ECOLOGICAL RISK ASSESSMENT OF J.H. BAXTER & CO. EUGENE, OREGON PLANT SITE

KEYSTONE
ENVIRONMENTAL

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OF J.H. BAXTER & CO.
EUGENE, OREGON
PLANT SITE

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1. INTRODUCTION

The J.H. Baxter Wood Preserving site in Eugene, Oregon (the "Site") (Figure 1), has been treating wood for several decades. The State of Oregon environmental cleanup law and administrative rules requires that characterisation of current and reasonably likely future risk posed by hazardous substances be based on baseline human health and ecological risk assessment. To address the requirement to perform a baseline ecological risk assessment (BERA), the Oregon Department of Environmental Quality (DEQ) has requested a Level II - screening ecological risk assessment be conducted for the vegetated area in the south west corner of the facility (fallow area), hereafter referred to as the area of potential concern (AOPC) (Figure 2). DEQ has stated that the fallow area is the AOPC at the Site with respect to ecological receptors.

1.1. Site Description

Refer to the Phase II Remedial Investigation report.

1.2. Site History

Refer to the Phase II Remedial Investigation report.

1.3. Summary of Previous Ecological Investigations

A qualitative Environment Impact Assessment (EIA) was conducted as part of the Phase II Remedial Investigation for the Site in 1994. An ecological survey to determine if threatened or endangered species were present or likely to be present on the Site, was performed. Except for a small area in the southwest corner of the Site there was no habitat suitable for threatened or endangered species. At the time of the survey this corner of the Site was dominated by the Himilayan blackberry. Below the blackberry there was a band of reed canary grass, which circled a small pond. Beggar ticks dominated the bottom of the pond. No threatened or endangered species were found on the Site during the site survey.

1.4. Assessment Objectives and Scope

The objective of the BERA is to evaluate the potential risk to ecological receptors in the AOPC from exposures to contaminants present at the Site. The performance of a BERA is governed by the State of Oregon environmental cleanup law ORS 465, and administrative rules OAR 340-122-080 and OAR 340-122-084. The BERA is being conducted under the guidance of DEQ and according to the *Guidance for Ecological Risk Assessment Level II - Screening* (DEQ, 1998). The BERA is designed to determine if constituents in the abiotic media of the AOPC pose a potential risk to ecological receptors and to assist in the development of risk-based remediation goal options. It will also provide information needed to evaluate and compare potential cleanup alternatives for future risk management decisions.

2. SITE SURVEY

The site survey was conducted by Mr. Bruce Newhouse of Salix Associates of Eugene, Oregon. The AOPC is in the south west corner of the J.H Baxter site, and is approximately 3.5 acres in size. It is about 300 feet by 500 feet in dimensions. The land form is generally flat except for a "L" shaped berm which runs along the south and west side of the AOPC. Along the north edge and northeast corner is a low lying area that ponds water from early winter to mid summer. The AOPC is dominated by scrub shrub and emergent wetland habitats, and upland herb-dominated habitats. A berm which runs along the south and west sides of the AOPC is dominated by Himalayan blackberry

(Rubus discolor), an introduced pest. The intermittent pond area is dominated by creeping foxtail (Alopercurus geniculatus) and nodding beggars-ticks (Bidens cernua). Reed canary grass (Phalaris arundincacea) is encroaching around the perimeter, and a few small patches are scattered in the intermittent pond area. The survey report is found in Appendix A.

3. PROBLEM FORMULATION

3.1. Assessment Endpoints and Endpoint Species

3.1.1. Assessment Endpoints

An assessment endpoint is an explicit expression of a specific ecological receptor and an associated function or quality that is to be maintained or protected; that provides a clear connection between regulatory policy goals and risk assessment results. For this assessment, the policy goal was protection of all terrestrial species from any adverse impacts due to the presence of site-related contaminants. These considerations lead to definition of the following assessment endpoints: *Protection of mammalian, and avian, receptors within the foraging range of the Site from reproductive impairment resulting from exposure to contaminants of potential ecological concern (CPEC) in the locality of the facility, and protection of plant and soil invertebrate receptors within the locality of the facility impairment resulting from exposure to CPECs.*

3.1.2. Endpoint Species

Specific ecological receptors (termed endpoint species) were selected from the site-specific species list developed form the site survey: based on their having substantial aesthetic, social, or economic value or are important in the biological functions or biodiversity of the system. These endpoint species are either themselves the object of protection or serve as surrogates for other ecological receptors requiring protection. For this assessment, endpoint species were selected on the basis of their: (a) documented presence at or in the locality of the site, (b) use in previous tissue residue studies and risk assessments, (c) sensitivity to the contaminant of concern, (d) ecological relevance, and (e) connection to policy goals.

The following endpoint species were selected: earthworms, Himalayan blackberry (*Rubrus discolor*), Reed canary grass (Phalaris arundincacea), deermouse (*Peromyscus maniculatus*), and the American Kestrel (*Falco sparverius*). The DEQ has concurred with the selection. The earthworm was selected to represent soil invertebrates, which are eaten by many carnivorous and omnivorous small mammals and birds including the American kestrel and deer mice. Earthworms are also in direct contact with CPECs in the soil. The Himalayan blackberry was selected to represent plants found on the site because of their great abundance on the site and because they are a source of food for many wildlife species including birds and deer mice. Reed canary grass (Phalaris arundincacea), found in water and wet places, was selected to represent plants growing in the intermittent ponded area of the AOPC because it was found in abundance, and it is a potential source of food for mammalian and avian species including deer mice. The American kestrel was selected because it is a top predator species that may potentially intake contaminants from various food sources. It represents the culmination of bioaccumulation processes in the food web (Figure 3). Higher-level predators tend to be ecological receptors of greatest concern because of this trophic bioaccumulation and their greater longevity. Although the majority of its diet is small mammals such as the deer mouse and small birds, the American kestrel will preferentially eat insects (EPA, 1993; Causti 1997) (Table 1).

3.2. Contaminants of Potential Ecological Concern (CPEC)

If the concentration of a contaminants of interest (COIs) in soil was less than 50 times its Level II Screening benchmark values (SBVs), as described in the Guidance for Ecological Risk Assessment (DEQ, 1998), and there were no observable significant effects to the health to the local population of each endpoint species, then the COI was not selected as a CPEC. The COI concentrations used for comparison were the maximum of the composite samples, as measured (SS98-12COMP, SD98-6COMP), and the calculated composite concentration (Tables 2 and 3). Four soils samples, that were not composites, were samples collected on February 3, 1998, and analyzed for phenols, polycyclic aromatic hydrocarbons (PAHs), arsenic, copper, chromium, and zinc. To compare the individual samples as measured to the composite samples taken at the area of concern, a composite concentration was calculated for each COI measured in the February 3, 1998, sampling event. The 90 percent UCL derived using the standard Bootstrap method were the calculated composite concentrations. The calculated composite concentration was referred to as "SS98-1-4 COMP" (Tables 4, 5, and 6).

The bootstrap method is a nonparametric statistical method (US EPA 1997). In the bootstrap procedure, repeated samples are drawn with replacement from the given set of observations. The process is repeated a large number of times, and each time an estimate of the mean is computed. The estimates thus obtained are used to calculate the standard error of the mean. The bootstrap UCL90 concentration is calculated as follows:

$$UCL95 = x + z_{\alpha}\sigma_{B}$$

where:

$$\sigma_B = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - x_B)^2}$$

σ_B	=	the bootstrap estimate of the standard error
x	=	the statistically unbiased estimate of the mean
x_i	=	the mean of the ith sample size n with replacement
x_B	=	the bootstrap estimate of the population mean if the N estimates x_i.
z_α	=	the standard normal critical values
N	=	number of times data re-sampled (1000)

(USEPA 1997).

When SBVs for COIs were not provided by DEQ, SBVs for COIs were derived by applying uncertainty factors to toxicity endpoints from the literature (Table 7). There are no DEQ SBVs for PAHs in soil except for benzo(a)pyrene with respect to mammals and fluoranthene with respect to plants. Toxicity endpoints from literature were used to screen the other PAHs in soil (Table 8). No PAHs were in excess of their literature based SBVs. PAHs in soil were not, therefore, carried forward as CPECs in this risk assessment. Individual chloro- and nitro-phenols in the soil of the AOPC were not detected and thus were not carried forward as CPECs (Table 9). Arsenic, copper and zinc were present in the soil at levels below 50 times their SBVs and were thus not carried forward as CPECs (Table 10). The level of chromium in the soil exceeded 50 times its SBV in soil with respect to soil invertebrates only (Table 4). However, the level of chromium in the soil (49.9 mg/kg) is less than the background concentration of chromium for the area (61 mg/kg). Therefore chromium was not retained as a CPEC. Dioxins and furans were found in soils at levels below 50 times their SBV; however, most were in excess of their SBV (Table 11). Dioxins and furans are persistent, lipophilic, highly toxic, and tend to bioaccumulate so that total exposure potentially increases from one trophic level to the next. For these reasons dioxin and furans are retained as CPECs in the AOPC soil.

If the concentration of a contaminants of interest (COI) in sediment was less than 10 times its' Level II Screening benchmark values (SBVs), as described in the Guidance for Ecological Risk Assessment (DEQ, 1998), and there were no observable significant effects to the health to the local population of each endpoint species, then the COI was not selected as a CPEC. All PAHs were present in the sediment at levels below 10 times their SBV (Table 12). PAHs were therefore not carried forward as CPECs. Individual chloro- and nitro - phenols in the sediment of the AOPC were not detected and thus were not carried forward as CPECs (Table 13). Arsenic, chromium, copper and zinc were present in the sediment at levels below 10 times their SBVs and were thus not carried forward as CPECs (Table 14). DEQ has no SBVs for dioxins and furans in sediment. Dioxins and furans are persistent, lipophilic, toxic and tend to bioaccumulate. For these reasons dioxin and furans are considered CPECs in the AOPC sediment (Table 15).

3.3. Risk Hypotheses

The following are risk hypotheses for this risk assessment:

- *Dioxin and furan and their congeners in the soil and sediment of the AOPC will not effect invertebrates and plants in the AOPC.*
- *Food chain accumulation and transfer of dioxin and furan and their congeners does not occur to the degree that allows for effects to the chicks of the American Kestrel utilising the site due to embryo exposures to dioxin and furan and congeners.*

- *Food chain accumulation and transfer of dioxin and furan and their congeners to deer mice does not occur to the degree that allows for effects to deer mice utilising the site .*

3.4. Relevant and Complete Exposure Pathways

An exposure route is the pathway by which a chemical or physical agent comes in contact with a receptor (i.e., by ingestion, inhalation, dermal contact, etc.). Ecological receptors may be exposed to chemical contaminants either through direct (primary) and/or indirect (secondary) exposure routes. Only those pathways that are complete, and are expected to contribute substantially to exposures by ecologically important receptors, are addressed. The following exposure pathways were addressed in this risk assessment:

- Direct contact and ingestion of soil by soil invertebrates;
- Direct contact of plant roots with soil;
- Ingestion of soil by terrestrial vertebrates;
- Ingestion, by terrestrial vertebrates, of plants that have bioaccumulated CPECs from the soil;
- Ingestion, by small mammals, of soil invertebrates that may have bioaccumulated CPECs from the soil;
- Direct contact of plant roots with sediment;
- Direct contact and ingestion of sediment by aquatic invertebrates;
- Ingestion, by carnivorous birds, of terrestrial and aquatic invertebrates that may have bioaccumulated CPECs from the soil or sediments (this is an indirect exposure pathway); and
- Ingestion, by carnivorous birds, of small mammals that may have bioaccumulated CPECs from soil invertebrates and plants that may intern have bioaccumulated CPECs from the soil. This is an indirect exposure pathway.

The relevant and complete exposure pathways present in the AOPC are summarized in Figure 4.

4. EXPOSURE ANALYSIS

The objective of exposure analysis is to estimate the concentration or dose of a contaminant received by an ecological receptor, taking into consideration a number of factors. These factors include the spatial distribution of contaminant concentrations relative to the spatial distribution of receptors. The exposure point value (EPV) is, for terrestrial species, the contaminant dose received by the receptor (applied dose) or, for aquatic species, the contaminant concentration in the media in which receptors are immersed (surface water or sediment). EPV estimation is a multi-step process, as described below.

4.1. Habitats and Receptors Considered

4.1.1. Habitats

The AOPC is in the south west corner of the Site. It is approximately 3.5 acres in size. There are two distinct areas on the AOPC, a low lying area in the north east corner that ponds water from early winter to mid summer and whose dominant vegetation is reed canary grass, beggars ticks, and foxtail. The rest of the AOPC is generally flat except for an "L" shaped berm which runs along the south and west sides of the AOPC. This area of the AOPC is dominated by Himalayan blackberry. To the north and east of the AOPC is the active industrial portion J. H. Baxter Wood Preserving Facility. To the west of the site is another industrial site. The portion of this site adjacent to the AOPC is a vegetated field, part of which is used for log storage. To the south of the AOPC across the rail road tracks is vacant industrial zoned property that is covered with grasses and weeds. Using the U.S. Environmental Protection Agency SITEPLUS map system a map was created showing the population distribution, national parks and recreation areas, wetlands, schools and hospitals on the lands within a 5 mile radius of the centroid of the J.H. Baxter site (Figure 7). Areas within the 5 mile radius were classified as industrial, commercial, residential, vacant, and roads and rail.

4.2. CPEC Environmental Concentrations (EC)

The calculation of the concentration of CPECs in sediment and soil followed that described in the work plan. Dioxins/furans in the composite sediment sample, which was comprised of five specimens, was carried forward into the risk assessment. (Table 15) The concentration of dioxins and furans in soil used in the risk assessment was the maximum of the following:

- 1) the measured concentration of dioxins and furans in a composite sample comprised of five specimens and sampled in the AOPC during the October 7, 1998 sampling event (Table 2 and 3), or
- 2) the measured concentration of dioxins and furans in a calculated composite sample comprised of four specimens and sampled in the AOPC during the February 3, 1998 sampling event (Table 2 and 3).

Dioxins and furans are believed to all have the same mode of action and effect (EPA, 1993a; Powell et al, 1998). Therefore to determine the maximum potential effect of dioxins and furans all congeners of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8 TCDD) for which the soil and sediment was analyzed were converted to 2,3,7,8 - TCDD toxic equivalents (TCDD-EQ) using the generally accepted international toxicity equivalency factors (I-TEFs) (Table 11). To be conservative the TCDD-EQ for each 2,3,7,8-TCDD congener was then summed. The total TCDD-EQ value for dioxins and furans in soil and sediment, was assumed to be the concentration in the soil and sediment.

The background level of 2,3,7,8-TCDD has been reported as 8 parts per trillion (ppt) (EPA 1997). To be conservative it was assumed that the ambient level of TCDD-EQ in the City of Eugene is 32 ppt.

