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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: July 20, 2001

SUBJECT: Elliot Ditch/Wea Creek Sediment Site Preliminary Ecological Risk Assessment

FROM: David Brauner, Ecologist

TO: Jan Pels

I have performed a Screening Level (preliminary) Ecological Risk Assessment (SLERA) for the above mentioned site. The SLERA is based on information gathered during a Preliminary Assessment/Site Investigation conducted on November 17, 18, and 19, 1999. Personnel present and sampling techniques are presented in the Indiana Department of Environment Management Integrated Assessment Report (U.S. EPA ID: INSFN0507954) for this site. The focus of this SLERA is to determine which chemical contaminants that may pose risk to the ecological communities present at the site.

1. *Preliminary Problem Formulation*

The preliminary problem formulation describes the scope of the SLERA. The information is presented in the following sections: environmental setting; identification of contaminants of potential ecological concern (COPECs); toxicity profiles; descriptions of ecotoxicity associated with contaminants at the site and likely categories of ecological receptors; and complete pathways. (See Appendix A for a list of acronyms used in this report.)

1.1 Environmental Setting

This site is located in Lafayette, Indiana. Elliot Ditch/Wea Creek runs through several urban and rural residential areas, with some residential properties lying within the floodplain of Elliot Ditch/Wea Creek. The presence of elevated levels of Polychlorinated Biphenyls (PCBs) in fish tissues has initated a Group 5 Fish Advisory for fish from this waterway.

PCBs may have entered the streams from nearby industries, including ALCOA, Inc. ALCOA has undertaken actions to alleviate the PCB contamination, in soils, catch basins, equipment, and sediments. However, there may be other sources of contamination, including outfalls from other facilities: Fairfield Gear, Rostone, Rea Magnet, and Staley.

U. S. EPA and IDEM personnel conducted a site inspection on November 17 to 19, 1999. The inspection included the collection of twenty soil samples, seven surface water/outfall samples, and seventy-nine sediment samples. The sample location maps, descriptions of most of the sampling locations, analytical results, and QA/QC information is presented in the inspection report. The following endangered species were identified: molluscs: *Cyprogenia stegaria, Obovaria retusa, Pleurobema plenum, P. pyramidatum, Quadrula c. cylindrica,* fish: *Etheostoma camurum.*

1.2.1 Identification of Contaminants of Potential Ecological Concern (COPECs)

Results of the chemical analysis of the samples collected during the inspection were reviewed. COPECs were selected based on concentrations determined from on-site samples versus generic ecological screening benchmarks. If the maximum concentration of a sample exceeded the benchmark/TRV (thus resulting in a Hazard Quotient of at least one), then the contaminant was considered to be a Contaminant of Potential Ecological Concern (COPEC).

A Hazard Quotient is the ratio between the measured concentration and the selected screening benchmark or TRV. A result of one or greater suggests the possibility of ecological risk.

I attempted to chose a single screening benchmark for calculations of HQs. The ARCS NEC benchmarks were chosen preferentially over the Region 4 benchmarks because the former uses no-effects concentrations for the sensitive species *Hyalella azteca* and *Chironomus riparius*. If the ARCS NEC benchmarks were not available for a particular contaminant, then I chose U.S.EPA Region 4's benchmarks over other sources. Region 4's benchmarks tended to be highly protective of species and were relatively conservative. If Region 4 benchmarks were not available, I chose benchmarks according to the following priorities (See Appendix B for references and more information on the benchmarks):

1. Chronic values were used when available.
2. More inclusive benchmarks (Canadian Water Quality Guidelines or the Dutch Target levels) over species-specific (LCV Daphnids) or more locally-derived benchmarks (Washington NEL)
3. Freshwater over marine
4. U. S. EPA Region 5's ESLs were generally chosen only if other benchmarks were not available as they were developed as detection limit numbers, not effect numbers.

These are the benchmarks used for the different categories of chemicals:

5. *Polychlorinated Biphenyls (PCBs):*
   a. Surface water: USEPA Region 4;
   b. Soil: No benchmarks available;
   c. Sediments: Ontario Low;
6. *Pesticides:*
   a. Surface water: EPA Region 4 Chronic; NWQC - CCC (Freshwater);
   b. Soils: EPA Region 4, Dutch Target, EPA Region 5 ESLs
   c. Sediments: EPA Region 4; Ontario Low, EPA Region 5 ESLs
7. *Inorganics:*
   a. Surface water: EPA Region 4 Chronic; Canadian Water Quality Guidelines; LCV Daphnids; or EPA Region 5 ESLs
   b. Soils: EPA Region 4; Dutch Target;
   c. Sediments: ARCS NEC; EPA Region 4; Ontario low; EPA Region 6 (Freshwater); EPA Region 6 (Marine);
8. *Other organics:*
   a. Surface water: EPA Region 4 Chronic, Canadian Water Quality Guidelines, EEC WQO; EPA Region 5 ESLs;
   b. Soils EPA Region 4 or EPA Region 5 ESLs;
   c. Sediments; ARCS NEC, EPA Region 4; EEC WQO; Washington NEL; EPA Region 5 ESLs.

See section 2.0 for a discussion of which chemical contaminants should be retained as COPECs for further investigation.

1.3 **Toxicity Profiles**

Presented below is a brief discussion of the general fate and transport processes associated with selected groups of COPECs present at this site.

1.3.1 **INORGANICS**

Heavy metals and other inorganic compounds are naturally-occurring in the environment, and in some cases are essential nutrients (i.e., calcium, magnesium, potassium, and sodium). Inorganics tend to adsorb strongly to clays, muds, humic, and organic materials. However, inorganics are very mobile in the environment. Depending upon the pH, hardness, salinity, oxidation state of the element, soil saturation, and other factors, inorganics are readily soluble.

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1.3.1.1 *Aluminum*

Toxicity information about aluminum is generally lacking. Fish tend to be more sensitive to aluminum toxicity than aquatic invertebrates (Sparling et al. 1997). Aluminum can cause pulmonary and development problems.

1.3.1.2 *Arsenic*

Arsenic has been shown in plants to cause inhibitition of light activation, wilting, chlorosis, browning, dehydration, and mortality (Eisler 1988a). It can cause mortality in soil microbiota and earthworms. There have been shown to be carcinogenic and mutagenic effects in aquatic organisms, with effects including behavioral impairments, growth reduction, appetite loss, and metabolic failure. Bottom feeders are more susceptible to arsenic. Avian tolerance to arsenic varies, but effects include destruction of gut blood vessels, hepatocyte damage, muscular incoordination, debility, slowness, jerkiness, falling, hyperactivity, fluffed feathers, drooped eyelids, immobility, seizures, and systemic, growth, behavioral, and reproductive problems (Stanley et al. 1994; Whitworth et al. 1991; Camardese et al. 1990). Arsenic is a carcinogen, teratogen, and possible mutagen in mammals (ATSDR 1993). Chronic exposure can result in fatigue, gastrointestinal distress, anemia, neuropathy, and skin lesions that can develop into skin cancer in mammals.

1.3.1.3 *Barium*

Elevated levels of barium can induce a wide range of effects in mammals including gastrointestinal distress, muscular paralysis, and cardiovascular effects. Barium is not bioaccumulated and concentrations in higher species rarely exceed 10 mg/kg (Moore 1991).

1.3.1.4 *Cadmium*

Cadmium is highly toxic to wildlife and is carcinogenic and teratogenic and potentially mutagenic, with severe sublethal and lethal effects at low environmental concentrations (Eisler 1985a). It is associated with increased mortality, and effects on respiratory functions, enzyme levels, muscule contractions, growth reduction, and reproduction. It is a bioaccumlant at all levels. It accumulates in the livers and kidneys of fish (Sindayigaya, et al. 1994; Sadiq 1992). Crustaceans appear to be more sensitive to cadmium than fish and molluscs (Sadiq 1992). Cadmium can be toxic to plants at lower soil concentrations than other heavy metals and is more readily taken up than other metals (EPA 1981). On the other hand, some insects can accumulate high levels of cadmium without adverse effects (Jamil and Hussain 1992).

1.3.1.5 *Calcium*

Calcium is an essential nutrient.

1.3.1.6 *Chromium*

There is no significant biomagnification by chromium in aquatic food webs (ATSDR, 1993). However, there are a wide range of adverse effects in aquatic organisms. In benthic invertebrates there has been observed reduced fecundity and survival, growth inhibition, and abnormal movement patterns (EPA 1980). Fish experienced reduced growth, chromosomal aberrations, reduced disease resistance, and morphological changes.

1.3.1.7 *Copper*

Copper is highly toxic in aquatic environments and has effects in fish, invertebrates, and amphibians (EPA 1992; Horne and Dunson 1995). Copper is highly toxic to amphibians, with adverse effects in tadpoles and embryoes, and mortality and sodium loss (Horne and Dunson 1995; Owen 1981). Copper will bioconcentrate in many different organs in fish and molluscs (Owen 1981). Toxic effects in birds include reduced growth rates, lowered egg production, and developmental abnormalities (Owen 1981). Toxicity in mammals includes a wide range of animals

and effects such as liver cirrhosis, necrosis in kidneys and the brain, gastrointestinal distress, lesions, and low blood pressure.

1.3.1.8 *Iron*

Information on the toxicity effects of iron is very limited.

1.3.1.9 *Lead*

Lead is carcinogenic, and adversely effects reproduction, liver and thyroid function, disease resistance (Eisler 1988b). It can be bioconcentrated from water, but does not bioaccumulate and tends to decrease with increasing trophic levels in freshwater habitats (Wong et al. 1978; Eisler 1988b). However, there are limited observed adverse effects in amphibians, including loss of sodium, reduced learning capability, and developmental problems (Horne and Dunson 1995; Freda 1991). Fish exposed to high levels of lead exhibit a wide-range of effects including muscular and neurological degeneration and destruction, growth inhibition, mortalitiy, reproductive problems, and paralysis (Eisler 1988b; EPA 1976). At elevated levels lead can cause reduced growth, photosynthesis, mitosis, and water absorption (Eisler 1988b). Birds and mammals suffer effects from lead poisoning such as damage to the nervous system, kidneys, liver, sterility, growth inhibition, developmental retardation, and detrimental effects in blood (Eisler 1988b; Amdur et al. 1991).

1.3.1.10 *Magnesium*

Magnesium is an essential nutrient.

