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**Preliminary Assessment of the Ecological Risks
to Wide-ranging Wildlife Species
on the Oak Ridge Reservation**

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to Wide-ranging Wildlife Species
on the Oak Ridge Reservation**

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PREFACE

This report, *Preliminary Assessment of the Ecological Risks to Wide-ranging Wildlife Species on the Oak Ridge Reservation*, DOE/OR/01-1407&D1, was prepared as a technical report documenting work performed under the Oak Ridge Reservation Ecological Assessment Program. This work was performed under work breakdown structure 1.4.12.2.3.4 (activity data sheet 8304, 'Technical Integration'). Publication of this document meets an activity data sheet milestone of August 31, 1995. This document provides the Environmental Restoration Program with a preliminary evaluation of the ecological risks that contaminants on the Oak Ridge Reservation present to selected wide-ranging species. These results will aid in the understanding of the magnitude of ecological risks to populations at larger spatial scales and will assist in the prioritization of source operable units for investigation and remediation.

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ACRONYMS

BEIDMS	Bechtel Environmental Information Data Management System
BCK	Bear Creek Kilometer
BCOU	Bear Creek Operable Unit
BMAP	Biological Monitoring and Abatement Program
CERCL	Comprehensive Environmental Response, Compensation, and Liability Act
COPECs	Chemicals of Potential Ecological Concern
CR	Chestnut Ridge
DQO	Data Quality Objectives
DOE	United States Department of Energy
EFPC	East Fork Poplar Creek
EFK	East Fork Kilometer
EMAP	Ecological Monitoring and Assessment Program
EPA	Environmental Protection Agency
ESD	Environmental Sciences Division
ER	Environmental Restoration
EROD	Ethoxyresorufin-o-deethylase
FFA	Federal Facilities Agreement
FS	Feasibility Study
GIS	Geographic Information System
HQ	Hazard Quotient
MEK	Melton Branch Kilometer
MIK	Mitchell Branch Kilometer
NOAEL	No Observed Adverse Effects Level
NTK	Northwest Tributary Kilometer
LEFPC	Lower East Fork Poplar Creek
LOAEL	Lowest Observed Adverse Effects Level
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PLE	Product Limit Estimator
RI	Remedial Investigation
SAIC	Science Applications International Corporation
SCF	South Campus Facility
Σ Tus	Sum of Toxic Units
STD	Standard Deviation
TDEC	Tennessee Department of Environment and Conservation
T&E	Threatened or Endangered
TWRA	Tennessee Wildlife Resources Agency
UEFPC	Upper East Fork Poplar Creek
UCL	Upper Confidence Limit
WAG	Waste Area Grouping

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EXECUTIVE SUMMARY

Historically, ecological risk assessment at CERCLA sites [such as the Oak Ridge Reservation (ORR)], has focused on species that may be definitively associated with a contaminated area or source operable unit. This is necessary to identify areas where risk is sufficiently high to warrant remediation. Consequently the species that are generally considered are those with home ranges small enough such that multiple individuals or a distinct population can be expected to reside within the boundaries of the contaminated site. This approach is adequate for sites with single, discrete areas of contamination that only provide habitat for species with limited spatial (e.g., small home range) requirements. This approach is not adequate however for large sites with multiple, spatially separated contaminated areas that provide habitat for wide-ranging wildlife species. Because wide-ranging wildlife species may travel between and use multiple contaminated sites they may be exposed to and be at risk from contaminants from multiple locations. Use (and therefore exposure and risk) of a particular contaminated site by wide-ranging species will be dependant upon the amount of suitable habitat available at that site. Therefore to adequately evaluate risks to wide-ranging species at the ORR-wide scale, the use of multiple contaminated sites must be weighted by the amount of suitable habitat on OUs. Highly contaminated OUs that provide little habitat are unlikely to be significant contributors to ORR-scale risk. Conversely, moderately contaminated sites that contain considerable habitat may significantly contribute to ORR-scale risk.

In spring of 1994, a series of meetings were held among the FFA (Federal Facilities Agreement) parties to develop an approach and plan for assessing risks to wide-ranging species that could not be adequately addressed at the source OU level. The results of these discussions are presented in the ORR ecological risk assessment strategy document (Suter et al. 1994a). This report is based upon this document and presents the preliminary assessment of ecological risks to wide-ranging species from contaminants on the ORR.

The reservation-wide ecological risk assessment is intended to serve several purposes. These include: (1) identifying which endpoints are significantly at risk, (2) which contaminants are responsible for this risk, and (3) which OUs significantly contribute to risk. To address these issues, this report contains the following:

- an evaluation of the potential use of OUs by 57 endpoint species identified in Suter et al. (1994a),
- a preliminary ranking of OUs according to those that may present the greatest ecological risk,
- a preliminary assessment of risks to selected piscivorous wildlife (i.e., mink, river otter, belted kingfisher, and great blue heron),
- a preliminary assessment of risks to selected vermivorous and herbivorous wildlife (i.e., American woodcock, short-tailed shrew, white-tailed deer, and wild turkey), and
- a proposed revision schedule.

Data used in this preliminary assessment included a reservation-wide land use/land cover classification (Washington-Allen et al. 1995), reservation-wide fish bioaccumulation data from the Biological Monitoring Programs, and soil contamination data for 12 of 37 OUs. These data were derived from ORR computer databases (OREIS and BEIDMS).

Potential use of OUs by endpoint species listed in Suter et al. (1994a) was estimated by comparing habitat requirements for the endpoint species (obtained from the literature) to the nine landcover types identified in Washington-Allen et al. (1995). An OU was considered to provide habitat for an endpoint species if at least one of the habitat types required by the species was present on the OU. OUs were ranked by the number of species for which they could potentially provide habitat and endpoint species were ranked by the number of OUs on which suitable habitat was available. Conclusions of this evaluation include: 1) The largest OUs on the ORR generally have the most diverse habitat and consequently can support the greatest number of potential endpoint species; and 2) Species that can use urban habitats or have broad habitat requirements have the highest potential to experience exposure due to the large numbers of OUs that provide suitable habitat.

Risks to piscivorous wildlife were assessed using contaminant concentrations in fish from four watersheds on the ORR (i.e., Bear Creek, East Fork Poplar Creek, the K-25 vicinity, and White Oak Creek). Additional data used in this assessment included toxicity tests performed on mink, and field surveys of mink and great blue heron. Monte Carlo simulations of contaminant exposure estimates were calculated for each species by watershed. The resulting exposure distributions were then combined with literature-derived population density data for each endpoint species to estimate the number of individuals of each species likely to experience adverse effects within each watershed. These numbers were then summed for the reservation as a whole to estimate the proportion of the ORR population potentially at risk. By combining the multiple lines of evidence available to assess risks to piscivores, the following conclusions may be made:

- Cadmium in fish presents a significant risk to mink within the Bear Creek watershed and to an estimated 17.5% of the mink population on the ORR. ORR-wide risk to mink from cadmium may be underestimated due to the lack of data from the two largest watersheds (i.e., East Fork Poplar Creek and the K-25 vicinity). Combined exposure of mink to PCBs and mercury may present a hazard to mink in East Fork Poplar Creek. Risks from contaminants in other watersheds are not significant.
- Evaluation of the potential risks to a future ORR-wide population of otter indicates that cadmium in Bear Creek presents a risk to 20% of the ORR-wide population; mercury in East Fork Poplar Creek presents a risk to either 12% or 36%. Because the river otter is a state threatened species, effects to any individual is significant. Therefore, the weight of evidence suggests that Cd in Bear Creek and mercury in East Fork Poplar Creek represent significant risks to establishment of a future ORR-wide river otter population.
- Mercury in fish presents a significant risk to belted kingfisher within the East Fork Poplar Creek watershed and consequently to an estimated 37% of the kingfisher population on the ORR.

- While mercury in fish is estimated to represent a significant risk to great blue heron within the East Fork Poplar Creek watershed and consequently to an estimated 37% of the heron population on the ORR, studies on two of five colonies adjacent to the ORR indicate that reproduction at these locations is not impaired. Contaminant bioaccumulation and reproductive success are unknown at the three additional colonies adjacent to the ORR. Additionally, the primary foraging locations for herons at the two studied colonies is unknown. Because herons can travel long distances in search of food (>15 km), they are likely to forage at off-site as well as onsite locations, reducing both the exposure they receive and the risk they experience. If birds from the unstudied colonies forage more extensively on the ORR, they may experience greater risk. Due to the high risk estimated for mercury exposure on the ORR, the lack of data for three of five heron colonies adjacent to the ORR, and uncertainty as to where birds from the five ORR colonies forage, a conclusion concerning whether or not great blue heron on the ORR are at risk cannot be made.

On the ORR, while most wide-ranging wildlife species reside primarily in the uncontaminated terrestrial habitats outside of source OUs, they may also use those source OUs on which suitable habitat is present. The degree to which a source OU is used (and therefore the risk that it may present) is dependant upon the availability of suitable habitat on the OU. OUs with little or no habitat will experience little use (and will present minimal risk) while those with considerable habitat are likely to experience considerable use (and depending upon the degree of contamination, may present significant risks). While *individuals* may experience adverse effects through exposures received at source OUs, the primary concern for ecological risk assessment is for effects at the population-level. To evaluate effects to the ORR-wide wildlife populations, habitat suitability and population density on the ORR and within OUs must be considered. A general, 6-step, habitat-based approach was developed that is applicable to all wildlife species on the ORR. The approach is outlined below:

1. Individual-based contaminant exposure estimates are generated for each OU using the generalized exposure model outlined in Sample and Suter (1994).
2. Contaminant exposure estimates are compared to NOAELs or LOAELs to determine the magnitude and nature of effects that may result from exposure at the OU. If the exposure estimate >LOAEL, then individuals at the OU may experience adverse effects.
3. Availability and distribution of habitat on the ORR and within each OU is determined using the ORR landcover map presented in Washington-Allen et al. (1995).
4. Habitat requirements for the endpoint species of interest are compared to the ORR habitat map to determine the area of suitable habitat on the ORR and within OUs.
5. The area of suitable habitat on the ORR and within OUs is multiplied by population density values for the selected endpoints to generate estimates of the ORR-wide population and the numbers of individuals expected to reside within each OU.
6. The number of individuals for a given endpoint species expected to be receiving exposures >LOAELs for each measured contaminant is totaled. This is performed using the OU-specific population estimate from step 5 and the results from step 2. This number is then compared with

the ORR-wide population to determine the proportion of the ORR-wide population that is receiving hazardous exposures. Using the 20% criterion outlined in Suter et al. (1994a), if the proportion of the ORR-wide population receiving hazardous exposures $\geq 20\%$, then an adverse population-level effect is assumed to be present.

Because contaminant concentrations in soil were the most readily available type of data and contaminant concentrations in plants and earthworms can be easily estimated using soil-plant or soil-worm uptake factors, vermivores and herbivores were selected as endpoint categories to demonstrate the applicability of the habitat-based approach. Conclusions of this assessment were that while there are significant risks to individuals of selected herbivore and vermivore endpoint species resident on OUs, the reservation-wide populations of these endpoints are unlikely to be significantly affected ($<20\%$ of the ORR population is affected). This conclusion must be viewed with caution, however because data were evaluated for only 12 of 37 OUs. Inclusion of additional OUs is likely to increase the proportion of the ORR populations exposed and at risk.

Finally, this preliminary assessment of risk to wide-ranging wildlife species on the ORR is based on only a small portion of the data available for the reservation. To accurately evaluate the nature and magnitude of risks on the ORR, all available data should be incorporated and considered. It is recommended that this report be revised and updated annually until all existing data have been incorporated. Following this, revisions should be produced on a five-yr schedule to incorporate new data that become available.

