5				17.5
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L	1.4				
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L	2.1				
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L	0.6				
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L	5				
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L	3.1				7950
106-47-8	4-CHLOROANILINE	UG/KG	UG/L	1.9				1100
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L	5				
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L	1.9				163000
100-01-6	4-NITROANILINE	UG/KG	UG/L	1.4				21900
100-02-7	4-NITROPHENOL	UG/KG	UG/L	1.9				7000
99-99-0	4-NITROTOLUENE	UG/KG	UG/L	2.4				
83-32-9	ACENAPHTHENE	UG/KG	UG/L	3.9				682500
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L	3.5				682500
67-64-1	ACETONE	UG/KG	UG/L	-0.24				2500
309-00-2	ALDRIN	UG/KG	UG/L	6.5				3.32
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L				30.7	
0	All Dioxins/Furans	UG/KG						
0	All Explosives	UG/KG	UG/L					

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
0	All Metals	MG/KG	MG/L					
0	All Other Parameters	MG/KG	MG/L					
0	All PCBs	UG/KG	UG/L					
0	All Pesticides	UG/KG	UG/L					
0	All Polynuclear Aromatic Hydrocarbons (PAHs)							
0	All Semivolatile Organic Compounds	UG/KG	UG/L					
0	All Volatile Organic Compounds	UG/KG	UG/L					
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	3.8				99.39
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L					119.27
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L	6				224
7429-90-5	ALUMINUM	MG/KG	UG/L		28800	11241	200	
120-12-7	ANTHRACENE	UG/KG	UG/L	4.5				1480000
7440-36-0	ANTIMONY	MG/KG	UG/L		0.83	1.9	6	5
7440-38-2	ARSENIC	MG/KG	UG/L		13.5	10.3	10	9
7440-39-3	BARIUM	MG/KG	UG/L		195	196	22.7	500
71-43-2	BENZENE	UG/KG	UG/L	2.1				16000
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L	5.7				5210
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L	6.1				4400000
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L	6.2				59800
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L	6.7				119000
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L	6.2				59800
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L	4.8				238.89
7440-41-7	BERYLLIUM	MG/KG	UG/L		0.76	1.6	5	10
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	3.8				3.98
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L					119.27
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L	0.75				302.9
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L	1.2				23700
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L					

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L	7.3				925.94
7440-42-8	BORON	MG/KG	UG/L		5.3			0.5
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L	2.1				539.78
75-25-2	BROMOFORM	UG/KG	UG/L	2.4				15900
74-83-9	BROMOMETHANE	UG/KG	UG/L	1.2				235.16
7440-43-9	CADMIUM	MG/KG	UG/L		0.19	1.6	5	29
7440-70-2	CALCIUM	MG/KG	UG/L		2497	1448	7197	
86-74-8	CARBAZOLE	UG/KG	UG/L	3.6				
75-15-0	CARBON DISULFIDE	UG/KG	UG/L	2				94.12
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L	2.7				1000000
57-74-9	CHLORDANE	UG/KG	UG/L	6.3				224
108-90-7	CHLOROBENZENE	UG/KG	UG/L	2.9				40000
75-00-3	CHLOROETHANE	UG/KG	UG/L	1.4				
67-66-3	CHLOROFORM	UG/KG	UG/L	1.9				1190
74-87-3	CHLOROMETHANE	UG/KG	UG/L	0.91				10400
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L		25.2	17.2	10	5
218-01-9	CHRYSENE	UG/KG	UG/L	5.7				4730
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L	1.9				787.3
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L	2				397.86
7440-48-4	COBALT	MG/KG	UG/L		21.7	9.1	50	20
7440-50-8	COPPER	MG/KG	UG/L		11.3	16.8	10	31
57-12-5	CYANIDE	MG/KG	MG/L		0.41			0.9
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	4.1				9940
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L	6.7				18400
132-64-9	DIBENZOFURAN	UG/KG	UG/L	4.2				
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L	2.2				2050
60-57-1	DIELDRIN	UG/KG	UG/L	5.4				2.38
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L	2.5				100000

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L	1.6				200000
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L	4.6				200000
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L	8.1				709000
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L	3.7				35.78
72-20-8	ENDRIN	UG/KG	UG/L	5.1				10.1
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L	4				10.5
53494-70-5	ENDRIN KETONE	UG/KG	UG/L					
100-41-4	ETHYLBENZENE	UG/KG	UG/L	3.1				5000
206-44-0	FLUORANTHENE	UG/KG	UG/L	5.1				122000
86-73-7	FLUORENE	UG/KG	UG/L	4.2				30000
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L	3.7				5
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L	6.4				224
76-44-8	HEPTACHLOR	UG/KG	UG/L	6.3				5.98
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L	5				151.88
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L	5.9				1000000
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L	4.8				39.76
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L	5.4				10000
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L	4				596.34
2691-41-0	HMX	UG/KG	UG/L	0.26				25000
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L	6.7				109000
7439-89-6	IRON	MG/KG	UG/L		19306	20750	100	200
465-73-6	ISODRIN	UG/KG	UG/L					3.32
78-59-1	ISOPHORONE	UG/KG	UG/L	1.7				139000
7439-92-1	LEAD	MG/KG	UG/L		23.4	24	2	433
7439-95-4	MAGNESIUM	MG/KG	UG/L		1552	1909	2534	
7439-96-5	MANGANESE	MG/KG	UG/L		3640	1043	582	100
7439-97-6	MERCURY	MG/KG	UG/L		0.06	0.15	0.2	7
72-43-5	METHOXYCHLOR	UG/KG	UG/L	5.1				19.88

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L	0.28				89600
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L	1.2				443000
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L	1.3				4050
91-20-3	NAPHTHALENE	UG/KG	UG/L	3.4				249000
110-54-3	N-HEXANE	UG/KG	UG/L					
7440-02-0	NICKEL	MG/KG	UG/L		18.9	16.9	10	30
98-95-3	NITROBENZENE	UG/KG	UG/L	1.8				40000
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L			217	0.26	
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L			1.5	0.05	
55-63-0	NITROGLYCERIN	UG/KG	UG/L	1.6				
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L	1.4				543.68
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L	3.2				20000
1336-36-3	PCB (total)	UG/KG	UG/L	6				40000
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L	4.38				
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L	4.09				
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L	4.54				
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L	4.11				
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L	6.11				
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L	6.3				
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L	6.8				
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L	5.1				6000
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L	1.61				
7601-90-3	PERCHLORATE	UG/KG	UG/L					
85-01-8	PHENANTHRENE	UG/KG	UG/L	4.5				45700
108-95-2	PHENOL	UG/KG	UG/L	1.5				40000
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L			632	0.05	
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L			3.03	0.47	
88-89-1	PICRIC ACID	UG/KG						

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	log Kow	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	Direct Pathway Soil
7440-09-7	POTASSIUM	MG/KG	UG/L		625	1421	1613	
129-00-0	PYRENE	UG/KG	UG/L	5.1				78500
121-82-4	RDX	UG/KG	UG/L	0.87				100000
7782-49-2	SELENIUM	MG/KG	UG/L		2.34	0.64	2.7	1
7440-22-4	SILVER	MG/KG	UG/L		0.58	3	10	2
7440-23-5	SODIUM	MG/KG	UG/L		170	1450	3169	
100-42-5	STYRENE	UG/KG	UG/L	2.9				300000
14808-79-8	SULFATE (AS SO4)		UG/L					
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L				8	
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L	2.7				13000
479-45-8	TETRYL	UG/KG	UG/L	2				
7440-28-0	THALLIUM	MG/KG	UG/L		0.41	0.31	10	1
108-88-3	TOLUENE	UG/KG	UG/L	2.8				3000
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L					787.3
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L				71.7	
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L		31393	62778	7.5	
8001-35-2	TOXAPHENE	UG/KG	UG/L	5.5				119.27
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L	2.1				787.3
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L	2				397.86
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L	2.7				9000
7440-62-2	VANADIUM	MG/KG	UG/L		47.2	28	50	46
75-01-4	VINYL CHLORIDE	UG/KG	UG/L	1.5				646.14
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L					600
7440-66-6	ZINC	MG/KG	UG/L		51.4	57.1	20	120

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L	170	11	
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L	940	240	
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L	1063.9	940	
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L	93.78	47	
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L	106.64	25	
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L	9200	44.9	
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L	340	14	
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L	1227.56	910	
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L	1380	525	
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L	41	30	
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L	1700	50.2	
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L	5	20	
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L	350	11.2	
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L			68
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L	0.0033		
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L	1449	63	
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L	18.38	3.2	
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L	580	40	
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L	365	36.5	
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L	45.05	21.2	
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L	12.4	6.2	
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L	648.6	230	
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L	85.68	42	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L		20	
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L	3503	310	
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L	221.44	43.8	
591-78-6	2-HEXANONE	UG/KG	UG/L	132.66	99	
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L	70	417	12

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L	4.56	13	
88-74-4	2-NITROANILINE	UG/KG	UG/L	48300	23132	200
88-75-5	2-NITROPHENOL	UG/KG	UG/L	3183.91	3451	
88-72-2	2-NITROTOLUENE	UG/KG	UG/L	16800	7300	
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L	2000	105	
99-09-2	3-NITROANILINE	UG/KG	UG/L	59500	68321	200
99-08-1	3-NITROTOLUENE	UG/KG	UG/L	11900	8300	
72-54-8	4,4'-DDD	UG/KG	UG/L	4.88	0.0064	
72-55-9	4,4'-DDE	UG/KG	UG/L	3.16	10.5	
50-29-3	4,4'-DDT	UG/KG	UG/L	4.16	0.001	0.001
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L			
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L	8.38	2.3	
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L		540	
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L	1300	1.5	
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L	0.15	0.3	
106-47-8	4-CHLOROANILINE	UG/KG	UG/L	16400	2250	
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L	1374.39	46	
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L	4002.91	2251	
100-01-6	4-NITROANILINE	UG/KG	UG/L	36206.04	46418	120
100-02-7	4-NITROPHENOL	UG/KG	UG/L	41.5	82.8	
99-99-0	4-NITROTOLUENE	UG/KG	UG/L	18700	7000	
83-32-9	ACENAPHTHENE	UG/KG	UG/L	16	17	
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L	44	665	
67-64-1	ACETONE	UG/KG	UG/L	84.14	507	
309-00-2	ALDRIN	UG/KG	UG/L	2	0.3	3
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L			
0	All Dioxins/Furans	UG/KG				
0	All Explosives	UG/KG	UG/L			