4.3. Exposure Estimation Models

The EPV for the sedentary endpoint species, soil invertebrates, and plants were based on the local concentration of CPECs in the soil. The EPV carnivorous avian and omnivorous mammal endpoint species was based on the dietary intake of the selected species and the CPEC concentrations therein. The estimation of CPEC concentration in the dietary food of the avian and mammalian endpoint species was based on the biouptake/bioaccumulation of CPECs by the dietary foods. The bioaccumulation/biouptake of CPECs was estimated using validated mathematical models or using literature biouptake values. The soil-to-wet plant uptake factor for metal and organic CPECs and the log of the octanol-water partition coefficient (K_{ow}), for organic CPECs, was taken from the *Toxicity & Chemical-Specific Factors Data Base* (Risk Assessment Program Oak Ridge National Laboratory, 1998) (Table 16). The bioaccumulation of organic CPECs by earthworms was calculated using the "Earthworm Model" (Jager and Hammers, 1997). The following equations are used to calculate the bioaccumulation of organic CPECs in earthworms:

Equation 1

$$BCF = \frac{F_{water} + F_{fat} + Kow}{\rho_{worm}}$$

where:

BCF	=	bioconcentration factor for worm $[m_{water}^{3} * kg_{wwt}^{-1}]$
F_{water}	=	volume fraction of water in worm $[m_{water}^{3} * m_{worm}^{-3}]$
F_{fat}	=	volume fraction of fat in worm $[m_{fat}^{3} * m_{worm}^{-3}]$
Kow	=	octanol-water partition coefficient $[m_{water}^{3} * m_{oct}^{-3}]$
ρ_{worm}	=	bulk density of worm $[kg_{wwt} * m_{worm}^{-3}]$

Equation 2

$$BAF = \frac{\frac{k_1}{Kp} + k_f}{k_2 + k_g + k_m}$$

where:

$$Koc = \frac{1.26 \times Kow^{0.81}}{1000}$$

$$Kp = Foc * Koc$$

BAF	=	bioaccumulation factor
Kp	=	solids-water partition coefficient in soil $[m^3/kg_{solids}]$
Foc	=	fraction of organic carbon in soil $[kg_{oc}/kg_{solids}]$
Koc	=	organic carbon-water partition coefficient $[m_{water}^{3}/kg_{oc}]$
k_1	=	0.35 (a constant when log Kow>4) diffusive uptake $[(mg * kg_{wwt})/(mg * m_{porew}^{3})/d]$
k_2	=	0.35/BCF diffusive losses [1/d]
k_f	=	0.034 (uptake through food) $[(mg * kg_{wwt})/(mg * m_{porew}^{3})/d]$
k_g	=	0.0058 (dilution by growth) [1/d]
k_m	=	0 (losses due to metabolism = 0 due to lack of general knowledge) [1/d]

(Figure 5; Table 17).

4.4. Exposure Point Value (EPV) Estimates

An exposure model is used to estimate the EPV. An exposure model must explicitly consider the spatial relationships between endpoint species, their habitat, and the distribution of contaminants, as well as habitat quality and temporal utilization of habitat. Simple non-spatial exposure models are often based on the assumption that contaminants are evenly distributed on the site or that an endpoint species forages randomly with respect to contamination on that portion of the site which constitutes habitat. In either case, an endpoint species is assumed to be exposed to mean concentrations.

However, because many sites are industrial or highly modified in nature, it is unlikely that all areas within their bounds will provide habitat suitable for endpoint species. For example, contaminant concentrations might be greatest near the centre of a site, but the habitat quality might be highest near the edges. Thus, if contaminant levels are related to habitat quality, the assumptions of a simple model would not hold. A more reasonable model and the model used in this risk assessment accounts for the proportional contribution of each area with a distinct combination of contaminant level and habitat quality, as follows:

Equation 3

$$EPV_j = \sum_{k=1}^{q}\sum_{i=1}^{d}\left[\left(\frac{IR_i \times C_{ijk}}{BW}\right)\times\left(\frac{\left(Hq_k / \sum_{k=1}^{q} Hq_k\right)\times Ha_k}{\sum_{k=1}^{q} Ha_k}\right)\right]\times AU \times S$$

where:

- EPV_j = Exposure point value for a given endpoint species for j^{th} contaminant (mg/[kg·d]);
- q = Number of habitat patches within local population boundary (unitless);
- d = Total number of i^{th} media (e.g., food, water, soil);

IR_i	=	Intake rate for i^{th} medium (kg/d or L/d);
C_{ijk}	=	90^{th} percentile UCL concentration of j^{th} contaminant in i^{th} medium in k^{th} habitat patch (mg/kg or mg/L);
BW	=	Body weight of endpoint species (kg);
Hq_k	=	Relative habitat quality (based on expected residency) of k^{th} habitat patch for a given endpoint species (unitless);
Ha_k	=	Area of k^{th} habitat patch (m^2); and
AU	=	Area use factor (unitless).
S	=	Seasonality factor for small mammal (unitless).

Equation 3 assumes that individuals within the local population boundary use habitat in proportion to the habitat area and quality. Here EPV is the applied dose (mg/[kg·d]) experienced by an individual of the endpoint species. Since multiple food items are considered, Equation 3 includes a term to represent that item's fraction of IR_i in the total intake, e.g., incidentally ingested soil may be only a small fraction (< 2%) of total food intake.

For abiotic media such as soils or water, C_{ijk} equals the environmental concentration. In the absence of measured contaminant concentrations, the value of C_{ijk} in the tissues of consumed prey and forage has been estimated using the environmental concentrations in soil and sediment in conjunction with an appropriate intermedia transfer factor. Some endpoint species have migration, hibernation, or other behaviour patterns that result in less exposure throughout the year at a site. The seasonality factor (S) quantifies the frequency of exposure to contaminated media as a function of such behaviour patterns. This factor is defined as the fraction of the number of days per year an endpoint species is active within a habitat, so that $1 \geq S > 0$. Non-hibernating, non-migratory species will have a unitless default seasonality factor of 1. For those species that use the habitat island only as a stop-over point during their annual migration it will be necessary to estimate a S value < 1. The S for the mammalian and avian endpoint species used in this assessment was assumed to be 1. An area use factor (AU) is included to account for the effect of a receptor's territory size or foraging area on frequency and duration of contact with contaminated media or prey. When a terrestrial receptor's territory size (A_{bird}) or foraging area (A_{mammal}) is equal to or less than the total contaminated area within the locality of the facility (A_{site}), AU will have a unitless default value of 1.0. When this area exceeds the area of contamination, AU is calculated as the ratio of the contaminated area to foraging area and will have a value less than 1.0.

4.4.1. Define Local Population Boundaries

Establishing a species-specific local population boundary sets a limit on the number of individual members of an endpoint species population that will be considered in the risk assessment. The boundary must be established with reference to the locality of the facility and must relate in some way to a biological feature of the species. The boundary cannot be so large as to include individuals that will have little probability of contacting a site-related contaminant or be so small as to exclude individuals who might reasonably contact such a contaminant. Its size will also necessarily have to vary with the endpoint species. With the recognition that the following approach has ecological limitations but practical advantages, population boundaries for sessile, mobile, and migratory species will be established as follows:

- For sessile terrestrial species (e.g., plants), the local population spatial boundary is assumed to be equal to the spatial boundaries of the locality of the facility.
- For sessile aquatic species (e.g., benthic invertebrates) in ponds or lakes within the locality of the facility, the local population spatial boundary is assumed to be equal to the spatial boundaries of the water body.

- Individuals of mobile terrestrial and avian species usually travel varying distances, on a daily to seasonal basis, to find food, water, and shelter. The area encompassed by these travels is termed an individual's foraging home range (FHR). Studies of dispersal behaviour in mammals suggest that there is a low probability of an animal moving more than five FHR diameters in a straight line from its natal range (Waser, 1987). Thus for both terrestrial and avian mobile species, the local population spatial boundary diameter is assumed to be equal to five FHR diameters from the spatial boundaries of the locality of the facility. FHRs are assumed to be non-overlapping.

For the deer mouse and the American Kestrel, the local population spatial boundary was determined as follows:

$$D_h = 10 \times \sqrt{\frac{A_h}{\pi}}$$

Equation 4

where:

D_h = Local population boundary diameter for the *h*th endpoint species (m); and

A_h = Foraging home range area for the *h*th endpoint species (m^2).

The foraging home range and the local population boundary diameter for the selected mammalian endpoint species is found in Table 18 (Figures 6 and 7) (USEPA 1993; Causti et al 1997).

4.4.2. Habitat Size and Quality

Observation and mapping of habitats were used to estimate: (a) number (q), (b) approximate habitat spatial extent (Ha_k), and (c) relative habitat quality (Hq_k) (based on relative expected residency) of each habitat (or habitat patch) within the local population boundary, including the locality of the facility. Presumably, habitat patches with greater relative quality will increase the probability of exposure by attracting and holding an endpoint species more strongly and for a longer duration (i.e., raising its expected residency) than those with minimal habitat quality. The quality of habitat, with respect to the needs of a given endpoint species relative to all other existing species-specific habitat within the local population boundary, were rated as follows:

- unsuitable (0),:
- poor (0.25);
- average (0.5);
- good (0.75); or
- excellent (1).

The habitat quality for the mammalian and avian endpoint species was determined based on a site visit, the performance of a species habitat survey and knowledge of the habitat requirements of the endpoint species. The resulting Hq_k values were then normalised so that the sum of all such factors for a given locality equals one. Information on each endpoint species is found in Appendix B. Tables 19 and 20 contains the habitat quality rating for mammalian and avian endpoint species.

Five habitat patches were identified in the local boundary for deer mice. The five habitat patches identified for the deer mouse are the following:

- 1) grass and shrubs;
- 2) intermittent pond;

- 3) grass;
- 4) grass-storage;
- and 5) industrial-active.

Seven habitats were identified in the local boundary for the American Kestrel. Because the size of the American kestrel local population boundary is so large only the two habitat patches within the AOPC 1) grass and shrubs, 2) intermittent pond, were specifically identified. The other five habitats areas are the following:

- 1)industrial (grass & shrubs);
- 2) commercial (grass & shrubs);
- 3) residential (grass & trees);
- 4) vacant (grass & shrubs); and
- 5) buildings active industrial sites and paved areas (Table 21).

These five habitat types were referenced in terms area of the percent of land each habitat occupies within the local population boundary. Information on land use was acquired from Clair Van Bloem of the Lane Council of Governments (1998). The information was based on information collect during 1994. It has been assumed the land allowed to grow fallow in the Eugene metropolitan area will soon end up with a combination of grass and shrubs. It was assumed that for residential land that 25% of the land was building or covered with pavement, gravel, or concrete. Sixty six percent of commercial land was assumed to be occupied by building or covered with pavement, concrete, or gravel. Half of all industrial land was assumed to be an active part of the facility, covered by building or paved. The type, size and relative quality of each habitat patch with respect to the mammalian endpoint species is listed in Tables 19, 20 and 21.

Areas covered with buildings, pavement, gravel, or concrete, and roads and rail lines, and active industrial sites were given a habitat rating of 0 and not carried any further into the EPV analysis.

5. ECOLOGICAL RESPONSE ANALYSIS

5.1. Receptor Toxicity Profiles

5.1.1. Dioxins and Furans

Dioxins and furans are ubiquitous in the environment. The background level of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) has been reported as 8 ppt (EPA 1997). Ecological receptors on the AOPC may potentially be exposed to elevated levels of dioxins and furans (Tables 4 and 6) present in AOPC soils and sediment. Dioxins and furans are polyhalogenated diaromatic hydrocarbons (PHDHs). 2,3,7,8-TCDD is the most toxic of these compounds. 2,3,7,8-TCDD is believed to exert many of its toxic effects by binding with the aryl hydrocarbon receptor (AhR), and subsequently entering the nucleus where this ligand AhR complex activates specific genes including CYP1A1, which encodes for protein cytochrome P4501A1 (Powell, D.C. et al, 1998). Enhanced expressions of this and other associated genes leads to a variety of responses attributed to TCDD. Other PHDHs structurally similar to 2,3,7,8-TCDD are known to act through the same mechanism of toxicity (Schecter, 1994). This allows the other PHDHs to be expressed relative to TCDD in the form of toxic equivalency factors. The TEFs can then be used to determine dioxin toxic equivalents (TEQs).

Dioxins and furans are known to cause a variety of adverse effects in avian species including embryo lethality, beak deformities, subcutaneous edema, hydropercardium, liver lesions and induction of P450 enzymes (Schecter 1994; Powell D.C., 1998). When chicken embryos were exposed to 2,3,7,8-TCDD injected into the air cell at the start of incubation the chick had a LD50 of 0.297 ug/kg egg (Hensel, 1997). When double-crested cormorant were exposed to 2,3,7,8-TCDD injected into the air cell at the start of incubation the LD50 calculated from mortality at hatching was of 4 ug/kg egg (Powell D.C., 1998) and when exposed to PCB 126 the calculated LD 50 was 177 ug/kg. The LD50 for the congeners of 2,3,7,8-TCDD polychlorinated biphenyl (PCB) 126 was 65 ug/kg egg for American kestrels (Hoffman 1996). Hoffman reported a TEF of 0.05 for the conversion of PCB 126 to TCD-EQ. This is more than twice as large as the TEF (0.022) calculated for the cormorant by Powell (1998). The TEF of 0.05 was use to convert PCB 126 exposures to the American kestrel TCDD-EQ.

Dioxins and furans are known to cause a variety of adverse effects in mammalian species including hepatotoxicity, wasting syndrome, immunotoxicity, and dermatitis in guinea pigs (Decaprio, 1986), amylodosis of the kidney spleen and liver, and cleft palate in mice (Toth et al 1979; Dillman 1982) and tetragenic effects in rats (Smith et al 1976). The acute toxicity of 2,3,7,8-TCDD to experimental animals is quite variable. Studies by Hochstein et al (1988) and Aulerich et al (1988) indicated that mink is among the mammalian species most sensitive to 2,3,7,8-TCDD intoxication (EPA 1993). The 28 day LD50 of 4.2 ug/kg for the mink is more than the LD50 of 0.600 to 2.0 ug/kg for the guinea pig, but less than the LD50 of 22 to 45 ug/kg for the rat, the LD50 of 115ug/kg for the rabbit, and LD50 of 114 to 284 for the mouse (EPA, 1993).

5.2. Ecological Benchmark Value Estimates

Per OAR 340-122-084(1)(h)(B)(ii), effects on species other than those classified as threatened or endangered are made only at the population level. The EBV for populations is defined as the median lethal dose or concentration (LD_{50} or LC_{50}). If a LD_{50} or LC_{50}, was not available for endpoint species considered in this risk assessment, the EBV was derived from other toxicological endpoints for those receptors or appropriate surrogates for those receptors, adjusted with uncertainty factors to equate to a LD_{50} or LC_{50}. The uncertainty factors process shown in Figure 3 of *the Guidance for Ecological Risk Assessment Level III - Baseline* (DEQ, 1998), is used to convert available toxicological endpoints to a LD_{50} or LC_{50} for an endpoint species.

The 2,3,7,8-TCDD EBV for the deer mouse is based on the LD 50 for 2,3,7,8-TCDD in the mouse (species unspecified) of .114 mg/kg/day (EPA, 1993). Using the methodology shown in Figure 3 of *the Guidance for Ecological Risk Assessment Level III - Baseline* (DEQ, 1998) LD50 for the mouse was converted to an LD 50 for the deer mouse. The mouse is assumed to be of the same genus as the deer mouse thus the LD50 for 2,3,7,8-TCDD in the mouse was multiplied by an uncertainty factor of 0.5 to account for the possibility of the mouse and deer mouse being a different species. The LD50 was multiplied by an additional uncertainty factor of 0.5 to account for the deer mouse not being a threatened or endangered species. EBV for 2,3,7,8-TCDD in the deer mouse used for the in this risk assessment was 0.029 mg/kg/day (Table 22).

The 2,3,7,8-TCDD EBV for the American kestrel was based on the LD 50 for polychlorinated biphenyl (PCB) 126 in the American kestrel of 0.065 mg/kg/day (Beyer et al, 1996). The conversion of PCB 126 to 2,3,7,8-TCDD was based on multiplying the LD50 for PCB 126 in the American kestrel by the toxic equivalency factor of 0.05 (Kubiak, 1991). The LD50 was multiplied by an additional uncertainty factor of 0.5 (DEQ, 1998) to account for the American kestrel not being threatened or endangered. The EBV used for 2,3,7,8-TCDD in the American kestrel in this risk assessment was 0.00163 mg/kg/day (Table 22).