1.3.1.11 *Manganese*

Elevated levels of manganese in birds have been shown to cause the following effects: decreased hemoglobin, anemia, reduced growth; in mammals, effects include alterations of brain chemicals, gastric irritation, delayed testicular development, low birth weights, behavioral changes, and muscular weakness (ATSDR 1991).

1.3.1.12 *Mercury*

Mercury is a mutagen, teratogen, and carcinogen, with toxicity and environmental effects varying with its form, dose, and route of ingestion, and with the exposed organism's species, sex, age, and general condition (Eisler, 1978a, Fimreite 1979). There is a high potential for bioaccumulation and biomagnification with mercury, with biomagnified concentrations reported in fish up to 100,000 times the ambient water concentrations (Eisler 1978a, Callahan et al. 1979).

In invertebrates, effects range from non-observable to chromosomal abnormalities in some flies and reduced segment regeneration in worms (Eisler 1987a). Mercury can inhibit frog metamorphosis and many effects in fish. Those effects include loss of appetite, brain lesions, cataracts, abnormal motor coordination, and behavioral changes (MacDonald 1993). There are also effects on reproduction, growth, behavior, metabolism, blood chemistry, osmoregulation, and oxygen exchange at relatively low concentrations of mercury (Eisler 1987a). There are similar effects in birds, including delayed testicular development, altered mating behavior, reduced fertility, reduced survivability and growth in young, and gonadal atresia. In mammals, it has been shown that mercury can cause ataxia, aphagia, tremors, and diminished movement coordination (ATSDR 1994). There are varied neurological and reproductive effects as well (Cagiano et al. 1990; Khera et al. 1973).

1.3.1.13 *Nickel*

Observed effects of nickel (a carcinogen and mutagen) in aquatic environments include tissue damage, genotoxicity, and growth reduction (Environment Canada 1994a). Molluscs and crustaceans are more sensitive than other organisms.

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1.3.1.14 *Potassium*

This is an essential nutrient.

1.3.1.15 *Selenium*

Selenium undergoes bioconcentration, bioaccumulation, and biomagnification as trophic levels increase (Taylor et al., 1992). It can enter the food web through both sediments and surface water. Elevated levels cause growth reduction in green algae (Eisler 1985b). In other aquatic organisms, the following adverse effects have been observed: loss of equilibrium and other neurological disorders, liver damage, reproductive failure, reduced growth, reduced movement rate, chromosomal aberrations, reduced hemoglobin and increased white blood cell, and necrosis of the ovaries.

1.3.1.16 *Silver*

Silver may biomagnify in some aquatic invertebrates (Adriano 1986). However, it is highly toxic to aquatic organisms (EPA 1992). Elevated concentrations can cause larval mortality, developmental abnormalities, and reduced larval growth in fish (Klein-MacPhee et al. 1984); growth reduction in juvenile mussels (Calabrese et al. 1984); and adverse effects on reproduction in gastropods (Nelson et al. 1983). There are some indications of toxicity in plants. However, there are other reports suggesting that silver is not highly phytotoxic. Silver is toxic to soil microbes, thus precluding biotransformation (ATSDR 1990b). Effects on mammals include pulmonary edema, congestion, and mortality.

1.3.1.17 *Sodium*

This is an essential nutrient.

1.3.1.18 *Thallium*

Low rates of bioconcentration may occur in aquatic systems and thallium may be as toxic as copper on a weight basis (Zitko et al. 1975). Thallium can cause reductions in larval fish growth and percent embryo hatchability and mortality (LeBlanc and Dean 1984).

1.3.1.19 *Zinc*

In many types of aquatic organisms, the following can be advsersely affected by elevated zinc levels: growth, survival, and reproduction (Eisler 1993). Zinc in aquatic systems tends to be partitioned into sediment and less frequently dissolved as hydrated zinc ions and organic and inorganic complexes (MacDonald 1993). Zinc is toxic to plants at elevated levels, causing adverse effects on growth, survival, and reproduction (Eisler 1993). Terrestrial invertebrates show sensitivity to elevated zinc levels, with reduced survival, growth, and reproduction. Elevated zinc levels can cause mortality, pancreatic degredation, reduced growth, and decreased weight gain in birds (Eisler 1993; NAS 1980); and they can cause a wide range of problems in mammals including: cardiovascular, developmental, immunological, hepatic, renal, neurological, hematological, pancreatic, and reproductive (Eisler 1993; Domingo 1994).

1.3.2. **POLYCHLORINATED BIPHENYLS *(PCBs)***

PCBs are mutagenic, carcinogenic, and teratogenic. They are readily absorbed through the gut, respiratory system, and skin in mammals and will concentrate in the liver, blood, muscle, adipose tissue, and skin (Eisler 1986). Mutagenic activity tends to decrease with increasing chlorination (USEPA 1980).

In general, in aquatic systems, increased toxicity is associated with increasing exposure, younger developmental stages, crustaceans, and lower chlorinated biphenyls (Eisler 1986). An increase in somatic mutations have been

observed in ostrich ferns (*Matteuccia struthiopteris*).

Toxic effects in avian species included the following: morbidity, tremors, upward pointing beaks, muscular incoordination, and hemorrhagic areas in the liver (Eisler 1986). Other sublethal effects include delayed reproduction and chromosomal aberrations in Ringed Turtle-doves; courtship and nestbuilding behavioral impairments in Mourning Doves; reduced hatchability in chicken eggs; and decline in sperm concentration in American Kestrels. However, birds tend to more resistant to acute exposure than other groups: no adverse reproductive effects were observed in Screech Owls fed 3 ppm PCB diets or in Japanese Quail, Northern Bobwhites, and Mallard Ducks.

Mink are very sensitive to PCBs, with concentrations as low as 0.1 mg/kg fresh weight diet producing an LD-50 in 3 months and complete reproductive inhibition among the survivors (Eisler 1986). Other effects include anorexia, weight loss, and lethargy. On the other hand, compared to mink, the European ferret is highly resistant to PCBs. Rhesus monkeys are extremely sensitive to PCBs, with an increase in stillborns and abortions, lowered birth rates, hyperpigmentation, skin eruptions, eye problems, and altered behavioral patterns.

There are a number of effects observed in aquatic organisms due to exposure to PCBs (Eisler 1986). They include growth reduction in algae and brook trout; reduced egg survival and reduced fertilization success in flounder, minnows, sea urchins (prior to fertilization, eggs were more resistant to PCBs at insemination and afterwards); and complete reproductive failure in brook trout. Carcinogenic and biochemical perturbations were observed in trout liver cells and marine teleosts; with anemia, hyperglycemia, and altered cholesterol metabolism in brown trout fed diets with 10 ppm PCBs (USEPA 1980).

1.3.3. **PESTICIDES**

DDE is bioavailable to soil invertebrates and plants and has been shown to bioaccumulate in some grains (Verma and Pillai 1991). It is also very persistent in aquatic systems, absorbing strongly to sediments, and bioconcentrating in aquatic organisms, including fish and other organisms (HSDB 1997). DDE tends to bioconcentrate in lower-trophic levels and will accumulate in food webs. DDT is toxic to many types of aquatic organisms, even at low concentrations.

Heptachlor and gamma-BHC are both highly toxic to aquatic invertebrates (EPA 1980). However, although fish are less susceptible to heptachlor than invertebrates, gamma-BHC is highly toxic to fishes as well. Birds show a wide range of susceptibility to pesticides: dieldrin (less toxic than in aquatic organisms); heptachlor (moderately to highly toxic); gamma-BHC (slightly to moderately toxic); DDT (slightly to non-toxic). However, DDT causes eggshell thinning and embryo mortality, especially in predatory birds. There is also courtship behavior changes and other reproductive impairments (EXOTOXNET 1996).

1.3.4. **POLYCYCLIC AROMATIC HYDROCARBONS (*PAHs*)**

PAHs are highly potent carcinogens that can produce tumors in some organisms at even single doses; but other non-carcinogenic effects are not well understood (Eisler 1987b). Their effects are wide-ranging within an organism and have been found in many types of organisms, including non-human mammals, birds, invertebrates, plants, amphibians, fish, and humans. However, their effects are varied and so generalizations cannot be readily made. However, it has been shown that the fungus *Cunninghamella elegans* can inhibit the mutagenic properties of various PAHs, including: benzo(a)pyrene and benzo(a)anthracene. Effects on benthic invertebrates include inhibited reproduction, delayed emergence, sediment avoidance, and mortality. Fish exposed to PAH contamination have exhibited fin erosion, liver abnormalities, cataracts, and immune system impairments leading to increased susceptibility to disease (Fabacher et al. 1991; Weeks and Warinner 1984; 1986; O'Conner and Huggett 1988).

Mammals can absorb PAHs by inhalation, dermal contact, or (more poorly) ingestion (Eisler 1987b). Plants can absorb PAHs from soils through their roots, and translocated them to other plant parts such as developing shoots. Uptake rates are generally governed by PAH concentration, PAH water solubility, soil type, and PAH

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physicochemical state (vapor or particulate). Lower molecular weight PAHs are absorbed more readily than higher molecular weight PAHs. PAH-induced phytotoxic effects are rare, howerver the database on this is limited. Some higher plants can catabolize PAHs, but this metabolic pathway is not well defined. Certain plants contain substances that can protect against PAH effects, inactivating their carcinogenic and mutagenic potential. Additionally, PAHs synthesized by plants may act as growth hormones.

In aquatic systems, PAHs tend towards increased toxicity with increased molecular weight (Eisler 1987b). In addition, although the rate of uptake from the environment is variable among species, bioaccumulation tends to be rapid.

2.0 ***Summary of benchmark screenings***

See Table 1 (Appendix C) for a summary of COPECs that should be retained for further investigation. An X indicates that the chemical should be retained, either because the maximum concentrations exceeded the respective screening level or as an uncertainty (see footnotes). Tables 2 to 14 contain the results of the benchmark screenings.

3.0 ***Potential Exposure Pathways:***

This section is a description of possible complete exposures pathways: ones in which a chemical can be traced from the source to a receptor that may be affected by the chemical. As site-specific information is not available on what species are present at the site, these exposure pathways and the associated conceptual site model are a generalized/hypothetical portrayal (see Figures 1 and 2).