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
0	All Metals	MG/KG	MG/L			
0	All Other Parameters	MG/KG	MG/L			
0	All PCBs	UG/KG	UG/L			
0	All Pesticides	UG/KG	UG/L			
0	All Polynuclear Aromatic Hydrocarbons (PAHs)					
0	All Semivolatile Organic Compounds	UG/KG	UG/L			
0	All Volatile Organic Compounds	UG/KG	UG/L			
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	6	2.2	
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L	2.9	0.056	
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L		1.09	
7429-90-5	ALUMINUM	MG/KG	UG/L	26000	87	
120-12-7	ANTHRACENE	UG/KG	UG/L	57	6	
7440-36-0	ANTIMONY	MG/KG	UG/L	3	30	
7440-38-2	ARSENIC	MG/KG	UG/L	9.79	190	190
7440-39-3	BARIUM	MG/KG	UG/L		5000	5000
71-43-2	BENZENE	UG/KG	UG/L	57	46	416
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L	108	0.027	
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L	150	0.014	
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L	27	0.0056	
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L	16	7.64	
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L	27	0.0056	
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L	11000	19	
7440-41-7	BERYLLIUM	MG/KG	UG/L		0.53	
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	5	2.2	
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L	14	0.056	
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L	1300	6400	
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L	2856	2380	
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L			

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L	750	3	
7440-42-8	BORON	MG/KG	UG/L		1000	
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L	17548.77	15215	
75-25-2	BROMOFORM	UG/KG	UG/L	1249.88	293	
74-83-9	BROMOMETHANE	UG/KG	UG/L	10477.28	67647	
7440-43-9	CADMIUM	MG/KG	UG/L	0.99	1.1	1.1
7440-70-2	CALCIUM	MG/KG	UG/L		116000	
86-74-8	CARBAZOLE	UG/KG	UG/L	3300	893	
75-15-0	CARBON DISULFIDE	UG/KG	UG/L	2	0.92	
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L	77.84	9.8	
57-74-9	CHLORDANE	UG/KG	UG/L	3.24	0.0043	
108-90-7	CHLOROBENZENE	UG/KG	UG/L	820	64	
75-00-3	CHLOROETHANE	UG/KG	UG/L	14473.34	21069	
67-66-3	CHLOROFORM	UG/KG	UG/L	70.33	28	
74-87-3	CHLOROMETHANE	UG/KG	UG/L	47762.98	67467	
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L	43.4	207	210
218-01-9	CHRYSENE	UG/KG	UG/L	166	16	
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L	1177.2	590	
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L	0.25	0.055	
7440-48-4	COBALT	MG/KG	UG/L	50	2.3	
7440-50-8	COPPER	MG/KG	UG/L	31.6	11.8	12
57-12-5	CYANIDE	MG/KG	MG/L	0.0001	0.0052	0.0052
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	30.24	2.2	
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L	33	0.0016	
132-64-9	DIBENZOFURAN	UG/KG	UG/L	2000	3.7	15
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L	30799.65	14607	
60-57-1	DIELDRIN	UG/KG	UG/L	1.9	0.056	
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L	630	210	

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L	523000	330	
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L	11000	9.4	
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L	708000	708	
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L	3	0.051	
72-20-8	ENDRIN	UG/KG	UG/L	2.22	0.036	0.033
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L	3200	0.15	0.033
53494-70-5	ENDRIN KETONE	UG/KG	UG/L			0.033
100-41-4	ETHYLBENZENE	UG/KG	UG/L	3600	7.3	17
206-44-0	FLUORANTHENE	UG/KG	UG/L	423	8.1	
86-73-7	FLUORENE	UG/KG	UG/L	77.4	3.9	
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L	2.37	0.08	
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L		1.09	
76-44-8	HEPTACHLOR	UG/KG	UG/L	10	0.0038	
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L	2.47	0.0038	
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L	100	3.68	
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L	47.7	0.93	
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L	2.99	0.07	
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L	67.99	9.8	
2691-41-0	HMX	UG/KG	UG/L	10	330	
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L	17	4.31	
7439-89-6	IRON	MG/KG	UG/L	190000	1000	1000
465-73-6	ISODRIN	UG/KG	UG/L	55.2	0.0309	
78-59-1	ISOPHORONE	UG/KG	UG/L	1146.36	1170	
7439-92-1	LEAD	MG/KG	UG/L	35.8	20.1	20
7439-95-4	MAGNESIUM	MG/KG	UG/L		82000	
7439-96-5	MANGANESE	MG/KG	UG/L	630	1000	1000
7439-97-6	MERCURY	MG/KG	UG/L	0.18	1.3	1.3
72-43-5	METHOXYCHLOR	UG/KG	UG/L	19	0.03	

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

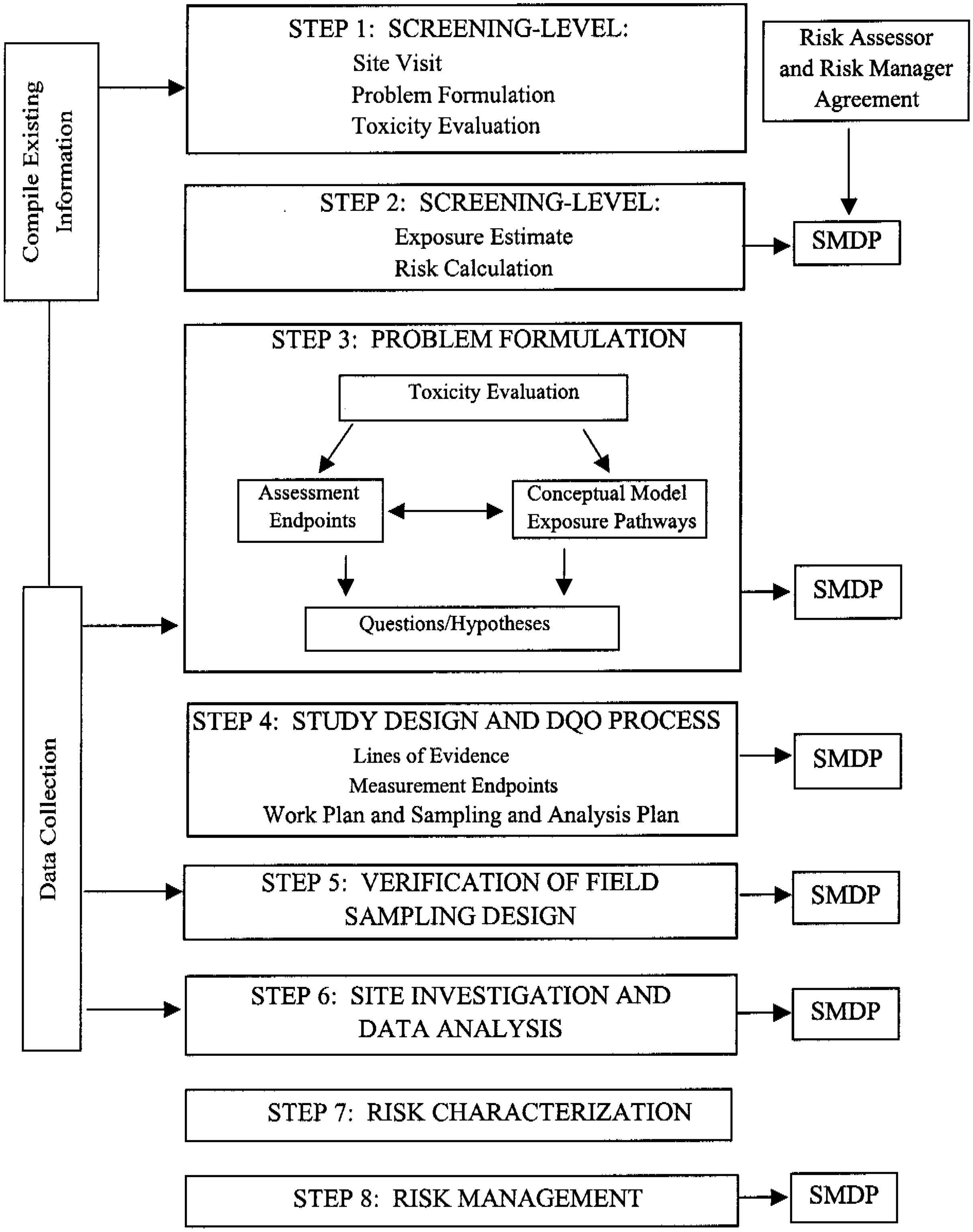
CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L	4396.09	14000	
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L	209.1	170	
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L	923.76	1930	1400
91-20-3	NAPHTHALENE	UG/KG	UG/L	176	12	68
110-54-3	N-HEXANE	UG/KG	UG/L			
7440-02-0	NICKEL	MG/KG	UG/L	22.7	1000	1000
98-95-3	NITROBENZENE	UG/KG	UG/L	585.28	270	
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L			
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L			
55-63-0	NITROGLYCERIN	UG/KG	UG/L	330	200	
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L			
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L	700	58.5	
1336-36-3	PCB (total)	UG/KG	UG/L	59.8		
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L	7	0.014	
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L	4	0.014	
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L		0.014	
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L		0.014	
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L	30	0.014	
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L	60	0.014	
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L	5	0.014	
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L	74	15	
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L	472000	85000	
7601-90-3	PERCHLORATE	UG/KG	UG/L			
85-01-8	PHENANTHRENE	UG/KG	UG/L	204	6.3	3.7
108-95-2	PHENOL	UG/KG	UG/L	48	100	
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L			
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L			
88-89-1	PICRIC ACID	UG/KG				