6. RISK CHARACTERIZATION

Risk characterization quantitatively defines the magnitude of potential risks to endpoint species under a specific set of circumstances. It is the process of applying numerical methods and professional judgement to determine whether acceptable risk levels for endpoint species are or could be exceeded as a result of exposure to site-related CPECs. Risk characterization involves two components: a quantitative risk estimate and a narrative risk description. Because no one piece of information can adequately define risks to complex ecological systems, a formal "weight-of-evidence" approach might be needed to compile and integrate various types of evidence indicating the degree of risk present for each CPEC and assessment endpoint.

6.1. Risk Estimation Methodology

The acceptable risk level for sessile species such as plants and some soil invertebrates is a toxicity quotient (TQ) of less than or equal to 1. The TQ = EPV/EBV and the toxicity index (TI) = ΣTQ. TQs are added for a given receptor only when they have the same mode of action and same effect. The EBV for populations of sessile species is the LD50 for that chemical with respect to the endpoint species.

The acceptable risk level (ARL) for populations of ecological receptors is a 10 percent chance, or less, that 20 percent or less of the total local population would have an exposure point value greater than the EBV for each contaminant of concern. Once an EPV distribution and a contaminant-specific ecological benchmark value, either as a point value or a distribution, have been established for each endpoint species, computation of the acceptable risk level (ARL) numerical criterion involves the following:

- Estimate an endpoint species local population abundance.

- Estimate the probability of an individual of an endpoint species experiencing an exposure in excess of the benchmark or p(EPV > EBV).
- Estimate the number of individuals in a local population of an endpoint species likely to experience p(EPV > EBV) ≥ 10%, using a cumulative binomial distribution function.

6.1.1. Estimation of Local Population Abundance

Because the definition of acceptable risk for a population is based on effects to a certain percentage of individuals, it is necessary to estimate the number of individuals of each endpoint species within the local population boundary. For sessile terrestrial species (e.g., plants), the local population spatial boundary is assumed to be equal to the spatial boundaries of the locality of the facility. For sessile aquatic species (e.g., benthic invertebrates) in ponds or lakes within the locality of the facility, the local population spatial boundary is assumed to be equal to the spatial boundaries of the water body. For transient and migratory species, local population abundance is defined as the number of individuals utilizing habitat within spatial boundaries of the locality of the facility over the course of a year. Population abundance for mammals used in the risk assessment was taken from the literature (U.S. EPA, 1993; Causti et al 1997). Estimates of population abundance are found in Table 21.

6.1.2. Probability of Exposure Exceeding the Benchmark

In general, risk is the relationship between an unfavourable consequence and the probability associated with the occurrence of that unfavourable consequence. For our purposes the "unfavourable consequence" is an ecological response in a local population. The "probability associated with the occurrence of the unfavourable consequence" is p(EPV > EBV). An ecological response occurs when toxicological responses in individuals of an endpoint species, as a consequence of long-term (chronic) exposure to a substance, results in the actual or projected loss of a minimum viable local population of that species (Newton, 1988). Aspects of individual health, viability, and performance are important only insofar as they might influence the sustainability of the local population.

Estimation of p(EPV > EBV) may be accomplished through the use of a normal density function (Suter et al, 1986). If EBV is expressed as a single point value and the mean and standard deviation of its natural logarithms define EPV, then the probability of EPV > EBV may be determined as follows:

$$p \cong \phi_Z\left(\frac{x_{EPV} - \ln(EBV)}{s_{EPV}}\right)$$

Equation 5

where:

p	=	Probability of EPV > EBV (unitless);
ϕ_Z	=	Cumulative distribution function of a standard normal random variable (NORMSDIST function in MS-Excel®);
x_{EPV}	=	Mean of natural logarithms of EPV (mg/[kg·d] or mg/L);
s_{EPV}	=	Standard deviation of natural logarithms of EPV (unitless); and
EBV	=	Single point value of EBV (mg/[kg·d] or mg/L).

The probability of EPV > EBV for the wildlife endpoint species deer mouse, and American kestrel was calculated for exposure to dioxins and furans in terms of the total 2,3,7,8-TCDD TEQ, in AOPC soils and sediment, plants, and/or soil and aquatic invertebrates. Using the total TEQ in this case is appropriate because dioxin furans and its congeners have the same mode of action and effect for each endpoint species, respectively. The probability of EPV > EBV due to exposure to dioxins and furans in AOPC soils and sediment by deer mouse (0, very small) or the American kestrel (0, very small) is less than 10% (Tables 19 and 20).

6.1.3. Number of Individuals Affected

The number of individuals of an endpoint species within the local population boundary with a ≥ 10% chance of experiencing EPV > EBV was estimated using a cumulative binomial distribution function defined as (Barnthouse et al, 1995):

Equation 6

$$e = CRITBINOM(n, p, \alpha)$$

Equation 7

$$r = CEILING\left(0.20 \times n, 1\right)$$

where:

e	=	Number of individuals with ≥ 10% chance of experiencing EPV > EBV (CRITBINOM function in MS Excel®);
n	=	Total number of individuals within the local population boundary;
p	=	Probability of EPV > EBV (Equation 6);
α	=	Probability of individual experiencing EPV > EBV (0.1); and
r	=	Twenty percent of individuals within the local population boundary (rounded-up to whole integer with CEILING function in MS Excel®).

Solving Equation (6) yields an estimate of the number of individuals within the local population boundary that have a $\geq$ 10% chance of encountering EPV > EBV. Solving Equation (7) provides an estimate of 20% of the total local population.

The number of individuals of the endpoint species deer mouse, racoon, and black-tail deer, respectively, within their respective local population boundary with a $\geq$ 10% chance of experiencing EPV > EBV was calculated for exposure to dioxins and furans in terms of the total 2,3,7,8-TCDD TEQ, in AOPC soils and sediment, plants, and/or soil and aquatic invertebrates. The number of individual of a species where EPV > EBP due to exposure to dioxins and furans in AOPC soils and sediment by deer mouse is zero and by the American kestrel is zero (Table 19 and 20).

Soil and sediment invertebrates and plants do not have the Ah receptor and are therefore are not believed to be susceptible to the potential toxic effects of dioxins and furans.

6.2. Risk Description

This is a qualitative narrative discussion of risks presented by the site and must include a discussion of any toxicological and ecological factors beyond those embodied in the quantitative risk estimates. Risk must be described for each CPEC-pathway-receptor combination, i.e., for each assessment endpoint.

Dioxins and furans, ubiquitous pollutants, are present in the site soils and sediment at levels in excess of generally accepted background levels of 8 ppt. Dioxins and furans have large octanol water partition coefficients, are hydrophobic in nature, and can be absorbed into the lipids of plants, invertebrates, and wildlife where they may bioaccumulate. Their high octanol water partition coefficient, also makes them bind very tightly to soil and sediment particles and are very insoluble in water. Soil and aquatic invertebrates and plants are not susceptible to the aryl hydrocarbon receptor (AhR) mediated toxic effects of dioxins and furans because they do not appear to have the Ah receptor. However, they do absorb dioxins and furans and transfer them to primary and subsequently secondary and tertiary consumers. Deer mice on the AOPC become exposed to TCDD via ingestion of soil invertebrates, plants, and incidental ingestion of soil. Mice birds have the Ah receptor and thus are susceptible to Ah receptor mediated toxic effects.

The total 2,3,7,8-TCDD TEQs in the soils (1.034 parts per billion (ppb)) and sediments (0.866 ppb) is less than the EBV for 2,3,7,8-TCDD in the deer mouse of 57 ppb (Table 22). Mice were caught on the AOPC for the purpose of sampling their tissues. Six mice were caught in mice trap in two days. This indicates that mice are likely using the site for there home. The home range of the deer mouse is much smaller than the size of the AOPC, consequently deer mice spend a significant portion of their time on the AOPC. The are no obvious effects to the mice caught and therefore no reason to believe that they are being negatively effected by exposures to CPECs on the site. The potential risk to the deermouse due to exposures to dioxin and furan like compounds at levels present at the AOPC are low.

The total 2,3,7,8-TCDD TEQs in the soils (1.034 ppb) and sediments (0.866 ppb) is less than the 2,3,7,8-TCDD LD50 of 1.63 ppb (Table 22). With the home range of the American kestrel being 300 acres, it likely spends only a small portion of its time on the 3.5 acre AOPC (Appendix B). The LD50 used for the American kestrel is based on embryo exposure to dioxin and furan like compounds. The preferred nest for the kestrel is a woodpecker hole or a natural cavity in a tree. There are no trees on the AOPC, therefore nesting and subsequent embryo exposures to dioxin and furan like compounds at levels present at the AOPC are unlikely. The potential risk to the American kestrel due to exposures to dioxin and furan like compounds at levels present at the AOPC are low.

7. UNCERTAINTY ANALYSIS

7.1. CPEC Selection and Quantification

The selection of the CPEC in the AOPC was based on collection of two composite samples of 5 specimens each and 4 individual samples. Should the distribution of contamination in the AOPC be very heterogeneous the sampling of 15 locations may not adequately inform one of contamination present. However, the contamination in the AOPC is due to the spray of wastewater over the area in the past. The spray was spread over the entire AOPC and thus contamination is likely reasonably homogeneous. It is unlikely that any CPECs were missed. The data allows for a very good estimate of the mean concentration. The maximum detected value for each CPECs was used in the risk assessment. Level of uncertainty is considered to be low to medium.

7.2. Receptor Selection

The receptors selected were from a list of those that were identified on the AOPC, that were believed to be abundant in case tissue sampling was necessary, were likely to come into contact with the site soils, and that fell into the food web of the higher level consumers selected as endpoint receptors of concern. Level of uncertainty is considered to be low.

7.3. Exposure Estimation

The uptake of dioxins and furans by the deer mouse and by the American kestrel was based on literature values for food consumption, amount and type. The concentration of dioxins in their food was estimated using a mathematical model and using literature uptake values. Uptake of organic constituents can be effected by the level of organic carbon in the soil. The home range size used in the exposure estimation was based on literature values. The types of habitats that each animal prefers was taken from the literature. The abiotic media was sampled; however, no tissue samples were analysed. The models used were conservative and likely to over-estimate the uptake of constituents from abiotic media. The level of uncertainty may be moderate to high, however, it is unlikely that exposure has been underestimated.

7.4. Response Estimation

Ecological benchmark values were more often than not unavailable for the endpoint species CPEC. This meant using uncertainty factors to adjust the toxicity value being used for another species. The TEF for PCB 126 was used to convert the LD50 for PCB 126 to a 2,3,7,8-TCDD toxic equivalence (TCDD -EQ) in the American kestrel. The level of uncertainty is moderate. The uncertainty in EBV values is difficult to reduce without performing site specific toxicity testing.

7.5. Risk Estimation

The uncertainty in the risk estimation is directly effected by the uncertainty in the exposure estimation, CPEC concentration, and response estimation that were, moderate to high, moderate and moderate, respectively. In each case conservative assumptions were made. The uncertainty in the risk estimation is moderate to high however the likelihood that the risk was under estimated is low.

8. CONCLUSION

The COIs that became CPECs are dioxins and furans with respect to mammals and birds. The probability of EPV > EBV due to exposure to dioxins and furans in AOPC soils and sediment by deer mouse (0, very small) or the American kestrel (0, very small) is less than 10%. Therefore, the number of deer mice or American kestrel, respectively, where EPV > EBP due to exposure to dioxins and furans in AOPC soils and sediment is zero for both. The level of acceptable risk to these species has not been exceeded. The risk for the deer mouse and the American kestrel due to exposures is low.

9. RECOMMENDATIONS

The CPECs in the AOPC are highly unlikely to present significant risk to soil invertebrates, plants, avian species, and small mammals and further ecological assessment is not recommended.

10. REFERENCES

Schecter, 1994. *Dioxins and Health.* Plenum Press, NY, NY

Powell D.C., Aulerich R.J., Meadows J.C., Tillitt D.E., Kelly M.E., Stromborg K.L., Melancon M.J., Fitzgerald S.D., and Bursian S.J., 1998. Effects of 3,3', 4,4',5-Pentachlorobiphenyl and 2,3,7,8-Tetrachlorodibenzo-p-dioxin Injected into the Yolk of Double-Crested Cormant (Phalacrocorax auritus) Eggs Prior to Incubation. *Environmental Toxicology and Chemistry.* 17:10:2035 - 2040.

Hensel D.S., Hehn B., Wagey R., Vo M., and Steeves J.D. 1997. The Relative Sensitivity of Chicken Embryos to Yolk- or Air Injected 2,3,7,8-Tetrachlorodibenzo-p-dioxin. *Environmental Toxicology and Chemistry.* 16:4:725 - 742.

Hoffman D.J., Rice C.P., and Kubiak T.J., 1996. PCBs and Dioxins in Birds. In Beyer W.N., Heinz G.H., and Redmon-Norway A.W., ed, *Environmental Contaminants in Wildlife.* Lewis Publishers Boca Raton, Flordia.

U.S. Environmental Protection Agency (EPA), 1993a. *Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife.* Office of Research and Development, EPA/600/R-93/055. Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1993b. *Wildlife Exposure Factors Handbook Volume 1.* Office of Research and Development, EPA/600/R-93/187a. Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1997. *Health assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds.* Chapter 8. Office of Research and Development,. Washington, D.C.

Shapuk I. 1991. The Chemistry of Chromium and Some Resulting Analytical Problems. *Environmental Health Perspectives.* 92:7-11.

Williams J.H., 1988. *Chromium in Sewage sludge Applied to Agricultural Land.* Office of Official Publications for the Commission of the European Communities, Brussels.

NRCC (National Research Council of Canada) 1976. *Effect of Chromium in the Canadian Environment.* (NRCC No. 15017) Associate Committee on Scientific Criteria for Environmental Quality, Ottawa.

Efroymsom R.A., Will M.E., Suter II G.W., and Wooten A.C., 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Cncern For Effects on Terrestrial Plants: 1997 Revision.* ES/ER/TM-85/R3. U.S. Department of Energy Office of management and Budget Oak Ridge, Tennessee.

Causti B., Kimerling A.J., O'Neil T.A., Shaughnessy M.M., Gaines E.P., and Huso M.M., 1997. *Distribution, Habitat, and Natural History Atlas of Oregon Wildlife.* OSU Press, Portland Oregon.

Oregon Department of Environmental Quality (DEQ), 1998. *Guidance for Ecological Risk Assessment.* Final. DEQ Portland, Oregon.

Jagers D.T. and Hamers T., 1977. *Estimation methods for bioaccumulation in risk assessment of organic chemicals*. Report No.679102013. National Institute of Public Health and the Environment, Bilthoven, Netherlands.

ORNL (Oak Ridge National Laboratory) , 1997Opresko, D. M., Sample, B. E., and Suter II, G. W. *Toxicological Benchmarks for Wildlife: Revision 1997.* Oak Ridge National Laboratory, Environmental Sciences Division ES/ER TM-86/R2.

Denneman, C.A.J. and van Gestral, C.A.M., 1990. Soil Contamination and Soil Ecosystems: Proposal for C- (test) Values Based on Ecotoxicological Risk, National Institute of Public Health and Environmental Protection (RIVM), Netherlands.

Germain A., Perron F., and Van Collie R., 1994. *PAHs in the Environment: Fate, Ecotoxicity and Regulations* - Priority Substance List Supporting Document No. 3. Government of Canada, Environment Canada, Quebec Region, Environmental Protection Branch, Montreal Quebec.