1. INTRODUCTION

More than approximately 50 years of operations, storage, and disposal of wastes generated by the three facilities on the Oak Ridge Reservation (ORR) (e.g., K-25, X-10, and Y-12), has resulted in a mosaic of uncontaminated property and lands that are contaminated to varying degrees. This contaminated property includes source areas (source operable units or OUs which are the industrial facilities themselves and the waste disposal or waste storage areas) and the terrestrial and aquatic habitats down gradient from these source areas (integrator OUs; Fig. 1.1). While the integrator OUs generally contain considerable habitat for biota, the source OUs provide little or no suitable habitat.

Historically, ecological risk assessment at CERCLA sites has focused on species that may be definitively associated with a contaminated area or source OU. This is necessary to identify areas where risk is sufficiently high to warrant remediation. Fig. 1.1 outlines a conceptual model for contaminant transfer both within and through a source OU. Endpoints considered in source OUs include plants, soil/litter invertebrates and processes, aquatic biota found in on-OU sediments and surface waters, and small herbivorous, omnivorous, and vermivorous (i.e., feeding on ground, litter, or soil invertebrates) wildlife. All of these endpoints have limited spatial distributions or home ranges such that numerous individuals or a distinct population can be expected to reside within the boundaries of the source OU. Contaminants move from the source to either surface soil, surface water, or sediments (Fig. 1.1). Aquatic biota may be exposed to contaminants through direct contact with water and sediment; small herbivores, omnivores, and vermivores may be exposed through ingestion of contaminated surface water. Contaminants in soil may be taken up by plants and soil/litter invertebrates; consequently small herbivores, omnivores, and vermivores that feed on these food types may be exposed. These small terrestrial wildlife species may also be exposed to contaminants through incidental or purposeful ingestion of soil.

Assessment of the endpoints outlined above is adequate for source OUs and for sites with single, discrete areas of contamination that only provide habitat for species with limited spatial (e.g., small home range) requirements. It is not adequate however for large sites with multiple, spatially separated contaminated areas the ORR that provide habitat for wide-ranging wildlife species. Because wide-ranging wildlife species may travel between and use multiple contaminated sites they may be exposed to and be at risk from contaminants from multiple locations. Use (and therefore exposure and risk) of a particular contaminated site by wide-ranging species will be dependant upon the amount of suitable habitat available at that site. Therefore to adequately evaluate risks to wide-ranging species at the reservation-wide scale, the use of multiple contaminated sites must be weighted by the amount of suitable habitat on OUs. Highly contaminated OUs that provide little habitat are unlikely to be significant contributors to ORR-scale risk. Conversely, moderately contaminated sites that contain considerable habitat may significantly contribute to ORR-scale risk.

In spring of 1994, a series of DQO (data quality objectives) meetings were held among the FFA (Federal Facilities Agreement) parties [i.e., U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Tennessee Department of Environment and Conservation (TDEC)] to develop an approach and plan for assessing risks to wide-ranging species that could not be adequately addressed at the source OU level. The results of these discussions are presented in the ORR ecological

Fig. 1.1. Conceptual model of the transfer of contaminants through a source OU and into integrator OUs.

risk assessment strategy document (Suter et al. 1994). This report is based upon this document and presents the preliminary assessment of ecological risks to wide-ranging species from contaminants on the ORR.

The reservation-wide ecological risk assessment is intended to serve several purposes. These include: (1) identifying which endpoints are significantly at risk, (2) which contaminants are responsible for this risk, and (3) which OUs significantly contribute to risk. To address these issues, this report contains the following:

- **An evaluation of the potential use of OUs by 57 endpoint species identified in Suter et al. (1994a)**—This is to identify endpoint species that may require additional attention in future assessments and is based on a comparison of species-specific habitat requirements and the amount of suitable habitat within OUs.
- **A preliminary ranking of OUs according to those that may present the greatest ecological risk**—This is to aid in the prioritization of OUs for potential remediation and is also based on habitat in OUs and the number of species for which this habitat is suitable.
- **A preliminary assessment of risks to piscivorous wildlife**—Because contaminants accumulate in aquatic systems, if reservation-scale risks are likely, they should be most evident among piscivores.
- **A preliminary assessment of risks to vermivorous and herbivorous wildlife**—This is to demonstrate the applicability of habitat-based assessment methodology.
- **A proposed revision schedule**—Because this assessment is based on only a portion of the data available for the ORR and RIs (remedial investigations) are currently in progress for two potential significant OUs (e.g., WAG 2 and Bear Creek), periodic updates should be performed until all available data have been assembled, incorporated, and evaluated.

Detailed assessments of risk were not performed for all 57 endpoint species for which habitat availability on OUs was evaluated. Risks were evaluated only for selected piscivores, vermivores and herbivores. Selection of these three trophic groups was determined by availability of data (i.e., fish body burdens, soil contaminant concentrations, and soil-plant or soil-earthworm uptake factors). Risks to selected species from other trophic groups identified in Suter et al. (1994a; i.e., aquatic herbivores, aquatic invertebrate feeders, flying insectivores, arboreal insectivores, large omnivores, predators, and scavengers) will be assessed in future revisions of this report.

The species for which detailed risk assessments were performed include: mink, river otter, belted kingfisher, great blue heron, wild turkey, white-tailed deer, American woodcock, and short-tailed shrew. These species were selected because they are known or expected to be sensitive to contaminants that are present on the ORR (i.e., mink and otter), are representative of groups that are likely to be highly exposed (i.e., piscivores (mink, otter, kingfisher, and heron) and vermivores (woodcock and shrew)), are threatened or endangered (T&E) species or a surrogate for related T&E species (i.e., otter and shrew), or are well characterized on the ORR (site-specific data exists for mink, great blue heron, white-tailed deer, and wild turkey).

It should be emphasized that the results presented in this report are preliminary, i.e, based on only a subset of all data that exists on the ORR. The most relevant and accessible data have been selected for use at this time. As additional data are collected, made available, and incorporated, conclusions concerning the presence or magnitude of risks to wide-ranging species on the ORR may change. The quality and completeness of data used will be discussed in each chapter as it relates to the uncertainty of the risk assessment.

Assessment of ecological risks from radionuclides are not considered at this time. In human health risk assessment, the primary concern from exposure to radionuclides is increased incidence of cancer at the individual level. In ecological risk assessment, the concern is for population-level effects (except for T&E species, however). Because there is little evidence that cancer plays any significant role in wildlife populations, radionuclides were not considered at this time. Due to the importance and prevalence of radionuclide contamination on the ORR, risks associated with radionuclide exposure will be evaluated in future revisions of this report.

2. DATA

To identify data that would be useful for this project, a data search was initiated in which OU project managers were contacted and queried concerning the existence, status, nature, and availability of data concerning their OU. The search emphasized data concerning concentrations of contaminants in soil, water, sediment, and biota. The results of this survey are summarized in Appendix A. Briefly, while considerable data have been collected at OUs on the ORR, aside from data that currently reside in OREIS (Oak Ridge Environmental Information System) or in BEIDMS (Bechtel Environmental Information Data Management System), much data were not readily available. The lack of availability was primarily due to data being stored and maintained in multiple forms (electronic vs. hard copy; various database programs; etc.). Compilation and standardization of the voluminous data for the ORR was beyond the current scope of this project. The data availability issue is currently being addressed through the Environmental Information Management Program as part of the ORR ER program.

Three general categories of data were identified, acquired, and used for this assessment. These include an reservation-wide land use/land cover classification (Washington-Allen et al. 1995), fish bioaccumulation data from the Biological Monitoring Programs, and soil contamination data derived from ORR computer databases (OREIS and BEIDMS).

The reservation-wide land use/land cover classification is presented in Washington-Allen et al. (1995). Availability and distribution of nine land use/land cover types (Table 2.1) on the ORR was determined using satellite imagery and ground-truthing. These data were incorporated into a Geographic Information System (GIS) to produce a map of the available cover types on the ORR. OU boundaries were then overlaid on the reservation-wide cover map to produce OU-specific cover maps. Finally the area (ha) of each cover type on the ORR as a whole and within each OU was calculated.

Fish bioaccumulation data consisted of contaminant concentrations in fish and were derived from five sources. Descriptions of these data sets are presented here.

- **Name: Bear Creek OU4**
 - Spatial coverage: three locations in Bear Creek (BCK 12.4, BCK 9.4, and BCK 3.3) and one off-site location (Hinds Creek)
 - Analytes: metals and PCBs
 - Species: stone rollers
 - Principal Investigator: George Southworth.
- **Name: BMAP Bioaccumulation Task**
 - Spatial coverage: reservation-wide; 8 locations in vicinity of K-25, 2 locations in Bear Creek, 8 locations in White Oak Creek basin, 12 locations in East Fork Poplar Creek, and 3 off-site locations (Beaver Creek, Brushy Fork, and Hinds Creek)
 - Analytes: primarily mercury and PCBs
 - Species: sunfish, largemouth bass, and carp
 - Principal investigators: George Southworth and Mark Peterson.

Table 2.1. The land use/landcover classes used in habitat classification

Land use/landcover	Description
Urban land	Mixture of administrative buildings, laboratories, heavy commercial and industrial buildings, lawns, and clumped shade trees
Deciduous forest land	Areas of hardwood forest types
Mixed Forest Land	Areas of a mixture of hardwoods and pine trees
Evergreen forest land	Areas dominated by mature pine forest type with trees generally older than 35 years (in 1994) and having an uneven canopy
Evergreen plantation	Areas of pine trees which are row planted, are of uniform age, and are generally younger than 35 years (in 1994)
Pasture land	Fields of pasture grasses, grassland, row crops, and/or shrub land cover
Transitional areas	Secondary early successional sites, usually grassland to grassland shrub mix; generally mowed along power line corridors
Barren land	Cropped fields, plowed or bare ground areas, or areas where vegetation has been removed, such as construction sites or quarries

- **Name: Upper East Fork Poplar Creek Bioaccumulation Study**
 - Spatial coverage: three locations in Upper East Fork Poplar Creek and one off-site location (Hinds Creek)
 - Analytes: mercury, PCBs, and pesticides
 - Species: stone rollers and shiners
 - Principal investigator: Walter Hill.
- **Name: Lower East Fork Poplar Creek RI**
 - Spatial coverage: 6 locations in East Fork Poplar Creek.
 - Analytes: Metals, PCBs, pesticides, and other organics
 - Species: sunfish, largemouth bass, and stone rollers
 - Principal investigator: SAIC.

- **Name: K-901 Holding Pond**
Spatial coverage: 1 location (K-901 pond)
Analytes: metals, radionuclides, PCBs, pesticides, and other organics
Species: shad, largemouth bass, and carp
Principal investigator: SAIC.

These data were combined into one large data set. While all small fish (stonerollers, shiners, and shad) were analyzed whole, all large fish (sunfish, largemouth bass, and carp) were analyzed as fillets only. Whole-body contaminant concentrations for metals in large fish were estimated using fillet-to-whole body ratios obtained from spotted bass collected in the vicinity of the Portsmouth Gaseous Diffusion Plant (Southworth 1994). Whole-body contaminant concentrations for organics in large fish were estimated using fillet-to-whole body ratios obtained from largemouth bass and catfish collected from the Clinch River.

The last data set used in this report consists of contaminant concentrations in soil from OUs. These data were extracted from the OREIS and BEIDMS databases. The data were restricted to include only the top two feet of soil. This was assumed to include the soil horizons wildlife species were most likely to be exposed to. Data were obtained for the following OUs: Bear Creek OU1, Bear Creek OU2, Lower East Fork Poplar Creek, Upper East Fork Poplar Creek OU2, WAG 1, WAG 6, South Campus Facility, K-1407, K-1414, and K-1420. In addition, soil data from risk assessments completed at two OUs (Chestnut Ridge OU2 and WAG 5) were evaluated.

Again it should be noted that these data do not represent all available data. They simply represent a subset of the total that could be assembled, collated and prepared at this time. Additional data will be acquired and incorporated in future revisions of this report.