TABLE 3-11
SUMMARY OF ECOTOXICOLOGICAL SCREENING VALUES

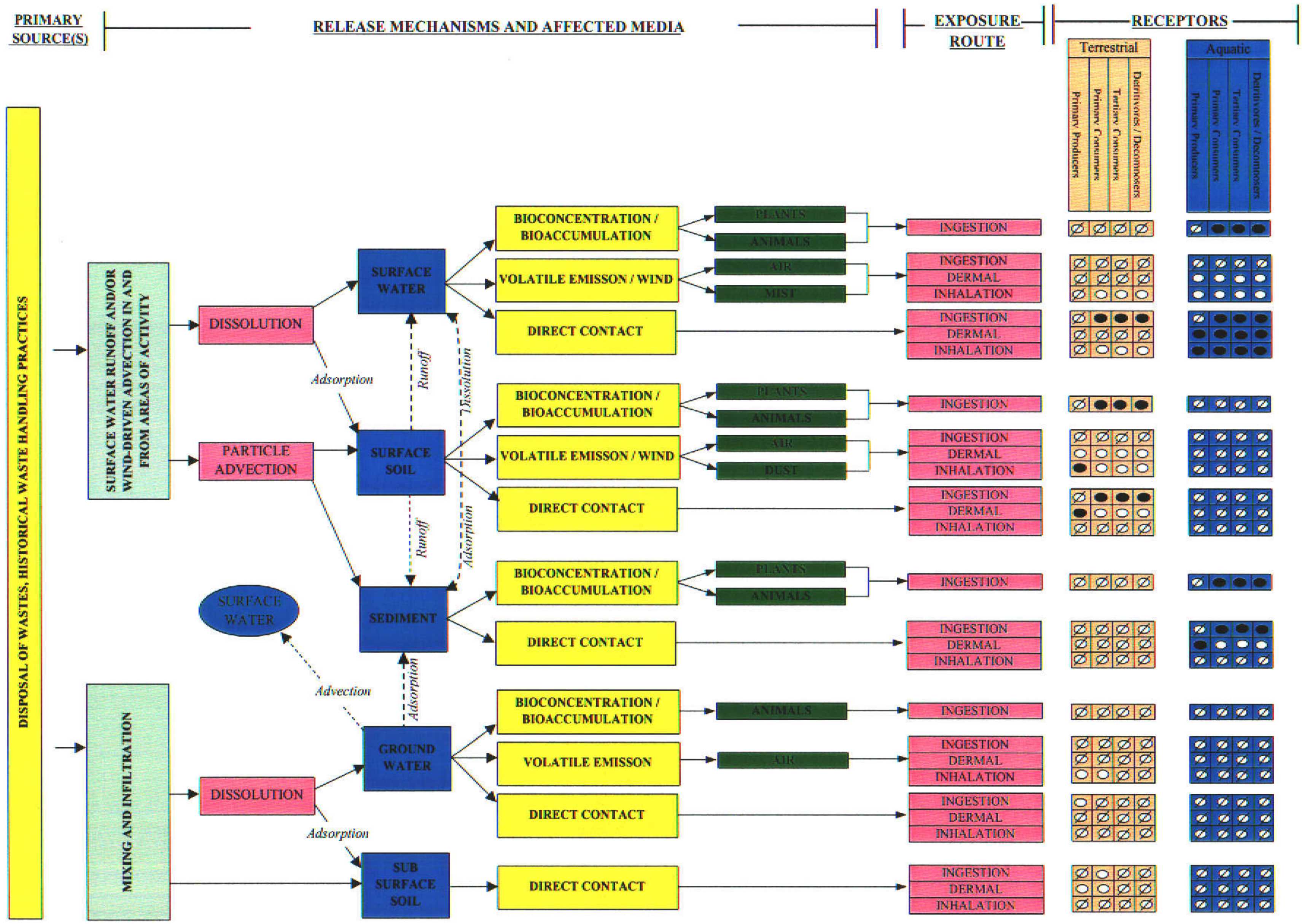
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Direct Pathway Sediment	Direct Pathway Surface Water	IEPA General Use SW Quality Aquatic Life Toxicity
7440-09-7	POTASSIUM	MG/KG	UG/L		53000	
129-00-0	PYRENE	UG/KG	UG/L	195	61	
121-82-4	RDX	UG/KG	UG/L	200	190	
7782-49-2	SELENIUM	MG/KG	UG/L		1000	1000
7440-22-4	SILVER	MG/KG	UG/L	1	5	5
7440-23-5	SODIUM	MG/KG	UG/L		680000	
100-42-5	STYRENE	UG/KG	UG/L	21596.04	4020	
14808-79-8	SULFATE (AS SO4)		UG/L			
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L			
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L	531.95	84	
479-45-8	TETRYL	UG/KG	UG/L			
7440-28-0	THALLIUM	MG/KG	UG/L		4	
108-88-3	TOLUENE	UG/KG	UG/L	670	9.8	110
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L	247.8	590	
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L			
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L			
8001-35-2	TOXAPHENE	UG/KG	UG/L	28	0.0002	
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L	1177.2	590	
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L	48.68	24.4	
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L	1600	47	
7440-62-2	VANADIUM	MG/KG	UG/L		19	
75-01-4	VINYL CHLORIDE	UG/KG	UG/L	26367.71	18242	
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L	25	1.8	120
7440-66-6	ZINC	MG/KG	UG/L	121	1000	1000

FIGURE 3-1
EIGHT-STEP ECOLOGICAL RISK ASSESSMENT PROCESS



SMDP = Scientific Management Decision Point



NOTE:
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS
DASHED LINES REPRESENT SECONDARY PATHWAYS

● Potentially Complete Pathway
○ Minor or Insignificant Pathway
∅ Incomplete Pathway

DRN BY MSG	DATE 06/12/00	CONCEPTUAL EXPOSURE MODEL ECOLOGICAL EXPOSURES ADDITIONAL AND UNCHARACTERIZED SITES OU	PROJECT NO. 2320000026.00 TASK 01011	FIG. NO. 3-2
CHK'D BY	REVISIONS: 0			

As noted in Section 1, the overall guidance for the human health evaluation will follow the structure presented in *Risk Assessment Guidance for Superfund* (RAGS) (USEPA 1989). Unlike the ecological evaluation, there are readily available published screening values for application in the human health evaluation. The evaluation will use published screening concentrations for soils from both the Illinois voluntary cleanup program (Illinois Tiered Approach to Corrective Action (TACO), 35 IAC 742) and USEPA Region IX. TACO/Region IX values are risk-based media-specific screening concentrations using a carcinogenic risk of 1×10^{-6} or a noncarcinogenic hazard quotient of 0.1. Note, however, that there are no published values for evaluating sediments. Because sediments are expected to comprise a minor portion of media applicable to the AUS OU (particularly for the human health evaluation), soil screening concentrations will be used to evaluate sediments in lieu of deriving sediment screening concentrations for all COIs. This is believed to be a conservative approach, since exposures to sediments will generally be less than those for soils. The soil screening criteria will also be used for drum samples. The soil screening level for 2,3,7,8-TCDD TEQ will be 1 ug/kg, based on USEPA policy for residential soils as presented in OSWER Directive 9200.4.-26, dated 13 April 1998.

Surface water results will be compared to Illinois surface water quality standards. Groundwater will be compared to Federal maximum contaminant levels for drinking water (MCLs), Illinois Class I Groundwater Standards, and USEPA Region IX tap water PRGs.

A summary of human health screening values is presented in Table 4-1.

The following criteria will be used in selecting COPCs:

- If a chemical is not detected, and there is no screening concentration, then the chemical will not be selected as a COPC.
- If an inorganic chemical is detected below site-specific background concentrations, then the chemical will not be selected as a COPC.
- If the maximum concentration of a chemical exceeds the screening concentration, then the chemical will be classified as a COPC.
- If the maximum concentration of a chemical is less than the screening concentration, then the chemical will not be classified as a COPC.
- If a chemical is detected, and there is no screening concentration, then the chemical will be carried forward as an uncertainty

As with the ecological risk screening approach, the screening concentrations are based on conservative assumptions to ensure that chemicals are not inadvertently screened out. COPCs and associated uncertainties will be discussed as warranting or not warranting further, more detailed evaluation as part of the SMDP following completion of the initial screening process.

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L				200
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L				
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L				5
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L				
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L				7
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L				70
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L				600
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L				5
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L				5
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L				
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L				
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L				
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L				75
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L				
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L				0.00003
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L				
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L				
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L				
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L				
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L				
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L				
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L				
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L				
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L				
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L				
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L				
591-78-6	2-HEXANONE	UG/KG	UG/L				

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L				
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L				
88-74-4	2-NITROANILINE	UG/KG	UG/L				
88-75-5	2-NITROPHENOL	UG/KG	UG/L				
88-72-2	2-NITROTOLUENE	UG/KG	UG/L				
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L				
99-09-2	3-NITROANILINE	UG/KG	UG/L				
99-08-1	3-NITROTOLUENE	UG/KG	UG/L				
72-54-8	4,4'-DDD	UG/KG	UG/L				
72-55-9	4,4'-DDE	UG/KG	UG/L				
50-29-3	4,4'-DDT	UG/KG	UG/L				
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L				
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L				
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L				
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L				
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L				
106-47-8	4-CHLOROANILINE	UG/KG	UG/L				
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L				
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L				
100-01-6	4-NITROANILINE	UG/KG	UG/L				
100-02-7	4-NITROPHENOL	UG/KG	UG/L				
99-99-0	4-NITROTOLUENE	UG/KG	UG/L				
83-32-9	ACENAPHTHENE	UG/KG	UG/L				
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L				
67-64-1	ACETONE	UG/KG	UG/L				
309-00-2	ALDRIN	UG/KG	UG/L				
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L			30.7	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
0	All Dioxins/Furans	UG/KG					
0	All Explosives	UG/KG	UG/L				
0	All Metals	MG/KG	MG/L				
0	All Other Parameters	MG/KG	MG/L				
0	All PCBs	UG/KG	UG/L				
0	All Pesticides	UG/KG	UG/L				
0	All Polynuclear Aromatic Hydrocarbons (PAHs)						
0	All Semivolatile Organic Compounds	UG/KG	UG/L				
0	All Volatile Organic Compounds	UG/KG	UG/L				
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L				
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L				
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L				2
7429-90-5	ALUMINUM	MG/KG	UG/L	28800	11241	200	
120-12-7	ANTHRACENE	UG/KG	UG/L				
7440-36-0	ANTIMONY	MG/KG	UG/L	0.83	1.9	6	6
7440-38-2	ARSENIC	MG/KG	UG/L	13.5	10.3	10	50
7440-39-3	BARIUM	MG/KG	UG/L	195	196	22.7	2000
71-43-2	BENZENE	UG/KG	UG/L				5
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L				
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L				0.2
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L				
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L				
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L				
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L				
7440-41-7	BERYLLIUM	MG/KG	UG/L	0.76	1.6	5	4
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L				
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L				