Environment Canada, 1994. *Canadian Soil Quality Criteria For Contaminated Sites Ecological Effects: Benzo(a)pyrene.* Draft Report, National Contaminated Sites Remediation Program. Ottawa, Ontario.

J.H. Baxter, 1994. Phase II Remedial Investigation for the J.H. Baxter Wood Preserving Site, Eugene, Oregon.

Waser PM (1987) A model predicting dispersal distance distributions. In *Mammalian Dispersal Patterns* (BD Chepko-Sade & ZT Halpin, eds), University of Chicago Press, Chicago, pp. 251-256.

Van Bloem, C., Lane Council of Governments. November 30, 1998. Telephone Conversation.

Newton I. (1988). Determination of critical pollutant levels in wild populations, with examples for organochlorine insecticides in birds of prey. *Environmental Pollution* **55**, 29-40.

Suter II GW, Rosen, AE & Linder E (1986). Analysis of extrapolation error. In *User's Manual for Ecological Risk Assessments* (LW Barnthouse & GW Suter II, eds), p. 55, Equation (4.7). Environmental Sciences Division, Oak Ridge National Laboratory, ESD No. 2679, ORNL-6251.

Barnthouse LW, Hull RN, Sample BE, & Suter II GW (1995). *Case study for ecological risk assessment at contaminated sites.* A SETAC Short Course given at the 16th annual meeting of the Society for Environmental Toxicology and Chemistry, Vancouver, B.C., Canada.

DeCaprio, A.P., McMartin, D.M., O'Keefe, P.W., Rej, R., Silkworth, J. B. and Kaminsky, L.S. 1986. Subchronic oral toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin in the guinea pig: Comparisons with PCB-containing transformer fluid pyrolysate. *Fundamentals in Applied Toxicology* . 6:454-463.

Toth, K., Somfai-Relle, S., Sugar, J., and Bence,J. 1985. Carcinogenicity testing of herbicide 2,4,5-Trichlorophenoxyethanol containing dioxin and pure dioxinand of pure dioxin in Swiss mice. *Nature* (London). 278(5704):548-549.

Denneman, C.A.J. and van Gestral, C.A.M., 1990. *Soil Contamination and Soil Ecosystems: Proposal for C- (test) Values Based on Ecotoxicological Risk,* National Institute of Public Health and Environmental Protection, RIVM, the Netherlands, April, 1990.

Irwin, R.J., VanMouwerik, M., Stevens, L., Seese, M.D., and Basham, W. 1997. *Environmental Contaminants Encyclopedia.* National Parks Service, Water Resources division, Fort Collins, Colorado.

Smith, F.A., Schwetz, B.A., and Nitschke, K.D. 1976. Teratogenicity of 2,3,7,8-Tetrachlorodibenzo-p-dioxin in CF-1 mice. *Toxicol. Appl, Pharmacol.* 38(3):517-523.

Efroymsom R.A., Will M.E., and Suter II G.W. 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Cncern For Effects on Soil Litter Invertebrates and Heterotrophic Process: 1997 Revision.* ES/ER/TM-126/R2. U.S. Department of Energy Office of management and Budget Oak Ridge, Tennessee.

U.S. Environmental Protection Agency (EPA), 1997a. *The Lognormal Distribution in Environmental Applications*. Office of Solid Waste and Emergency Response. EPA/600/R-97/006. Washington, D.C.

Table 1 Selected Endpoint Species

Endpoint Species	Trophic Level
American Kestrel (Falco sparverius)	tertiary consumer
Deer mouse (Permyscus maniculatus)	secondary consumer
Earthworm	primary consumer
Himilayan blackberry (Rubus discolor)	producer
Reed canary grass (Phalaris arundinacea	producer

Table 2 Composite Data and Summary Statistics
Media: Soil

Contaminants of Intrest	SS98-12 COMP 10/7/98 (mg/kg)	SS98-1-4COMP 2/3/98 (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Mean (mg/kg)
Polycyclic Aromatic Hydrocarbons					
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthylene	0.12	0.05	0.12	0.05	0.085
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	
Fluorene	0.041	0.011	0.041	0.011	0.026
Phenanthrene	0.025	0.019	0.025	0.019	0.022
Anthracene	0.2	0.06	0.2	0.06	0.13
Fluoranthene	0.039	0.039	0.039	0.039	0.039
Pyrene	0.044	0.025	0.044	0.025	0.0345
Benzo(a)anthracene	0.11	0.11	0.11	0.11	0.11
Chrysene	0.14	0.063	0.14	0.063	0.1015
Benzo(b)fluoranthene	0.033	0.11	0.11	0.033	0.0715
Benzo(k)fluoranthene	0.15	0.2	0.2	0.15	0.175
Benzo(a)pyrene	0.078	0.11	0.11	0.078	0.094
Indeno(1,2,3,-cd)pyrene	0.12	0.089	0.12	0.089	0.1045
Dibenzo(a,h)anthracene	0.058	0.025	0.058	0.025	0.0415
Benzo(g,h,i)perylene	0.11	0.13	0.13	0.11	0.12
Phenols					
Phenol	< 1	< 0.5			
2-Chlorophenol	< 1	< 0.5			
2-Nitrophenol	< 1	< 0.5			
2,4,-Dimethylphenol	< 1	< 0.5			
2,4-Dichlorophenol	< 1	< 0.5			
2,6-Dichlorophenol	< 1	< 0.5			
4-Chloro-3-methylphenol	< 1	< 0.5			
2,4,6,-Trichlorophenol	< 1	< 0.5			
2,4,5-Trichlorophenol	< 1	< 0.5			
2,4-Dinitophenol	< 10	< 5.0			
4-Nitrophenol	< 1	< 0.5			
2,3,5,6-Tetrachlorophenol	< 2	< 1.0			
2,3,4,6-Tetrachlorophenol	< 2	< 1.0			
2-Methyl-4,6-dinitrophenol	< 1	< 0.5			
Pentachlorophenol	< 1	< 0.5			
Metals					
Arsenic (Total)	36	73.7	73.7	36	54.85
Copper (Total)	46	49.9	49.9	46	47.95
Chromium (Total)	71.3	54.6	71.3	54.6	62.95
Zinc (Total)	128	199.9	199.9	128	163.95

Table 2 Composite Data and Summary Statistics
Media: Soil

Contaminants of Intrest	SS98-12 COMP 10/7/98 (mg/kg)	SS98-1-4COMP 2/3/98 (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Mean (mg/kg)
Dioxins/Furans [a]					
2378-TCDD	8.7	< 50	< 50	8.7	16.9
1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD)	42.7	< 90	< 90	42.7	43.9
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	219	< 310	219	< 310	192.0
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	1070	410	1070	410	740.0
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin (HxCDD)	335	< 270	335	< 270	235.0
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (HpCDD)	25770	7940	25770	7940	16855.0
octachlorodibenzo-p-dioxin (OCDD)	412130	160370	412130	160370	286250.0
2,3,7,8-tetrachlorodibenzofuran (TCDF)	22.7	<30	22.7	<30	18.9
1,2,3,7,8-pentachlorodibenzofuran (PeCDF)	55.6	< 50	55.6	< 50	40.3
2,3,4,7,8-pentachlorodibenzofuran (PeCDF)	38.6	< 50	38.6	< 50	31.8
1,2,3,4,7,8-hexachlorodibenzofuran (HxCDF)	343	< 190	343	< 190	219.0
1,2,3,6,7,8-hexachlorodibenzofuran (HxCDF)	112	< 160	112	< 160	96.0
2,3,4,6,7,8-hexachlorodibenzofuran (HxCDF)	171	< 190	171	< 190	133.0
1,2,3,7,8,9-HxCDF	13.1	< 210	< 210	13.1	59.1
1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF)	6750	2080	6750	2080	4415.0
1,2,3,4,7,8,9-heptachlorodibenzofuran (HpCDF)	372	< 420	372	< 420	291.0
octachlorodibenzofuran (OCDF)	12730	7740	12730	7740	10235.0

a = Dioxins/Furans in ng/kg

Table 3 Composite Data and Summary Statistics
Media: Soil

Contaminants of Intrest	SD98-6 (mg/kg)
Polycyclic Aromatic Hydrocarbons	
Naphthalene	ND
Acenaphthylene	0.052
Acenaphthene	
Fluorene	ND
Phenanthrene	0.016
Anthracene	0.1
Fluoranthene	0.027
Pyrene	0.024
Benzo(g,h,i,)perylene	0.027
Chrysene	0.015
Benzo(a)anthracene	0.04
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Benzo(a)pyrene	0.013
Dibenzo(a,h)anthracene	0.01
Indeno(1,2,3-cd)pyrene	0.027
Phenols	
Phenol	< 0.5
2-Chlorophenol	< 0.5
2-Nitrophenol	< 0.5
2,4,-Dimethylphenol	< 0.5
2,4-Dichlorophenol	< 0.5
2,6-Dichlorophenol	< 0.5
4-Chloro-3-methylphenol	< 0.5
2,4,6,-Trichlorophenol	< 0.5
2,4,5-Trichlorophenol	< 0.5
2,4-Dinitophenol	< 5.0
4-Nitrophenol	< 0.5
2,3,5,6-Tetrachlorophenol	< 1.0
2,3,4,6-Tetrachlorophenol	< 1.0
2-Methyl-4,6-dinitrophenol	< 0.5
Pentachlorophenol	< 0.5

Table 3 Composite Data and Summary Statistics
Media: Soil

Contaminants of Intrest	SD98-6 (mg/kg)
Metals	
Arsenic	58.9
Chromium(III)	40.8
Chromium(VI)	40.8
copper	84.2
zinc	288
Dioxins/Furans [a]	
2378-TCDD	12.9
1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD)	96.7
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	556
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	1360
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin (HxCDD)	668
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (HpCDD)	25830
octachlorodibenzo-p-dioxin (OCDD)	173880
2,3,7,8-tetrachlorodibenzofuran (TCDF)	14.4
1,2,3,7,8-pentachlorodibenzofuran (PeCDF)	33.2
2,3,4,7,8-pentachlorodibenzofuran (PeCDF)	34.4
1,2,3,4,7,8-hexachlorodibenzofuran (HxCDF)	209
1,2,3,6,7,8-hexachlorodibenzofuran (HxCDF)	129
2,3,4,6,7,8-hexachlorodibenzofuran (HxCDF)	236
1,2,3,7,8,9-HxCDF	12.9
1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF)	2890
1,2,3,4,7,8,9-heptachlorodibenzofuran (HpCDF)	181
octachlorodibenzofuran (OCDF)	4870

a = Dioxins/Furans in ng/kg

Table 4 Calculated Composite Concentration for Phenols in Soil Sampled February 3, 1998

Contaminant of Interest	SS98-1 2/3/98 (mg/kg)	SS98-2 2/3/98 (mg/kg)	SS98-3 2/3/98 (mg/kg)	SS98-4 2/3/98 (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)
Phenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Chlorophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2-Nitrophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,4,-Dimethylphenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,4-Dichlorophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,6-Dichlorophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
4-Chloro-3-methylphenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,4,6,-Trichlorophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,4,5-Trichlorophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,4-Dinitophenol	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
4-Nitrophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,3,5,6-Tetrachlorophenol	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,3,4,6-Tetrachlorophenol	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Methyl-4,6-dinitrophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pentachlorophenol	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Table 5 Calculated Composite Concentration for Metals in Soil Sampled February 3, 1998

Contaminant of Interest	SS98-1 2/3/98 (mg/kg)	SS98-2 2/3/98 (mg/kg)	SS98-3 2/3/98 (mg/kg)	SS98-4 2/3/98 (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Mean (mg/kg)	UCL95 (SS98-1-4COMP) (mg/kg)
Arsenic (Total)	80.5	72.7	13.8	43.6	80.5	13.8	52.65	73.7
Copper (Total)	62.8	44.6	41.6	38.5	62.8	38.5	46.875	49.9
Chromium (Total)	38.8	21.7	61.9	27.7	61.9	21.7	37.525	54.6
Zinc (Total)	231	176	110	114	231	110	157.75	199.9

Table 6

Calculated Composite Concentration for Polycyclic Aromatic Hydrocarbons in Soil Sampled February 3, 1998

Contaminant of Interest	SS98-1 2/2/98 (mg/kg)	SS98-2 2/2/98 (mg/kg)	SS98-3 2/2/98 (mg/kg)	SS98-4 2/2/98 (mg/kg)	Maximum Detected (mg/kg)	Minimum Detected (mg/kg)	Mean (mg/kg)	UCL95 (SS98-1-4 COMP) (mg/kg)
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		0.05
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1
Fluorene	< 0.01	0.01010	0.0105	0.0104	0.0104	0.005	0.0077	0.011
Phenanthrene	0.021	0.011	0.017	0.017	0.021	0.011	0.0165	0.019
Anthracene	0.058	0.021	0.055	0.055	0.058	0.021	0.04725	0.06
Fluoranthene	0.039	0.025	0.038	0.038	0.039	0.025	0.035	0.039
Pyrene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		0.025
Benzo(a)anthracene	0.04	0.027	0.115	0.115	0.115	0.027	0.07425	0.11
Chrysene	0.032	0.027	0.066	0.066	0.066	0.027	0.04775	0.063
Benzo(b)fluoranthene	0.075	0.051	0.213	0.213	0.213	0.051	0.138	0.11
Benzo(k)fluoranthene	0.039	0.032	0.115	0.115	0.115	0.032	0.07525	0.2
Benzo(a)pyrene	0.025	0.023	0.094	0.094	0.094	0.023	0.059	0.11
Indeno(1,2,3,-cd)pyrene	0.074	0.052	0.212	0.212	0.212	0.052	0.1375	0.089
Dibenzo(a,h)anthracene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		0.025
Benzo(g,h,i)perylene	0.047	0.035	0.142	0.142	0.142	0.035	0.0915	0.13

Table 7. Screening Benchmark Value (SBV) for Soil

Constituent	Terrestrial Receptor	Endpoint	Ltierature Toxicity Value (mg/kg)	SBV (mg/kg)	Reference
Acenaphthylene	terrestrial	NOEC	95	6	a
Fluorene	terrestrial	NOEC	95	6	a
Phenanthrene	terrestrial	NOEC	95	6	Denneman and van Gestral, 1990
Anthracene	terrestrial	NOEC	95	6	a
Fluoranthene	terrestrial	NOEC	95	6	a
Pyrene	terrestrial	NOEC	2500	156	b
Benzo(g,h,i,)perylene	terrestrial	NOEC	2500	156	b
Chrysene	terrestrial	NOEC	2500	156	b
Benzo(a)anthracene	terrestrial	NOEC	2500	156	b
Benzo(b)fluoranthene	terrestrial	NOEC	2500	156	b
Benzo(k)fluoranthene	terrestrial	NOEC	2500	156	b
Benzo(a)pyrene	terrestrial	NOEC	2500	156	Denneman and van Gestral, 1990
Dibenzo(a,h)anthracene	terrestrial	NOEC	2500	156	b
Indeno(1,2,3-c,d)pyrene	terrestrial	NOEC	2500	156	b
Benzo(b+k)fluoranthene	terrestrial	NOEC	2500	156	b
Indeno(1,2,3-c,d)pyrene	terrestrial	NOEC	2500	156	b

NOEC (no-observed-effect-concentration) - the highest concentration of a test material to which organisms are exposed that does not cause any observed or statistically significant effect to the organism.