3. EVALUATION OF POTENTIAL USE OF OPERABLE UNITS ON THE OAK RIDGE RESERVATION BY WILDLIFE

One of the primary factors determining the presence or absence of wildlife species in any area is the availability of suitable habitat. If suitable habitat is available (and the wildlife species of interest are present in the area), use of a site by wildlife is likely. Conversely, if no suitable habitat is available, use of the site is unlikely. In terms of risk to wildlife on the ORR, if an OU contains habitat for wildlife, it is likely to be used, and therefore wildlife that use the site may be exposed to contaminants and potentially be at risk. By comparing the habitat requirements of wildlife endpoints to the habitats available on OUs on the ORR, OUs that *may* present risk and endpoints that *may* be at risk can be identified.

Uncertainty associated with identifying OUs or endpoints as presenting or being at risk must be emphasized because contaminant data are not used in this evaluation; it is simply based on a co-occurrence of factors that increase the *potential* for an OU to present a risk or for an endpoint to be at risk. While this evaluation can identify those species that are not at risk and OUs that do not present on-OU risk (If an OU contains no suitable habitat, use and exposure are unlikely, therefore risks are unlikely; It should be noted, however that OUs that do not contain any suitable habitat may act as sources of contamination to down gradient areas. Therefore, while there may be no on-OU risks, they may contribute significantly to off-OU risks), without incorporating OU-specific contaminant data and estimating exposure, the actual nature and magnitude of risk at an OU cannot be determined.

Information concerning the habitat requirements for the 57 endpoint species identified in Suter et al. (1994) was obtained from the literature (Table B.1). These data were then compared to the nine landcover types identified on the ORR in Washington-Allen et al. (1995) to identify landcover types on the ORR that an endpoint is likely to use (Table B.2). Habitat requirements information for endpoint species was generally far more detailed than the land cover types identified on the ORR. Consequently some assumptions and professional judgments were applied in matching habitat requirements with available habitat types. For example, many species are listed as requiring floodplain, bottom land, or riparian forest (Table B.1). This habitat type is not specifically delineated in Washington-Allen et al. (1995). Because the dominant forest habitat types at the three OUs that are located in floodplains (e.g. WAG 2, Bear Creek, and Lower East Fork Poplar Creek) are deciduous and mixed forest (Table B.3), if a species was identified as requiring floodplain forest, it was assigned to these habitats. This approach is conservative, because deciduous and mixed forests are not restricted to floodplain locations. A similar approach was used for other landcover types not specifically identified in Washington-Allen et al. (1995).

The amount of habitat (in ha) in each of the nine categories observed at each OU is summarized in Table B.3. The presence or absence of habitat for the 57 endpoint species at OUs at K-25, X-10, and Y-12 are summarized in Tables B.4, B.5, and B.6, respectively. Tables B.7 and B.8 present the total number of OUs that provide habitat for each species and the total number of species with habitat on each OU, respectively. An OU was considered to have habitat for a species if any one of the landcover categories from Tables B.2 and B.3 coincided. Professional judgement was employed in determining if the habitat at an OU was suitable for an endpoint. For example, if the species required large bodies of water, and while water was present an OU but consisted on a small stream, the habitat was considered unsuitable. Habitat was considered only on a presence/absence basis—the amount of habitat was not incorporated into the evaluation of whether or not an species would use

an OU. It is recognized that this approach is overly simplistic and conservative. Use of an OU by a species will depend on the amount of habitat available (not just suitability), the connectivity of the on-OU habitat to similar habitat off the OU (isolated patches will receive less use than contiguous patches), and the amount of human activity in the vicinity (use by many species is inversely related to human activity). This evaluation was performed to determine simply if an endpoint could use an OU. A more detailed evaluation of the quality and quantity of habitat at an OU will be performed in a manner similar to that in Sect. 5 as part of a future revision of this report.

As would be expected, OUs with high diversity of landcover types (i.e., many landcover types present on the OU) were determined to be able to support the greatest number of endpoint species (Table B.8). These OUs were also the largest on the ORR (Table B.3). Small OUs located within the plant sites (i.e., UEFPC OU2 and OU3) were estimated to support the lowest number of endpoint species. If potential on-OU risk is determined simply by the number of species that might use an OU, WAG 2, K-901, LEFPC, Bear Creek, and WAGs 4, 5, 6, and 7 present the greatest risk (Table B.8). OUs that present the least risk (based solely on number of endpoints) include K-1413, K-1004, K-1401, K-1420, UEFPC OU2 and UEFPC OU 3.

Endpoint species estimated to be present at all 37 OUs are either habitat generalists (i.e., starlings, raccoons), tolerant of human activities (e.g., groundhog, American robins, Canada geese), or make use of structures (e.g., barn owl, Rafinesque's big-eared bat; Table B.7). The next most common group of endpoint species (expected to be found at 31 OUs), consists of species with broad habitat preferences. These species use both forested and open (i.e. pasture and transitional) habitats. Species that require aquatic habitat (ponds, streams, etc.) are expected at 16 OUs, while only three OUs (K-901, K-1007, and WAG 2) are suitable for those species that need large bodies of water (bald eagle, osprey, double-crested cormorant, and gray bat; Table B.7). Only three endpoint species are not expected to be present on any OUs on the ORR: golden eagles and cougars (the ORR as a whole probably does not provide sufficient suitable habitat for these species) and the Tennessee cave salamander (no caves are currently known to exist on any OU, therefore there is no habitat for this aquatic troglodytic salamander). The last endpoint, the green salamander, requires moist rock outcroppings. Locations and possible distributions of this habitat feature within OUs is unknown at this time.

3.1. QUALITY AND COMPLETENESS OF DATA

The completeness of data for this portion of the assessment is adequate, however, the quality of data needs improvement. While a highly significant first step, the level of detail in the ORR landcover map is far less than what is needed to accurately estimate the actual presence of suitable habitat on each OU. Incorporation of aspect and elevation data in the ORR landcover map would be useful to differentiate dry upland sites from moist bottom lands. It would also allow floodplain habitats to be delineated. Additional, more detailed data on habitat requirements (and their relative value) for each endpoint species would also increase the precision in the habitat use predictions for each OU. By combining the relative habitat preferences for each endpoint species with the amounts of each habitat type present on each OU, a better estimate of the likelihood of use (and therefore the potential for exposure and risk) may be obtained.

4. ASSESSMENT OF RISKS TO PISCIVORES ON THE OAK RIDGE RESERVATION

4.1. PROBLEM FORMULATION

This section discusses the attributes and selection of appropriate ecological endpoints, describes the ecological setting, provides information on the sources and hazards to which organisms may be exposed, and integrates this information into a conceptual model that portrays the interaction among sources and endpoints at the sites. The information provided here sets the stage for the exposure assessment section that follows.

4.1.1. Ecological Assessment Endpoints

The hazard identification phase of an ecological risk assessment must identify both the assessment endpoints, which are explicit statements of the characteristics of the environment that are to be protected, and the measurement endpoints, which are quantitative summaries of a measurement or series of measurements that are related to effects on an assessment endpoint.

4.1.1.1 Assessment endpoints

The following assessment endpoints selected for the assessment of risks to piscivorous wildlife: toxicity to mink (*Mustela vison*), river otter (*Lutra canadensis*), belted kingfisher (*Ceryle alcyon*), and great blue heron (*Ardea herodias*) resulting in a reduction in population abundance or production. These assessment endpoints are those that have been agreed to be appropriate for the ORR by the FFA parties (Suter et al. 1994a). The criteria for selection of the entities are those recommended by the EPA (Risk Assessment Forum 1992), plus considerations of scale and practical considerations.

River otter are listed as a threatened species by the TWRA (Tennessee Wildlife Resources Agency). While this species is not known to occur on the ORR at the present time, they have been included in this assessment because the ORR contains suitable habitat, a reintroduction program is underway in east Tennessee, and they may become established on the ORR in the future. To determine if the ORR could support this threatened species, it is important to evaluate the nature and magnitude of risk that contaminants on the ORR may present to otter.

The appropriate properties of the entities selected by these criteria depend on the level of organization of the entity and the criteria that led to their selection. **Organism level**—In general, protection of individual organisms is appropriate only for threatened and endangered species. Only one of the selected species, river otter, is a T&E species; therefore organism-level properties were used for this assessment endpoint. **Population level**—The appropriate endpoint properties for populations of endpoint species are abundance and production.

Finally, the level of effects on these properties of the endpoint entities that is considered to be potentially significant is 20% as agreed by the FFA parties (Suter et al. 1994a). This level is consistent with current regulatory practice.

Assessment of piscivores is a logical first step to evaluate reservation-wide risks. Contaminants present on the ORR are known to accumulate readily in aquatic foodwebs (i.e., mercury and PCBs).

Some piscivores (mink in particular) are known to be sensitive to mercury and PCBs. The diet of piscivores frequently consists exclusively of fish or other aquatic prey, therefore members of this group are likely to be highly exposed. Finally, most piscivores are highly mobile, they therefore may be exposed to contaminants from multiple locations.

The ORR was partitioned into four watersheds: Bear Creek, Fork Poplar Creek, the K-25 area (consisting of the K-25 ponds, Mitchell Branch, and Poplar Creek adjacent to the K-25 plant), and White Oak Creek. Risks were evaluated within each watershed and these results were used to determine risks to piscivores across the ORR as a whole. For comparison, risks were evaluated in three nearby, off-site streams (Beaver Creek, Brushy Fork, and Hinds Creek).

4.1.1.2 Measurement endpoints

Three basic types of effects data are potentially available to serve as measurement endpoints: results of biological surveys, toxicity tests performed using fish from the ORR, and literature derived toxicity test results for chemicals found on the ORR. Following are measurement endpoints for each assessment endpoint:

- **Mink**

- Biological survey data—Limited data concerning presence/absence, movements, and bioaccumulation of contaminants are available for mink on the ORR.
- Media toxicity data—Results of reproductive toxicity tests are available for ranch mink fed fish obtained for the Poplar Creek embayment.
- Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in mammals with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.

- **River otter**

- Biological survey data—None.
- Media toxicity data—Results of reproductive toxicity tests are available for ranch mink fed fish obtained for the Poplar Creek embayment. Because both mink and otter are mustelids, the test endpoints for mink are assumed to correspond to the assessment endpoint (otter) after allometric scaling.
- Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in mammals with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.

- **Belted kingfisher**

- Biological survey data—None.
- Media toxicity data—None.
- Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in birds with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.

- **Great blue heron**

- Biological survey data—Field data concerning contaminant bioaccumulation and reproductive success were available for four heron rookeries near the ORR.
- Media toxicity data—None.
- Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in birds with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.

4.1.2. Ecological Conceptual Model

The ecological conceptual model graphically represents the relationships between the contaminant sources and the endpoint receptors. It integrates the information in the other subsections of the hazard identification and presents them graphically. It is not intended to show all of the possible sources, routes of transport, modes of exposure, or effects. Rather, it includes the only identified CERCLA source, the receptors that are designated as assessment endpoint species or communities, and the major routes that result in exposure to contaminants from the ORR.

The conceptual model for exposure of piscivores to contaminants is presented in Fig. 4.1. Components of this model include aquatic biota (aquatic plants, invertebrates, fish, and amphibians) that reside in ponds and streams on the ORR and the piscivorous wildlife that feeds on aquatic biota. The aquatic biota are exposed to contaminants from surface water and sediments. Contaminants are bioaccumulated in lower trophic levels (i.e., plants or invertebrates) and transferred to higher trophic levels (i.e., invertebrates, fish, or amphibians). Piscivorous wildlife consume fish, amphibians, and invertebrates and are therefore exposed to accumulated contaminants (Fig. 4.1).

Fig. 4.1. Conceptual model for the exposure of piscivorous wildlife to contaminants.