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L				
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L				
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L				
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L				
7440-42-8	BORON	MG/KG	UG/L	5.3			2000
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L				
75-25-2	BROMOFORM	UG/KG	UG/L				
74-83-9	BROMOMETHANE	UG/KG	UG/L				
7440-43-9	CADMIUM	MG/KG	UG/L	0.19	1.6	5	5
7440-70-2	CALCIUM	MG/KG	UG/L	2497	1448	7197	
86-74-8	CARBAZOLE	UG/KG	UG/L				
75-15-0	CARBON DISULFIDE	UG/KG	UG/L				
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L				5
57-74-9	CHLORDANE	UG/KG	UG/L				2
108-90-7	CHLOROBENZENE	UG/KG	UG/L				100
75-00-3	CHLOROETHANE	UG/KG	UG/L				
67-66-3	CHLOROFORM	UG/KG	UG/L				
74-87-3	CHLOROMETHANE	UG/KG	UG/L				
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L	25.2	17.2	10	100
218-01-9	CHRYSENE	UG/KG	UG/L				
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L				70
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L				
7440-48-4	COBALT	MG/KG	UG/L	21.7	9.1	50	1000
7440-50-8	COPPER	MG/KG	UG/L	11.3	16.8	10	650
57-12-5	CYANIDE	MG/KG	MG/L	0.41			0.2
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L				
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L				

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
132-64-9	DIBENZOFURAN	UG/KG	UG/L				
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L				
60-57-1	DIELDRIN	UG/KG	UG/L				
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L				
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L				
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L				
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L				
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L				
72-20-8	ENDRIN	UG/KG	UG/L				2
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L				2
53494-70-5	ENDRIN KETONE	UG/KG	UG/L				2
100-41-4	ETHYLBENZENE	UG/KG	UG/L				700
206-44-0	FLUORANTHENE	UG/KG	UG/L				
86-73-7	FLUORENE	UG/KG	UG/L				
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L				0.2
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L				2
76-44-8	HEPTACHLOR	UG/KG	UG/L				0.4
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L				0.2
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L				1
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L				
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L				50
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L				
2691-41-0	HMX	UG/KG	UG/L				
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L				
7439-89-6	IRON	MG/KG	UG/L	19306	20750	100	5000
465-73-6	ISODRIN	UG/KG	UG/L				
78-59-1	ISOPHORONE	UG/KG	UG/L				

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
7439-92-1	LEAD	MG/KG	UG/L	23.4	24	2	7.5
7439-95-4	MAGNESIUM	MG/KG	UG/L	1552	1909	2534	
7439-96-5	MANGANESE	MG/KG	UG/L	3640	1043	582	150
7439-97-6	MERCURY	MG/KG	UG/L	0.06	0.15	0.2	2
72-43-5	METHOXYCHLOR	UG/KG	UG/L				40
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L				
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L				
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L				5
91-20-3	NAPHTHALENE	UG/KG	UG/L				
110-54-3	N-HEXANE	UG/KG	UG/L				
7440-02-0	NICKEL	MG/KG	UG/L	18.9	16.9	10	100
98-95-3	NITROBENZENE	UG/KG	UG/L				
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L		217	0.26	
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L		1.5	0.05	1
55-63-0	NITROGLYCERIN	UG/KG	UG/L				
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L				
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L				
1336-36-3	PCB (total)	UG/KG	UG/L				0.5
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L				
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L				
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L				
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L				
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L				
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L				
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L				
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L				1
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L				

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
7601-90-3	PERCHLORATE	UG/KG	UG/L				
85-01-8	PHENANTHRENE	UG/KG	UG/L				
108-95-2	PHENOL	UG/KG	UG/L				100
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L		632	0.05	
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L		3.03	0.47	
88-89-1	PICRIC ACID	UG/KG					
7440-09-7	POTASSIUM	MG/KG	UG/L	625	1421	1613	
129-00-0	PYRENE	UG/KG	UG/L				
121-82-4	RDX	UG/KG	UG/L				
7782-49-2	SELENIUM	MG/KG	UG/L	2.34	0.64	2.7	50
7440-22-4	SILVER	MG/KG	UG/L	0.58	3	10	50
7440-23-5	SODIUM	MG/KG	UG/L	170	1450	3169	
100-42-5	STYRENE	UG/KG	UG/L				100
14808-79-8	SULFATE (AS SO4)		UG/L				400000
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L			8	
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L				5
479-45-8	TETRYL	UG/KG	UG/L				
7440-28-0	THALLIUM	MG/KG	UG/L	0.41	0.31	10	2
108-88-3	TOLUENE	UG/KG	UG/L				1000
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L				70
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L			71.7	1200
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L	31393	62778	7.5	
8001-35-2	TOXAPHENE	UG/KG	UG/L				3
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L				100
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L				
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L				5
7440-62-2	VANADIUM	MG/KG	UG/L	47.2	28	50	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	Background Soil UTL	Background Sediment UTL	Background Surface Water UTL	USEPA MCL or IEPA Class I GW Standard
75-01-4	VINYL CHLORIDE	UG/KG	UG/L				2
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L				10000
7440-66-6	ZINC	MG/KG	UG/L	51.4	57.1	20	5000

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L		3327877.661	
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L	898.2441398	3905507.868	0.055338246
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L	1901.545743	152174.1968	0.199513188
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L		2061342.609	
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L	118.7040165	67364.8162	0.045582836
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L		7617530.493	
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L		3320151.024	
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L	764.8111837	35207.06851	0.123142779
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L	767.7612452	21301.72047	0.164794013
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L		26427572.11	
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L		51755.44384	
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L		88091.90704	
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L	8128.692807	1921503.597	0.501760384
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L		188556.6272	
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L			
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L		88091907.04	
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L	224234.3458		6.111957631
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L	82219.11324	440459.5352	2.24105114
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L		2642757.211	
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L		17618381.41	
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L		1761838.141	
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L		1761838.141	
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L		880919.0704	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L			
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L		27284279.68	
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L		241335.0775	
591-78-6	2-HEXANONE	UG/KG	UG/L			

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L		54224141.17	
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L		44045953.52	
88-74-4	2-NITROANILINE	UG/KG	UG/L		50338.2326	
88-75-5	2-NITROPHENOL	UG/KG	UG/L		7047352.564	
88-72-2	2-NITROTOLUENE	UG/KG	UG/L			
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L	5481.274216		0.14940341
99-09-2	3-NITROANILINE	UG/KG	UG/L		50338.2326	
99-08-1	3-NITROTOLUENE	UG/KG	UG/L		2031548.307	
72-54-8	4,4'-DDD	UG/KG	UG/L	17078.42096		0.280131393
72-55-9	4,4'-DDE	UG/KG	UG/L	12055.35597		0.197739807
50-29-3	4,4'-DDT	UG/KG	UG/L	12055.35983	731932.3268	0.197739807
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L	18973.64152	616643.3493	0.517165649
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L			
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L			
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L			
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L		44045953.52	
106-47-8	4-CHLOROANILINE	UG/KG	UG/L		3523676.282	
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L			
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L		4404595.352	
100-01-6	4-NITROANILINE	UG/KG	UG/L		50338.2326	
100-02-7	4-NITROPHENOL	UG/KG	UG/L		7047352.564	
99-99-0	4-NITROTOLUENE	UG/KG	UG/L		2031548.307	
83-32-9	ACENAPHTHENE	UG/KG	UG/L		38358301.13	
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L		54224141.17	
67-64-1	ACETONE	UG/KG	UG/L		6219622.777	
309-00-2	ALDRIN	UG/KG	UG/L	145.0923851	26427.57211	0.003954796
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L			

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
0	All Dioxins/Furans	UG/KG				
0	All Explosives	UG/KG	UG/L			
0	All Metals	MG/KG	MG/L			
0	All Other Parameters	MG/KG	MG/L			
0	All PCBs	UG/KG	UG/L			
0	All Pesticides	UG/KG	UG/L			
0	All Polynuclear Aromatic Hydrocarbons (PAHs)					
0	All Semivolatile Organic Compounds	UG/KG	UG/L			
0	All Volatile Organic Compounds	UG/KG	UG/L			
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	594.4134631		0.010671672
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L		5285514.423	
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L	10699.44234	668515.7129	0.192090098
7429-90-5	ALUMINUM	MG/KG	UG/L		1676575.028	
120-12-7	ANTHRACENE	UG/KG	UG/L		389736017.6	
7440-36-0	ANTIMONY	MG/KG	UG/L		817.5986631	
7440-38-2	ARSENIC	MG/KG	UG/L	2.727184614	439.2548214	0.044821023
7440-39-3	BARIUM	MG/KG	UG/L		124517.0862	
71-43-2	BENZENE	UG/KG	UG/L	1464.611975	24234.81234	0.409975021
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L	2886.460762		0.092097992
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L	288.6460762		0.009209799
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L	2886.460762		0.092097992
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L		54224141.17	
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L	28864.60762		0.920979922
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L		176183814.1	
7440-41-7	BERYLLIUM	MG/KG	UG/L	2241.586667	3694.642785	
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	2080.447121		0.037350852
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L		5285514.423	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L			
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L	619.8940451		0.009779781
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L	8078.137483	4248956.55	0.2744299
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L	176183.8141	17618591.22	4.802252431
7440-42-8	BORON	MG/KG	UG/L		79129.82199	
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L	2357.294718	1043943.716	0.180741821
75-25-2	BROMOFORM	UG/KG	UG/L	312245.4499	17618381.41	8.510320732
74-83-9	BROMOMETHANE	UG/KG	UG/L		13137.83798	
7440-43-9	CADMIUM	MG/KG	UG/L	2988.764357	810	
7440-70-2	CALCIUM	MG/KG	UG/L			
86-74-8	CARBAZOLE	UG/KG	UG/L	123328.6699		3.361576706
75-15-0	CARBON DISULFIDE	UG/KG	UG/L		1208831.871	
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L	529.2574635	6996.64826	0.171299577
57-74-9	CHLORDANE	UG/KG	UG/L	10699.44234	668515.7129	0.192090098
108-90-7	CHLOROBENZENE	UG/KG	UG/L		542926.7506	
75-00-3	CHLOROETHANE	UG/KG	UG/L	6506.871308	18872429.89	4.637023572
67-66-3	CHLOROFORM	UG/KG	UG/L	521.0098748	1288.831391	0.164553996
74-87-3	CHLOROMETHANE	UG/KG	UG/L	2661.828435		1.510905426
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L	448.3169314		
218-01-9	CHRYSENE	UG/KG	UG/L	288646.0762		9.209799142
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L		147355.8384	
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L	177.840129	44039.79878	0.081006857
7440-48-4	COBALT	MG/KG	UG/L		122609.9262	
7440-50-8	COPPER	MG/KG	UG/L		75908.47406	
57-12-5	CYANIDE	MG/KG	MG/L		17620.37917	
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	2080.450569		0.037350852
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L	288.6460762		0.009209799