3.1 *Aquatic systems*

- Aquatic macrophytes (non-microscropic plants): uptake from sediment and surface water;
- Benthic organisms: ingestion and incidental contact of sediments; ingestion of and contact with surface water;
- Fish: incidental contact of sediments; bioaccumulation from prey; ingestion of and contact with surface water;
- Piscivorus (fish-eating) birds/mammals: incidental contact of sediments; bioaccumulation from prey; ingestion and contact with surface water.

3.2 *Terrestrial systems*

- Plants: uptake from soil;
- Invertebrates: incidental contact and ingestion of soil; bioaccumulation from plants;
- Small rodents: incidental contact of soil; bioaccumulation from plants/prey;
- Top predators: incidental contact of soil; bioaccumulation from prey.

3.3 *Potential Receptors*

- Benthic invertebrates
- Earthworms
- Fish
- Piscivorus birds (e.g., Great Blue Heron, Kingfisher)
- Piscivorus mammals (e.g., mink)
- Small mammals (e.g., shrew, prairie vole, meadow vole, deer mouse)
- Passerine (perching/song-birds) birds (e.g., American Robin)
- Aquatic birds (e.g., Mallard Ducks)
- Aquatic macrophytes
- Terrestrial plants

3.4. **Wildlife Exposure**

Additional comparisons were made against established Wildlife Exposure Factors. The maximum concentration for each COPEC was compared against exposure screening levels for various groups of organisms or specific species: aquatic plants, daphnids (water fleas), minnows, rainbow trout, benthic (bottom-dwelling) invertebrates, terrestrial plants, and earthworms. If the maximum concentration exceeded the screening benchmark, that indicates potential toxic effects (generally mortality) for that receptor. The results of these comparisions are presented in Tables 1, 5, 9, and 13. Note that although the specific species found at Elliot Ditch/Wea Creek (save for the endangered species listed above) are not known, these additional screenings are representative of species that are typically found in habitats such as those found at this site.

3.5. **Assessment Endpoints**

The following are potential assessment endpoints:

- Survival and diversity in benthic and terrestrial invertebrates;
- Survival, reproduction, and diversity in fishes;
- Survival, reproduction, and diversity in piscivorus birds;
- Survival, reproduction, and diversity in aquatic birds;
- Survival, reproduction, and diversity in piscivorus mammals;
- Survival, reproduction, and diversity in carnivorous birds.

4.0 ***Uncertainties***

Uncertainty arises from several sources in the SLERA process. First, there is the application of generic benchmarks to a given habitat with site-specific chemical, physical, and biological conditions. The benchmarks are designed to be conservative, however, to protect sensitive species.

The likelihood of the postulated exposures actually occurring on this site is another source of uncertainty. The exposure pathways identified are all plausible, but the presence of appropriate, site-specific receptors and the frequencies of occurrence of the exposures are unknown. The exposures vary with behavior and life cycle requirements of each potentially-exposed organism and the various exposure pathways may or may not be present depending on the specific species actually present at the site.

Basic uncertainties underlying the preliminary toxicity assessment include those arising from the design, execution, or relevance of the scientific studies upon which the toxicity benchmarks are based. There are also uncertainties involved in extrapolation from the underlying scientific studies to the exposure situation being evaluated, including variable responses to chemical exposure between animal species, and between the chemical and physical differences in the habitats evaluated. These uncertainties could result in toxicity estimates that are either overconservative or underconservative regarding the true toxicity of the chemical in the habitat under consideration.

Another uncertainty arises as a result of the laboratory analysis. In some cases, the maximum detection limit for a particular chemical was greater than the maximum detected concentration; this is because the analytical machines are not calibrated below the DL, hence the accuracy of the result is uncertain. These maximum concentrations were qualified with a "J" qualifier (i.e., estimated concentration). In the results tables the maximum detection limit was given, but the maximum concentration was used to calculate the HQ.

For undetected COPECs, one-half of the maximum detection limit was used to calculate the HQ. In some instances, these calculations resulted in HQs exceeding one. However, these particular COPECs were not retained for further investigation as they are probably not driving risk at the site, but are a source of uncertainty. Undetected COPECs without screening benchmarks are not retained for further investigation or as uncertainties.

Another related, but potentially minor, source of uncertainty was that in the case of duplicate samples from a single location, only the highest concentration of each chemical was used in the risk analysis. The lower values were ignored.

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Finally, because there was no sediment or soil depth data available for almost all of the samples, it was assumed that the depth for all samples was zero (0). This assumption is reasonable for the following reasons. One, benthic invertebrates tend to most active in the uppermost sediment layers; and two, the data that were available suggest that most samples were taken from soil or sediment depths of 0-6" or 0-12" (see the IDEM Integrated Assessment Report for this site).

The uncertainties tend to err in the conservative direction and provide a reasonable estimate of the maximum risk posed to a given receptor from site-specific contamination.

5.0 ***Conclusions and Recommendations***

Based on the information presented in this assessment, the conditions at the Elliot Ditch/Wea Creek site may pose risk to benthic invertebrates, terrestrial invertebrates, and aquatic invertebrates, as well as possibly to organisms in higher trophic levels. Additional evaluation may be warranted to further refine the potential risk to ecological receptors. Further studies should include the following:

- an evaluation of the presence of threatened or endangered species in the areas potentially effected by the site;
- an evaluation of the actual existence of postulated exposure pathways, which should include a more detailed habitat/vegetation survey and surveys of benthic, aquatic, and terrestrial organisms (both vertebrates and invertebrates);
- a chemical analysis of benthic, aquatic, and terrestrial invertebrates;
- additional analytical tests including site-specific toxicity testing, especially for invertebrates and fishes, to help determine levels and extent of bioaccumulation in the various ecosystems/habitats found at the site;
- tissue residue analyses for potential ecological receptors.

* * *

I may be contacted at 6-1526 if you have questions or comments. Please fill out the attached evaluation form and return it to Larry Schmitt, SR-6J. The information is used to assess and improve our services.

cc: Larry Schmitt, Section Chief, RRS #1

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Appendix A. List of Acronyms

ARCS NEC	Assessment and Remediation of Contaminated Sediments: No-Effects Concentration
COPEC	Contaminant of Potential Ecological Concern
EEC WQO	European Economic Community Water Quality Objectives
ESL	Environmental Screening Level
IDEM	Indiana Department of Environmental Management
LCV	Lethal Concentration Value
NEL	No-Effects Level
NWQC - CCC	National Ambient Water Quality Criteria - Criteria Continuous Concentration
PAH	Polycyclical Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
SLERA	Screening Level Ecological Risk Assessment
TRV	Toxicity Reference Value
WQG	Water Quality Guidelines

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Appendix B. Benchmark Sources

B.0.

Please note, these are the references for the various benchmarks. However, the values were taken from the software "Spatial Analysis and Decision Assistance"(http://www.sis.utk.edu/sada/), a package that "incorporates tools from environmental assessment fields into an effective problem solving environment. These tools include integrated modules for visualization, geospatial analysis, statistical analysis, human health risk assessment, cost/benefit analysis, sampling design, and decision analysis." (SADA website).

B.1. ***Descriptions of selected benchmark sources:***

B.1.1. **USEPA Region 4:**The Region 4 *surface water* screening values were obtained from Water Quality Criteria documents and represent the chronic ambient water quality criteria values for the protection of aquatic life. They are intended to protect 95% of the species, 95% of the time. For *sediments*, these are the higher of two values, the EPA Contract Laboratory Program Practical Quantitation Limit and the Effects Value, which is the lower of the ER-L and the TEL. These are possible effects benchmarks.

B.1.2. **Dutch Target**: Target Values for soil are related to negligible risk for ecosystems. This is assumed to be 1% of the Maximal Permissible Risk (MPR) level for ecosystems, where MPR is the concentration expected to be hazardous for 5% of the species in the ecosystem, or the 95% protection level. For metals, background concentrations are taken into account in arriving at a value.

B.1.3. **NWQC - CCC:** USEPA National Recommended Water Quality Criteria - Chronic; CCC: Criterion Continuous Concentration, chronic exposure limits; freshwater values were used.

B.1.4. **ARCS NEC:** U.S. EPA Assessment and Remediation of Contaminated Sediments Program.No-effects criteriB. The representative effect concentration selected from among the high no-effect-concentrations for Hyalella azteca and Chironomus riparius are presented in EPA (1996) based on the ranking method presented in Jones et al. (1997). The majority of the data are for freshwater sediments. These are no effects benchmarks.

B.1.5. **USEPA Region 5 ESLs:** RCRA values derived from the Environmental Data Quality Levels.

B.1.6. **Washington NEL:** A concentration above which toxic effects occurred at sites in Puget Sound. These are no-effects benchmarks.

B.2. *PCBs:*

B.2.1. **USEPA Region 4** (Surface Water): USEPA 1995. Supplemental Guidance to RAGS: Region 4 Bulletins No. 2. Ecological Risk Assessment. Region IV, Waste Management Division. Office of Health Assessment. Values presented are as updated Aug. 1999. (http://www.epB.gov/region4/wastepgs/oftecser/epatab4.pdf)

B.2.2. **Ontario Low** (Sediments): Persaud, D., R. Jaagumagi, and B. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment and Energy. August. ISBN 0-7729-9248-7. (http://www.ene.gov.on.ca/envision/gp/B1-3.pdf)

B.3. *Pesticides:*

B.3.1. **USEPA Region 4** (Soil, Sediment, Surface Water): USEPB. 1995. Supplemental Guidance to RAGS: Region 4 Bulletins No. 2. Ecological Risk Assessment. Region IV, Waste Management Division. Office of Health Assessment. Values presented are as updated Aug. 1999. (http://www.epB.gov/region4/wastepgs/oftecser/ecolbul.htm)

B.3.2. **Dutch Target** (Soil): Swartjes, F.B. 1999. Risk-based Assessment of Soil and Groundwater Quality in the Netherlands: Standards and Remediation Urgency. Risk Analysis 19(6): 1235-1249

B.3.3. **Ontario Low** (Sediment):

B.3.4. **NWQC - CCC** (Surface Water): USEPA. 1999. National Recommended Water Quality Criteria. EPA 822-Z-99-001.