a - value represents NOEC for phenanthrene and is used as surrogate

b - value represents NOEC for benzo(a)pyrene and is used as surrogate

Denneman, C.A.J. and van Gestral, C.A.M., 1990. Soil Contamination and Soil Ecosystems: Proposal for C- (test) Values Based on Ecotoxicological Risk, National Institute of Public Health and Environmental Protection, RIVM, the Netherlands, April, 1990

Table 8 A Comparison of 50 Times the Screening Benchmark Value to the Concentration of Polycyclic Aromatic Hydrocarbons (PAHs) in Soil for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Contaminants of Intrest	SBV[a]plants (mg/kg)	SBVplants x 50 (mg/kg)	SBVinverts[b] (mg/kg)	SBVinverts x 50 (mg/kg)	SBVbirds (mg/kg)	SBVbirds x 50 (mg/kg)	SBVmammals (mg/kg)	SBVmammals x 50 (mg/kg)	Soil Concentration (mg/kg)	CPEC[d]
Acenaphthylene	6		6		6		6		0.12	No
Fluorene	6		30	1500	6		6		0.041	No
Phenanthrene	6		6		6		6		0.025	No
Anthracene	6		6		6		6		0.2	No
Fluoranthene	6		6		6		6		0.039	No
Pyrene	156		156		156		156		0.044	No
Benzo(g,h,i,)perylene	156		156		156		156		0.11	No
Chrysene	156		156		156		156		0.14	No
Benzo(a)anthracene	156		156		156		156		0.11	No
Benzo(b)fluoranthene	156		156		156		156		0.2	No
Benzo(k)fluoranthene	156		156		156		156		0.11	No
Benzo(a)pyrene	7		156		7		7	350	0.153	No
Dibenzo(a,h)anthracene	156		156		156		156		0.058	No
Indeno(1,2,3-cd)pyrene	156		156		156		156		0.13	No

There are no screening benchmark values for PAHs in soil except for benzo(a)pyrene with respect to mammals and Fluoroanthene with respect to soil invertebrates therefore PAHs will be carried forward int the risk assessment with respect to all but these endpointsthese endpoints

a - SBV = Screening Benchmark Value

b - inverts = invertebrates

* Benzo(k)fluoranthene sediment SBV used as surrogate for Benzo(b)fluoranthene

EPV - Exposure Point Value

Table 9. A Comparison of 50 Times the Screening Benchmark Value to the Concentrations of Phenols in Soil for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Sample ID Date Sampled	Soil Concentration (mg/kg)	CPEC
Phenol	< 1	no
2-Chlorophenol	< 1	no
2-Nitrophenol	< 1	no
2,4,-Dimethylphenol	< 1	no
2,4-Dichlorophenol	< 1	no
2,6-Dichlorophenol	< 1	no
4-Chloro-3-methylphenol	< 1	no
2,4,6,-Trichlorophenol	< 1	no
2,4,5-Trichlorophenol	< 1	no
2,4-Dinitophenol	< 10	no
4-Nitrophenol	< 1	no
2,3,5,6-Tetrachlorophenol	< 2	no
2,3,4,6-Tetrachlorophenol	< 2	no
2-Methyl-4,6-dinitrophenol	< 1	no
Pentachlorophenol	< 1	no

Table 10. A Comparison of 50 Times the Screening Benchmark Value to the Concentration of Selected Metals in Soil for the Selection of Contaminants of Potential Ecological Concern

Contaminants of Intrest	Background	SBV[a]plants (mg/kg)[c]	SBVplants x 50 (mg/kg)	SBVinverts[b] (mg/kg)	SBVinverts x 50 (mg/kg)	SBVbirds (mg/kg)	SBVbirds x 50 (mg/kg)	SBVmammals (mg/kg)	SBVmammals x 50 (mg/kg)	Soil Concentration (mg/kg)	CPEC
Arsenic	10	10	500	60	3000	126	13000	8	400	73.7	No
Chromium(III)	61	1	50	0.4	20			33000	165000	49.9	No
Chromium(VI)						49	2450	30	1500		No
Copper	41	100	5000	50	2500	605	30500	184	9200	71.6	No
Zinc	104	50	2500	200	10000	1284	64200	3800	190000	199.9	No

a - SBV = Screening Benchmark Value
b - inverts = invertebrates
c - mg/kg = milligrams per kilogram
EPV - Exposure Point Value

Table 11. A Comparison of 50 Times the Screening Benchmark Value to the Concentration of Dioxin/Furan and Congeners in Soil for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Contaminants of Intrest	I-TEF[a]	SBV[b] birds pg/kg(ppt)	SBVbirds x 50 pg/kg(ppt)	SBVmammals pg/kg(ppt)	SBVmammals x 50 pg/kg(ppt)	Soil Concentration pg/kg(ppt)	TCDD-EQ pg/kg(ppt)	CPEC
2378-TCDD	1	100[c]	5000	10[c]	500	8.7	8.7	Yes
1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD)	0.5	200[d]	10000	20[d]	1000	42.7	21.35	Yes
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	0.1	1000[d]	50000	100[d]	5000	219	21.9	Yes
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	0.1	1000[d]	50000	100[d]	5000	1070	107	Yes
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin (HxCDD)	0.1	1000[d]	50000	100[d]	5000	335	33.5	Yes
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (HpCDD)	0.01	10000[d]	500000	1000[d]	50000	25770	257.7	Yes
octachlorodibenzo-p-dioxin (OCDD)	0.001	100000[d]	5000000	10000[d]	500000	412130	412.13	Yes
2,3,7,8-tetrachlorodibenzofuran (TCDF)	0.1	8[c]	400	100[d]	5000	22.7	2.27	Yes
1,2,3,7,8-pentachlorodibenzofuran (PeCDF)	0.05	2000[d]	100000	2000[c]	100000	55.6	2.78	Yes
2,3,4,7,8-pentachlorodibenzofuran (PeCDF)	0.5	200[d]	10000	200[c]	10000	38.6	19.3	Yes
1,2,3,4,7,8-hexachlorodibenzofuran (HxCDF)	0.1	1000[d]	50000	100[d]	5000	343	34.3	Yes
1,2,3,6,7,8-hexachlorodibenzofuran (HxCDF)	0.1	1000[d]	50000	2000[c]	100000	112	11.2	Yes
2,3,4,6,7,8-hexachlorodibenzofuran (HxCDF)	0.1	1000[d]	50000	100[d]	5000	171	17.1	Yes
1,2,3,7,8,9-HxCDF	0.1	1000[d]	50000	100[d]	5000	13.1	1.31	Yes
1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF)	0.01	10000[d]	500000	1000[d]	50000	6750	67.5	Yes
1,2,3,4,7,8,9-heptachlorodibenzofuran (HpCDF)	0.01	10000[d]	500000	1000[d]	50000	372	3.72	Yes
octachlorodibenzofuran (OCDF)	0.001	100000[d]	5000000	10000[d]	500000	12730	12.73	Yes
Total TCDD-EQ							1034.49	

Plants and soil invertebrates do not have the Ah receptor and are thus believed to have a relatively low toxicity with respect to dioxin and dioxin like compounds.
a - I-TEF = International Toxicity Equivalents for mammals
b - SBV = Screening Benchmark Value
c - SBVs taken for the "Guidance for Ecological Risk Assessment Level II Screening Benchmark Values (Origon Department of Environmental Quality, 1998)
d - SBVs for dioxin like congeners derived by multiplying the SBV for 2,3,7,8-TCDD by its I-TEF
EPV - Exposure Point Value

Table 12. A Comparison of 10 Times the Screening Benchmark Value to the Concentration of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Contaminants of Intrest	SBV[b] (mg/kg)	SBV x 10	Sediment Concentration (mg/kg)	CPEC
Naphthalene	0.032	0.32	ND	No
Acenaphthylene	0.33	3.3	0.052	No
Fluorene	0.034	0.34	ND	No
Phenanthrene	0.56	5.6	0.016	No
Anthracene	0.032	0.32	0.1	No
Fluoranthene	0.064	0.64	0.027	No
Pyrene	0.57	5.7	0.024	No
Benzo(g,h,i,)perylene	0.29	2.9	0.027	No
Chrysene	0.5	5	0.015	No
Benzo(a)anthracene	0.26	2.6	0.04	No
Benzo(b)fluoranthene	0.24	2.4*	0.1	No
Benzo(k)fluoranthene	0.24	2.4	0.1	No
Benzo(a)pyrene	0.35	3.5	0.013	No
Dibenzo(a,h)anthracene	0.23	2.3	0.01	No
Indeno(1,2,3-cd)pyrene	0.078	0.78	0.027	No

* Benzo(k)fluoranthene sediment SBV used as surrogate for Benzo(b)fluoranthene

a - SBV = Screening Benchmark Value

Table 13. A Comparison of 10 Times the Screening Benchmark Value to the Concentrations of Phenols in Sediment for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Sample ID Date Sampled	Sediment Concentration (mg/kg)	CPEC
Phenol	< 0.5	no
2-Chlorophenol	< 0.5	no
2-Nitrophenol	< 0.5	no
2,4,-Dimethylphenol	< 0.5	no
2,4-Dichlorophenol	< 0.5	no
2,6-Dichlorophenol	< 0.5	no
4-Chloro-3-methylphenol	< 0.5	no
2,4,6,-Trichlorophenol	< 0.5	no
2,4,5-Trichlorophenol	< 0.5	no
2,4-Dinitophenol	< 5.0	no
4-Nitrophenol	< 0.5	no
2,3,5,6-Tetrachlorophenol	< 1.0	no
2,3,4,6-Tetrachlorophenol	< 1.0	no
2-Methyl-4,6-dinitrophenol	< 0.5	no
Pentachlorophenol	< 0.5	no

Table 14. A Comparison of 10 Times the Screening Benchmark Value to the Concentration of Selected Metals in Sediment for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Contaminants of Intrest	SBV[b] (mg/kg)	SBV x 10	Sediment Concentration (mg/kg)	CPEC
Arsenic	12	120	58.9	No
Chromium(III)	56	2800	40.8	No
Chromium(VI)			40.8	
copper	28	1400	84.2	No
zinc	159	79500	288	No

a - SBV = Screening Benchmark Value
c - mg/kg = milligrams per kilogram

Table 15. A Comparison of 10 Times the Screening Benchmark Value to the Concentration of Dioxin/Furan and Congeners in Sediment for the Selection of Contaminants of Potential Ecological Concern (CPEC)

Contaminants of Intrest	I-TEF[a]	Sediment Concentration (ppt)	TCDD-EQ (ppt)	CPEC
Dioxin/Furan				
2378-TCDD	1	12.9	12.9	Yes
1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD)	0.5	96.7	48.35	Yes
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	0.1	556	55.6	Yes
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin (HxCDD)	0.1	1360	136	Yes
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin (HxCDD)	0.1	668	66.8	Yes
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (HpCDD)	0.01	25830	258.3	Yes
octachlorodibenzo-p-dioxin (OCDD)	0.001	173880	173.88	Yes
2,3,7,8-tetrachlorodibenzofuran (TCDF)	0.1	14.4	1.44	Yes
1,2,3,7,8-pentachlorodibenzofuran (PeCDF)	0.05	33.2	1.66	Yes
2,3,4,7,8-pentachlorodibenzofuran (PeCDF)	0.5	34.4	17.2	Yes
1,2,3,4,7,8-hexachlorodibenzofuran (HxCDF)	0.1	209	20.9	Yes
1,2,3,6,7,8-hexachlorodibenzofuran (HxCDF)	0.1	129	12.9	Yes
2,3,4,6,7,8-hexachlorodibenzofuran (HxCDF)	0.1	236	23.6	Yes
1,2,3,7,8,9-HxCDF	0.1	12.9	1.29	Yes
1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF)	0.01	2890	28.9	Yes
1,2,3,4,7,8,9-heptachlorodibenzofuran (HpCDF)	0.01	181	1.81	Yes
octachlorodibenzofuran (OCDF)	0.001	4870	4.87	Yes
Total			866.4	

a - I-TEF = International Toxicity Equivalents for mammals
b - SBV = Screening Benchmark Value

KEYSTONE ENVIRONMENTAL

Table 16 Literature Soil to Plant, Sediment to Invertebrate, and Small Mammal Uptake factors

Chemical	Soil-to-Plant Wet Uptate	Sediment-to-Invertebrate Uptake	Log Kow	Small Mammal Uptake	Molecular Weight	Reference
HpCDD, 2,3,7,8-	2.40E-04				425.31	a
OCDD	6.20E-05					a
OCDF	7.90E-05					a
PeCDD, 2,3,7,8-	1.30E-03					a
PeCDF, 1,2,3,7,8-	8.90E-04					a
PeCDF, 2,3,4,7,8-	7.50E-04					a
TCDD, 2,3,7,8-	8.80E-04	0.99	6.54	1.77	322	a,b,c,d
TCDF, 2,3,7,8-	3.20E-03					a

Log Kow - Logrithim of the octanol-water partition coefficient
a - Toxicity and Chemical specific factors Data Base (Rrisk Assessment Program Oak Ridge National Laboratory
b - Sample et al Development and Bioaccumulation Model for Earthworms ES/ER/TM-200 ORNL Oak Ridge, Tenn.
c - Suter G.W. 1997. Guidance For Ecological Risk Estimation Methods
d - Sample et al, 1998 Development and validation of Bioaccumulation Models for Small Mammals

Table 17 The Earthworm Bioaccumulation Factor (BAF)

$$BCF = \frac{F_{water} + F_{fat} + Kow}{\rho_{worm}}$$

Chemical	F_{water}	F_{fat}	Kow	ρ_{worm}	BCF
2,3,7,8 -TCDD	8.400E-01	1.000E-02	3.467E+06	1.000E+03	3.467E+03

$$BAF = \frac{\frac{k_1}{Kp} + k_f}{k_2 + k_g + k_m}$$

3388441.56

Chemical	k_1	k_f	Kp	k_2	k_g	k_m	BCF	BAF
2,3,7,8 -TCDD	3.50E-01	3.40E-02	2.50E+00	1.01E-04	5.80E-03	0.00E+00	3.47E+03	2.95E+01

Table 18 Foraging Home Range

Species	Foraging Home Range (A_h) (m^2)	FHR Diameter (m)	Local Population Boundary Diameter (D_h) (m^2)	Preferred Habitat Type	Area (m^2)
Deer mouse	900	34	170	Any	1.88E+05
American Kestrel	1200000	1236	6180	grasslands,deserts, junipe woodlands, meadows	1.28E+08

Table 19: Deer Mouse Results of Exposure Model Calculations for Dioxin

Endpoint Species > Deer Mouse	Area #1 grass/shrubs	Area #2 Intermittent Pond	Area #3 grass	Area #4 gass/storage
Habitat (k)	1	2	4	5
Habitat Quality	0.75	0.75	0.75	0.25
Relative Habitat Quality (Hqk)	0.300	0.300	0.300	0.100
Habitat Area (metres2)	12138	2023	66714	38243
Total Area (metres2)				119118
Geometric Mean of Soil Concentration (Cijk)	1.034E-03	8.660E-04	2.000E-05	2.000E-05
Standard Deviation of Soil Concentrations	5.120E-04	5.120E-04	1.000E-05	1.000E-05
Plant Concentration (based on uptake factor = 8.8e-4)	9.099E-07	7.621E-07	1.760E-08	1.760E-08
Invertebrate Concentration (based on uptake factor =29.5)	3.05E-02	2.55E-02	5.90E-04	5.90E-04
Area use Factor (AU)	1	1	1	1
Seasonality factor	1	0.4	1	1
Body Weight (kilograms)	2.200E-02	2.200E-02	2.200E-02	2.200E-02
Intake Rate (kg/d)	4.180E-03	4.180E-02	4.180E-03	4.180E-03
Exposure Point Value (EPV) (mg/kg/d)	4.583E-05	2.559E-05	4.873E-06	9.311E-07
Total Area (mg/kg/d)				7.723E-05
Natural Logarithm of EPV	-9.990	-10.573	-12.232	-13.887
Mean of Natural Logarithm of EPV area of concern				-11.671
Standard Deviation of Mean of Natural Logarithm of EPV (calculated using Crystal Ball)				0.204
p(EPV>EBV) for area of concern and associated areas				0.0E+00
Number of Individuals With > 10% Chance of EPV > EBV				0.00E+00
Twenty Percent of Individuals Within the Local Population Boundary				47