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
132-64-9	DIBENZOFURAN	UG/KG	UG/L		5062805.008	
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L	2653.770449	1592259.738	0.133404677
60-57-1	DIELDRIN	UG/KG	UG/L	154.1607111	44045.95352	0.004201971
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L		704735256.4	
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L		8809190704	
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L		88091907.04	
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L		17618381.41	
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L		5285514.423	
72-20-8	ENDRIN	UG/KG	UG/L		264275.7211	
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L		264275.7211	
53494-70-5	ENDRIN KETONE	UG/KG	UG/L		264275.7211	
100-41-4	ETHYLBENZENE	UG/KG	UG/L		5973247.268	
206-44-0	FLUORANTHENE	UG/KG	UG/L		30099724.28	
86-73-7	FLUORENE	UG/KG	UG/L		33133182.14	
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L	2880.619091	401229.0876	0.051716565
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L	10699.44234	668515.7129	0.192090098
76-44-8	HEPTACHLOR	UG/KG	UG/L	548.1266238	440459.5352	0.014940341
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L	271.0520217	11451.94792	0.007388081
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L	1541.607111	704735.2564	0.042019709
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L	31622.73586	176183.8141	0.861942747
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L	0	5896843.213	
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L	176183.8141	880919.0704	4.802252431
2691-41-0	HMX	UG/KG	UG/L		44045953.52	
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L	2886.460762		0.092097992
7439-89-6	IRON	MG/KG	UG/L		612448.8927	
465-73-6	ISODRIN	UG/KG	UG/L			
78-59-1	ISOPHORONE	UG/KG	UG/L	2596393.05	176183814.1	70.77003115

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
7439-92-1	LEAD	MG/KG	UG/L			
7439-95-4	MAGNESIUM	MG/KG	UG/L			
7439-96-5	MANGANESE	MG/KG	UG/L		32250.164	
7439-97-6	MERCURY	MG/KG	UG/L			
72-43-5	METHOXYCHLOR	UG/KG	UG/L		4404595.352	
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L		27714466.48	
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L		2886852.932	
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L	20526.14823	9775336.032	4.275631827
91-20-3	NAPHTHALENE	UG/KG	UG/L		188556.6272	
110-54-3	N-HEXANE	UG/KG	UG/L		403564.6226	
7440-02-0	NICKEL	MG/KG	UG/L		40876.65792	
98-95-3	NITROBENZENE	UG/KG	UG/L		114463.4629	
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L			
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L			
55-63-0	NITROGLYCERIN	UG/KG	UG/L	176183.8141		4.802252431
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L	352.3676282		0.009604505
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L	503382.326		13.72072111
1336-36-3	PCB (total)	UG/KG	UG/L	1004.668058		0.033615767
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L	28704.80166	50233.40291	0.96045049
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L	1004.668058		0.033615767
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L	1004.668058		0.033615767
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L	1004.668058		0.033615767
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L	1004.668058		0.033615767
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L	1004.668058	14352.40083	0.033615767
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L	1004.668058		0.033615767
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L	11090.68891	14259457.17	0.560262786
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L			

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
7601-90-3	PERCHLORATE	UG/KG	UG/L		1021997.911	
85-01-8	PHENANTHRENE	UG/KG	UG/L		54224141.17	
108-95-2	PHENOL	UG/KG	UG/L		528551442.3	
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L		40.87999666	
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L			
88-89-1	PICRIC ACID	UG/KG				
7440-09-7	POTASSIUM	MG/KG	UG/L			
129-00-0	PYRENE	UG/KG	UG/L		54224141.17	
121-82-4	RDX	UG/KG	UG/L	22423.39452	2642757.211	0.611195766
7782-49-2	SELENIUM	MG/KG	UG/L		10219.79111	
7440-22-4	SILVER	MG/KG	UG/L		10219.79111	
7440-23-5	SODIUM	MG/KG	UG/L			
100-42-5	STYRENE	UG/KG	UG/L		20440667.76	
14808-79-8	SULFATE (AS SO4)		UG/L			
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L			
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L	18666.91896	1703122.832	1.081776366
479-45-8	TETRYL	UG/KG	UG/L		8809190.704	
7440-28-0	THALLIUM	MG/KG	UG/L		143079.9591	
108-88-3	TOLUENE	UG/KG	UG/L		1987470.145	
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L		147355.8384	
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L			
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L			
8001-35-2	TOXAPHENE	UG/KG	UG/L	2242.334111		0.061119577
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L		214152.3188	
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L	177.840129	44039.79878	0.081006857
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L	6116.227568	79059.65031	1.639888244
7440-62-2	VANADIUM	MG/KG	UG/L		14307.59057	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG Industrial Soil (cancerous)	PRG Industrial Soil (non-cancerous)	PRG Tap Water (cancerous)
75-01-4	VINYL CHLORIDE	UG/KG	UG/L	48.66564823		0.019774669
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L		4453346.872	
7440-66-6	ZINC	MG/KG	UG/L		612448.8927	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L	792.248062	100	
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L	365	0.2	
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L	24.33333333	0.9	8200000
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L	811.1111111	1000	200000000
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L	54.75	3	18000000
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L	194.4392523	300	20000000
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L	370.1408451	900	180000000
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L	10.12549538	1	63000
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L	6.907526882	1	84000
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L	1094.998801		
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L	5.475		
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L	3.649999987		
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L	182.5	100	
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L	6.202940797	4000	82000000
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L			
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L	3649.986678	10000	200000000
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L		8	520000
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L	18.24999967		
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L	109.499988	50	6100000
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L	729.9994671	400	41000000
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L	72.99999467	10	4100000
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L	72.99999467	0.04	8400
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L	36.49999867	0.03	8400
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L			
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L	486.6666667		
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L	30.41666667	200	10000000
591-78-6	2-HEXANONE	UG/KG	UG/L			

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L	182.5	200000	61000000
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L	1824.996669	800	100000000
88-74-4	2-NITROANILINE	UG/KG	UG/L	2.085714281		
88-75-5	2-NITROPHENOL	UG/KG	UG/L	291.9999147		
88-72-2	2-NITROTOLUENE	UG/KG	UG/L			
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L		0.3	13000
99-09-2	3-NITROANILINE	UG/KG	UG/L	2.085714281		
99-08-1	3-NITROTOLUENE	UG/KG	UG/L	60.83333333		
72-54-8	4,4'-DDD	UG/KG	UG/L		800	24000
72-55-9	4,4'-DDE	UG/KG	UG/L		3000	17000
50-29-3	4,4'-DDT	UG/KG	UG/L	18.24999967	2000	17000
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L	25.54999935		
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L			
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L			
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L			
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L	1824.996669		
106-47-8	4-CHLOROANILINE	UG/KG	UG/L	145.9999787	30	8200000
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L			
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L	182.4999667		
100-01-6	4-NITROANILINE	UG/KG	UG/L	2.085714281		
100-02-7	4-NITROPHENOL	UG/KG	UG/L	291.9999147		
99-99-0	4-NITROTOLUENE	UG/KG	UG/L	60.83333333		
83-32-9	ACENAPHTHENE	UG/KG	UG/L	365	30000	120000000
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L	182.5	200000	61000000
67-64-1	ACETONE	UG/KG	UG/L	608.3333333	800	200000000
309-00-2	ALDRIN	UG/KG	UG/L	1.094999999	600000	300
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L			

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
0	All Dioxins/Furans	UG/KG				
0	All Explosives	UG/KG	UG/L			
0	All Metals	MG/KG	MG/L			
0	All Other Parameters	MG/KG	MG/L			
0	All PCBs	UG/KG	UG/L			
0	All Pesticides	UG/KG	UG/L			
0	All Polynuclear Aromatic Hydrocarbons (PAHs)					
0	All Semivolatile Organic Compounds	UG/KG	UG/L			
0	All Volatile Organic Compounds	UG/KG	UG/L			
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L		0.03	900
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L	218.999952		
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L	18.24999967	500	4000
7429-90-5	ALUMINUM	MG/KG	UG/L	36498.6678		
120-12-7	ANTHRACENE	UG/KG	UG/L	1825	600000	610000000
7440-36-0	ANTIMONY	MG/KG	UG/L	14.59999979	0.3	820
7440-38-2	ARSENIC	MG/KG	UG/L	10.94999988	1	3
7440-39-3	BARIUM	MG/KG	UG/L	2554.993472	80	140000
71-43-2	BENZENE	UG/KG	UG/L	11.20556553	2	200000
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L		80	8000
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L		400	800
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L		200	8000
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L	182.5	200000	61000000
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L		2000	78000
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L	7299.94671	800000	410000000
7440-41-7	BERYLLIUM	MG/KG	UG/L	72.99999467	3	1
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L		0.1	
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L	218.999952		