B.3.5. **USEPA Region 5 ESLs** (Soil, Sediment): (Ecological Screening Levels). USEPA. 1999. http://www.epa.gov/Region5/rcraca/edql.htm

B.4. *Inorganics:*

B.4.1. **ARCS NEC** (Sediments): USEPA 1996. Calculation and evaluation of sediment effect concentrations for

the amphipod Hyalella azteca and the midge Chironomus riparius. EPA 905/R96/008. Great Lakes National Program Office, Chicago, IL. (http://www.cerc.usgs.gov/clearinghouse/data/brdcerc0004.html) *and* Jones, D.S. , G.W. Suter II, and R.N. Hull 1997. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Sediment-Associated Biota: 1997 Revision. ES/ER/TM-95/R3. Oak Ridge National Laboratory, Oak Ridge, Tennessee. (http://www.hsrd.ornl.gov/ecorisk/tm95r4.pdf)

B.4.2. **Dutch Target** (Soil):

B.4.3. **USEPA Region 4** (Soil, Surface Water, Sediments):

B.4.4. **Canadian WQG** (Surface Water): Canadian Council of Ministers of the Environment. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life. (http://www.ec.gc.ca/ceqg-rcqe/water.pdf)

B.4.5. **LCV Daphnids** (Surface Water): Suter, G. W. II, and C. L. Tsao. 1996. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 104pp, ES/ER/TM-96/R2 (http://www.esd.ornl.gov/programs/ecorisk/tm96r2.pdf)

B.4.6. **USEPA Region 6 - Freshwater** (Sediments): ***no reference available***

B.4.7. **USEPA Region 6 - Marine** (Sediments): ***no reference available***

B.4.8. **USEPA Region 5 ESLs** (Surface Water):

B.5. *Organics:*

B.5.1 **ARCS NEC** (Sediments):

B.5.2. **USEPA Region 4** (Soil, Sediments, Surface Water):

B.5.3. **Canadian WQG** (Surface Water):

B.5.4. **USEPA Region 5 ESLs** (Ecological Screening Levels) (Soil, Surface Water, Sediments):

B.5.5. **Washington NEL** (Sediments)**:** ***no reference available***

B.5.6. **EEC WQO** (European Water Quality Objectives) (Surface Water): EEC. 1994. EEC Water Quality Objectives for Chemicals Dangerous to Aquatic Environments (List 1). *Reviews of Environmental Contamination and Toxicology.* 137:83-110

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Appendix C. Summary of COPECs Retained

Table 1. Chemicals Retained as COPECs, Listed by Medium and Wildlife Exposure

Table 1a. Pesticides

Chemical	Surface Water (Table 2)	Soil (Table 3)	Sediment (Table 4)	Daphnids (Table 5)	Fathead minnows (Table 5)	Rainbow Trout (Table 5)	Benthic Invertebrates (Table 5)
4,4-DDD							X
4,4-DDE			X				X3
4,4-DDT	X	X	X	X	X		
Aldrin	X	X	X	X3			
beta-BHC		X					
gamma-BHC (Lindane)	X		X				
alpha-Chlordane	1	X3	X3				
gamma-Chlordane	1	X3	X3				
Dieldrin	X	X	X		X	X	X
Endosulfan I	2		X				X3
Endosulfan II	2	X	X				X3
Endosulfan sulfate		X	X				X
Endrin	X		X	X	X	X	X
Endrin aldehyde							X
Endrin ketone		X3	X3				X
Heptachlor	X		X		X	X	
Heptachlor epoxide			X				X
PCB Aroclor-1248 (Table 14)	X4	X3	X		X4		X

X - Maximum concentration exceeds screening benchmark.
1 The benchmark for Chlordane was used for these two COPECs.
2 The benchmark for alpha-Endosulfan was used for Endosulfan I; the benchmark for beta-Endosulfan was used for Endosulfan II.
X3 No benchmarks available for this compound.
X4 All of the surface water samples were non-detect for Aroclor-1248. However, 0.5 of the detection limit was greater than the generic screening benchmark as well as the Fathead Minnow benchmark. This COPEC was retained because of the concern over the presence of PCBs at the site.

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Table 1b. Inorganics

Chemical	Surface Water (Table 6)	Soil (Table 7)	Sediment (Table 8)	Aquatic Plants (Table 9)	Daphnids (Table 9)	Fathead minn. (Tab. 9)	Rainbow trout (Table 9)	Benth. Inverts. (Tab. 9)	Terr. Plants (Tab. 9)	Earthworms (Table 9)
Aluminum	X		X						X	X3
Antimony									X	X3
Arsenic								X		
Barium			X			X3		X	X	X3
Beryllium		X3						X3	X	X3
Cadmium	X			X	X			X	X	
Calcium		X1	X1	X1	X	X1	X	X1		X1
Chromium			X						X	X
Cobalt								X3		X3
Copper	X		X	X	X		X	X		X
Iron	X	X	X	X3		X	X	X3	X3	X3
Lead		X	X					X	X	X
Manganese		X	X	X3				X	X	X3
Magnesium		X1	X1	X1		X1	X1	X1	X	X1
Mercury	X2		X					X3		X
Nickel		X		X	X			X		
Potassium		X1	X1	X1		X1	X1	X1	X1	X1
Selenium		X						X	X	
Silver	X	X	X			X	X		X	X3
Sodium		X	X1	X1		X1	X1	X1	X1	X1
Thallium		X3						X3		X3
Vanadium			X					X3	X	X3
Zinc	X		X	X	X	X	X	X	X	X

X1 There are no TRVs for this essential nutrient.
X2 Not detected, but the one-half of the reporting limit exceeds the screening benchmark. Mercury should be retained because of its potential as a bioaccumulator.
X3 There are no benchmarks for this COPEC.

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Table 1c. Other Organics

Chemical	Surface Water (Table 10)	Soil (Table 11)	Sediment (Table 12)	Daphnids (Table 13)	Fathead minnows (Table 13)	Rainbow trout (Table 13)	Benthic Invertebrates (Table 13)
2-Chlorophenol	X		X	X1		X1	
3-Methyl-4-chlorophenol	X		X	X1			
2-Methylnaphthalene			X				X
4-Nitrophenol	X		X				X
2,4-Dinitrotoluene			X	X1		X1	X
Acenaphthene	X		X		X		
Anthracene		X	X	X	X		X
Benzaldehyde		X	X1				
Benz(a)anthracene		X	X	X	X		X
Benzo(a)pyrene		X	X	X			X
Benzo(b)fluoranthene			X				X
Benzo(g,h,i)perylene			X	X			X1
Benzo(k)fluoranthene			X	X			X
Bis(2-ethylhexyl)phthalate	X		X		X		
Butylbenzylphthalate		X					
Carbazole		X1	X1				X1
Chrysene		X	X	X			X
Dibenzofuran	X	X1	X				
Dibenz(a,h)anthracene			X	X	X1	X1	X
Dibutylphthalate			X				
Di-n-octylbutylphthalate					X1		
Fluoranthene	X	X	X				
Fluorene	X		X				X
Indeno(1,2,3-cd)pyrene			X				X
Naphthalene			X				
N-Nitrosodiphenylamine	X		X				
Pentachlorophenol		X	X				
Phenanthrene		X	X		X		
Phenol			X			X	X
Pyrene	X	X	X	X	X		X1

X1- No benchmarks available for this compound.

References for Tables 5, 9, 13:

ECOTOX Database. http://www.epa.gov/ecotox/

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

Jones, D.S., G.W. Suter II, and R.N. Hull. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge TN. 34 pp, ES/ER/TM-95/R4

Sample, B.E., G.W. Suter,II, M.B. Shaeffer, D.S. Jones, R.A. Efroymson. 1997. Ecotoxicological Profiles for Selected Metals and Other Inorganic Chemicals. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-210

Suter, G. W. II, and C. L. Tsao. 1996. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 104pp, ES/ER/TM-96/R2

USEPA. 1999. Toxicity Reference Values. Screening Level Ecological Risk Assessment Protocol. Appendix E. (http://www.epa.gov/hwcmact/eco-risk/volume3/appx-e.pdf)

Table 2. Screening Results for Pesticides (Surface Water)

Analyte	Screening Benchmark	Maximum Conc. (mg/L SW)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
4,4-DDD	6.4E-006	0.0001	U	15.625	3	0	USEPA Region 4 - Chronic
4,4-DDE	0.011	0.0001	U	0.009	6	0	USEPA Region 4 - Chronic
4,4-DDT	1.0E-006	0.003		***3000***	6	3	USEPA Region 4 - Chronic
Aldrin	3.0E-004	0.00152		***5.067***	6	3	USEPA Region 4 - Chronic
alpha-Chlordane	0.0043	0.00005	U	0.012	6	0	NWQC - CCC (Chlordane)
gamma-Chlordane	0.0043	0.00005	U	0.012	6	0	NWQC - CCC (Chlordane)
BHC, alpha	0.5	0.00005	U	0.0001	6	0	USEPA Region 4 - Chronic
BHC, beta	5	0.00005	U	0.00001	2	0	USEPA Region 4 - Chronic
BHC, gamma- (Lindane)	8.0E-005	0.00154		***19.250***	6	3	USEPA Region 4 - Chronic
Dieldrin	1.9E-006	0.0034		***1789.474***	6	3	USEPA Region 4 - Chronic
Endosulfan I	0.056	0.00005	U	0.001	6	0	NWQC - CCC (a-Endosulfan)
Endosulfan II	0.056	0.0001	U	0.002	6	0	NWQC - CCC (b-Endosulfan)
Endosulfan sulfate		0.0011	U		6	0	No Benchmark Available
Endrin	2.3E-006	0.0038		***1652.174***	6	3	USEPA Region 4 - Chronic
Endrin aldehyde		0.0001	U		3	0	No Benchmark Available
Endrin ketone		0.0001	U		3	0	No Benchmark Available
Heptachlor	3.8E-006	0.00142		***373.684***	6	3	USEPA Region 4 - Chronic
Heptachlor epoxide		0.00005	U		6	0	No Benchmark Available

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

Key: U - not detected; Note: the value for undetected contaminants in all tables is one-half of the maximum detection limit.