Table 20: American Kestrel Results of Exposure Model Calculations for Dioxin

Endpoint Species > American Kestrel	Area #1 grass 1	Area #2 wetland	Area #3 Industrial	Area #4 Commercial	Area #5 Residential	Area #6 Vacant
Habitat (k)	1	2	4	4	4	5
Habitat Quality	0.75	0.75	0.5	0.5	0.25	0.75
Relative Habitat Quality (Hqk)	0.300	0.300	0.300	0.300	0.300	0.100
Habitat Area (metres2)	12138	2023	2165788	11160325	35485358	35669659
Total Area (metres2)						84495291
Geometric Mean of Soil Concentration (Cijk)	1.03E-03	8.66E-04	3.200E-05	3.200E-05	3.200E-05	3.200E-05
Standard Deviation of Soil Concentrations	5.120E-04	5.120E-04	1.000E-05	1.000E-05	1.000E-05	1.000E-05
Invertebrate (based on uptake factor = 29.5)	3.050E-02	2.555E-02	9.440E-04	9.440E-04	9.440E-04	9.440E-04
Small mammal (based on uptake factor =1.77)	5.10E-05	5.10E-05	5.10E-05	5.10E-05	5.10E-05	5.10E-05
Area use Factor (AU)	1.44E-04	2.39E-05	2.56E-02	1.32E-01	4.20E-01	4.22E-01
Seasonality factor	1	1	1	1	1	1
Body Weight (kilograms)	0.1200	0.1200	0.12	0.12	0.12	0.12
Intake Rate (kg/d)	0.035	0.035	0.035	0.035	0.035	0.035
Exposure Point Value (EPV) (mg/kg/d)	2.377E-11	5.533E-13	2.498E-08	6.634E-07	6.707E-06	2.259E-06
Total Area (mg/kg/d)						9.654E-06
Natural Logarithm of EPV	-24.463	-28.223	-17.505	-14.226	-11.912	-13.001
Mean of Natural Logarithm of EPV area of concern						-18.222
Standard Deviation of Mean of Natural Logarithm of EPV (calculated using Crystal Ball)						0.152
p(EPV>EBV) for area of concern and associated areas						0.0E+00
Number of Individuals With > 10% Chance of EPV > EBV						0
Twenty Percent of Individuals Within the Local Population Boundary						2

Table 21 Population Abundance

Habitat	k	Area (ha)	Area (m^2)	Endpoint Species	Density (# / ha)	Estimated Abundance
grass/shrub	1	1.214	12138	Deer Mouse	12.7 - 45.5	18 - 64
intermittent pond	2	0.202	2023	Deer Mouse	12.7 - 45.5	4 - 13
grass/shrub	3	6.671	66714	Deer Mouse	12.7 - 45.5	85 - 304
J.H. Baxter active site	4	5.956	59561	Deer Mouse	12.7 - 45.5	76 - 271
grass/storage	5	3.824	38243	Deer Mouse	12.7 - 45.5	49 - 174
grass/shrub	1	1.214	12138	American Kestrel	0.0005 - 0.0012	0 - 0
intermittent pond	2	0.202	2023	American Kestrel	0.0005 - 0.0012	0 - 0
Industrial (1.8%)*	3	216.579	2165788	American Kestrel	0.0005 - 0.0012	0 - 1
Commercial (9.1%)*	4	1116.032	11160325	American Kestrel	0.0005 - 0.0012	1 - 1
Residentrial (28.9%)*	5	3548.536	35485358	American Kestrel	0.0005 - 0.0012	2 - 4
Vacant (29%)*	6	3566.966	35669659	American Kestrel	0.0005 - 0.0012	2 - 4

*The the areas by percentage for each area as communicated by Clair Van Bloem were industrial = 3.5% commercial = 26.5%, residential = 38.5%, vacant = 29%, roads/rail/water = 2%. It was assumed that 50% of industrial land was actively used, building, and/or paved; that 66% of the commercial land was building and/or paved; and 25% of residential land was building and/or paved. Paved areas buildings, active industrial sites, roads, and rail is considered to have a habitat rating of 0 and was not included. 32% of the land fell into this category.

Table 22 Expsosure Benchmark Values (EBV) for Selected Terrestrial and Aquatic Species (LC50 or LD50)

Species	2,3,7,8-TCDD (mg/kg-day)	Reference
Deer Mouse[b]	2.850E-02	EPA 1993
American Kestrel	1.63E-03	Hoffman et al 1991
Earthworm	NA	
Reed Canary grass	NA	
Himilayan blackberry	NA	

EUGENE WEST QUADRANGLE
OREGON – LANE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

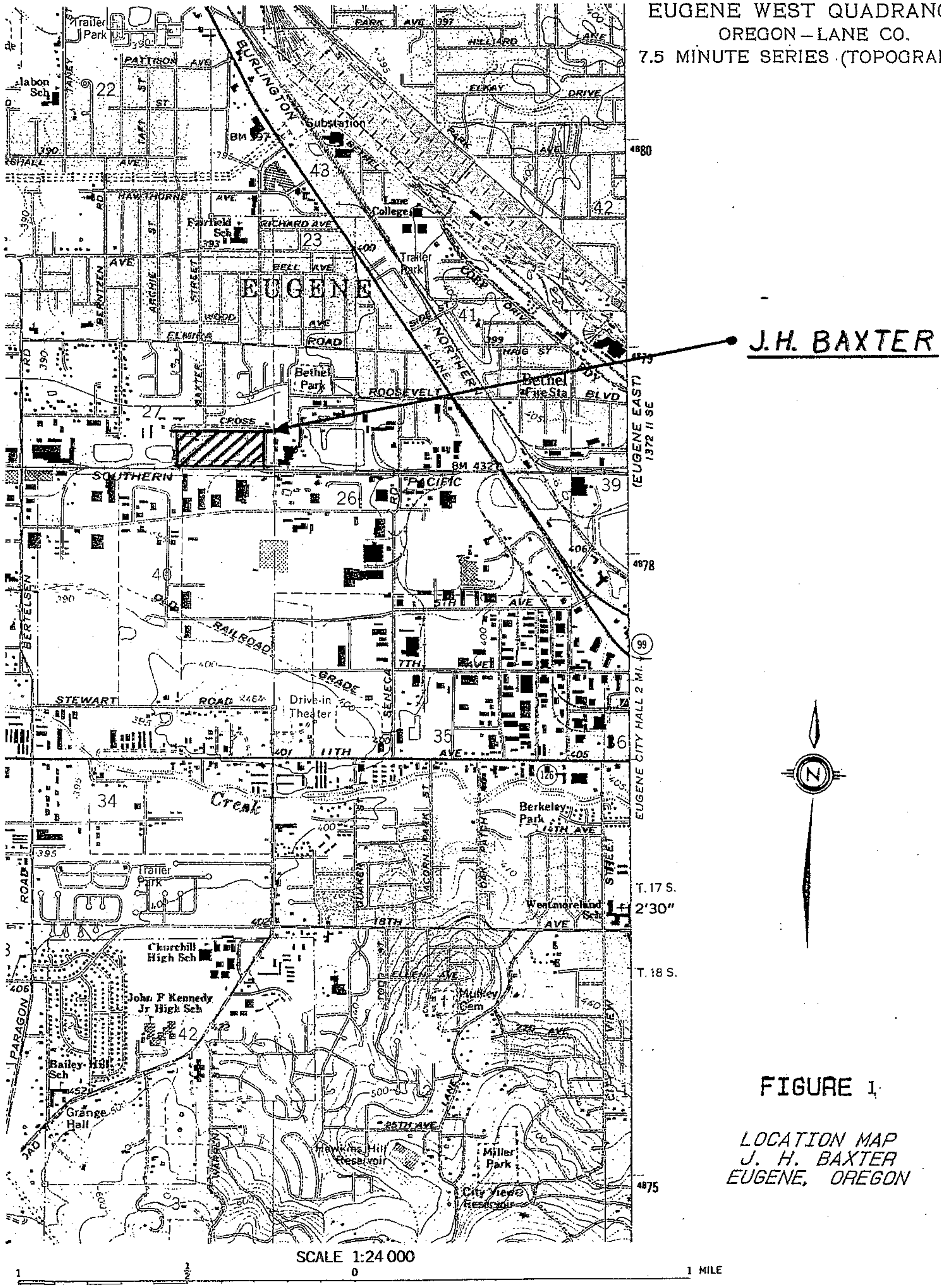
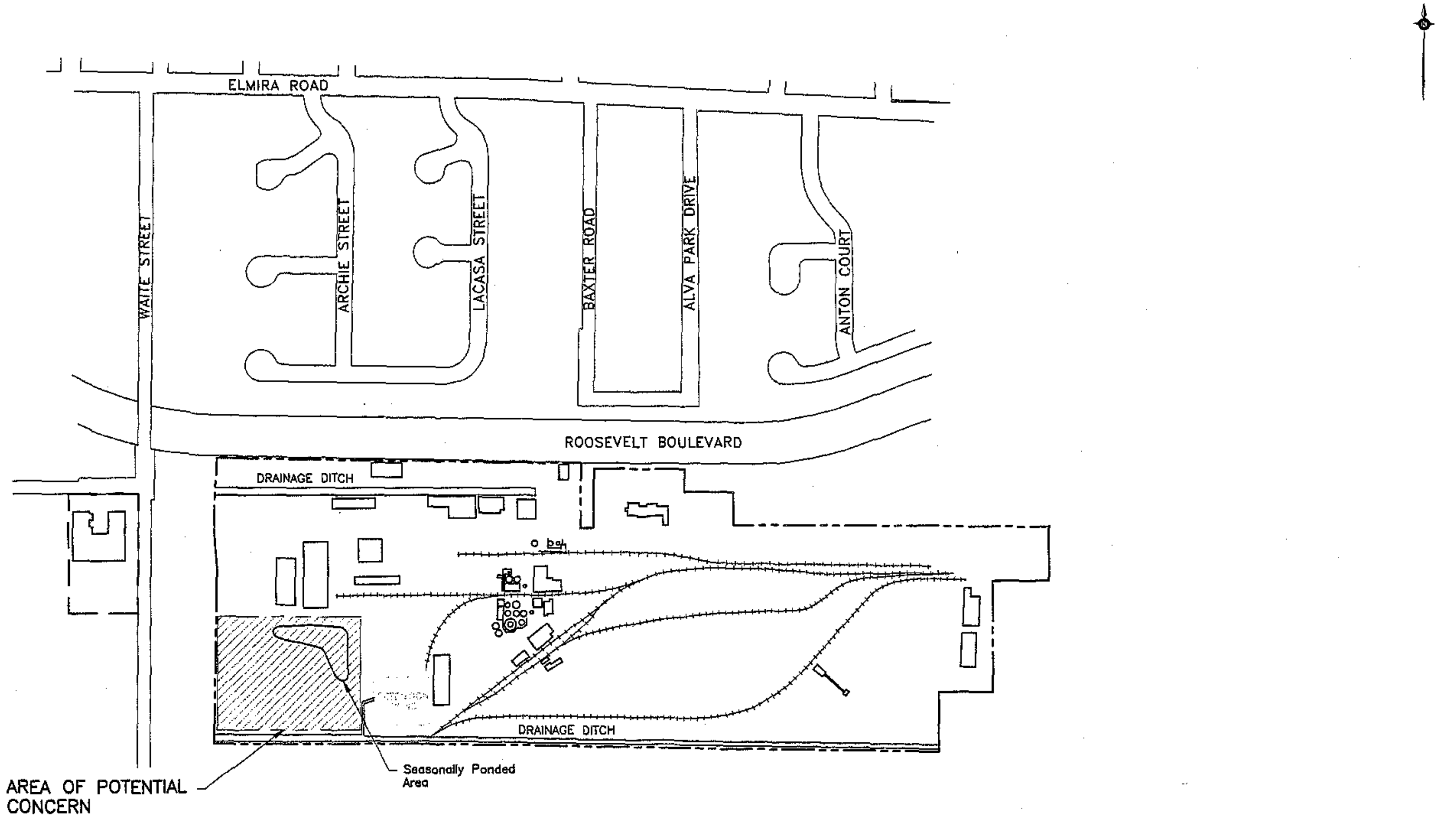


FIGURE 1

LOCATION MAP
J. H. BAXTER
EUGENE, OREGON



KEYSTONE ENVIRONMENTAL

100 0 500ft

SCALE: 1" = 300'

EUGENE, OREGON
J.H. BAXTER

REVISION No.	DATE	PROJECT No.
00	DEC. 1998	6465-14

Figure 2
Area of Potential Concern

ECOLOGICAL RISK ASSESSMENT

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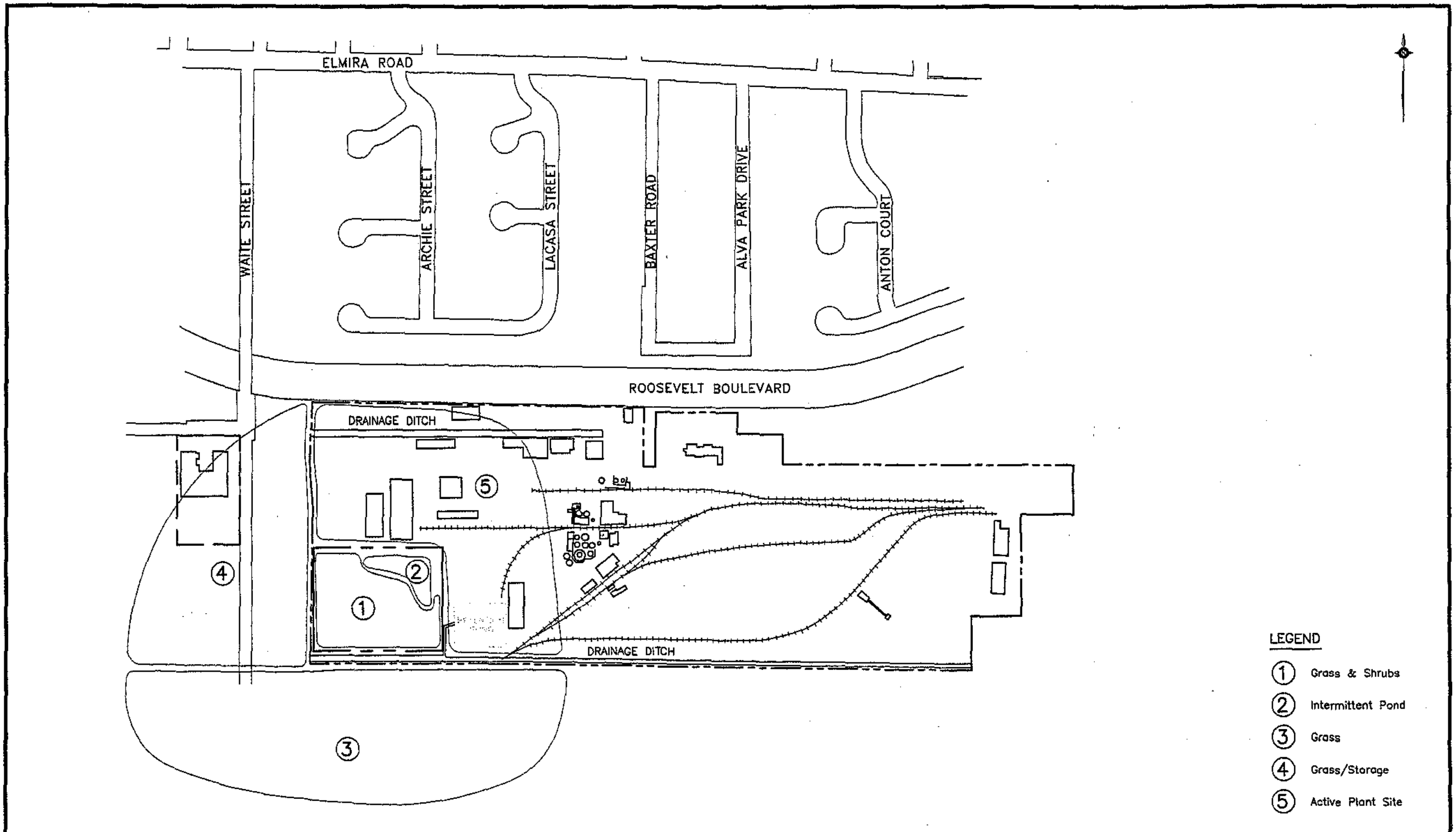

KEYSTONE ENVIRONMENTAL

EUGENE, OREGON
J.H. BAXTER

REVISION No.	DATE	PROJECT No.
00	DEC. 1998	6465-14

Figure 6
Deer Mouse
Local Population Boundary
ECOLOGICAL RISK ASSESSMENT

CADD FILE NO. 6465\Phase14\Figures\Fig6.DWG PLOT SCALE: 1:300 DRAWN BY: B.H.P.