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L			
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L		0.02	5000
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L	243.3333333		
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L	729.9994671		410000
7440-42-8	BORON	MG/KG	UG/L	3284.989209		180000
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L	121.6666667	30	92000
75-25-2	BROMOFORM	UG/KG	UG/L	729.9994671	40	720000
74-83-9	BROMOMETHANE	UG/KG	UG/L	8.661016949	10	2900000
7440-43-9	CADMIUM	MG/KG	UG/L	18.24999967	0.4	2000
7440-70-2	CALCIUM	MG/KG	UG/L			
86-74-8	CARBAZOLE	UG/KG	UG/L		30	290000
75-15-0	CARBON DISULFIDE	UG/KG	UG/L	1042.857143	2000	200000000
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L	4.258333333	3	44000
57-74-9	CHLORDANE	UG/KG	UG/L	18.24999967	500	4000
108-90-7	CHLOROBENZENE	UG/KG	UG/L	106.0683761	70	41000000
75-00-3	CHLOROETHANE	UG/KG	UG/L	8588.235294		
67-66-3	CHLOROFORM	UG/KG	UG/L	0.626722038	30	940000
74-87-3	CHLOROMETHANE	UG/KG	UG/L			
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L		2	10000
218-01-9	CHRYSENE	UG/KG	UG/L		8000	780000
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L	60.83333333	20	20000000
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L	8.673267327		
7440-48-4	COBALT	MG/KG	UG/L	2189.995204		120000
7440-50-8	COPPER	MG/KG	UG/L	1355.712448		82000
57-12-5	CYANIDE	MG/KG	MG/L	0.729999467	2	41000
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L			
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L		80	800

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
132-64-9	DIBENZOFURAN	UG/KG	UG/L	24.33333333		
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L	121.6666667	20	41000000
60-57-1	DIELDRIN	UG/KG	UG/L	1.824999997	0.2	400
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L	29199.14738		1000000000
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L	364866.8236		
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L	3649.986678	300000	200000000
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L	729.9994671	10000000	41000000
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L	218.999952		
72-20-8	ENDRIN	UG/KG	UG/L	10.94999988	50	610000
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L	10.94999988	50	610000
53494-70-5	ENDRIN KETONE	UG/KG	UG/L	10.94999988	50	610000
100-41-4	ETHYLBENZENE	UG/KG	UG/L	1339.873418	700	200000000
206-44-0	FLUORANTHENE	UG/KG	UG/L	1459.997868	200000	82000000
86-73-7	FLUORENE	UG/KG	UG/L	243.3333333	30000	82000000
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L	10.94999988	0.5	4000
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L	18.24999967	500	4000
76-44-8	HEPTACHLOR	UG/KG	UG/L	18.24999967	1000	1000
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L	0.4745	30	600
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L	29.19999915	100	4000
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L	7.299999947	100	
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L	255.4999347	20000	14000000
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L	36.49999867	20	2000000
2691-41-0	HMX	UG/KG	UG/L	1824.996669		
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L		700	8000
7439-89-6	IRON	MG/KG	UG/L	10949.8801		
465-73-6	ISODRIN	UG/KG	UG/L			
78-59-1	ISOPHORONE	UG/KG	UG/L	7299.94671	30	410000000

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
7439-92-1	LEAD	MG/KG	UG/L			400
7439-95-4	MAGNESIUM	MG/KG	UG/L			
7439-96-5	MANGANESE	MG/KG	UG/L	875.9992326		96000
7439-97-6	MERCURY	MG/KG	UG/L			610
72-43-5	METHOXYCHLOR	UG/KG	UG/L	182.4999667	8000	10000000
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L	1904.347826		
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L	157.8378378		
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L	1622.222222	1	760000
91-20-3	NAPHTHALENE	UG/KG	UG/L	6.202940797	4000	82000000
110-54-3	N-HEXANE	UG/KG	UG/L	350.4		
7440-02-0	NICKEL	MG/KG	UG/L	729.9994671	7	41000
98-95-3	NITROBENZENE	UG/KG	UG/L	3.395348837		1000000
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L			
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L	1		1000000
55-63-0	NITROGLYCERIN	UG/KG	UG/L			
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L		0.002	800
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L		60	1200000
1336-36-3	PCB (total)	UG/KG	UG/L			1000
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L	2.554999993		
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L			
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L			
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L			
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L			
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L	0.729999999		
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L			
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L	1094.998801	1	24000
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L			

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
7601-90-3	PERCHLORATE	UG/KG	UG/L	18.24999967		
85-01-8	PHENANTHRENE	UG/KG	UG/L	182.5	200000	61000000
108-95-2	PHENOL	UG/KG	UG/L	21899.5204	5000	1000000000
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L	0.00073		
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L			
88-89-1	PICRIC ACID	UG/KG				
7440-09-7	POTASSIUM	MG/KG	UG/L			
129-00-0	PYRENE	UG/KG	UG/L	182.5	200000	61000000
121-82-4	RDX	UG/KG	UG/L	109.499988		
7782-49-2	SELENIUM	MG/KG	UG/L	182.4999667	0.3	10000
7440-22-4	SILVER	MG/KG	UG/L	182.4999667	2	10000
7440-23-5	SODIUM	MG/KG	UG/L			
100-42-5	STYRENE	UG/KG	UG/L	1641.085271	200	410000000
14808-79-8	SULFATE (AS SO4)		UG/L			
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L			
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L	253.7195122	3	110000
479-45-8	TETRYL	UG/KG	UG/L	364.9998668		
7440-28-0	THALLIUM	MG/KG	UG/L	2.554999993		160
108-88-3	TOLUENE	UG/KG	UG/L	723.4234234	600	410000000
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L	60.83333333	20	20000000
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L			
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L			
8001-35-2	TOXAPHENE	UG/KG	UG/L		2000	5200
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L	121.6666667	30	41000000
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L	8.673267327		
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L	36.5	3	520000
7440-62-2	VANADIUM	MG/KG	UG/L	255.4999347	300	14000

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	PRG TapWater (non-cancerous)	Region 9 Migration to Groundwater DAF 1	IEPA Ind/Com Soil Ingestion
75-01-4	VINYL CHLORIDE	UG/KG	UG/L		0.7	3000
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L	1431.372549	10000	1000000000
7440-66-6	ZINC	MG/KG	UG/L	10949.8801	600	610000

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L		2000
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L		
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L	8200000	20
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L	200000000	23000
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L	1800000	60
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L	2000000	5000
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L	18000000	17000
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L	1400000	20
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L	1800000	30
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L		
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L		
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L		
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L		2000
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L	8200000	84000
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L		
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L	200000000	270000
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L	11000000	200
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L		
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L	610000	1000
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L	41000000	9000
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L	410000	200
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L	180000	0.8
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L	180000	0.7
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L		
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L		
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L	10000000	4000
591-78-6	2-HEXANONE	UG/KG	UG/L		

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L	61000000	4200000
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L	100000000	15000
88-74-4	2-NITROANILINE	UG/KG	UG/L		
88-75-5	2-NITROPHENOL	UG/KG	UG/L		
88-72-2	2-NITROTOLUENE	UG/KG	UG/L		
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L	280000	7
99-09-2	3-NITROANILINE	UG/KG	UG/L		
99-08-1	3-NITROTOLUENE	UG/KG	UG/L		
72-54-8	4,4'-DDD	UG/KG	UG/L	520000	16000
72-55-9	4,4'-DDE	UG/KG	UG/L	370000	54000
50-29-3	4,4'-DDT	UG/KG	UG/L	100000	32000
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L		
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L		
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L		
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L		
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L		
106-47-8	4-CHLOROANILINE	UG/KG	UG/L	820000	700
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L		
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L		
100-01-6	4-NITROANILINE	UG/KG	UG/L		
100-02-7	4-NITROPHENOL	UG/KG	UG/L		
99-99-0	4-NITROTOLUENE	UG/KG	UG/L		
83-32-9	ACENAPHTHENE	UG/KG	UG/L	120000000	570000
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L	61000000	4200000
67-64-1	ACETONE	UG/KG	UG/L	200000000	16000
309-00-2	ALDRIN	UG/KG	UG/L	6100	500
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L		

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
0	All Dioxins/Furans	UG/KG			
0	All Explosives	UG/KG	UG/L		
0	All Metals	MG/KG	MG/L		
0	All Other Parameters	MG/KG	MG/L		
0	All PCBs	UG/KG	UG/L		
0	All Pesticides	UG/KG	UG/L		
0	All Polynuclear Aromatic Hydrocarbons (PAHs)				
0	All Semivolatile Organic Compounds	UG/KG	UG/L		
0	All Volatile Organic Compounds	UG/KG	UG/L		
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	20000	0.5
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L		
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L	12000	10000
7429-90-5	ALUMINUM	MG/KG	UG/L		
120-12-7	ANTHRACENE	UG/KG	UG/L	610000000	12000000
7440-36-0	ANTIMONY	MG/KG	UG/L	82	5
7440-38-2	ARSENIC	MG/KG	UG/L	61	28
7440-39-3	BARIUM	MG/KG	UG/L	14000	1200
71-43-2	BENZENE	UG/KG	UG/L	4300000	30
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L	170000	2000
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L	17000	8000
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L	170000	5000
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L	61000000	4200000
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L	1700000	49000
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L	410000000	930000
7440-41-7	BERYLLIUM	MG/KG	UG/L	29	6.6
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L		
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L		

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L		
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L	75000	0.4
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L		
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L	4100000	3600000
7440-42-8	BORON	MG/KG	UG/L	18000	
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L	2000000	600
75-25-2	BROMOFORM	UG/KG	UG/L	16000000	800
74-83-9	BROMOMETHANE	UG/KG	UG/L	1000000	200
7440-43-9	CADMIUM	MG/KG	UG/L	200	3.7
7440-70-2	CALCIUM	MG/KG	UG/L		
86-74-8	CARBAZOLE	UG/KG	UG/L	6200000	600
75-15-0	CARBON DISULFIDE	UG/KG	UG/L	20000000	32000
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L	410000	70
57-74-9	CHLORDANE	UG/KG	UG/L	12000	12000
108-90-7	CHLOROBENZENE	UG/KG	UG/L	4100000	1000
75-00-3	CHLOROETHANE	UG/KG	UG/L		
67-66-3	CHLOROFORM	UG/KG	UG/L	2000000	600
74-87-3	CHLOROMETHANE	UG/KG	UG/L		
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L	4100	28
218-01-9	CHRYSENE	UG/KG	UG/L	17000000	160000
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L	20000000	400
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L		
7440-48-4	COBALT	MG/KG	UG/L	12000	
7440-50-8	COPPER	MG/KG	UG/L	8200	11000
57-12-5	CYANIDE	MG/KG	MG/L	4100	40
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L		
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L	17000	2000