1 See Appendix A for list of benchmark sources used in these calculations.

Table 3. Screening Results for Pesticides (Soils)

Analyte	Screening Benchmark	Maximum Detection Limit (DL) (mg/L SW)	Maximum Conc. (mg/kg soil)1	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
4,4-DDD	0.7582	n.a.	0.026		0.034	9	1	USEPA Region 5 ESL
4,4-DDE	0.5959	n.a.	0.152		0.255	19	7	USEPA Region 5 ESL
4,4-DDT	0.0175	n.a.	0.062	J	***3.543***	19	4	USEPA Region 5 ESL
Aldrin	0.0025	n.a.	0.022	J	***8.8***	19	3	USEPA Region 4
alpha-Chlordane		n.a.	0.24			19	7	No Benchmark Available
gamma-Chlordane		n.a.	0.186			19	7	No Benchmark Available
BHC, alpha	0.0025	0.02	0.01	U	4	19	0	USEPA Region 4
BHC, beta	0.001	n.a.	0.0148	J	***14.8***	6	2	USEPA Region 4
BHC, gamma- (Lindane)	0.00005	0.02	0.01	U	200	19	0	USEPA Region 4
Dieldrin	0.0005	n.a.	0.194		***388***	19	6	USEPA Region 4
Endosulfan I	0.1193	0.038	0.019	J	0.159	19	1	USEPA Region 5 ESL
Endosulfan II	0.1193	n.a.	0.22	J	***1.844***	19	2	USEPA Region 5 ESL
Endosulfan sulfate	0.0358	0.11	0.0108	J	0.302	19	2	USEPA Region 5 ESL
Endrin	0.001	0.038	0.019	U	19	19	0	USEPA Region 4

Endrin aldehyde	0.0105	0.038	0.019	U	1.810	8	0	USEPA Region 5 ESL
Endrin ketone	[redacted]	0.019	0.0094	J	[redacted]	8	1	No Benchmark Available
Heptachlor	0.006	0.02	0.01	U	1.667	19	0	USEPA Region 5 ESL
Heptachlor epoxide	0.1519	n.a.	0.04	J	0.263	19	4	USEPA Region 5 ESL

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 For some chemicals, the maximum detected concentration was less than the maximum non-detected value. To calculate the HQ, the maximum detected concentration was used. See section 4.0 Uncertainties for further discussion.

2 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 4. Screening Results for Pesticides (sediments)

Analyte	Screening Benchmark	Maximum Detection Limit (mg/kg soil)	Maximum Conc. (mg/kg sediments)1	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source2
4,4-DDD	0.0033	0.25	0.125	U	37.88	36	0	USEPA Region 4
4,4-DDE	0.0033	n.a	0.3	J	***90.91***	46	19	USEPA Region 4
4,4-DDT	0.0033	0.125	0.104	J	***31.52***	46	4	USEPA Region 4
Aldrin	0.002	0.065	0.126	J	***63***	46	23	Ontario Low
alpha-Chlordane	[redacted]	n.a.	0.066	J	[redacted]	46	5	No Benchmark Available
gamma-Chlordane	[redacted]	n.a.	0.58	J	[redacted]	46	8	No Benchmark Available
BHC, alpha	0.006	0.13	0.065	U	10.833	46	0	Ontario Low
BHC, beta	0.005	0.0054	0.0027	U	0.54	17	0	Ontario Low
BHC, gamma- (Lindane)	0.0033	0.125	0.024	J	***7.273***	46	8	USEPA Region 4
Dieldrin	0.0033	n.a.	0.114	J	***34.545***	46	2	USEPA Region 4
Endosulfan I	0.0002	0.28	0.036	J	***180***	46	2	USEPA Region 5 ESL
Endosulfan II	0.0001	n.a.	0.56	J	***5600***	46	6	USEPA Region 5 ESL
Endosulfan sulfate	0.0346	n.a.	0.044		***1.272***	46	1	USEPA Region 5 ESL
Endrin	0.0033	n.a.	0.07		***21.212***	31	3	USEPA Region 4
Endrin aldehyde	3.2	0.125	0.009	J	0.002813	27	1	USEPA Region 5 ESL
Endrin ketone	[redacted]	0.065	0.015	J	[redacted]	46	5	No Benchmark Available
Heptachlor	0.0003	n.a.	0.03		***100***	46	18	Ontario Low
Heptachlor epoxide	0.005	n.a.	0.118		***23.6***	46	5	Ontario Low

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 For some chemicals, the maximum detected concentration was less than the maximum non-detected value. To calculate the HQ, the maximum detected concentration was used. See section 4.0 Uncertainties for further discussion.

2 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 5. Wildlife Exposure Screening Results for Pesticides

Analyte	Maximum Conc. (mg/L SW)	Qualifier	Maximum Conc. Soil	Qualifier	Maximum Conc. Sediments	Qualifier	Daphnids (Daphnia spp.) (a)	Endpoint	HQ for Daphnia	Fathead minnow (Pimephales promelas) (b)
4,4-DDD	0.00010	U	0.026		0.125	U	0.003	LC50/CH	0.031	0.002
4,4-DDE	0.00010	U	0.152		0.300	J	n.a.		Z	
4,4-DDT	0.00300		0.062	J	0.104	J	0.000	CV	***187.500***	0.001
Aldrin	0.00152		0.022	J	0.126	J	n.a.		X	0.008

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alpha-Chlordane	0.00005	U	0.240		0.066	J	0.016	CV	0.00313	0.002
gamma-Chlordane	0.00005	U	0.186		0.580	J	0.016	CV	0.00313	0.002
BHC, alpha	0.00005	U	0.010	U	0.065	U	0.800		0.00006	0.095
BHC, beta	0.00005	U	0.015	J	0.003	U	0.800		0.00006	0.095
BHC, gamma- (Lindane)	0.00154		0.010	U	0.024	J	0.015	CV	0.106	0.015
Dieldrin	0.00340		0.194		0.114	J	0.080	LC50/AC	0.043	0.003
Endosulfan I	0.00005	U	0.019	U	0.036	J	n.a.		Z	0.002
Endosulfan II	0.00010	U	0.220	J	0.560	J	0.177	LC50/AC	0.001	0.002
Endosulfan sulfate	0.00110	U	0.011	J	0.044		0.623	LC50/AC	0.002	n.a.
Endrin	0.00380		0.019	U	0.070		0.001	LC50/AC	***2.923***	0.002
Endrin aldehyde	0.00010	U	0.019	U	0.009	J	n.a.		Z	n.a.
Endrin ketone	0.00010	U	0.009	J	0.015	J	n.a.		Z	n.a.
Heptachlor	0.00142		0.010	U	0.030		0.003	CV	0.447	0.001
Heptachlor epoxide	0.00005	U	0.040	J	0.118		0.120	LC50/AC	0.000	n.a.
PCB Aroclor-1248	0.00100		3.300	U	11.000		0.003	CV	0.400	0.000

Key: U - Undetected; J - estimated value; X - detected, but no benchmark available; Z - not detected and no benchmark available; CV - Chronic Value; CH - Chronic;

(a) Suter & Tsao 1996 - BHC (Lindane); Chlordane, DDT, Heptachlor; **ECOTOX Database**: Dieldrin, Endrin, Endosulfan sulfate, Endosulfan II, Heptachlor epoxide

(b) Suter & Tsao 1996 - DDD, DDT, Chlordane (all), BHC (all), Endosulfan, Heptachlor; ECOTOX Database: Aldrin, Dieldrin

(c) Suter & Tsao 1996: Chlordane (all); ECOTOX Database - DDT, **DDE, Aldrin, g-BHC** (Lindane), Dieldrin, Heptachlor epoxide

(d) Jones 1997 - all but DDE (EPA 1999)

Table 6. Screening Results for Inorganics (surface water)

Analyte	Screening Benchmark	Maximum Concentration (mg/L SW)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
Aluminum	0.087	0.093		***1.069***	6	6	USEPA Region 4
Antimony	0.16	0.0033	J	0.0206	6	3	USEPA Region 4
Arsenic	0.19	0.0038		0.02	6	6	USEPA Region 4
Barium	5	0.198		0.04	6	6	USEPA Region 5 ESL
Beryllium	0.0005	0.00005	U	0.1	6	0	USEPA Region 4
Cadmium	0.001	0.0035		***3.5***	6	1	USEPA Region 4
Calcium	116	108		0.931	6	6	LCV Daphnids
Chromium III	0.178	0.00058	J	0.003	6	2	USEPA Region 4
Cobalt	0.0051	0.0015	J	0.294	6	5	LCV Daphnids
Copper	0.0114	0.317	J	***27.807***	6	6	USEPA Region 4
Iron	1	1.31		***1.31***	6	5	USEPA Region 4
Lead	0.0025	0.002	J	0.8	6	2	USEPA Region 4
Magnesium	82	36.1		0.44	6	6	LCV Daphnids
Manganese	1.1	0.0922		0.084	6	6	LCV Daphnids
Mercury	1.00E-005	0.00005	U	***4.902***	6	0	USEPA Region 4
Nickel	0.1572	0.0069	J	0.044	6	6	USEPA Region 4
Potassium	53	10.2		0.192	6	6	LCV Daphnids
Selenium	0.005	0.0018	U	0.36	6	0	USEPA Region 4
Silver	0.0001	0.0011	J	***11***	6	4	Canadian WQG
Sodium	680	109		0.16	6	6	LCV Daphnids
Thallium	0.004	0.00105	U	0.263	6	0	USEPA Region 4
Vanadium	1.9	0.00073		0.00038	6	2	LCV Daphnids
Zinc	0.1045	0.218	J	***2.086***	6	6	USEPA Region 4

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 7. Screening Results for Inorganics (soil)

Analyte	Screening Benchmark	Maximum Concentration (mg/kg soil)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
Aluminum	50	12,400.00		***248.00***	20	20	USEPA Region 4
Antimony	3.5	0.78	J	0.22	20	2	USEPA Region 4
Arsenic	10	7.9		0.79	20	20	USEPA Region 4
Barium	165	210		***1.27***	20	20	USEPA Region 4
Beryllium	1.1	0.6		0.55	20	20	USEPA Region 4
Cadmium	1.6	1.3		0.81	20	6	USEPA Region 4
Calcium		66,500.00	J		20	20	No Benchmark Available
Chromium III	0.4	31.3	J	***78.25***	20	20	USEPA Region 4
Cobalt	20	8.6		0.43	20	20	USEPA Region 4
Copper	40	93.2	J	***2.33***	20	20	USEPA Region 4
Iron	200	18,000.00		***90.00***	20	20	USEPA Region 4
Lead	50	227	J	***4.54***	20	20	USEPA Region 4
Magnesium		19,800.00	J		20	20	No Benchmark Available
Manganese	100	821		***8.21***	20	20	USEPA Region 4
Mercury	0.1	0.19		***1.90***	20	2	USEPA Region 4
Nickel	30	19.7		0.66	20	20	USEPA Region 4
Potassium		2,200.00			20	20	No Benchmark Available
Selenium	0.81	0.62		0.77	20	3	USEPA Region 4
Silver	2	28.4		***14.20***	20	18	USEPA Region 4
Sodium		199			20	6	No Benchmark Available
Thallium	1	0.29	U	0.29	20	0	USEPA Region 4
Vanadium	2	24.8		***12.40***	20	20	USEPA Region 4
Zinc	50	261		***5.22***	20	20	USEPA Region 4