4.2 EXPOSURE ASSESSMENT

Piscivorous wildlife may be exposed to contaminants through ingestion of contaminated media (fish, other aquatic prey, and water) and through contaminants accumulated in the tissues of the piscivore itself. In this assessment, ingestion of food was the only pathway considered. Exposure through ingestion of water will be included in a future revision. Contaminant exposure through ingestion was estimated for mink, otter, belted kingfisher, and great blue heron. Exposure estimates were calculated for 41 locations on the ORR: five locations in Bear Creek, 20 locations in East Fork Poplar Creek, 8 locations in the vicinity of the K-25 plant, and 8 locations in the White Oak Creek basin. For comparison, contaminant exposure was also estimated for three off-site locations. Exposure through contaminants accumulated in tissues was measured for nestling great blue herons. Locations of sampling locations within Bear Creek, East Fork Poplar Creek, K-25, White Oak Creek, and the off-site locations are presented in Figs. C.1 through C.5.

4.2.1 Exposure Through Oral Ingestion of Fish

For exposure estimates to be useful in the assessment of risk to wildlife, they must be expressed in terms of a body weight-normalized daily dose or mg contaminant per kg body weight per day (mg/kg/d). Exposure estimates expressed in this manner may then be compared with toxicological benchmarks for wildlife, such as those derived by Opresko et al. (1994), or to doses reported in the toxicological literature. Estimation of the daily contaminant dose an individual may receive from a particular medium for a particular contaminant may be calculated using the following equation:

$$E_j = \sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \quad (1)$$

where:

E_j = total exposure to contaminant (j) (mg/kg/d)

m = total number of ingested media (e.g., food, water, or soil)

IR_i = consumption rate for medium (i) (kg/d or L/d)

C_{ij} = concentration of contaminant (j) in medium (i) (mg/kg or mg/L)

BW = body weight of endpoint species (kg).

Exposure estimates were calculated for all contaminants detected at all ORR sampling locations. Because wildlife are mobile, their exposure is best represented by the mean contaminant concentration in media. To be conservative, the 95% upper confidence limit (UCL) is used in exposure estimates. To prevent bias that may result from calculating 95% UCLs using data that contains values below the detection limit, product limit estimator (PLE) was used to calculate the 95% UCLs for contaminants observed in fish and water. These data were used in the initial exposure estimates. Exposure estimates for contaminants that may potentially present a risk to piscivorous wildlife (based upon comparisons to NOAELs and LOAELs) were recalculated using Monte Carlo simulations. (Note: Because the purpose of the initial exposure estimate is to be conservative and to identify COPECs, the 95% UCL was used regardless of whether or not the value exceeded the maximum observed value. Overestimates of exposure that may occur at the screening level are addressed through the use of Monte Carlo simulation.)

4.2.1.1 Fillet-to-whole fish ratios

Fish data from the ORR consisted of analyses of both whole body concentrations (generally in stonerollers, shiners, and shad) and concentrations in fillets (in sunfish, largemouth bass, and carp). Because piscivores consume whole fish (not fillets) and fillet concentrations do not accurately represent whole body concentrations, contaminant-specific fillet-to-whole fish ratios were calculated to estimate the whole-body contaminant concentration in fish for which only fillet analyses were performed. For organic chemicals, the ratios were developed using data from 15 largemouth bass and 10 channel catfish collected from the Clinch River for which both fillet and carcass (whole-body minus fillet) analyses were performed. Whole fish contaminant concentrations were determined by calculating the weighted average of the fillet and carcass contaminant concentrations (weighted by the proportion of the total fish weight represented by the carcass and fillet weights, respectively). The contaminant concentration in the whole fish was then divided by the fillet concentration to produce the fillet-to-whole fish ratio (Table C.5). Both bass and catfish were pooled to produce one ratio for each contaminant. Ratios were not available for all contaminants detected in fish from the ORR. Ratios for these contaminants were approximated using ratios for related contaminants. The ratios for inorganic contaminants were obtained from spotted bass collected in the vicinity of the Portsmouth Gaseous Diffusion Plant (Southworth 1994). Mean ratio values were used to generate all whole-fish contaminant concentration estimates.

4.2.1.2 Contaminant concentrations in fish

Contaminant concentrations in fish are needed to estimate exposure. The 95% UCLs (calculated using the PLE) for contaminants detected in fish from the ORR are presented in Table C.6. Contaminants detected in fish from the background locations are presented in Table C.7. Note that data were aggregated into two size classes: <30 cm and >30 cm in length. This is because piscivore species forage on different size fish and contaminant body burdens are related to size (larger, older fish generally have higher contaminant concentrations). While mink, belted kingfisher, and great blue heron generally consume fish <30 cm in size, otter forage equally on small and large fish (see Tables C.1 to C.4). To more accurately reflect exposure, data were segregated according to size and exposure was estimated using data from the size of fish most likely to be consumed by that endpoint species. Because it was assumed that piscivores would select fish according to size and not by species all species were pooled within each size class.

While data concerning fish size were included in the BMAP, Bear Creek OU4, and Upper East Fork Poplar Creek data sets, fish sizes were not included in the Lower East Fork Poplar Creek RI or K-901 data sets. Based upon the size data in the first three data sets, all sunfish, stonerollers and shad were assumed to be <30 cm in size and largemouth bass and carp were assumed to be >30 cm for both the Lower East Fork Poplar Creek RI or K-901 data sets.

4.2.1.3 Exposure modeling using point-estimates

Initial estimates of exposure of piscivorous wildlife to contaminants were performed for each sampling point using point estimates of parameters in the exposure model (Equation 1). Species-specific parameters necessary to estimate exposure using the Equation 1 are listed in Tables C.1–C.4.

To estimate contaminant exposure experienced by mink, the following assumptions were made:

- Body weight = 1 kg.
- Food consumption = 0.137 kg/d (fresh weight).
- Diet consists 54.6% of fish or other aquatic prey.
- Contaminant concentration in fish is representative of that in other aquatic prey.
- Fish sizes consumed = 100% <30 cm.
- All non-aquatic prey consumed are uncontaminated.

To estimate contaminant exposure experienced by otter, the following assumptions were made:

- Body weight = 8 kg.
- Food consumption = 0.9 kg/d (fresh weight).
- Diet consists 100% of fish or other aquatic prey.
- Contaminant concentration in fish is representative of that in other aquatic prey.
- Fish sizes consumed = 50% <30 cm and 50% >30 cm.

To estimate contaminant exposure experienced by kingfisher, the following assumptions were made:

- Body weight = 0.148 kg.
- Food consumption = 0.75 kg/d (fresh weight).
- Diet consists 100% of fish.
- Fish sizes consumed = 100% <30 cm.

To estimate contaminant exposure experienced by great blue heron, the following assumptions were made:

- Body weight = 2.39 kg.
- Food consumption = 0.42 kg/d (fresh weight).
- Diet consists 100% of fish or other aquatic prey.
- Contaminant concentration in fish is representative of that in other aquatic prey.
- Fish sizes consumed = 100% <30 cm.

Using Equation 1 and the assumptions and data described above, exposure to contaminants was estimated for mink (Tables C.8 and C.9), otter (Tables C.10 and C.11), kingfisher (Tables C.12 and C.13), and great blue heron (Tables C.14 and C.15) for each location on the ORR. Exposure estimates for all analytes detected in fish samples at the off-site locations are presented in Table C.16.

4.2.1.4 Exposure modeling using Monte Carlo simulations

Employing point estimates for the input parameters in the exposure model does not take into account the variation and uncertainty associated with the parameters and therefore may over or under estimate the contaminant exposure that endpoints may receive in any given reach. In addition, calculating the model using point estimates produces a point estimate of exposure. This estimate provides no information concerning the distribution of exposures or the likelihood that individuals

within a watershed will actually experience potentially hazardous exposures. To incorporate the variation in exposure parameters and to provide a better estimate of the potential exposure experienced by piscivores on the ORR, the exposure model was re-calculated using Monte Carlo simulations.

Monte Carlo simulation is a resampling technique frequently used in uncertainty analysis in risk assessment (Hammonds et al. 1994). In practice, distributions are assigned to input parameters in a model and the model is recalculated many times to produce a distribution of output parameters (e.g., estimates of contaminant exposure). Each time the model is recalculated, a value is selected from within the distribution assigned for each input parameter. As a result, distribution of exposure estimates is produced that reflects the variability of the input parameters. To determine which input parameters most strongly influence the final exposure estimate, a sensitivity analysis is performed (Hammonds et al. 1994). Detailed discussions of sensitivity and uncertainty analysis, and the use of Monte Carlo simulations in risk assessment are provided by Hammonds et al. (1994).

Monte Carlo simulations were performed on the mean exposure (mean of all sampling locations) for each watershed. The percentiles of the resulting exposure distributions represent the likelihood that an individual piscivore within a watershed will experience a given exposure level. It was also assumed that each sampling location contributed equally to the overall mean exposure (i.e., individuals within each watershed do not preferentially forage at any one location within the watershed). Watershed-wide simulations were performed for mercury and PCBs because these contaminants are among the most important on the ORR and data for these contaminants were available at all sampling locations. Additional Monte Carlo simulations were performed for contaminants where comparison of point exposure estimates to LOAELs produced $HQs \geq 1$ (LOAELs are presented in Sect. 4.3.1.; screening of exposure estimates against LOAELs is presented in Sect. 4.4.1.)

Distributions were used for the following parameters in the exposure model: endpoint body weight, average contaminant concentrations in fish, and the proportion of aquatic prey in mink diet. All distributions were assumed to be normal, except otter body weight which was assigned a triangular distribution (while a standard deviation was not available, a range was). Because these wildlife are mobile, the contaminant concentration they are exposed to on a daily basis is best represented by the average concentration instead of the entire distribution. The standard error of the mean was used to describe variation in the average contaminant concentration. All other distributions employed the calculated standard deviation of the observed data. Piscivore body weight distributions and values are listed in the following table:

Endpoint	Distribution	Mean (kg)	Standard deviation	Range	Source
Mink	normal	0.974	0.202		EPA 1993c
River otter	triangular	8		5.84–10.4	EPA 1993c
Belted kingfisher	normal	0.148	0.0208		Dunning 1984
Great blue heron	normal	2.204	0.337		Dunning 1984

The proportion of aquatic prey in the diets of otter, kingfisher, and herons were assumed to be 100%. No data suggest that non-aquatic prey constitute a significant portion of their diet (see endpoint discussion, above). In contrast, mink have a very variable diet. Aquatic prey (fish, amphibians, crayfish, etc.) may make up from 16% to 92%. Nine observations from five studies indicate the proportion of aquatic prey to be 0.546 ± 0.21 (mean $\pm$ standard deviation; Table C.1). Mean and standard errors for contaminants in fish are presented in Table C.6.

Monte Carlo simulations were performed using the @Risk software. Samples from each distribution were selected using Latin hypercube sampling. The number of iterations, or recalculations, of each exposure simulation was determined by the convergence criteria set in the software. Under these criteria, iterations are performed until the between-iteration percent change in the percentiles, mean, and standard deviation are below 1.5% (i.e., the percentile, mean, and standard deviation for the latest iteration is less than 1.5% different than the those from the previous iteration). Using this convergence criteria, from 600 to 1000 model iterations were performed for each exposure estimate. Monte Carlo estimates of contaminant exposures are presented in Table C.17.

4.2.2 Internal Exposure of Great Blue Herons to Contaminants

To determine if contaminants from the ORR are being bioaccumulated by piscivorous wildlife, great blue heron eggs and chicks were collected from two colonies located within 3 km of the ORR and two colonies located >10 km from the site (Halbrook, unpubl. data; see Appendix F). Analyses were performed to determine the concentrations of arsenic, chromium, mercury, and PCBs in eggs, and feathers, liver, fat, and muscle of chicks. Elevated levels of Cr, Hg, and PCBs were observed in eggs from the ORR colonies (Tables F.2 and F.4, Appendix F). Hg concentrations in feathers and liver (Table D.3, Appendix D) and PCB concentrations in fat (Table F.5, Appendix F), liver (Table F.6, Appendix F), and muscle (Table F.7, Appendix F) were significantly elevated in samples from the ORR as compared to data from the off-site locations. A detailed discussion of these data are presented in Appendix F.