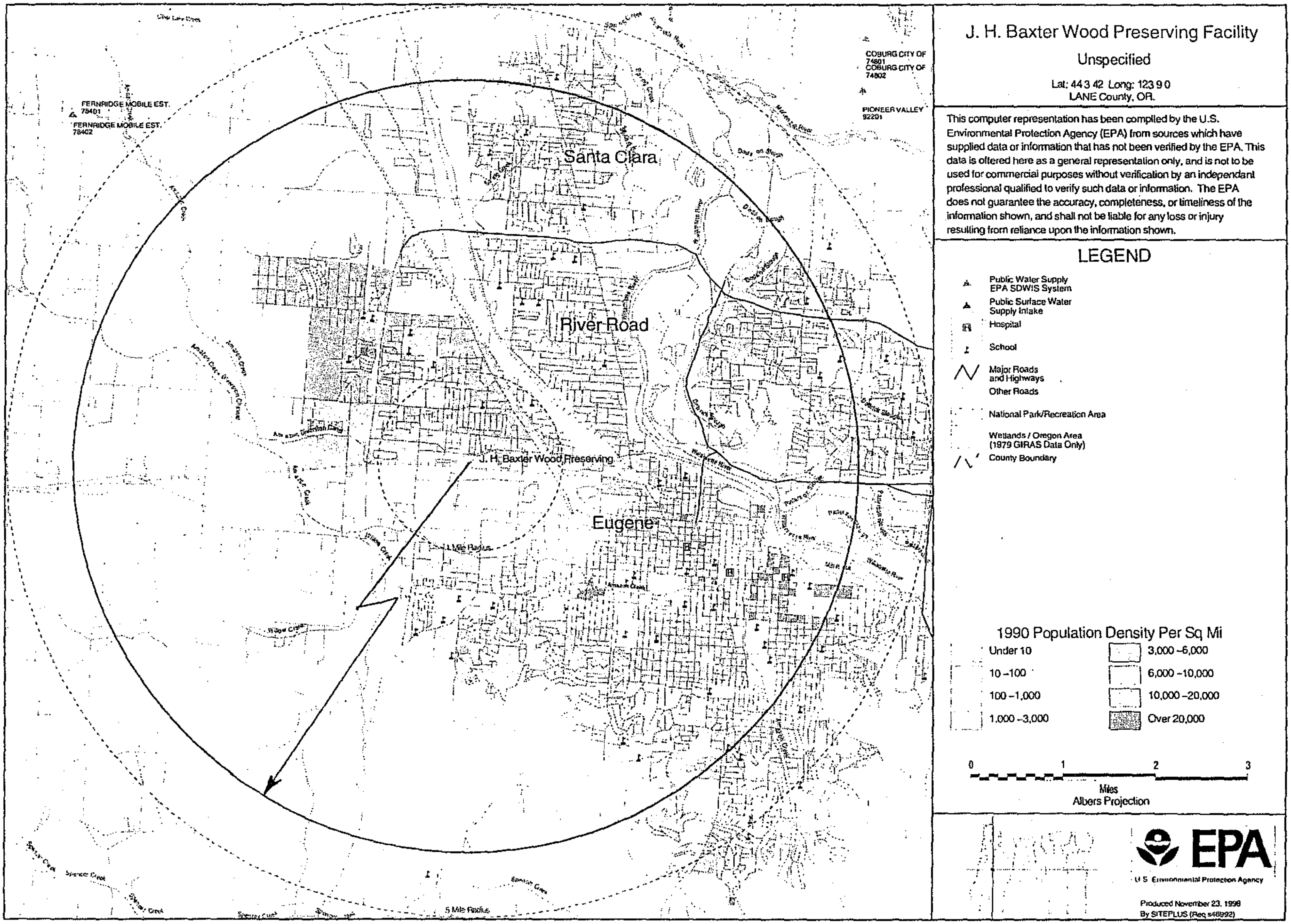

FIGURE 7 – **Local Population Boundary for the American Kestrel**

APPENDIX A

Species and Habitat Survey

Salix Associates 2525 Potter, Eugene, OR 97405 • 541.343.2364 • fax 541.341.1752

Inventory and Habitat Assessment for Rare Plant Species for the J. H. Baxter Site and Reference Site Eugene, Oregon

Introduction

Salix Associates was requested by Keystone Environmental to inventory plant and animal species of the J. H. Baxter site, and assess habitats for possible occurrence of rare species. A visit to a nearby reference site also was requested. The site visits occurred on September 16 and 18, 1998.

Site Descriptions

The Baxter site is located on the south side of Roosevelt Street in west Eugene, about half way between Seneca and Bertelsen streets (Attachment A). The site is mostly developed with heavy industrial operations, primarily related to treating wood with preservatives. The subject portion of the site (hereinafter called "Site 1") is in the southwest corner, and is approximately 3.5 acres in size. It measures about 300' in a north-south direction, and 500' in an east-west direction. The land form is generally flat, however an L shaped berm several feet in height is present along the south and west sides of the site. (The exact height of the berm is difficult to determine because of thick cover of Himalaya blackberry.) The source of material in the berm is not known to the site manager, but likely originated from the excavated retention pond directly to the east. Along the north edge and in the northeast corner is a low-lying area that ponds water through the winter and into the spring. The area was dry at the time of field surveys. A small ditch, also dry at the time of the surveys, is located along the south property line. A chain link fence is located along the west and south property lines bordering the subject site. A railroad line runs east-west immediately south of the site, and industrial uses border on the west, north and east sides.

The reference site ("Site 2") begins approximately 1/4 mile to the west, on the southwest corner of Bertelsen and Roosevelt streets, and runs westward another 1/4 mile. It is about 16.5 acres in size, and also is flat except for a berm and two drainage channels. The large berm runs towards the west from the old home site, which is just southwest of the northeast corner. Drainageways several feet wide and of unknown depth run along the west and south boundaries of the site. Both drainageways contained water at the time of the field surveys.

Habitat Assessment

Site 1 is dominated by scrub-shrub and emergent wetland habitats, and upland herb-dominated habitats. Scrub-shrub dominates the berms along the west and south portions. The dominant species on the berms is Himalaya blackberry (*Rubus discolor*), an introduced pest. (Species seen at the site are listed in Attachment B.)

The low emergent wetland in the north/northeast portion of Site 1 is dominated by creeping foxtail (*Alopecurus geniculatus*) and nodding beggars-tick (*Bidens cernua*). These plants are of low stature, averaging one to two decimeters in height. Reed canarygrass (*Phalaris arundinacea*) is encroaching around the perimeter, and a few small patches are scattered in the wetland. According to the site manager, the area has standing water through late spring and into early summer. A few Piper's willows (*Salix hookeriana*) are along the northern edge of the emergent wetland.

Between the berms along the south and west sides, and this wetland, is an uneven area dominated by reed canarygrass (averaging approximately a meter in height or more), occasional patches of Himalaya blackberry, and other weeds. This area comprises the majority of the site. It is likely that the area is transitional between wetlands and uplands.

Overall, the site has been disturbed extensively, and now is overwhelmingly dominated by non-native weeds. The habitats have some value for insects, small mammals and songbirds. Occasionally, other medium sized mammals (in addition to nutria), and raptors (such as American kestrels or sharp-shinned hawks) and shorebirds (such as killdeer and common snipe) could be expected to use the area.

Site 2 is much larger and more complex than Site 1. Large scale disturbance also has occurred on this site, as evidenced by the presence of straight drainage channels, a large berm, large fields of planted pasture grasses, and a former home site. Species seen at the site are listed in Attachment B.

The large, mostly open areas to the south and east of the former home site contain a variety of emergent and scrub-shrub wetland patches. Overall, the area is dominated by tall fescue (*Festuca arundinacea*), a weedy pasture grass. Some patches of emergent wetlands have significant populations of native species such as tufted hairgrass (*Deschampsia cespitosa*, particularly toward the southeast corner of the site). Patches of scrub-shrub wetlands near the central and south central portion of the site are dominated by Piper's willow (*Salix hookeriana*). Channelized drainages on the west and south borders probably are perennial waterways, or nearly so. Both drainages contained water at the time of the field surveys after a long summer drought period, and both have banks dominated by non-native grasses. The only forested habitat on the site is a grove of ornamental trees surrounding the former home site. Significant use by transient campers was noted in this area, primarily by the presence of garbage, and evidence of parked vehicles and trampling.

Rare Plant and Animal Species

Rare federally or state listed species which occur in the west Eugene area usually are found in undisturbed or slightly disturbed habitats. Most rare plant species in the area are associated with native wet prairies. Potentially occurring rare species are listed in the table in Attachment C, as are other rare species tracked by the Oregon Natural Heritage Program. Occurrence of any of these species on the Baxter site is highly unlikely because of the high level of disturbance of the habitat, dominance of the site by aggressive non-native species (Himalaya blackberry and reed canarygrass), and the small size and isolated character. Occurrence of several of these species is possible on the reference site because of overall higher quality of habitat (in the open field areas), larger size, and greater connectivity to other west Eugene open spaces.

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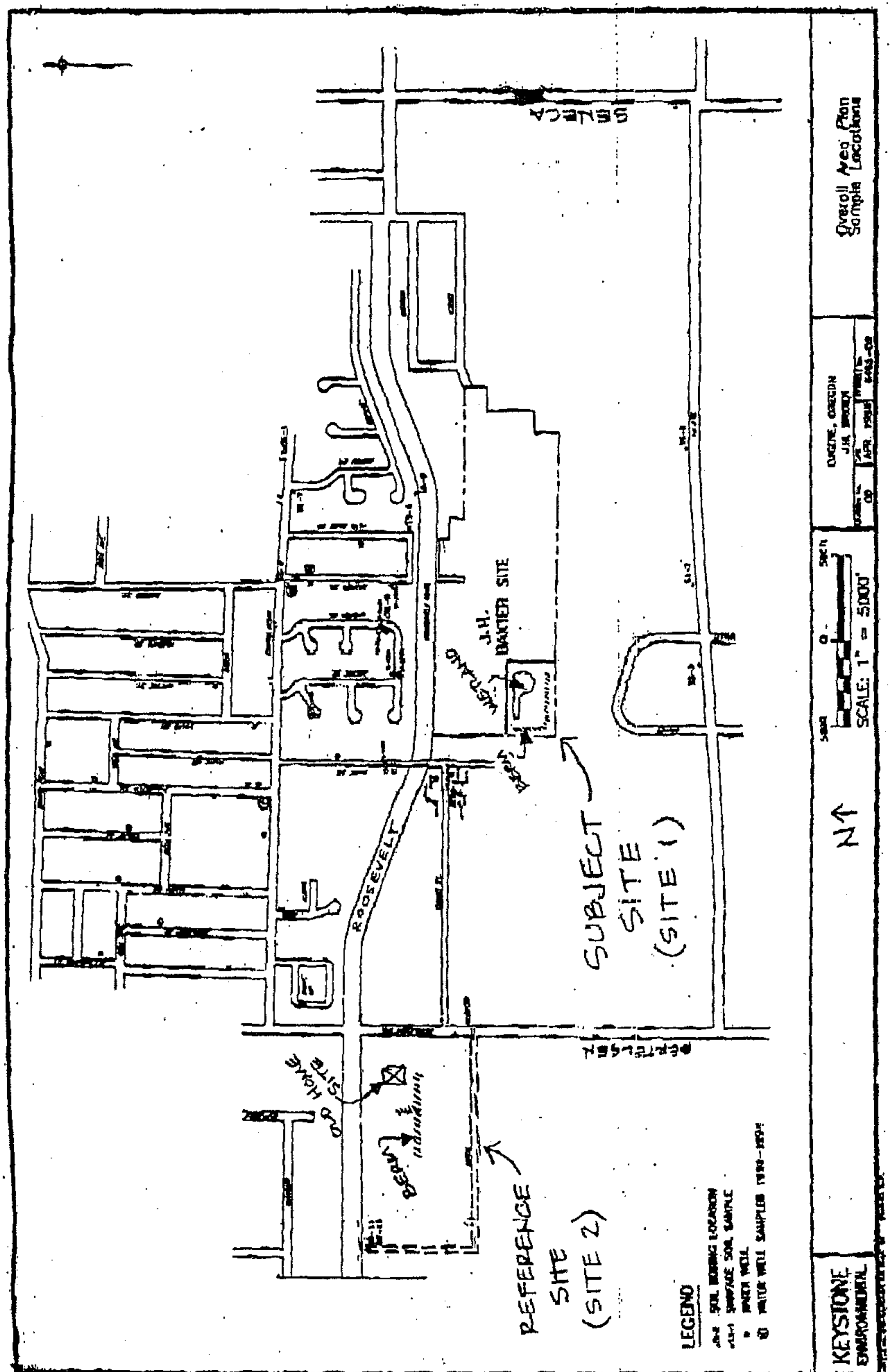
ATTACHMENTS

A Location maps

B Species lists
- Baxter Site
- Reference Site

C Potentially Occurring Rare Species

ATTACHMENT A



ATTACHMENT B

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Preliminary Plant and Animal Species List for the JH Baxter Site, Eugene, OR
September 16, 1998 (9:45-11 a.m.; warm, sunny; preceded by record long drought period)
Dick Brainerd and Bruce Newhouse

D = dominant

PLANTS

General site list: NW, W, S, SE portions

Agrostis capillaris
Aira caryophyllea
Anaphalis margaritacea
Arrhenatherum elatius
Avena sativa
Bromus diandrus
Bromus sterilis
Centaureum erythraea
Cirsium arvense
Crataegus douglasii
Crepis setosa
Cytisus scoparius
Daucus carota
Equisetum arvense
Fraxinus latifolia
Holcus lanatus
Hypochaeris radicata
Juncus effusus
Lactuca saligna
Leontodon taraxacoides ssp. *taraxacoides*
Leucanthemum vulgare
Lupinus rivularis
Madia elegans
Madia sativa
Melilotus albus
Parentucellia viscosa
Phalaris arundinacea -D
Poa sp.
Rubus discolor - D
Rumex crispus
Senecio jacobaea
Trifolium pratense
Vulpia myuros