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 8. Screening Results for Inorganics (sediments)

Analyte	Screening Benchmark	Maximum Concentration (mg/kg soil)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
Aluminum	73200	7650	J	0.105	45	45	ARCS NEC
Antimony	12	1.6	J	0.133	45	6	USEPA Region 4
Arsenic	92.9	12.1		0.13	45	44	ARCS NEC
Barium	48000	942	J	0.0196	45	45	USEPA Region 6 - MARINE
Beryllium		0.44			45	44	No Benchmarks Available
Cadmium	41.1	0.7	J	0.017	45	12	ARCS NEC
Calcium		119000			45	45	No Benchmarks Available
Chromium III	312	13.8	J	0.0442	45	45	ARCS NEC
Cobalt	10000	22.1		0.00221	45	45	USEPA Region 6 - Freshwater
Copper	54.8	52.3	J	0.954	45	45	ARCS NEC
Iron	20000	36100	J	***1.805***	45	45	USEPA Region 6 - Freshwater
Lead	68.7	126		***1.834***	45	45	ARCS NEC

Manganese	819	834	J	*1.018*	45	45	ARCS NEC
Magnesium	[redacted]	34500		[redacted]	45	45	No Benchmarks Available
Mercury	0.13	0.08	U	0.615	45	0	USEPA Region 4
Nickel	37.9	46.9	J	*1.237*	45	45	ARCS NEC
Potassium	[redacted]	1730	J	[redacted]	45	45	No Benchmarks Available
Selenium	1	1.1		*1.1*	45	8	USEPA Region 6 - MARINE
Silver	2	2		*1*	45	40	ARCS NEC
Sodium	[redacted]	157	J	[redacted]	45	23	No Benchmarks Available
Thallium	[redacted]	2.3		[redacted]	45	5	No Benchmarks Available
Vanadium	57	29	J	0.509	45	45	USEPA Region 6 - MARINE
Zinc	541	159	J	0.294	45	45	ARCS NEC

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 9. Wildlife Exposure Screening Results for Inorganics

	Maximum Conc. Soil (mg/kg)	Maximum Conc. Sediment (mg/kg)	Maximum Conc. Surface Water (mg/L)	Aquatic Plants (a)	Endpoint	HQ for aquatic plants	Water flea (Daphnia magna) (b)	Endpoint	HQ for Daphnia	Fathead minnow (Pimephales promelas) (c)
Aluminum	12,400.00	7650	0.093	0.4	LOEC/ CH	0.2325	0.74	CV	0.1256757	3.29
Antimony	0.78	1.6	0.0033	0.61	CV	0.0054	9	LOEC/AC	0.0003667	1.6
Arsenic	7.9	12.1	0.0038	0.048	LOEC	0.0792	0.914	CV	0.0041575	0.89
Barium	210	942	0.198	25	LOEC	0.0079	14.5	EC50/AC	0.0136552	
Beryllium	0.6	0.44	0.00005	100	LOEC	5E-007	0.005	CV	0.01	0.2
Cadmium	1.3	0.7	0.0035	0.002	LOEC	*1.75*	0.000233	CV	*15.021459*	0.0262
Calcium	66,500.00	119000	108			X	11.6	CV	*9.3103448*	
Chromium III	31.3	13.8	0.00058	0.4	LOEC	0.0015	0.044	CV	0.0131818	1.025
Chromium VI	31.3	13.8	0.00058	0.002	LOEC	0.29	0.0025	CV	0.232	1.98
Cobalt	8.6	22.1	0.0015	10	LOEC	0.0002	0.0051	CV	0.2941176	0.0286
Copper	93.2	52.3	0.317	0.001	LOEC	*317*	0.0115	CV	*27.565217*	0.0183
Iron	18,000.00	36100	1.31			X	158	CV	0.0082911	1.3
Lead	227	126	0.002	0.5	CV	0.004	0.01226	CV	0.1631321	0.01888
Magnesium	19,800.00	34500	36.1			X	82	CV	0.4402439	2610
Manganese	821	834	0.0922			X	1.1	CV	0.0838182	1.78
Mercury	0.19	0.08	0.00005	0.005	CV	0.01	0.00096	CV	0.0520833	0.00023
Nickel	19.7	46.9	0.0069	0.005	CV	*1.38*	0.005	CV	*1.38*	0.035
Potassium	2,200.00	1730	10.2			X	53	CV	0.1924528	
Selenium	0.62	1.1	0.0018	0.1	CV	0.018	0.09165	CV	0.0196399	0.08832
Silver	28.4	2	0.0011	0.03	CV	0.0367	0.0026	CV	0.4230769	0.00012
Sodium	199	157	109			X	680	CV	0.1602941	
Thallium	U	2.3	0.00105	0.1	CV	0.0105	0.13	CV	0.0080769	0.057
Vanadium	24.8	29	0.00073	0.03	CV	0.0243	1.9	CV	0.0003842	0.08
Zinc	261	159	0.218	0.03	CV	*7.2667*	0.04673	CV	*4.6650974*	0.03641

Key: CV - Lowest Chronic Value; LOEC - Lowest Effects Concentration; CH - Chronic; MOR - Mortality; AC - Acute; NOEC - No Effects Concentration; LETC - Lowes Reproductive effects; X - Chemical detected, but no screening number available; all values are mg/kg or mg/L; U - not detected

(a) Sample 1997: Aluminum, Antimony, Arsenic, Beryllium, Cadmium, Chromium (III & VI), Cobalt, Copper; Suter & Tsao 1996 - Lead, Mercury, Nickel, Selenium, Sil

(b) Sample 1997 - Aluminum, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium (III & VI), Cobalt, Copper; Suter & Tsao 1996 - Iron, Lead, Magnesium, Man

(c) Sample 1997 - Aluminum, Antimony, Arsenic, Beryllium, Cadmium, Chromium (III & VI), Cobalt, Copper; Suter & Tsao 1996 - Iron, Lead, Manganese, Mercury,

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(d) Sample 1997 - Aluminum, Arsenic, Barium, Cadmium, Calcium (Salmo trutta),Chromium (III & VI), Copper, Manganese (S. trutta); Suter & Tsao 1996 - Iron, Lead

(e) Sample 1997 - Antimony, Arsenic, Cadmium, Chromium (III & VI), Copper, Manganese

(f) Sample 1997 - Aluminum, Arsenic, Beryllium, Cadmium, Chromium (III & VI), Cobalt, Copper, Manganese; ECOTOX Database - others

(g) Sample 1997 - Arsenic, Cadmium, Copper; Efroymson 1997 - Lead, Nickel, Selenium, Zinc

Table 10. Screening Results for Other Organics (surface water)

Analyte	Screening Benchmark	Maximum Conc. (mg/L SW)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
2,4-Dinitrotoluene	0.31	0.182		0.587097	6	3	USEPA Region 4 - Chronic
2-Chlorophenol	0.0438	0.2		***4.56621***	6	3	USEPA Region 4 - Chronic
2-Methylnaphthalene	0.3296	0.01	U	0.03034	6	0	USEPA Region 5 ESL
3-Methyl-4-chlorophenol	0.0003	0.24		***800***	6	3	USEPA Region 4 - Chronic
4-Nitrophenol	0.0828	0.28		***3.381643***	6	3	USEPA Region 4 - Chronic
Acenaphthene	0.017	0.16		***9.411765***	6	3	USEPA Region 4 - Chronic
Anthracene	0.000012	0.01	U	833.3333	6	0	Canadian WQG
Benzaldehyde		0.01	U		6	0	No Benchmarks Available
Benz[a]anthracene	0.000018	0.01	U	555.5556	6	0	Canadian WQG
Benzo[a]pyrene	0.000015	0.01	U	666.6667	6	0	Canadian WQG
Benzo[b]fluoranthene	0.0091	0.01	U	1.098901	6	0	USEPA Region 5 ESL
Benzo(ghi)perylene	0.0076	0.01	U	1.315789	6	0	USEPA Region 5 ESL
Benzo[k]fluoranthene	0.0000056	0.01	U	1785.714	6	0	USEPA Region 5 ESL
Bis(2-ethylhexyl)phthalate (DEHP)	0.0003	0.24		***800***	6	2	USEPA Region 4 - Chronic
Carbazole		0.01	U		6	0	No Benchmarks Available
Chrysene	0.000033	0.01	U	303.0303	6	0	USEPA Region 5 ESL
Dibenz[ah]anthracene	0.0000016	0.01	U	1	6	0	USEPA Region 5 ESL
Dibenzofuran	0.02	0.02		***1***	6	2	USEPA Region 5 ESL
Dibutyl phthalate	0.0094	0.004		0.425532	6	2	USEPA Region 4 - Chronic
Di-n-octylphthalate	0.03	0.004	J	0.133333	6	1	USEPA Region 5 ESL
Fluoranthene	0.0398	0.082		***2.060302***	6	1	USEPA Region 4 - Chronic
Fluorene	0.003	0.02	J	***6.666667***	6	1	Canadian WQG
Indeno[1,2,3-cd]pyrene	0.0043	0.01	U	2.325581	6	0	USEPA Region 5 ESL
Naphthalene	0.062	0.18	U	2.903226	6	0	USEPA Region 4 - Chronic
Nitrosodiphenylamine [N-]	0.0585	0.098		***1.675214***	6	3	USEPA Region 4 - Chronic
Pentachlorophenol	1	0.32		0.32	6	4	EEC WQO
Phenanthrene	0.0004	0.01	U	25	6	0	Canadian WQG
Phenol	0.256	0.196		0.765625	6	3	USEPA Region 4 - Chronic
Pyrene	0.000025	0.116		***4640***	6	3	Canadian WQG

Italics indicates a maximum concentration that exceeds the screening limit (HQ >= 1).