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
132-64-9	DIBENZOFURAN	UG/KG	UG/L		
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L	41000000	400
60-57-1	DIELDRIN	UG/KG	UG/L	7800	4
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L	1000000000	470000
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L		
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L	200000000	2300000
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L	4100000	10000000
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L		18000
72-20-8	ENDRIN	UG/KG	UG/L	61000	1000
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L	61000	1000
53494-70-5	ENDRIN KETONE	UG/KG	UG/L	61000	1000
100-41-4	ETHYLBENZENE	UG/KG	UG/L	20000000	13000
206-44-0	FLUORANTHENE	UG/KG	UG/L	82000000	4300000
86-73-7	FLUORENE	UG/KG	UG/L	82000000	560000
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L	96000	9
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L	12000	10000
76-44-8	HEPTACHLOR	UG/KG	UG/L	28000	23000
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L	2700	700
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L	78000	2000
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L		
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L	14000000	400000
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L	2000000	500
2691-41-0	HMX	UG/KG	UG/L		
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L	170000	14000
7439-89-6	IRON	MG/KG	UG/L		
465-73-6	ISODRIN	UG/KG	UG/L		
78-59-1	ISOPHORONE	UG/KG	UG/L	410000000	8000

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
7439-92-1	LEAD	MG/KG	UG/L	400	
7439-95-4	MAGNESIUM	MG/KG	UG/L		
7439-96-5	MANGANESE	MG/KG	UG/L	9600	
7439-97-6	MERCURY	MG/KG	UG/L	61	0.15
72-43-5	METHOXYCHLOR	UG/KG	UG/L	1000000	160000
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L		
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L		
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L	12000000	20
91-20-3	NAPHTHALENE	UG/KG	UG/L	8200000	84000
110-54-3	N-HEXANE	UG/KG	UG/L		
7440-02-0	NICKEL	MG/KG	UG/L	4100	76
98-95-3	NITROBENZENE	UG/KG	UG/L	1000000	100
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L		
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L	330000	10
55-63-0	NITROGLYCERIN	UG/KG	UG/L		
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L	18000	0.05
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L	25000000	1000
1336-36-3	PCB (total)	UG/KG	UG/L	1000	
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L		
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L		
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L		
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L		
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L		
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L		
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L		
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L	520000	30
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L		

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
7601-90-3	PERCHLORATE	UG/KG	UG/L		
85-01-8	PHENANTHRENE	UG/KG	UG/L	61000000	4200000
108-95-2	PHENOL	UG/KG	UG/L	120000000	100000
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L		
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L		
88-89-1	PICRIC ACID	UG/KG			
7440-09-7	POTASSIUM	MG/KG	UG/L		
129-00-0	PYRENE	UG/KG	UG/L	61000000	4200000
121-82-4	RDX	UG/KG	UG/L		
7782-49-2	SELENIUM	MG/KG	UG/L	1000	2.4
7440-22-4	SILVER	MG/KG	UG/L	1000	1.5
7440-23-5	SODIUM	MG/KG	UG/L		
100-42-5	STYRENE	UG/KG	UG/L	41000000	4000
14808-79-8	SULFATE (AS SO4)		UG/L		
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L		
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L	2400000	60
479-45-8	TETRYL	UG/KG	UG/L		
7440-28-0	THALLIUM	MG/KG	UG/L	160	2.4
108-88-3	TOLUENE	UG/KG	UG/L	410000000	12000
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L	20000000	400
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L		
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L		
8001-35-2	TOXAPHENE	UG/KG	UG/L	110000	31000
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L	41000000	700
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L		
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L	1200000	60
7440-62-2	VANADIUM	MG/KG	UG/L	1400	980

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA Construction Worker Soil Ingestion	IEPA Class I Soil Component of GW
75-01-4	VINYL CHLORIDE	UG/KG	UG/L	65000	10
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L	410000000	150000
7440-66-6	ZINC	MG/KG	UG/L	61000	3600

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
71-55-6	1,1,1-TRICHLOROETHANE	UG/KG	UG/L	
79-34-5	1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/L	
79-00-5	1,1,2-TRICHLOROETHANE	UG/KG	UG/L	
75-34-3	1,1-DICHLOROETHANE	UG/KG	UG/L	
75-35-4	1,1-DICHLOROETHENE	UG/KG	UG/L	
120-82-1	1,2,4-TRICHLOROBENZENE	UG/KG	UG/L	
95-50-1	1,2-DICHLOROBENZENE	UG/KG	UG/L	
107-06-2	1,2-DICHLOROETHANE	UG/KG	UG/L	
78-87-5	1,2-DICHLOROPROPANE	UG/KG	UG/L	
99-35-4	1,3,5-TRINITROBENZENE	UG/KG	UG/L	
541-73-1	1,3-DICHLOROBENZENE	UG/KG	UG/L	
99-65-0	1,3-DINITROBENZENE	UG/KG	UG/L	
106-46-7	1,4-DICHLOROBENZENE	UG/KG	UG/L	
90-12-0	1-METHYLNAPHTHALENE	UG/KG	UG/L	
1746-01-6	2,3,7,8-TCDD	UG/KG	UG/L	
95-95-4	2,4,5-TRICHLOROPHENOL	UG/KG	UG/L	
88-06-2	2,4,6-TRICHLOROPHENOL	UG/KG	UG/L	
118-96-7	2,4,6-TRINITROTOLUENE	UG/KG	UG/L	
120-83-2	2,4-DICHLOROPHENOL	UG/KG	UG/L	
105-67-9	2,4-DIMETHYLPHENOL	UG/KG	UG/L	
51-28-5	2,4-DINITROPHENOL	UG/KG	UG/L	
121-14-2	2,4-DINITROTOLUENE	UG/KG	UG/L	
606-20-2	2,6-DINITROTOLUENE	UG/KG	UG/L	
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	UG/KG	UG/L	
91-58-7	2-CHLORONAPHTHALENE	UG/KG	UG/L	
95-57-8	2-CHLOROPHENOL	UG/KG	UG/L	
591-78-6	2-HEXANONE	UG/KG	UG/L	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
91-57-6	2-METHYLNAPHTHALENE	UG/KG	UG/L	3500
95-48-7	2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/L	
88-74-4	2-NITROANILINE	UG/KG	UG/L	
88-75-5	2-NITROPHENOL	UG/KG	UG/L	
88-72-2	2-NITROTOLUENE	UG/KG	UG/L	
91-94-1	3,3'-DICHLOROBENZIDINE	UG/KG	UG/L	
99-09-2	3-NITROANILINE	UG/KG	UG/L	
99-08-1	3-NITROTOLUENE	UG/KG	UG/L	
72-54-8	4,4'-DDD	UG/KG	UG/L	0.00027
72-55-9	4,4'-DDE	UG/KG	UG/L	0.00019
50-29-3	4,4'-DDT	UG/KG	UG/L	0.00019
101-14-4	4,4'-METHYLENE-BIS(2-CHLOROANILINE)	UG/KG	UG/L	
534-52-1	4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/L	
19406-51-0	4-AMINO-2,6-DINITROTOLUENE	UG/KG	UG/L	
101-55-3	4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/L	
59-50-7	4-CHLORO-3-METHYLPHENOL	UG/KG	UG/L	
106-47-8	4-CHLOROANILINE	UG/KG	UG/L	
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/L	
106-44-5	4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/L	
100-01-6	4-NITROANILINE	UG/KG	UG/L	
100-02-7	4-NITROPHENOL	UG/KG	UG/L	
99-99-0	4-NITROTOLUENE	UG/KG	UG/L	
83-32-9	ACENAPHTHENE	UG/KG	UG/L	
208-96-8	ACENAPHTHYLENE	UG/KG	UG/L	3500
67-64-1	ACETONE	UG/KG	UG/L	
309-00-2	ALDRIN	UG/KG	UG/L	0.000046
ALK	ALKALINITY, TOTAL (AS CACO3)		MG/L	

TABLE 4-1
SUMMARY OF HUMAN HEALTH SCREENING VALUES

ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
0	All Dioxins/Furans	UG/KG		
0	All Explosives	UG/KG	UG/L	
0	All Metals	MG/KG	MG/L	
0	All Other Parameters	MG/KG	MG/L	
0	All PCBs	UG/KG	UG/L	
0	All Pesticides	UG/KG	UG/L	
0	All Polynuclear Aromatic Hydrocarbons (PAHs)			
0	All Semivolatile Organic Compounds	UG/KG	UG/L	
0	All Volatile Organic Compounds	UG/KG	UG/L	
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	
959-98-8	ALPHA ENDOSULFAN	UG/KG	UG/L	
5103-71-9	ALPHA-CHLORDANE	UG/KG	UG/L	0.00019
7429-90-5	ALUMINUM	MG/KG	UG/L	
120-12-7	ANTHRACENE	UG/KG	UG/L	35000
7440-36-0	ANTIMONY	MG/KG	UG/L	
7440-38-2	ARSENIC	MG/KG	UG/L	
7440-39-3	BARIUM	MG/KG	UG/L	5000
71-43-2	BENZENE	UG/KG	UG/L	21
56-55-3	BENZO(A)ANTHRACENE	UG/KG	UG/L	0.1
50-32-8	BENZO(A)PYRENE	UG/KG	UG/L	0.01
205-99-2	BENZO(B)FLUORANTHENE	UG/KG	UG/L	0.1
191-24-2	BENZO(G,H,I)PERYLENE	UG/KG	UG/L	3500
207-08-9	BENZO(K)FLUORANTHENE	UG/KG	UG/L	
85-68-7	BENZYL BUTYL PHTHALATE	UG/KG	UG/L	
7440-41-7	BERYLLIUM	MG/KG	UG/L	
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	
33213-65-9	BETA ENDOSULFAN	UG/KG	UG/L	