4.3 EFFECTS ASSESSMENT FOR PISCIVOROUS WILDLIFE

4.3.1 Single Chemical Toxicity Data

In cases where a NOAEL for a specific chemical was not available, but a Lowest Observed Adverse Effects Level (LOAEL) had been determined experimentally or where the NOAEL was from a subchronic study, the chronic NOAEL was estimated. EPA (1993d) suggests the use of uncertainty factors of 1 to 10 for subchronic to chronic NOAEL and LOAEL to NOAEL estimation. Because no data were available to suggest the use of lower values, uncertainty factors of 10 were used in all instances in which they were required.

Smaller animals have higher metabolic rates and are usually more resistant to toxic chemicals because of more rapid rates of detoxification. It has been shown that metabolism is proportional to

body surface area which, for lack of direct measurements, can be expressed in terms of body weight (bw) raised to the 2/3 power ($bw^{2/3}$) (EPA, 1980a). If the dose (d) itself has been calculated in terms of unit body weight (i.e., mg/kg), then the dose per unit body surface area (D) equates to:

$$D = \frac{d \times bw}{bw^{2/3}} = d \times bw^{1/3} \quad (2)$$

The assumption is that the effective dose per body surface area for species "a" and "b" would be equivalent. Therefore, knowing the body weights of two species and the dose (d_b) producing a given effect in species "b," the dose (d_a) producing the same effect in species "a" can be determined. Using this approach, if a NOAEL was available for the test species ($NOAEL_t$), the equivalent NOAEL for a wildlife species ($NOAEL_w$) was calculated by using the adjustment factor for differences in body size:

$$NOAEL_w = NOAEL_t \left(\frac{bw_t}{bw_w} \right)^{1/3} \quad (3)$$

This methodology is equivalent to that the EPA uses in their carcinogenicity assessments and Reportable Quantity documents for adjusting from animal data to an equivalent human dose.

NOAEL's and LOAEL's were derived for mink, river otter, belted kingfisher, and great blue heron. Mammalian and avian NOAEL's and experimental information used to estimate wildlife NOAEL's and LOAEL's (e.g., test species, test endpoints, citation) are listed in Tables C.18 and C.19.

Ecotoxicological profiles of the effects of Cd, Cr, Hg, Se, DDT, and PCBs to wildlife are presented in Appendix D.

4.3.2 Effects of Contaminants on the Reproductive Performance of Mink

Halbrook (unpubl. data; see Appendix E) conducted at Michigan State University Experimental Fur Farm, evaluated bioaccumulation of contaminants and reproductive effects in mink fed fish collected from Poplar Creek, the Clinch River (upstream of Melton Hill Dam) and the ocean. Mink were fed five diets consisting of 75% fish and 25% commercial mink diet. The diet composition and contaminant concentrations for each diet are described in the following table:

Diet	Fish composition	Contaminant concentration (mg/kg)	
		Mercury	PCB 1260
A	75% ocean	0.02 ± 0.00	0.169 ± 0.002
B	75% Clinch River	0.05 ± 0.00	11.44 ± 0.327
C	25% Poplar Creek 50% ocean	0.09 ± 0.00	4.69 ± 0.174
D	50% Poplar Creek 25% ocean	0.15 ± 0.01	10.41 ± 0.250
E	75% Poplar Creek	0.22 ± 0.01	20.67 ± 0.458

Twenty-three PCB congeners were also present in varying amounts. Concentrations of most congeners increased progressively from diets A through E (Table E.5, Appendix E).

Ten mink (eight females and two males) were fed each diet for ~7 months (3 months before breeding—6 weeks postpartum). Reproductive indices measured included: number of females mated; number of females whelping; length of gestation; number of kits whelped (alive, dead); kit sex ratio; average kit body weight at birth, 3, and 6 weeks of age; and kit survival to 3 to 6 weeks of age. At 6 weeks of age, 3 kits from dietary groups A, B, C, and E were euthanized, organs (liver, spleen, and kidneys) were weighed, and tissue samples (liver, kidney, and remaining carcass) were analyzed for contaminant accumulation. (note: kits from diet D were not sampled). At the termination of the study, all adult mink were necropsied. Organs (brain, liver, kidneys, heart, lungs, gonads, and adrenal glands) were weighed and examined for histopathologies. Adipose tissue, liver, kidney, and hair were analyzed for contaminant accumulation. Liver tissue also was analyzed for ethoxyresorufin-o-deethylase (EROD) activity.

The bioaccumulation of mercury in liver, kidney, and hair (Table E.3; Appendix E), and Aroclor 1260 (and other PCB congeners) in liver and fat (Tables E.6 and E.7, Appendix E) substantially increased in adult female mink from groups fed diet A up to diet E. Mink offspring also bioaccumulated mercury in kidney tissue and carcasses and many other PCB congeners in the liver and carcasses (Tables E.8 and E.9; Appendix E), increasing progressively from mink fed diets A through E. The lowest levels were observed for mink fed diet A and increased to a maximum observed among mink fed diet E.

Significant effects were observed only among mink fed diet E; no adverse effects were observed for any other diet. Adverse effects from diet E included: weight reduction in adult mink and their offspring, reduction in litter size, and increase in liver EROD activity in adult females. Weight reduction was observed at the end of the experimental period, increasing magnitude from diet groups A to E. At the end of the experiment, the mean whole body weights of female mink in diet group E were significantly less ($p = 0.03$) than mean weights of females in diet group A (percent reduction = 20%). Mean female relative organ weights (organ weights/body weight) were not significantly different among diet groups. At 6 weeks of age, mean whole body weights were also significantly lower ($p = 0.004$) in male kits from diet group E compared to those from diet group A (percent reduction = 17%). Similar trends were observed for female kits, although differences were not statistically significant. No histological lesions were attributed to any diet. Mean litter size was significantly reduced ($p = 0.01$) in diet group E compared to diet groups A, B, and C (percent reduction relative to diet A = 38%); but not diet group D. Liver EROD activity was significantly increased in adult female mink from diet groups D and E compared with those from diet group A.

4.3.3 Biological Surveys

4.3.3.1 Great blue heron reproduction survey

To determine if contaminants from the ORR are adversely affecting great blue heron, Halbrook (unpubl. data; see Appendix F) monitored the reproductive success at two heron colonies located adjacent to the ORR and two colonies located >10 km from the reservation. Data were collected from each nest colony between 1992 and 1994. The mean number of eggs/nest, number of chicks/nest, egg weight, and eggshell thickness did not differ between colonies within 3 km of the ORR and those >10 km away (Table F.8; Appendix F). A detailed discussion of these data are presented in Appendix F.

4.3.3.2 Mink survey

Stevens (1995) investigated bioaccumulation of mercury in mink on the ORR in 1993 through 1995. The methods used in the mink survey, while indicating that mink are present on the reservation, cannot be used to estimate abundance or density on mink on the ORR. A total of four male mink were live-trapped over the course of 6073 trapnights (trapnight = 1 trap set for 24 h). One juvenile was captured along East Fork Poplar Creek, two adults were captured along Bear Creek, and one adult was captured along White Oak Creek. Captured mink were fitted with an intraperitoneal radio transmitter (to monitor movements and home range) and released. Prior to release samples of hair was collected and metals analysis. An additional 8 roadkill mink (5 male and 3 female) were collected from the ORR and surrounding areas of Roane and Anderson counties. While one roadkill sample (a male) was collected on a bridge over Bear Creek and was assumed to be a resident of Bear Creek, all others were collected off the ORR and were used as references.

The Results of metals analysis are presented in the following table:

Metal concentrations in hair of mink from the ORR and from off-site reference samples^a

Site	N	Hg	Se	As	Cd	Pb
East Fork Poplar Creek	1	104	0.69	ND ^b	ND	0.33
Bear Creek	3	10.97 ± 3.42	1.88 ± .141	0.15 ± 0.09	0.04 ± .002	0.97 ± 1.28
White Oak Creek	1	8.8	1	ND	ND	0.37
Off site	7	5.15 ± 3.43	1.11 ± 0.25	0.22 ± 0.31	0.04 ± 0.02	0.7 ± 0.31

^aMean ± standard deviation mg/kg dry weight.

^bND = Not detected.

Radiotelemetry data on home ranges and movements were obtained for 3 mink - one each from the East Fork Poplar Creek, Bear Creek, and White Oak Creek watersheds. Mean ($\pm$ standard deviation) home range for these three individuals was found to be 7.5 ± 3 km of stream. The entire home range of the East Fork Poplar Creek mink was in a highly urbanized area; it included all of upper East Fork inside the Y-12 plant and all areas of East Fork upstream of the Oak Ridge Turnpike-Illinois Avenue intersection. The home range of the White Oak Creek mink included all of White Oak Creek from the headwater tributaries to the Clinch River, including the X-10 facility. This individual was observed to use dens within the X-10 facility and moved through the facility on several occasions.

4.4. RISK CHARACTERIZATION FOR PISCIVOROUS WILDLIFE

Risk Characterization integrates the results of the exposure assessment (Sect. 4.2) and effects assessment (Sect. 4.3) to estimate risks (the likelihood of effects given the exposure) based on each line of evidence, and then applies a weight of evidence inference logic to determine the best estimate of risk to each assessment endpoint. In an ideal risk assessment there are three lines of evidence: literature-derived single chemical toxicity data (which indicate the toxic effects of the concentrations

measured in site media), biological surveys of the affected system (these indicate the actual state of the receiving environment), and toxicity tests with ambient media (these indicate the toxic effects of the concentrations measured in site media). While three lines of evidence are available to assess risks to piscivorous wildlife, all are not available for each endpoint or for all watersheds on the ORR. Single chemical toxicity data are available for all four endpoints within all four watersheds. Toxicity tests and a field survey/bioaccumulation study were performed for mink along Poplar Creek and in the Bear Creek, East Fork Poplar Creek, and White Oak Creek watersheds, respectively. Lastly, a field survey/bioaccumulation study was performed for great blue heron along Poplar Creek and Melton Hill Lake.

Procedurally, the risk characterization is performed for each assessment endpoint by (1) screening all measured contaminants against toxicological benchmarks and background concentrations (if available), (2) estimating the effects of the contaminants retained by the screening analysis, (3) estimating the toxicity of the ambient media based on the media toxicity test results, (4) estimating the effects of exposure on the endpoint biota based on the results of the biological survey data, (5) logically integrating the lines of evidence to characterize risks to the endpoint, and (6) listing and discussing the uncertainties in the assessment. A detailed discussion of methods and the approach to risk characterization on the ORR is presented in Suter et al. (1994a).

4.4.1 Single Chemical Toxicity Data

Exposure estimates generated by the exposure model (see Sect. 4.2.1.) produced by both point estimates of parameter values and Monte Carlo simulation represent exposure at the individual level. The exposure estimates using point estimates of parameter values at each individual sampling point are used to identify COPECs and locations that contribute significantly to risk. In contrast, the watershed-level exposure distributions generated by Monte Carlo simulation represent the likelihood that an individual within the area for which exposure is modeled will experience a particular exposure.

Two types of single chemical toxicity data are available with which to evaluate piscivore contaminant exposure: NOAELs and LOAELs. NOAEL's are used to screen exposure estimates generated from point-estimates of exposure parameters; if the estimate is greater than the NOAEL, adverse effects are possible and additional evaluation is necessary (i.e., exposure modeling using Monte Carlo simulation). LOAELs are compared to the exposure distribution generated by the Monte Carlo simulation. If the LOAEL is lower than the 80th percentile of the exposure distribution, there is a >20% likelihood that individuals within the modeled location are experiencing contaminant exposures that are likely to produce adverse effects. By combining literature-derived population density data with the likelihood or probability of exceeding the LOAEL, population-level impacts may be estimated.