1 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 11. Screening Results for Other Organics (soils)

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Analyte	Screening Benchmark	Maximum Detection Limit (DL) (mg/kg)	Maximum Conc or 0.5 Maximum DL (mg/kg soil)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source
2,4-Dinitrotoluene	1.28	3.8	1.9	U	***1.484***	19	0	USEPA Region 5 ESL
2-Chlorophenol	0.2427	3.8	1.9	U	***7.829***	5	0	USEPA Region 5 ESL
2-Methylnaphthalene	3.24	3.8	1.9	U	0.586	19	0	USEPA Region 5 ESL
3-Methyl-4-chlorophenol	7.95	9.4	4.7	U	0.591	19	0	USEPA Region 5 ESL
4-Nitrophenol	7	3.8	1.9	U	0.271	19	0	USEPA Region 4
Acenaphthene	20	3.8	1.12	J	0.056	19	4	USEPA Region 4
Anthracene	0.1	3.8	1.9	J	***19.000***	19	10	USEPA Region 4
Benzaldehyde	0.2427	3.8	1.24	J	***5.109***	19	7	USEPA Region 5 ESL
Benz[a]anthracene	5.21	n.a.	9		***1.727***	19	14	USEPA Region 5 ESL
Benzo[a]pyrene	0.1	n.a.	9.6		***96.000***	19	13	USEPA Region 4
Benzo[b]fluoranthene	59.8	n.a.	9.6		0.161	19	14	USEPA Region 5 ESL
Benzo(ghi)perylene	119	n.a	3	J	0.025	19	11	USEPA Region 5 ESL
Benzo[k]fluoranthene	148	n.a.	11.4		0.077	19	14	USEPA Region 5 ESL
Bis(2-ethylhexyl)phthalate (DEHP)	0.9259	3.8	0.58	J	0.626	19	8	USEPA Region 5 ESL
Butyl benzyl phthalate	0.2389	10	5	U	***20.929***	8	0	USEPA Region 5 ESL
Carbazole		3.8	2.4	J		19	7	No Benchmarks Available
Chrysene	4.73	n.a.	12.2		***2.579***	19	13	USEPA Region 5 ESL
Dibenz[ah]anthracene	18.4	2.2	2.2	J	0.120	19	11	USEPA Region 5 ESL
Dibenzofuran		3.8	0.76	J		19	1	No Benchmarks Available
Dibutyl phthalate	200	3.8	0.14	J	0.00070	19	6	USEPA Region 4
Di-n-octylphthalate	709	n.a.	16.4		0.023	19	4	USEPA Region 5 ESL
Fluoranthene	0.1	n.a.	26		***260***	19	15	USEPA Region 4
Fluorene	30	3.8	1.22	J	0.041	19	4	USEPA Region 4
Indeno[1,2,3-cd]pyrene	109	2.9	5.8	J	0.053	19	13	USEPA Region 5 ESL
Naphthalene	0.1	3.8	1.9	U	***19***	19	0	USEPA Region 4
Nitrosodiphenylamine [N-]	0.5451	3.8	1.9	U	***3.486***	8	0	USEPA Region 5 ESL
Pentachlorophenol	0.002	n.a.	0.098		***49***	19	1	USEPA Region 4
Phenanthrene	0.1	n.a.	16		***160***	19	14	USEPA Region 4
Phenol	0.05	3.8	1.9	U	***38***	19	0	USEPA Region 4
Pyrene	0.1	n.a.	22		***220***	19	13	USEPA Region 4

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 For some chemicals, the maximum detected concentration was less than the maximum non-detected value. To calculate the HQ, the maximum detected concentration was used. See section 4.0 Uncertainties for further discussion.

2 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the value for undetected contaminants is one-half of the maximum detection limit. n.a. - not applicable, except for Benzaldehyde (not available)

Table 12. Screening Results for Other Organics (sediments)

Analyte	Screening Benchmark	Maximum Conc. (mg/kg sediment)1	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source2
2-Chlorophenol	0.0117	4.4	J	***376.068***	47	5	USEPA Region 5 ESL
2-Methylnaphthalene	0.33	0.5	J	***1.515***	35	1	USEPA Region 4
3-Methyl-4-chlorophenol	0.3882	5.8		***14.941***	47	6	USEPA Region 5 ESL

4-Nitrophenol	0.0078	2.8		*358.974*	47	6	USEPA Region 5 ESL
2,4-Dinitrotoluene	0.0751	3.4	J	*45.273*	47	5	USEPA Region 5 ESL
Acenaphthene	0.33	7		*21.212*	47	8	USEPA Region 4
Anthracene	1.7	9.6		*5.647*	47	18	ARCS NEC
Benzaldehyde		0.62	J		47	2	No Benchmarks Available
Benz[a]anthracene	3.5	22		*6.286*	47	29	ARCS NEC
Benzo[a]pyrene	0.44	19.6		*44.545*	47	26	ARCS NEC
Benzo[b]fluoranthene	4	18.6		*4.650*	47	29	ARCS NEC
Benzo(ghi)perylene	3.8	11.6		*3.053*	47	18	ARCS NEC
Benzo[k]fluoranthene	4	18.6		*4.650*	47	29	ARCS NEC
Bis(2-ethylhexyl)phthalate (DEHP)	0.182	0.3	J	*1.648*	47	9	USEPA Region 4
Butyl benzyl phthalate	4.19	0.1	J	0.02	29	1	USEPA Region 5 ESL
Carbazole		7.2			47	14	No Benchmarks Available
Chrysene	4	26		*6.500*	47	31	ARCS NEC
Dibenzofuran	1.52	4	J	*2.632*	47	5	USEPA Region 5 ESL
Dibutyl phthalate	0.1105	0.28	J	*2.534*	47	19	USEPA Region 5 ESL
Di-n-octylphthalate	40.6	2	J	0.049	47	14	USEPA Region 5 ESL
Dibenz[ah]anthracene	0.87	3.8	J	*4.368*	47	14	ARCS NEC
Fluoranthene	7.5	68		*9.067*	47	37	ARCS NEC
Fluorene	1.8	6		*3.333*	48	8	ARCS NEC
Indeno[1,2,3-cd]pyrene	3.8	11.6		*3.053*	48	23	ARCS NEC
Nitrosodiphenylamine [N-]	0.29	2.8		*9.655*	48	6	ARCS NEC
Naphthalene	0.1552	0.83	J	*5.348*	32	3	USEPA Region 5 ESL
Pentachlorophenol	0.0036	3.6		*1000.000*	48	7	Washington NEL
Phenanthrene	0.33	58		*175.758*	48	27	USEPA Region 4
Phenol	0.0273	4.2		*153.846*	48	6	USEPA Region 5 ESL
Pyrene	6.1	64		*10.492*	48	38	ARCS NEC

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

1 For some chemicals, the maximum detected concentration was less than the maximum non-detected value. To calculate the HQ, the maximum detected concentration was used. See section 4.0 Uncertainties for further discussion.

2 See Appendix A for list of benchmark sources used in these calculations.

Key: U - not detected; J - estimated result; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

Table 13. Wildlife Exposure Screening Results for Other Organics

Analyte	Maximum Conc. (mg/L SW)	Qualifier	Maximum Conc. Soil	Qualifier	Maximum Conc. Sediments	Qualifier	Daphnids (Daphnia spp.) (a)	Endpoint	HQ for Daphnia	Fathead minnow (Pimephales promelas) and other small fish in general (b)
2,4-Dinitrotoluene	0.182		1.900	U	3.400	J	n.a		X	24.300
2-Chlorophenol	0.200		1.900	U	4.400	J	n.a		X	9.410
2-Methylnaphthalene	0.010	U	1.900	U	0.500	J	n.a		Z	0.526
3-Methyl-4-chlorophenol	0.240		4.700	U	5.800		n.a		X	4.050
4-Nitrophenol	0.280		1.900	U	2.800		1.316	CV	0.213	0.481
Acenaphthene	0.160		1.120	J	7.000		6.646	CV	0.024	0.074
Anthracene	0.010	U	1.900	J	9.600		0.002	CV	4.762	0.000
Benz[a]anthracene	0.010	U	9.000		22.000		0.001	CV	15.385	0.002
Benzo[a]pyrene	0.010	U	9.600		19.600		0.000	CV	33.333	n.a
Benzo[b]fluoranthene	0.010	U	9.600		18.600		n.a		Z	n.a
Benzo(ghi)perylene	0.010	U	3.000	J	11.600		0.000	LT50/MOR	50.000	n.a

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Benzo[k]fluoranthene	0.010	U	11.400		18.600		0.001	LT50/MOR	7.143	n.a
Bis(2-ethylhexyl)phthalate (DEHP)	0.240		0.580	J	0.300	J	0.912	CV	0.263	0.160
Butyl benzyl phthalate	n.a.		5.000	U	0.100	J	0.280	NOEC/MOR		0.440
Carbazole	0.010	U	2.400	J	7.200		2.300	EC50/MOR	0.004	0.930
Chrysene	0.010	U	12.200		26.000		0.001	LT50/MOR	14.286	n.a
Dibenzofuran	0.020	U	0.760	J	4.000	J	1.003	CV	0.020	0.840
Dibutyl phthalate	0.004		0.140	J	0.280	J	0.697	CV	0.006	0.717
Di-n-octylphthalate	0.004		16.400	J	2.000	J	0.708	CV	0.006	3.822
Dibenz[ah]anthracene	0.010	J	2.200		3.800	J	0.000	LT50/MOR	***25.000***	n.a
Fluoranthene	0.082		26.000		68.000		0.015	CV	***5.467***	0.030
Fluorene	0.020	J	1.220	J	6.000		0.212	EC50	0.094	100.000
Indeno[1,2,3-cd]pyrene	0.010	U	5.800	J	11.600		n.a		Z	n.a
Nitrosodiphenylamine [N-]	0.098	U	1.900	U	2.800		1.042	CV	0.094	0.332
Naphthalene	0.180	U	1.900	U	0.830	J	1.163	CV	0.155	0.620
Phenanthrene	0.010		16.000		58.000		0.200	CV	0.050	n.a
Phenol	0.196		1.900	U	4.200		2.005	CV	0.098	0.200
Pyrene	0.116		22.000		64.000		0.004	LC50/MOR	***29.000***	0.026

Key: CV - Lowest Chronic Value; LOEC - Lowest Effects Concentration; CH - Chronic; MOR - Mortality; AC - Acute; NOEC - No Effects Concentration; LETC - Lowes undetected and no screening number available; U - Undetected; J - Estimated Concentration; all values are mg/kg or mg/L

(a) Suter & Tsao 1996 - 4-Nitrophenol, Acenaphthene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, DEHP, Dibenzofuran, Dibutylphthalate, Di-n-octylphthalate, Butyl benzyl phthalate, Carbazole, benzo(k)fluoranthene, chrysene, dibenz(ah)anthracene, fluorene, pyrene

(b) Suter & Tsao 1996 - 2-Methylnaphthalene, 4-Nitrophenol, Acenaphthene, Anthracene, Dibutylphthalate, Di-n-octylphthalate, Fluoranthene, N-Nitrosodiphenylamin Carbazole, DEHP, dibenzofuran, fluorene, pyrene

(c) ECOTOX Database - 3-Methyl-4-chlorophenol; 2-Methylnaphthalene; Acenaphthene, Butyl benzyl phthalate, DEHP, dibutylphthalate, fluoranthene, fluorene, phen

(d) Jones 1997, except EPA 1999 TRVs (H.a.): benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, 2,4-dinitrotol

(e) Efroymson et al 1997 - Fluorene, N-nitrosodiphenylamine, Phenol, 4-nitrophenol, 3-chlorophenol (used for 2-chlorophenol), EPA 1999 TRVs - Benzo(a)pyrene

Table 14. Screening Results for PCBs (Aroclor-1248).