Small wet ditch along S property line

Anaphalis margaritacea
Bidens cernua
Cirsium arvense
Cirsium vulgare
Crataegus douglasii
Echinochloa crus-galli - D
Epilobium ciliatum ssp *watsonii*
Festuca arundinacea
Holcus lanatus
Lolium perenne
Salix hookeriana
Toxicodendron diversiloba

Large vernal pool in NE corner, including periphery

Agrostis exarata
Alopecurus geniculatus - D
Bidens cernua - D
Carex densa
Carex stipata
Cirsium vulgare
Dipsacus fullonum
Gnaphalium sp.
Lotus corniculatus
Lythrum portula
Mentha pulegium
Panicum capillaris
Phalaris arundinacea
Polygonum hydropiperoides
Populus balsamifera ssp. *trichocarpa*
Salix hookeriana
Salix lucida ssp. *lasiandra*

ANIMALS

Birds

American kestrel
barn swallow
black-capped chickadee
common snipe (overhead)
European starling (adjacent to S)
greater yellowlegs (retention pond to E)
killdeer (overhead)
sparrow, unidentified (brief look; in RUBDIS thicket; probably song sparrow; possibly golden-

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crowned or Lincoln's
spotted towhee (adjacent to S)

Mammals
nutria (scat/trail)
house mouse (trapped by G. Orth)
deer mouse (trapped by G. Orth)

Reptiles
northwestern garter snake

Insects
blue (butterfly: unidentified species; female)
Carolina locust
juba skipper
moth (unidentified, buff colored, ~3cm wingspan)
sulphur (butterfly; probably orange or common)

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J. H. Baxter Reference Site: SW corner of Bertelsen and Roosevelt, Eugene, OR
September 16 and 18, 1998: D. Brainerd, B. Newhouse, J. Tilson

D = dominant

East and west fields, and large berms

Asclepias speciosa
Aira caryophyllea
Allium sp.
Alopecurus pratensis - D
Arum italicum
Aster hallii
Beckmannia syzigachne
Bidens frondosa
Briza minor
Bromus cf. secalinus
Bromus sitchensis
Carex obnupta
Carex unilateralis
Centaureum erythraea
Convolvulus arvensis
Crataegus douglasii
Crataegus monogyna
Crepis setosa
Cynosurus echinatus
Cytisus scoparius
Dactylis glomerata
Daucus carota - D
Deschampsia cespitosa - D
Deschampsia danthonioides
Dianthus armeria
Dipsacus fullonum
Epilobium brachycarpum
Epilobium ciliatum ssp. *watsonii*
Festuca arundinacea - D
Fraxinus latifolia
Gnaphalium sp.
Holcus lanatus - D
Hordeum brachyantherum
Hypericum perforatum
Hypochaeris radicata
Juncus patens
Kickxia elatine
Lactuca serriola
Lathyrus latifolius
Leontodon taraxacoides ssp. *taraxacoides*
Lotus denticulatus
Lotus purshianus
Madia elegans
Madia glomerata
Madia sativa
Mentha pulegium
Parentucellia viscosa - D
Phalaris arundinacea - D
Phleum pratense
Poa pratensis
Populus balsamifera ssp. trichocarpa
Rosa multiflora
Rubus discolor - D
Rubus laciniatus
Rumex crispus
Rumex salicifolius
Salix hookeriana - D
Senecio jacobea
Tragopogon sp.
Trifolium pratense
Vicia cf. hirsuta
Vicia cracca

Ditch along west boundary

Bromus sitchensis
Cirsium arvense
Crataegus douglasii
Dipsacus fullonum
Echinochloa crus-galli -D
Epilobium ciliatum ssp. *watsonii*
Festuca arundinacea - D
Hordeum brachyantherum
Hypericum perforatum
Hypochaeris radicata
Juncus effusus
Lemna minor
Phalaris arundinacea-D
Phleum pratense
Plantago lanceolata
Poa pratensis
Rubus discolor -D

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Rumex sp.
Salix hookeriana

Ditch along south boundary
All spp. except *Lemna* rooted on bank.
Agrostis capillaris
Carex stipata
Cirsium arvense
Holcus lanatus
Juncus effusus
Lemna minor - D
Melissa officinalis
Poa sp.
Polystichum munitum
Torilis arvensis

Homesite area: NE corner
Asclepias speciosa
Agrostis capillaris - D
Cirsium arvense
Cirsium vulgare
Corylus cf. avellana
Crataegus douglasii
Deschampsia cespitosa
Festuca arundinacea - D
Juglans nigra
Lactuca serriola
Malus sylvestris
Phleum pratense
Prunus cerasiformis
Pyrus communis
Rubus discolor - D
Salix babylonica

Birds
American kestrel
barn swallow
black-capped chickadee
common snipe (o-head)
European starling
greater yellowlegs
house finch
killdeer (o-h)
mallard
savannah sparrow
spotted towhee (to S)
song sparrow

Mammals
nutria (scat, trail, grazed vegetation)
raccoon scat

Reptiles
(Northwestern?) Garter snake

Insects
Carolina locust
juba skipper
sulphur butterfly
tan (female?) "blue"
unid., sm., white moth (~3cm dia)

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Occurrence of Rare Vascular Plants, Amphibians, Birds, Mammals and Reptiles at the J. H. Baxter and Reference Sites, Lane County, Willamette Valley Province

This list was excerpted from "Rare, Threatened and Endangered Plants and Animals of Oregon" (March 1998, Oregon Natural Heritage Program). Species listed below do not include invertebrates, non-vascular plants and fungi, for which very little information is known in most cases. Species known to occur in Lane County in the Willamette Valley Province are included on the list. Habitat and survey information from Salix Associates and: Corkran and Thoms 1996, Csuti et al. 1997, Leonard et al. 1993, Marshall 1996, Storm and Leonard eds. 1995, Verts and Carraway 1998.

Key to "At JHB/R Site?": 1 = Baxter site, 2 = Reference site; C = confirmed on site; P = possible on site, but not confirmed; U = unlikely on site.

Scientific Name	Fed. Status	State Status	ONHP Status	Best Survey Time	Habitat	At JHB/R site?
VASCULAR PLANTS						
Aster curtus	SoC	LT	1	8/1-9/15	Native upland prairie, usually just above jurisdictional wetlands.	1U, 2P
Aster vialis	SoC	LT	1	7/1-8/30	Upland forest edges or openings in woods, occasionally in part shade; usually with TOXDIV.	1U, 2U
Cicendia quadrangularis	---	---	2	5/15-6/15	Vernally moist areas, usually with little competing veg	1U, 2P
Cimicifuga elata	SoC	C	1	6/1-9/15	North slopes with PSEMEN/ACEMAC (rarely PSEMEN/ALNRUB); moist site herbs (DICFOR, PROHOO, HYDTEN, ADIALE)	1U, 2U
Erigeron decumbens var. decumbens	Prop. E	LE	1	6/15-7/30	Native to disturbed, wetland to upland, prairies, pastures, tree farms, roadsides.	1U, 2P
Horkelia congesta ssp. congesta	SoC	C	1	6/15-7/30	Native prairie, moist to upland.	1U, 2P

ATTACHMENT C

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Lathyrus holochlorus	—	—	4	6/15-7/31	Hedgerows, edges of woods, usually upland, occasionally moist.	1U, 2U
Lomatium bradshawii	LE	LE	1	4/1-5/15	Usually native, wet prairie. Occasionally in pastures.	1U, 2P
Lupinus sulphureus ssp. kincaidii	PT	LT	1	6/1-7/15	Wetland to upland, native to disturbed, prairie to hedgerow; occ. under RUBDIS.	1U, 2P
Montia howellii	SoC	C	1	11/15-4/31	Survey time variable depending on rainfall. Prefers flat or gently sloping areas with shallow standing water (e.g., vernal pools) or flow; often in gravel areas (parking lots, old roads, gravel piles), or occasionally native wet prairie. Often with POAANN.	1U, 2P
Sidalcea campestris	---	C	4	5/15-7/15	Hedgerows, fences, edges of woods. Upland to moist	1U, 2P
Sidalcea cusickii	—	—	4	5/15-7/15	Hedgerows, fences, edges of woods. Moist to upland.	1U, 2P
AMPHIBIANS						
clouded salamander	---	SU	3	warm, wet	Edges of Valley, foothills. In decomposing logs and stumps. Occasionally in rock crevices.	1U, 2U
northern red-legged frog	SoC	SV	3	"	Streams, ponds, swamps and adjacent forests.	1U, 2U
Oregon spotted frog	C	SC	1*	"	Marshes, wet meadows, ponds, slow streams.	1U, 2U
Cascade seep salamander	—	SC	3*	"	West edge of Valley, foothills. Cold streams and adjacent forests.	1U, 2U
BIRDS						
grasshopper sparrow	---	SP	3*	4/15-6/30	Undisturbed grasslands.	1U, 2U
w. Oregon little willow flycatcher	SoC	SV	3	"	Thickets of willows or other shrub species, usually near water.	1U, 2P
streaked horned lark	—	SC	3*	"	Large, open fields.	1U, 2U
yellow-breasted chat	---	SC	4	5/15-6/30	Tree and shrub thickets, usually near water.	1U, 2P

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acorn woodpecker	---	---	3	4/15-6/30	Associated with oak forests.	1U, 2U
Oregon vesper sparrow	---	SC	3*	"	Grasslands, fields, often with scattered shrubs.	1U, 2P
western bluebird	---	SV	4	"	Usually in foothills in mixed open/forest habitats. Occasional on valley floor.	1U, 2P
western meadowlark	---	SC	4	"	Open fields and grasslands, usually with scattered shrubs or small trees.	1U, 2P
MAMMALS						
pallid bat	---	SV	3	summer	Brushy, rocky areas; edges of woods, open fields. Day roosts in crevices in structures, caves, trees, etc.	1U, 2U
white-footed vole	SoC	SU	3	spring- fall	Associated with streams in deciduous forest, and conifer forest.	1U, 2U
Pacific western big-eared bat	SoC	SC	2*	summer	Associated with coniferous forests. Day roosts in shallow roof depressions in caves, buildings	1U, 2U
long-eared bat	SoC	SU	4	"	Associated with coniferous forests. Day roosts in buildings, caves, hollow trees, under bridges, tree bark, in rock outcrops.	1U, 2U
fringed bat	SoC	SV	3*	"	Generally associated with forests. Day roosts in caves, buildings.	1U, 2U
Yuma bat	SoC	---	4	"	Associated with water. Day roosts in buildings, caves, trees.	1U, 2P
western gray squirrel	---	SU	3	any	Usually associated with Oregon white oak forests and savannas.	1U, 2U
REPTILES						
northwestern pond turtle	SoC	SC	2*	4/1-9/30	Ponds, oxbows, slow-moving streams.	1U, 2P
sharptail snake	---	SV	4	3/1-11/15	Moist areas in coniferous or deciduous forest; occ. in grasslands.	1U, 2P
western rattlesnake	---	SV	4	5/1-9/30	Usually associated with warm, rocky hillsides.	1U, 2U

APPENDIX B

Endpoint Species Description

Appendix B Endpoint Species Description

Deer Mouse (Perymyscus maniculatus) (Taken from Distribution, Habitat and Natural History Atlas of Oregon Wildlife (Causti, 1997))

The deer mouse is found from coast to coast from central Canada to southern Mexico. It is absent only from southeastern United States and Coastal Mexico. About the only habitat that deer mice do not use is open water. They are found through Oregon in every habitat type. Deer mice are capable of breeding throughout the year. However, populations along the Oregon coast may have fewer litters from October to February. Deer mice are opportunistic Omnivores. The deer mouse weighs about 0.021 kilograms. They eat seeds, green vegetation, insects, berries and fungi. For the purposes of this risk assessment the were assumed to eat 72.2% vegetation and seeds, 25.8% insects and soil invertebrates, and 2% soil (EPA 1993). They consume approximately 0.00418 kilograms/day of food. Their home range is about 0.09 hectares. Deer mice are a stable prey for about everything carnivorous.

American Kestrel (Taken from Distribution, Habitat and Natural History Atlas of Oregon Wildlife (Causti, 1997))

The American kestrel is widely distributed in the New World, except for dense tropical moist forest. It breeds from Alaska south through Canada, the United States, and Mexico, into Central America and farther south into South America. The American kestrel uses a wide variety of open and semi-open habitats, including grassland, desert, juniper woodlands, meadows and clearcuts in forests, marshes, agricultural fields, and even urban areas. Their preferred nests are a woodpecker hole or a natural cavity in a tree, but an American kestrel will make do with covered rock ledges, or nest boxes. The breeding season begins in April and the young are fledged by August. A clutch of 4 or 5 are incubated 29 - 30 days by the female. Young are tended by both parents and are independent in 4 or 5 weeks. The American kestrel will feed insects when available but when insects are seasonally low they will feed on small mammals and sometimes birds. Studies on feeding by the American kestrel indicate that it eats about 55% wildlife and 45% insects. For the purposes of the risk assessment it was assumed that they also incidentally consume 2% of their diet by weight of soil. The American kestrel density varies with food supply. Two studies found territory size of 109 and 130 hectares. For the purposes of this risk assessment it was assumed that their territory size (home range) is 120 hectares. The American kestrel weighs about 0.12 kilograms and eats about .0348 kilograms of food each day (EPA 1993).

Himalayan Blackberry (Rubus discolor) (Taken *from Plants of Coastal British Columbia including Washington, Oregon, and Alaska*. (Pojar and Mackinnon 1994))

The Himalayan blackberry is an Asian species of blackberry introduced from India via England and widely naturalized, in disturbed sites and streamside areas. It is the most common introduced blackberry in this area and a favourite of berry pickers. They are erect to sprawling; stout stems erect, then arching, then trailing along the ground and rooting at the ends. They have stout reformed prickles and often form dense impenetrable thickets. The leaves are more or less evergreen, trifoliate to 5-foliate, smooth above and covered with white hairs below. They produce edible blackberries.

Reed Canary Grass (Taken *from Plants of Coastal British Columbia including Washington, Oregon, and Alaska*. (Pojar and Mackinnon 1994))

Reed canary grass is a robust perennial, 0.7 - 2 metres tall, with long, scaly, pinkish rhizomes and hollow stems. The leaves are roughened; sheaths open, margins overlapping; ligules 4-10 millimetres long, usually tattered and turned backwards. They have glumes about 4-5 centimetres long. They prefer wet places in disturbed sites including clearings, along ditches, marshy spots and depressions, stream-banks and along the edges of wetlands, they are scattered but often locally abundant.

Earthworms (Taken from *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1977 Revision* (Efroymson et al 1977)

Earthworms are probably the most important soil invertebrates in promoting soil fertility. Their feeding and borrowing activities break down organic matter and release nutrients and improve aeration, drainage, and aggregation of soil. Earthworms are also am important component of the diet of many higher animals. Earthworms are known to take up many organic and inorganic contaminants.

One of the most common species of earthworm is Eisenia fetida, a non-borrowing organism found in organic rich environments. Another species Lumbricus rubellus is a shallow-burrowing lumbricid active is surface and litter horizons of pastures and grasslands. It may forage for food, such as dead roots in the subsurface horizon, and dig deep borrows in which to rest during periods of environmental stress. A third species Octalasium cyaneum is a burrowing lumbricid species that lives in the soil and feeds on dead roots. It is common in pastureland where it creates deep horizontal burrows.