4.4.1.1 Screening point estimates of exposure

To determine if the contaminant exposures experienced by mink, river otter, belted kingfisher, and great blue heron on the ORR are potentially hazardous, the dietary contaminant exposure estimates (generated using point estimates of parameter values; Tables C.8 through C.16) were compared to estimated NOAELs and LOAELs for these species (Tables C.18 and C.19). To quantify the magnitude of hazard, a hazard quotient (HQ) was calculated where: $HQ = \text{exposure}/\text{NOAEL}$ or LOAEL . Hazard quotients greater than 1 indicate that individuals may be experiencing exposures that are in excess of NOAELs or LOAELs. While exceeding the NOAEL suggests that adverse

effects are possible, exceeding the LOAEL suggests that adverse effects are likely. Hazard quotients for mink, river otter, belted kingfisher, and great blue heron on the ORR are presented along with the point estimates of exposure in Tables C.8 through C.16. It should be noted that because few data are available for specific PCB (Aroclor) mixtures, all PCBs were summed and the total was compared to Aroclor-1254 toxicity data.

A summary of the analytes and number of locations within each watershed where $HQs > 1$ were observed is presented in Table C.20. The number of analytes where $HQs > 1$ were observed is partially an artifact of the data. More contaminants appear in Bear Creek and East Fork Poplar Creek because the fish from these locations were analyzed for more contaminants. Mercury and PCBs were the contaminants that most frequently exceeded both NOAELs and LOAELs. Cadmium and Selenium exceeded both NOAELs and LOAELs for mink and otter in Bear Creek (Table C.20). DDT and chromium exceeded both NOAELs and LOAELs for both kingfisher and heron in East Fork Poplar Creek and the K-25 area, respectively (Table C.20). In White Oak Creek, while exposure at most locations exceeded NOAELs, LOAELs were infrequently exceeded; no LOAELs were exceeded for mink and PCB exposure exceeded the LOAEL for otter at only one location. Mercury exposure exceeded the LOAEL for kingfisher and heron at only one location (Table C.20).

The spatial distribution of contamination and potential risks to piscivores in Bear Creek, East Fork Poplar Creek, K-25, and White Oak Creek are illustrated in Figs. C.6, C.7, C.8, and C.9, respectively. These figures display the sum of the NOAEL-based HQs (e.g., sum of toxic units or ΣTUs) for total PCBs and mercury. Because additional data were available, arsenic, cadmium, and selenium were included for Bear Creek. Importance of contaminants was determined based upon the magnitude of the HQ . Sampling locations were arranged upstream to downstream; side tributaries are included in the order in which they enter the main stream.

In Bear Creek, cumulative risks to mink and otter decreases with increasing distance from the Y-12 plant (Figs. C.6a and C.6b). The contaminant accounting for the majority of risk to mink and otter in Bear Creek is cadmium. Among kingfisher and heron, while mercury and PCBs present the greatest hazard, no clear spatial pattern of risk is evident; cumulative risk is greatest at BCK (Bear Creek Kilometer) 4.5 and 0.6, respectively (Figs. C.6c and C.6d). This lack of a distinct pattern is likely a result of differences in data from each location and not related to a source. While data from BCK 12.4, 9.4, and 3.3 consisted of bodyburdens in stonerollers (a grazing species), data from BCK 4.5 and 0.6 consisted of bodyburdens in rock bass and red-breast sunfish (both invertebrate feeders). Mercury bodyburdens were substantially higher at BCK 4.5 and 0.6 (rock bass and red-breast sunfish) than at BCK 12.4, 9.4, and 3.3 (stonerollers; see Table C.6). The differences in bodyburdens are likely related to food habits of the fish and species-specific mercury uptake kinetics and not to a particular contaminant source.

In East Fork Poplar Creek, the pattern of cumulative risk is similar for all endpoint species; except for peaks represented by the EFPC RI sampling locations (presented as numbers in parentheses), hazard declines with increasing distance from the Y-12 plant (Fig. C.7 a-d). As would be expected, mercury accounts for the majority of risk; however, PCBs contribute approximately 50% of risk to mink and otter in upper East Fork Poplar Creek (EFK 24.8-23.4; Figs. C.7a and C.7b). It is unclear why exposure estimated with the EFPC RI data should be higher than that from the BMAP data. The time frames are comparable for both sets of data (BMAP = 1982-1993; EFPC RI = 1991); species included are comparable (BMAP = sunfish, largemouth bass, and carp; EFPC RI = sunfish, largemouth bass, and stonerollers); and no sources are known where the peaks occur (along Illinois Avenue in the City of Oak Ridge). One possible explanation for the peaks may be differences in analytical methods employed between the two data sets.

At K-25, the pattern of cumulative risk was similar for mink (Fig. C.8a), kingfisher (Fig. C.8c), and herons (C.8d); in Poplar Creek, mercury accounted for most risk while PCBs were the primary risk agent in Mitchell Branch (MIK 0.2) and at the K-901 pond. For otter (Fig. C.8b), PCBs presented the greatest risk, with the highest risks observed at the K-25 ponds (most at K-1007, least at K-710). The peaks in mercury risk observed for all species occurred at PCK 8.2 and 6.9, are most likely attributable to the input of mercury from East Fork Poplar Creek. The difference between the pattern of cumulative risk for otter and that for other piscivores can be attributed to dietary differences and variation in contaminant concentration according to fish size. It was assumed that the diet of otter consisted 50% of fish < 30 cm in size and 50% fish >30 cm; all other piscivores were assumed to consume only fish <30 cm in size. In the K-1007 pond, mean ($\pm$ SE) PCB-1254 and PCB-1260 concentrations in fish <30 cm in size were 0.08 ± 0.02 mg/kg and 0.1 ± 0.05 mg/kg, respectively. In contrast, PCB-1254 and PCB-1260 concentrations in fish >30 cm in size were 21.3 ± 13 mg/kg and 20.8 ± 13 mg/kg, respectively. Mink, kingfisher, and heron experience minimal risk at the K-1007 pond because the fish they consume have low PCB concentrations. In contrast, because otter would be expected to consume the larger fish with the higher bodyburdens, the risk they experience at the same location is significant. At the K-901 pond, while PCBs were only detected in small fish (shad), concentrations in these fish were high (6.2 ± 1.4 mg/kg). As a result, significant risks are estimated for all piscivores at this location.

Similar to K-25, the pattern of cumulative risk in the White Oak Creek watershed was similar for mink (Fig. C.9a), kingfisher (Fig. C.9c), and herons (C.9d) but different for otters (C.9b). In general, cumulative risk was greater in White Oak Creek than in its tributaries (NTK and MEK) and declined with increasing distance from the X-10 plant. Mercury was the primary risk agent for kingfisher and heron (Figs. C.9c and C.9d), while PCBs were the primary factor for mink and otter (Figs. C.9s and C.9b). A peak for risk to otters from PCBs was observed at White Oak Lake. This peak can be attributed to the presence of data for large fish (>30 cm); PCBs in large fish were 3 to 5 times higher than that in small fish (Table C.6).

4.4.1.2 Screening Monte Carlo simulation estimates of exposure

To incorporate the variation present in the parameters employed in the exposure model, Monte Carlo simulations were performed for exposure of each species to mercury and PCBs in each watershed. Simulations for mercury and PCBs in East Fork Poplar Creek were performed both with and without the EFPC RI data to determine the influence of these data points. Additional simulations were performed for any analyte-endpoint-watershed combination where at least one LOAEL-based $HQ > 1$ was observed or where data were adequate to evaluate an entire watershed. These additional simulations included exposure of mink and otter to cadmium and selenium in Bear Creek; exposure of mink and otter to cadmium in White Oak Creek; exposure of kingfisher and heron to DDT in East Fork Poplar Creek; and exposure of kingfisher and heron to chromium from the K-901 pond. For comparison, simulations of exposure to PCBs and mercury at the off-site locations were performed for all species. Additional simulations were performed to evaluate off-site exposure of mink and otter to cadmium and selenium and of kingfisher and heron to chromium and DDT.

Monte Carlo simulations were performed on the mean exposure for each watershed (i.e., mean of sampling locations). It was assumed that each sampling location contributes equally to the overall mean exposure (i.e., the individuals within each watershed do not preferentially forage at any one location within the watershed). The mean, standard deviation, and 80th percentile of the simulated

exposures are presented in Table C.17. By superimposing NOAEL and LOAEL values on these distributions, the likelihood of an individual experiencing potentially hazardous exposures can be estimated and the magnitude of risk may be determined. Interpretation of the comparison of exposure distributions to NOAELs and LOAELs is described in the following table:

Comparison	Meaning	Risk-based interpretation
NOAEL > 80th percentile of exposure distribution	Less than 20% of exposures > NOAEL	Individual- and population-level adverse effects are highly unlikely
NOAEL < 80th percentile < LOAEL	More than 20% of exposures > NOAEL, but less than 20% of exposures > LOAEL	Individuals experiencing exposures at the high end of the distribution may experience adverse effects, but those effects are unlikely to significantly contribute to effects on the ORR population
LOAEL < 80th percentile of exposure distribution	More than 20% of exposures > LOAEL	Effects on some individuals are likely and they may contribute significantly to effects on the ORR population

To evaluate the likelihood and magnitude of population-level effects on piscivores, literature-derived population density data (expressed as number of individuals/km of stream or pond shoreline) were combined with lengths of streams or pond shorelines for which risks were assessed to estimate the number of individuals of each endpoint species expected to be present in each watershed. Literature-derived population densities used for each endpoint species were: mink: 0.6/km; river otter 0.37/km; belted kingfisher: 0.4/km; and great blue heron; 2.3/km. It should be noted that density values for all endpoint species but the great blue heron represent the maximum

values obtained from the literature (see Tables C.1, C.2, and C.3). The values for herons (see Table C.4) appear inflated and are not believed to accurately represent densities on the ORR. For this reason, the minimum value was used. Population estimates based upon these densities are listed in the following table.

Watershed	Watershed length (km)			Estimated number of individuals by watershed			
	Stream length	Pond shoreline length	Total length	Mink	River otter	Belted kingfisher	Great blue heron
Bear Creek	12.4	0	12.4	7	5	5	29
East Fork Poplar Creek	24.8	0	24.8	15	9	10	57
K-25	18.4	5.2	23.6	14	9	9	54
White Oak Creek	3.9	2.5	6.4	4	2	3	15
ORR total				40	25	27	155

The number of individuals within a given watershed likely to experience exposures >LOAELs can be estimated using cumulative binomial probability functions (Dowdy and Wearden 1983). Binomial probability functions are estimated using the following equation:

$$b(y;n;p) = \binom{n}{y} p^y (1-p)^{n-y} \quad (4)$$

where:

y = the number of individuals experiencing exposures >LOAEL

n = total number of individuals within the watershed

p = probability of experiencing an exposure in excess of the LOAEL

b(y; n; p) = probability of y individuals out of a total of n, experiencing an exposure >LOAEL, given the probability of exceeding the LOAEL = p.

By solving Equation 4 for y = 0 to y = n, a cumulative binomial probability distribution may be generated that can be used to estimate the number of individuals within a watershed that are likely to experience adverse effects. Summing the number within each watershed across all watersheds and dividing by the total estimated ORR-wide population, the proportion of the total ORR population potentially at risk may be estimated.

Binomial probability distributions were generated only for contaminant-endpoint-watershed combinations where the percent of the exposure distribution exceeding the LOAEL was 20% to 80% (these values are reported in Table C.17). Only two contaminant-endpoint-watershed combinations met this criterion: mercury exposure to otter in East Fork Poplar Creek (Fig. C.10) and PCB

exposure to otter in K-25 area (Fig. C.11). Three of nine otter in East Fork Poplar Creek may be adversely affected by mercury exposure (Fig C.10); six of nine otter in the K-25 area may be adversely affected by PCB exposure (Fig C.11) (the number of individuals where the cumulative probability of exceeding the LOAEL >0.5).