Analyte	Screening Benchmark	Maximum Concentration (mg/kg or mg/L)	Qualifier	Hazard Quotient	No. Samples	No. Detects	Benchmark Source1
Aroclor-1248 Surface Water	0.000014	0.001	U	71.429	6	0	USEPA Region 4 - Chronic
Aroclor-1248 Soils		3.3	J		20	15	No Benchmark Available
Aroclor-1248 Sediments	0.03	11		***366.667***	46	32	Ontario Low

Italics indicates a maximum concentration or maximum reporting limit that exceeds the screening limit (HQ >= 1).

Key: U - not detected; Note: the maximum concentration for undetected contaminants in all tables is one-half of the maximum detection limit.

1 See Appendix A for list of benchmark sources used in these calculations.

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Endpoint	HQ for minnows	Rainbow Trout (Oncorhynchus) (c)	Endpoint	HQ for trout	Benthic inverts. (d)	Endpoint	HQ for inverts
CV	0.059	0.070	LC50/CH	0.001	n.a.		X
		0.026	LC50/AC	0.004	0.005		***60.000***
CV	***4.110***	0.007	LC50/AC	0.441	0.420	CV	0.248
LC50/AC	0.185	0.002	LC50/AC	0.661	n.a.		Z

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CV	0.031	0.020	CV	0.003	260.000	CV	0.000
CV	0.031	0.020	CV	0.003	260.000	CV	0.002
CV	0.001	n.a.		Z	0.120	CV	0.542
CV	0.001	n.a.		Z	0.120	CV	0.023
CV	0.105	0.00180	LC50/AC	0.856	0.670	CV	0.036
LC50/AC	***1.097***	0.00019	LC50/AC	***17.895***	0.060	MOR	***1.900***
CV	0.025	n.a.		Z	0.006	CV	***6.545***
CV	0.050	n.a.		Z	0.006	CV	***101.818***
	Z	n.a.		Z	n.a.		Z
CV	***2.405***	0.000	LC50/AC	***54.286***	n.a.		Z
	Z	n.a.		Z	n.a.		Z
	Z	n.a.		Z	n.a.		Z
CV	***1.127***	0.001		***2.254***	31.000	CV	0.001
	Z	0.002	LC50/AC	0.031	n.a.		Z
CV	***2.500***	5.570	LC50/AC	0.000	1.000	CV	11.000

AC - Acute; MOR - Mortality

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Endpoint	HQ for minnows	Rainbow Trout (Oncorhynchus) (d)	Endpoint	HQ for trout	Benthic inverts. (e)	Endpoint	HQ for inverts	Terrestrial Plants (f)	Endpoint	HQ for plants	Earthworms (g)	Endpoint
CV	0.028268	8.6	CV	0.010814	14000	LOEC	0.5464286	50	EC30/REP	***248***		
CV	0.002063	0.53	LC50/MOR	0.0062264	2	LOEC/ AC	0.8	0.5	LOEC	***1.56***		
CV	0.00427	20	NOEC	0.00019	1.88	LC100	***6.4361702***	10	NOEC	0.79	68	LOEC
	X	150	LC50 (Brown trt)	0.00132	20	LOEC	***47.1***	5	LOEC	***42***		
LC50/AC	0.00025	0.26	LC50/MOR	0.0001923			X	10	LOEC	0.06		
CV	0.133588	0.00784	CV	0.4464286	0.07	LC25	***10***	1	NOEC	***1.3***	10	NOEC/ CH
	X	1	LOEC	***108***			X			X		
CV	0.000566	0.06963	CV	0.0083297	35.7	20d LC95	0.3865546	0.35	NOEC	***89.428571***	2	LOEC
CV	0.000293	0.0732	CV	0.0079235	35.7	20d LC95	0.3865546	0.35	NOEC	***89.428571***	2	LOEC
CV	0.052448	0.18	LETC50/ MOR	0.0083333			X	20	LOEC	0.43		
CV	***17.3224***	0.04	CV	***7.925***	1	LOEC	***52.3***	100	LOEC	0.932	32	NOEC
CV	***1.007692***	1.3	CV	***1.0076923***			X			X		
CV	0.105932	0.01888	CV	0.1059322	31	LOEC	***4.0645161***	4.6	LOEC	***49.347826***	2.5	NOEC
LC50/MOR	0.013831			X			X	500	LOEC	***39.6***		
CV	0.051798	1.78	CV	0.0517978	460	NOEC	***1.8130435***	500	LOEC	***1.642***		
CV	0.217391	0.00023	CV	0.2173913			X	0.3	LOEC	0.6333333	0.1	LOEC
CV	0.197143	0.035	CV	0.1971429	16	LOEC	***2.93125***	25	LOEC	0.788	100	NOEC
	X			X			X			X		
CV	0.02038	0.08832	CV	0.0203804	0.1		***11***	0.05	LOEC	***12.4***	77	LOEC
CV	***9.166667***	0.00012	CV	***9.1666667***	4.5	LOEC	0.4444444	0.02	LOEC	***1420***		
	X			X			X			X		
CV	0.018421	0.057	CV	0.0184211			X	0.01		n.a.		
CV	0.009125	0.08	CV	0.009125			X	2	LOEC	***12.4***		
CV	***5.987366***	0.03641	CV	***5.9873661***	110	LOEC	***1.4454545***	0.9	LOEC	***290***	85	NOEC

t Effects Threshold Concentration; REP -

ver, Thallium, Vanadium, Zinc

ganese, Mercury, Nickel, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc

Nickel, Selenium, Silver, Thallium, Vanadium, Zinc

, Manganese, Mercury, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc; ECOTOX Database - Antimony

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Endpoint	HQ for minnows	Rainbow Trout (Oncorhynchus or Salmo) (c)	Endpoint	HQ for trout	Benthic inverts (d)	Endpoint	HQ for inverts***	Earthworms (e)	Endpoint	HQ for worms
LC50/MOR	0.007	n.a		X	0.047		72.495	n.a		Z
LC50/MOR	0.021	n.a		X	n.a		X	0.075	LOEC/LC50	***25.333***
CV	0.019	1.070	LC50/MOR	0.009	0.130	Sec. CV	3.846	n.a		Z
LC50/MOR	0.059	0.917	LC50/MOR	0.262	11.400	C50/MO	0.509	n.a		Z
CV	0.582	2.200	NOEC/MOR	0.127	0.500	C50/MO	***5.600***	0.038	LOEC/LC50	***50.000***
CV	2.162	0.600	LC50/MOR	0.267	16.000	CV	0.438	n.a		X
CV	108.696	n.a		Z	0.620	CV	***15.484***	n.a		X
LT50/MOR	5.556	n.a		Z	2.600	CV	***8.462***	n.a		X
	Z	n.a		Z	3.000	CV	***6.533***	25.000	NOAEL	0.384
	Z	n.a		Z	0.037		***502.703***	n.a		X
	Z	n.a		Z	n.a		X	n.a		X

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	Z	n.a		Z	0.037		***502.703***	n.a		X
LC50/MOR	***1.500***	0.320	LC50/MOR	0.750	13.300		0.023	n.a		X
NOEC/MOR	[redacted]	0.480	NOEC/MOR	[redacted]	11.000	Sec. CV	0.009	n.a		Z
LC50/MOR	0.011	n.a		Z	n.a		X	n.a		X
	Z	n.a		Z	0.030	ERL	866.667	n.a		X
LC50/MOR	0.024	n.a		Z	110.000	CV	0.036	n.a		X
CV	0.006	0.100	NOEC/MOR	0.040	240.000	CV	0.001	n.a		X
CV	0.001	n.a		X	11600		0.00000017	n.a		X
	X	n.a		X	0.010	ERL	***380.000***	n.a		X
CV	***2.733***	0.118	LC50/MOR	0.695	16.000	CV	***4.250***	n.a		X
LC50/MOR	0.0002	0.550	LC50/MOR	0.036	0.540	Sec. CV	***11.111***	0.170	LOEC/LC50	***7.176***
	Z	n.a		Z	0.030	ERL	***386.667***	n.a		X
CV	0.295	n.a		Z	n.a		X	0.109	LOEC/LC50	***17.431***
CV	0.290	0.090	LC50/MOR	2.000	23.000	CV	0.036	n.a		Z
	X	10.000	LC50/MOR	0.001	59.000	CV	0.983	n.a		X
CV	0.980	0.014	LOEC/MOR	14.412	0.570	CV	***7.368***	0.188	LOEC/LC50	***10.106***
LT50/MOR	***4.531***	2.000	LC50/MOR	0.058	n.a		X	n.a		X

t Effects Threshold Concentration; REP - Reproductive effects; X - Chemical detected, but no screening number available; Z - Chemical

Fluoranthene, N-Nitrosodiphenylamine, Naphthalene, Phenanthrene, Phenol; PCB Aroclor-1248; ECOTOX Database - benzo(ghi)perylene,

, Naphthalene, Phenol; PCB Aroclor-1248; ECOTOX Database - 4-Methyl-3-chlorophenol, Benz(a)anthracene, Butyl benzyl phthalate,

anthrene, naphthalene, pyrene

ene, DEHP; ECOTOX Database - 4-Methyl-3-chlorophenol

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