TABLE 4-1
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CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
111-91-1	BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/L	
111-44-4	IS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/L	
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	UG/L	
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/L	
7440-42-8	BORON	MG/KG	UG/L	1000
75-27-4	BROMODICHLOROMETHANE	UG/KG	UG/L	
75-25-2	BROMOFORM	UG/KG	UG/L	
74-83-9	BROMOMETHANE	UG/KG	UG/L	
7440-43-9	CADMIUM	MG/KG	UG/L	
7440-70-2	CALCIUM	MG/KG	UG/L	
86-74-8	CARBAZOLE	UG/KG	UG/L	
75-15-0	CARBON DISULFIDE	UG/KG	UG/L	
56-23-5	CARBON TETRACHLORIDE	UG/KG	UG/L	
57-74-9	CHLORDANE	UG/KG	UG/L	0.00019
108-90-7	CHLOROBENZENE	UG/KG	UG/L	
75-00-3	CHLOROETHANE	UG/KG	UG/L	
67-66-3	CHLOROFORM	UG/KG	UG/L	
74-87-3	CHLOROMETHANE	UG/KG	UG/L	
7440-47-3	CHROMIUM, TOTAL	MG/KG	UG/L	
218-01-9	CHRYSENE	UG/KG	UG/L	10
156-59-2	CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/L	
10061-01-5	CIS-1,3-DICHLOROPROPENE	UG/KG	UG/L	
7440-48-4	COBALT	MG/KG	UG/L	
7440-50-8	COPPER	MG/KG	UG/L	
57-12-5	CYANIDE	MG/KG	MG/L	
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/L	
53-70-3	DIBENZ(A,H)ANTHRACENE	UG/KG	UG/L	

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CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
132-64-9	DIBENZOFURAN	UG/KG	UG/L	
124-48-1	DIBROMOCHLOROMETHANE	UG/KG	UG/L	
60-57-1	DIELDRIN	UG/KG	UG/L	
84-66-2	DIETHYL PHTHALATE	UG/KG	UG/L	
131-11-3	DIMETHYL PHTHALATE	UG/KG	UG/L	
84-74-2	DI-N-BUTYL PHTHALATE	UG/KG	UG/L	
117-84-0	DI-N-OCTYLPHTHALATE	UG/KG	UG/L	
1031-07-8	ENDOSULFAN SULFATE	UG/KG	UG/L	
72-20-8	ENDRIN	UG/KG	UG/L	0.26
7421-93-4	ENDRIN ALDEHYDE	UG/KG	UG/L	0.26
53494-70-5	ENDRIN KETONE	UG/KG	UG/L	0.26
100-41-4	ETHYLBENZENE	UG/KG	UG/L	9300
206-44-0	FLUORANTHENE	UG/KG	UG/L	120
86-73-7	FLUORENE	UG/KG	UG/L	4500
58-89-9	GAMMA BHC (LINDANE)	UG/KG	UG/L	
5566-34-7	GAMMA-CHLORDANE	UG/KG	UG/L	0.00019
76-44-8	HEPTACHLOR	UG/KG	UG/L	0.000068
1024-57-3	HEPTACHLOR EPOXIDE	UG/KG	UG/L	
118-74-1	HEXACHLOROBENZENE	UG/KG	UG/L	
87-68-3	HEXACHLOROBUTADIENE	UG/KG	UG/L	
77-47-4	HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/L	
67-72-1	HEXACHLOROETHANE	UG/KG	UG/L	
2691-41-0	HMX	UG/KG	UG/L	
193-39-5	INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/L	0.1
7439-89-6	IRON	MG/KG	UG/L	1000
465-73-6	ISODRIN	UG/KG	UG/L	
78-59-1	ISOPHORONE	UG/KG	UG/L	

TABLE 4-1
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CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
7439-92-1	LEAD	MG/KG	UG/L	
7439-95-4	MAGNESIUM	MG/KG	UG/L	
7439-96-5	MANGANESE	MG/KG	UG/L	1000
7439-97-6	MERCURY	MG/KG	UG/L	0.012
72-43-5	METHOXYCHLOR	UG/KG	UG/L	
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/L	
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/L	
75-09-2	METHYLENE CHLORIDE	UG/KG	UG/L	340
91-20-3	NAPHTHALENE	UG/KG	UG/L	
110-54-3	N-HEXANE	UG/KG	UG/L	
7440-02-0	NICKEL	MG/KG	UG/L	1000
98-95-3	NITROBENZENE	UG/KG	UG/L	
7664-41-7	NITROGEN, AMMONIA (AS N)	MG/KG	MG/L	
Nitrate+Nitrite	NITROGEN, NITRATE-NITRITE	MG/KG	MG/L	
55-63-0	NITROGLYCERIN	UG/KG	UG/L	
621-64-7	N-NITROSODI-N-PROPYLAMINE	UG/KG	UG/L	
86-30-6	N-NITROSODIPHENYLAMINE	UG/KG	UG/L	
1336-36-3	PCB (total)	UG/KG	UG/L	0.000056
12674-11-2	PCB-1016 (AROCHLOR 1016)	UG/KG	UG/L	
11104-28-2	PCB-1221 (AROCHLOR 1221)	UG/KG	UG/L	
11141-16-5	PCB-1232 (AROCHLOR 1232)	UG/KG	UG/L	
53469-21-9	PCB-1242 (AROCHLOR 1242)	UG/KG	UG/L	
12672-29-6	PCB-1248 (AROCHLOR 1248)	UG/KG	UG/L	
11097-69-1	PCB-1254 (AROCHLOR 1254)	UG/KG	UG/L	
11096-82-5	PCB-1260 (AROCHLOR 1260)	UG/KG	UG/L	
87-86-5	PENTACHLOROPHENOL	UG/KG	UG/L	
78-11-5	PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/L	

TABLE 4-1
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ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
7601-90-3	PERCHLORATE	UG/KG	UG/L	
85-01-8	PHENANTHRENE	UG/KG	UG/L	3500
108-95-2	PHENOL	UG/KG	UG/L	100
7723-14-0	PHOSPHORUS, TOTAL (AS P)	MG/KG	MG/L	
Ortho P	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	MG/KG	MG/L	
88-89-1	PICRIC ACID	UG/KG		
7440-09-7	POTASSIUM	MG/KG	UG/L	
129-00-0	PYRENE	UG/KG	UG/L	3500
121-82-4	RDX	UG/KG	UG/L	
7782-49-2	SELENIUM	MG/KG	UG/L	1000
7440-22-4	SILVER	MG/KG	UG/L	5
7440-23-5	SODIUM	MG/KG	UG/L	
100-42-5	STYRENE	UG/KG	UG/L	
14808-79-8	SULFATE (AS SO4)		UG/L	500000
TSS	SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)		MG/L	
127-18-4	TETRACHLOROETHYLENE(PCE)	UG/KG	UG/L	
479-45-8	TETRYL	UG/KG	UG/L	
7440-28-0	THALLIUM	MG/KG	UG/L	
108-88-3	TOLUENE	UG/KG	UG/L	62000
540-59-0	TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/L	
TDS	TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)		MG/L	1000
TOC	TOTAL ORGANIC CARBON	MG/KG	MG/L	
8001-35-2	TOXAPHENE	UG/KG	UG/L	
156-60-5	TRANS-1,2-DICHLOROETHENE	UG/KG	UG/L	
10061-02-6	TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/L	
79-01-6	TRICHLOROETHYLENE (TCE)	UG/KG	UG/L	
7440-62-2	VANADIUM	MG/KG	UG/L	

TABLE 4-1
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ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE, WILLIAMSON COUNTY, ILLINOIS

CAS	PARNAME	Soil/Sediment Units	Water Units	IEPA General Use SW Quality Human Health
75-01-4	VINYL CHLORIDE	UG/KG	UG/L	
1330-20-7	XYLENES, TOTAL	UG/KG	UG/L	62000
7440-66-6	ZINC	MG/KG	UG/L	1000

The lead risk assessor communicates the results of the screening risk assessment to the risk managers (Step 2 of the ERAGS process). The risk managers decide whether the information available is adequate to make a risk management decision, which may require technical advice from the ecological risk assessment team or human health risk assessors to reach a decision. The decision is referred to as the Scientific/Management Decision Point (SMDP). Though the SMDP terminology has not typically been applied to the human health risk evaluation process, the approach and rationale is equally applicable in that the purpose of the screening results discussion is to aid risk managers in the decision-making process.

There are three possible decisions at this point.

- There is adequate information to conclude that risks are negligible and therefore no need for remediation on the basis of risk;
- The information is not adequate to make a decision at this point, and the risk assessment process will continue; or
- The information indicates a potential for adverse effects, and a more thorough assessment is warranted.

The SMDP made at the end of the screening-level risk calculation will not set preliminary cleanup goals. The screening process is conservative to avoid underestimating risk. Requiring a cleanup based solely on screening values would not be technically defensible.

The following are potential issues to take into consideration following development of the COPECs:

- background concentrations – If concentrations of COPECs detected in water, sediments, or soil are equal to or less than concentrations in reference areas, then no further evaluation will be recommended for those COPECs.
- the frequency and magnitude of exceedances of a screening concentration or quotient – If there are few detections of a chemical, and there is only minimal exceedance of the screening concentration, then risks may not be significant.
- location of the exceedance and the ecological relevance of specific assessment endpoints – if a chemical exceeds a screening concentration in an area where a receptor is not present (e.g., benthic invertebrates and anoxic sediments), then risk may not be significant.
- location of the exceedance and the potential for human exposure – if a chemical exceeds a human health screening concentration in an area infrequented by human receptors, then risk may not be significant.
- bioavailability of chemicals – for example, sequestration (e.g., high organic carbon) or metabolism (PAHs) of a chemical may substantially reduce exposures.
- uncertainty in the risk estimate – Several issues relate to the uncertainty in the risk assessment. It may be recommended that additional data be collected, or more detailed food chain modeling be conducted, to reduce uncertainty in order for the risk managers to make a decision. Uncertainties may also be related to reporting limits or lack of

screening concentrations. For example, if a chemical is never detected in any media, in any area, at any time, even though the reporting limit may exceed a screening concentration, then the uncertainty may not be significant. Conversely, if a chemical is routinely detected in multiple media but not detected in one media where the reporting limit exceeds the screening concentration, the associated uncertainty may be significant, and additional evaluation may be warranted.

The risk managers document both the decision and the basis for it. If the risk characterization supports the first decision (i.e., negligible risk), the risk assessment process ends here with appropriate documentation to support the decision.

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