If the percent of the exposure distribution exceeding the LOAEL was <20%, it was assumed that no individuals within that watershed were experiencing adverse effects. Conversely, if the percent of the exposure distribution exceeding the LOAEL was >80%, it was assumed that all individuals within that watershed were experiencing adverse effects. The total numbers of individuals for each endpoint species estimated to be experiencing adverse effects within each watershed and across the ORR are summarized in Table C.21.

Inclusion or exclusion of the EFPC RI data generally had little effect on the exposure estimates for any species in East Fork Poplar Creek (Table C.17). While mean estimated exposure varied somewhat (lower for mercury and higher for PCBs with the EFPC RI data excluded), conclusions concerning the presence or absence of risk were constant regardless of whether or not the EFPC RI data were included. The only exception was for exposure of otter to mercury. Exclusion of the EFPC RI data reduced the likelihood of exceeding the LOAEL by over 50% (Table C.17). As a consequence, the number otter estimated to be adversely affected by mercury in East Fork Poplar Creek ranged from three to nine individuals, and the percent of the potential ORR-wide population at risk ranged from 12 to 36 % (Table C.21).

For mink, only one contaminant (cadmium) in one watershed (Bear Creek) presented a significant risk (LOAEL <80th percentile of exposure distribution, Table C.17). Mean estimated cadmium exposure in Bear Creek is 30-60 times greater than that estimated in White Oak Creek or at an off-site location (Hinds Creek). Using only cadmium exposure data from Bear Creek and White Oak Creek, 17.5% of the estimated ORR-wide mink population is likely to be adversely affected by cadmium (Table C.21). Exposure of mink to mercury, PCBs, and selenium at all locations on the ORR, while greater than NOAELs (NOAEL <80th percentile of exposure distribution) was not greater than LOAELs, indicating that while individual mink that may forage in the more contaminated areas may experience adverse effects, the mink population on the ORR as a whole is unlikely to adversely affected.

Several contaminants present significant hazards to otter (LOAEL <80th percentile of exposure distribution): cadmium in Bear Creek, mercury in East Fork Poplar Creek, and PCBs in East Fork Poplar Creek, and the K-25 vicinity (Table C.17). In terms of risks to the potential ORR-wide otter population, about 20% of the population could be adversely affected by cadmium, 12% or 36% by mercury, and 60% by PCBs (Table C.21). These data suggest that the successful re-establishment of otter on the ORR may be limited by contamination. In comparison to estimated exposures at off-site locations, cadmium exposure in Bear Creek is approximately 100 times greater, mercury exposure in East Fork Poplar Creek is 10 to 15 times greater, and PCB exposures in East Fork Poplar Creek, K-25, and across the ORR are about 10 times greater than that at one of two off-site locations (Hinds Creek; Table C.17). Estimated PCB exposure at the other off-site location (Brushy Fork) exceeds the highest observed on the ORR, suggesting that this off-site location is contaminated. Exposure of otter to selenium in Bear Creek, while greater than the NOAEL (NOAEL <80th percentile of exposure distribution) was not greater than the LOAEL (Table C.17).

Similar risk results were obtained for both kingfisher and heron: mercury presents a significant hazard (LOAEL <80th percentile of exposure distribution) to both species in East Fork Poplar Creek

(Table C.17) and as a result to their ORR-wide populations (Table C.21). Additionally, chromium in the K-901 pond presents a hazard to individual kingfisher and heron that may feed extensively from this pond. Mean estimated mercury exposure in East Fork Poplar Creek and on the ORR as a whole is 5-20 times greater than that estimated at three off-site locations; chromium in K-901 is approximately 20 times greater than observed off site (Table C.17). Exposure of kingfisher or heron to DDT or PCBs, while greater than NOAELs at all locations on the ORR (NOAEL < 80th percentile of exposure distribution) was not greater than LOAELs.

4.4.1.3 Effects of retained contaminants

Cadmium. The mink and otter NOAEL and LOAEL for cadmium were derived from a study of rats fed cadmium chloride for 4 generations. (Wills et al. 1981). While consumption of 0.01 mg/kg/d cadmium reduced fertility (no. litters/no. females) by 63%, no adverse effects were observed at a 0.008 mg/kg/d exposure level. The study was considered to represent a chronic exposure, therefore a subchronic-chronic correction factor was not employed. The 0.008 mg/kg/d exposure was considered to be a chronic NOAEL; the 0.01 mg/kg/d exposure was considered to be a chronic LOAEL. Based on the results of Wills et al. (1981), mink or otter experiencing exposure $\geq$ LOAEL are likely to display reduced fertility.

Chromium. The kingfisher and heron NOAEL and LOAEL for chromium were derived from a study of black ducks fed Cr^{+3} for 10 months. (Haseltine et al., unpubl. data). While consumption of 5 mg/kg/d chromium reduced duckling survival, no adverse effects were observed at a 1 mg/kg/d exposure level. The study was considered to represent a chronic exposure, therefore a subchronic-chronic correction factor was not employed. The 1 mg/kg/d exposure was considered to be a chronic NOAEL; the 5 mg/kg/d exposure was considered to be a chronic LOAEL. Based on the results of Haseltine et al. (unpubl. data), kingfisher or heron experiencing exposure $\geq$ LOAEL are likely to display reduced offspring survival.

Mercury. For the purposes of this assessment, it is assumed that 100% of the Hg to which piscivores are exposed consists of methylmercury.

Both the avian NOAEL and the LOAEL are based upon a study of mallard ducks fed methyl mercury for three generations (Heinz 1979). The study was considered to represent a chronic exposure and a subchronic-chronic correction factor was not employed. The only dose level administered, 0.064 mg/kg/d, caused hens to lay fewer eggs, lay more eggs outside of the nest box, and produce fewer ducklings. This dose level was considered to be a LOAEL. Because an experimental NOAEL was not established, the NOAEL was estimated using LOAEL-NOAEL correction factor of 0.1. Based on the results of Heinz (1979), birds experiencing exposure $\geq$ LOAEL are likely to display impaired reproduction.

The otter NOAEL for mercury was derived from a study of mink fed methyl mercury for 93 d (Wobeser et al. 1976). While consumption of 0.247 mg/kg/d methyl mercury resulted in significant mortality, weight loss, and behavioral impairment, no effects were observed at the 0.15 mg/kg/d exposure level. The 0.15 mg/kg/d exposure was considered to be a NOAEL and the 0.247 mg/kg/d exposure was considered to be a LOAEL. Because the study was subchronic in duration (<1 year), a subchronic-chronic correction factor was applied (NOAEL = 0.015, LOAEL = 0.025). While the estimated chronic NOAEL based on results from Wobeser et al. (1976) was considered appropriate for screening purposes (the conservatism added by the application subchronic-chronic correction

factor serves to identify areas of potential risk), the estimated chronic LOAEL based on Wobeser et al. (1976) was considered too severe and therefore inappropriate to evaluate the nature and magnitudes of potential population-level effects. Therefore the LOAEL was derived from a study that was considered to be more appropriate. The LOAEL for mercury was derived from a study that evaluated reproduction in rats fed methyl mercury for three generations (Verschuuren et al. 1976). While consumption of 0.16 mg/kg/d methyl mercury resulted in reduced pup viability, no effects were observed among rats consuming 0.032 mg/kg/d. Because the data were derived from a multigenerational study, the 0.16 mg/kg/d exposure was considered to be a chronic LOAEL. Based on the results of Verschuuren et al. (1976), otter experiencing exposure $\geq$ LOAEL are likely to display impaired reproduction.

PCBs. The otter NOAEL and LOAEL for PCBs was derived from a study of mink fed Aroclor 1254 for 4.5 months (Aulerich and Ringer 1977). While consumption of 0.69 mg/kg/d Aroclor 1254 reduced kit survivorship, no effects were observed at the 0.14 mg/kg/d exposure level. The 0.14 mg/kg/d exposure was considered to be a chronic NOAEL; the 0.69 mg/kg/d exposure was considered to be a chronic LOAEL. Based on the results of Aulerich and Ringer (1977), mink experiencing exposure $\geq$ LOAEL are likely to display reduced kit survivorship.

4.4.2 Mink Toxicity Tests

To evaluate the nature and magnitude of toxicity of contaminants in fish from the Clinch River to mink, fish were collected from the Poplar Creek embayment, formulated into mink diets, and fed to mink. Mink were fed five different diets. Ten mink (2 males, 8 females) were fed each diet for 7 months; starting approximately 3 months prior to breeding, extending to 6 weeks post-partum. Bioaccumulation, growth, histopathology, and reproduction were recorded. Significant effects were observed only among mink fed diet E. These effects included statistically significant reductions in body weights of adult females and male kits and in litter size. Percent reductions were 20% and 17% for adult female and male kit weights, respectively, and 37.7% for litter size. A detailed discussion of the methods and results of the mink toxicity test is presented in Appendix-E.

To evaluate how the exposures experienced by mink in the toxicity test compare to those modeled for mink on the ORR, Monte Carlo simulations of mink exposure were performed using the concentrations of mercury and PCB 1260 measured in the five diets (Tables F.1 and F.5, Appendix E). Parameter values in the exposure model were those used in estimates on the ORR (body weight = 0.974 ± 0.202 kg; food ingestion rate = 0.137 kg/d). Results of the exposure simulation are presented in Table C.22. Estimated exposures to mercury and PCB 1260 in diet A were below both the NOAEL and LOAEL. For diets B, C, D, and E, mercury exposures exceeded the NOAEL (only marginally for diet B) but not the LOAEL, suggesting that it is possible but unlikely that toxicity observed in diet E is attributable to mercury. However, exposures to Aroclor 1260 in diets B, C, D, and E were greater than both the NOAEL and LOAEL (Table C.22). These data suggest that toxicity was due primarily to PCBs rather than mercury and that impaired reproduction should have been evident in all four diets, not just diet E.

Estimating that toxicity should be observed in four diets, but actually observing it only in the highest concentration suggests that the LOAEL for PCBs used in this assessment is too low and is not representative of the toxicity of the PCBs present on the ORR. ORR-specific NOAEL and LOAEL for PCBs (represented by PCB 1260) of 1.7 mg/kg/d and 3 mg/kg/d can be derived from the toxicity test exposure estimate for diets B and E (Table C.22). While an ORR-specific LOAEL for mercury cannot be derived from these toxicity test results, a site-specific NOAEL may be

estimated. The ORR-specific NOAEL for mercury would be 0.022 mg/kg/d (diet D) or 0.033 mg/kg-d (diet E, assuming that mercury is not contributing significantly to toxicity observed from this diet).

The mercury exposure estimate for mink in the watershed where the highest exposure estimate was obtained (East Fork Poplar Creek; mean = 0.067 ± 0.029 mg/kg/d) is higher than that estimated for all test diets (Table C.22). The estimated total PCB exposure in East Fork Poplar Creek (excluding EFPC RI data; mean = 0.35 ± 0.17 mg/kg/d) is less than that in all test diets except the control diet (diet A; Table C.22).

Several conclusions may be drawn from these toxicity test data.

- Comparisons of exposure estimates to NOAELS and LOAELs suggest that effects observed in diet E are attributable to PCBs. It is unlikely that mercury is significantly contributing to adverse effects observed in the toxicity test. A significant contribution of mercury to the toxic effects would have resulted in a LOAEL that was lower than literature values, not higher.
- Given the difference between predicted and observed toxicity from the test diets, the PCB LOAEL used in this assessment is too low and does not reflect toxicity observed among mink exposed to Poplar Creek fish.
- Consumption of a diet consisting of 75% fish from the Poplar Creek produces reproductive impairment in mink.
- Assuming that toxicity in the test is entirely due to PCBs, a LOAEL for mink on the ORR fish of 3 mg/kg/d can be derived. Using the ORR-specific value rather than the literature value, PCBs would not be expected to cause toxic effects on survival, growth, or reproduction of mink in any ORR watershed.

Differences between the results of the toxicity tests and modeled exposures for mink on the ORR may result for several reasons.

- Differences in fish size. Exposure estimates for mink on the ORR were based solely on contaminant concentrations in fish most likely to be consumed by mink (i.e., ≤ 30 cm in length). Due to the large volume of fish needed to formulate the test diets and to feed mink for 7 months, the majority of fish used in the toxicity test were large (mean = 39 cm, STD = 17 cm). Because body burdens of bioaccumulative contaminants like mercury and PCBs are generally greater in older, larger individuals, concentrations in the toxicity test diets were higher than that in fish expected to be consumed by mink on the ORR.
- Differences in fish species. More than 50% of the fish used in the test diets were sucker, carp, or buffalo (Table E.1, Appendix E). None of these species were included in the data used to estimate mink exposure on the ORR. Because fish species accumulate contaminants differently (as seen in stonerollers and sunfish in Bear Creek), variation in species included in test diets and modeled diets may have contributed to the differences in results.
- Differences in the PCB congener composition on the ORR vs. that used in the literature toxicity test. PCBs measured in environmental samples are not Aroclors. Aroclors are specific mixtures of PCB congeners as manufactured. The environmental measurements of PCBs used in the

Poplar Creek toxicity test are called PCB 1254 or PCB 1260 because they have ~54% or 60% Cl. The congener makeup of PCB 1254 or 1260 from the Poplar Creek fish is likely to be very different from the congener makeup of Aroclor 1254 or 1260. More importantly, PCB toxicity is generally correlated with individual congeners, not with Aroclors.

4.4.3 Biological Surveys

4.4.3.1 Great blue heron reproduction study

To determine if contaminants from the ORR are adversely affecting great blue heron, bioaccumulation of contaminants and reproductive success of herons at two colonies located adjacent to the ORR and two colonies located >10 km from the site was monitored. Data were collected from each nest colony between 1992 and 1994. A detailed discussion of these data are presented in Appendix F.

Analyses indicated statistically significantly elevated levels of Cr, Hg, and PCBs in eggs (Tables F.2 and F. 4, Appendix F), Hg in feathers and liver of chicks (Table F.3, Appendix F) and PCBs in fat (Table F.5, Appendix F), liver (Table F.6, Appendix F), and muscle (Table F.7, Appendix F) of chicks from samples from the ORR as compared to data from the off-site locations. King et al. (1991) report that 0.5 to 1.5 mg/kg mercury concentrations in bird eggs may be associated with reproductive failure; Harris et al. (1993) report a NOAEL for hatching success of Forster's Tern eggs to be 7 mg/kg. Mean concentrations of mercury (0.17 mg/kg) and PCBs (1.68 mg/kg) in great blue heron eggs from within 3 km of the ORR are substantially below both levels, suggesting that reproductive effects from mercury or PCBs in eggs are unlikely.

Despite elevated contaminant burdens, the mean number of eggs/nest, number of chicks/nest, egg weight, and eggshell thickness did not differ between colonies within 3 km of the ORR and those >10 km away (Table F.8; Appendix F). In addition, the number of eggs/nest observed at the colonies within 3 km of the ORR (3.5 eggs/nest) and at the colonies >10 km away (3.2 eggs/nest) are comparable to those reported in EPA (1993b) (3.16 to 4.37 eggs/nest).

The results of the great blue heron reproduction survey indicate that herons are experiencing higher contaminant exposures at the colonies adjacent to the ORR. However, this exposure is not sufficiently high to result in adverse effects to the populations at the studied colonies. [Note: there are currently five great blue heron colonies around the margins of the ORR (R. Brewer, pers. comm.). Bioaccumulation and reproductive success have only been evaluated for two of these five colonies.]

4.4.3.2 Mink survey

Results of the mink survey (see Sect. 4.3.3) indicate that mink are present on the ORR, have large home ranges and do not avoid the industrial facilities on the ORR. The methods employed in the study do not allow numbers or density of mink to be determined. While mercury levels in hair of mink were statistically significantly greater on the ORR than in reference samples, no statistically significant differences were observed for arsenic, cadmium, lead, or selenium.

4.4.4 Weight of Evidence

4.4.4.1 Mink

Three lines of evidence, literature toxicity data, toxicity test data, and field surveys were available to evaluate risk to mink. Comparison of exposure estimates to LOAELs indicates a significant risk from cadmium in Bear Creek. While data for cadmium exposure are lacking for East Fork Poplar Creek and the K-25 area, cadmium in the Bear Creek drainage is estimated to present a risk to 17.5% of the ORR-wide mink population (Table C.21). Data concerning cadmium in fish at K-25 and East Fork Poplar Creek are needed to determine if cadmium presents a serious risk (i.e., percent exposed $\geq 20\%$) to the ORR-wide mink population.

While no risks were identified in any other watershed or on the ORR as a whole for any other contaminant evaluated singly, it should be noted that Wren et al. (1987) report a synergistic effect of combined exposure of mink to PCBs and methylmercury. While the most severe effects (50% reduction in kit survival) were observed among mink consuming 0.14 mg/kg/d each of PCB and methylmercury, consumption of 0.07 mg/kg/d each of PCB and methylmercury produce a 13% reduction in kit survival and reduced the mean number of kits/female by 20%. While exposure of mink to PCBs at all locations on the ORR exceeded the highest effects level (0.14 mg/kg/d; Table C.17), only in East Fork Poplar Creek does mercury exposure exceed the lower effects level (0.07 mg/kg/d). Because Wren et al. (1987) only considered the synergistic effects of equal exposures to PCBs and methylmercury, combined effects of PCBs and methylmercury in the proportions present on the ORR are unknown (except for Poplar Creek).

Toxicity test results indicate that consumption of a diet consisting primarily of fish from the Poplar Creek embayment adversely affects mink reproduction. Because PCB exposure in four of the five diets (Table C.22) were 5 to 22 times higher than highest dose level in Wren et al. (1987; 0.14 mg/kg/d) while the mercury level in the highest diet (diet E) was less than half the lower dose level in Wren et al. (1987), and PCB exposure in 4 of five test diets exceeded PCB LOAELs while no diet exceeded mercury LOAELs (Table C.22), effects observed in the toxicity test using Poplar Creek fish are most likely attributable to PCBs. The maximum PCB exposure estimated for mink on the ORR however is significantly lower than the toxicity test exposure level that produced effects.

Limited data from field surveys indicate that while mink are present on the reservation, the health and abundance of the population is unknown (the trapping methods that were employed, while suitable for capturing animals for radiotelemetry purposes, were not adequate to estimate population abundance and density). Mink on the ORR have large home ranges, make use of the creeks within the industrial facilities, and have higher mercury concentrations in hair than do mink from off-site locations. Cd concentrations in hair were not different between mink on the ORR and those from off-site locations.

The weight of evidence suggests that Cd presents a hazard to mink in Bear Creek and consequently to a substantial portion (17.5%) of the ORR-wide mink population. ORR-wide risk to mink from cadmium may be underestimated due to the lack of data from the two largest watersheds (i.e., East Fork Poplar Creek and the K-25 vicinity). Combined exposure of mink to PCBs and mercury may present a hazard to mink in East Fork Poplar Creek. Risks from contaminants in other watersheds are not significant (Table 4.1).

Table 4.1. Summary of risk characterization for piscivores on the ORR

Species	Evidence	Result	Explanation
Mink	Literature toxicity data	+	Estimated Cd exposure in the Bear Creek watershed exceeds LOAELs. Effects from combined exposure to PCBs and Hg may produce adverse effects to mink in East Fork Poplar Creek.
	Biological surveys	±	Mink are present on the ORR, but abundance and density are unclear but clearly not high. While Hg in hair from mink from ORR is elevated relative to references, As, Cd, Pb, and Se are not.
	Medium toxicity tests	-	A diet consisting primarily of fish from Poplar Creek adversely affects reproduction, with effects attributed to PCBs. The maximum PCB exposure estimated for mink on the ORR however is significantly lower than the toxicity test exposure level that produced effects. This is likely the results of higher proportion of fish in the toxicity test diet and variation in the congener makeup of PCBs on the ORR vs that in the literature toxicity tests.
	Weight of evidence	+	Cd presents a hazard to mink in Bear Creek and consequently to 17.5% of the ORR-wide mink population. Combined exposure of mink to PCBs and mercury may present a hazard to mink in East Fork Poplar Creek. Risks from contaminants in other watersheds are not significant.
River otter	Literature toxicity data	+	Comparison of exposure estimates to LOAELs indicates a significant risk from cadmium in Bear Creek, from mercury in East Fork Poplar Creek, and from PCBs in East Fork Poplar Creek, and the K-25 vicinity.
	Biological surveys	NA	
	Medium toxicity tests	-	Use of the ORR-specific PCB LOAEL generated from the mink toxicity test indicates that PCBs on the ORR are unlikely to adversely affect otter. The ORR-specific mercury NOAEL while greater than the literature-based NOAEL, is less than the literature-based LOAEL. Conclusions concerning risk to otter from mercury are therefore unaffected by the results of the mink toxicity test.
	Weight of evidence	+	Because the river otter is a state threatened species, effects to any individual are significant. Consequently, cadmium in Bear Creek, mercury in East Fork Poplar Creek, present a significant risk to a potential ORR-wide otter population.

Table 4.1 (continued)

Species	Evidence	Result	Explanation
Belted kingfisher	Literature toxicity data	+	Comparison of exposure estimates to LOAELs indicates a significant risk from mercury in East Fork Poplar Creek and on the ORR as a whole. Individual kingfisher foraging from the K-901 pond may be adversely affected by chromium.
	Biological surveys	NA	
	Medium toxicity tests	NA	
	Weight of evidence	+	Mercury in East Fork Poplar Creek presents a significant risk to the ORR-wide belted kingfisher population.
Great blue heron	Literature toxicity data	+	Comparison of exposure estimates to LOAELs indicates a significant risk from mercury in East Fork Poplar Creek and on the ORR as a whole. Individual heron foraging from the K-901 pond may be adversely affected by chromium.
	Biological surveys	-	Biomonitoring data at 2 of 5 colonies around the ORR indicate that while PCBs and mercury are being accumulated in heron eggs and chicks, the levels in eggs are lower than levels reported in the literature to produce adverse effects. Observations of the two of the five colonies adjacent to the ORR indicate that reproduction is not reduced relative to colonies >10 km from the ORR.
	Medium toxicity tests	NA	
	Weight of evidence	±	Contaminant bioaccumulation and reproductive success are unknown at the three additional colonies adjacent to the ORR; the primary foraging locations for herons at the two studied colonies is unknown. Because herons can travel long distances in search of food, they are likely to forage at offsite as well as on-site locations, reducing both the exposure they receive and the risk they experience. If birds from the unstudied colonies forage more extensively on the ORR, they may experience greater risk. Due to the high risk estimated for mercury exposure on the ORR, the lack of data for three of five heron colonies adjacent to the ORR, and uncertainty as to where birds from the five ORR colonies forage, a conclusion concerning whether or not great blue heron on the ORR are at risk cannot be made

+ indicates that the evidence is consistent with the occurrence of the endpoint effect.
 - indicates that the evidence is inconsistent with the occurrence of the endpoint effect.
 ± indicates that the evidence is too ambiguous to interpret.
 NA indicates that the information is not available.

4.4.4.2 River otter

Two lines of evidence, literature toxicity data and the PCB NOAEL and LOAEL and mercury NOAEL derived from the Poplar Creek mink toxicity test, were available to evaluate potential risk to river otter. Comparison of exposure estimates to literature-derived LOAELs indicates a significant risk from cadmium in Bear Creek, from mercury in East Fork Poplar Creek, and from PCBs in East Fork Poplar Creek, and the K-25 vicinity.

Using Equation 3 and the ORR-specific PCB NOAEL and LOAEL and mercury NOAEL for mink (see Sect. 4.4.2), ORR-specific values for otter were estimated to be as follows:

Analyte	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)
PCBs	0.85	1.5
Mercury	0.011 ^a	no data

^aTo be conservative, based on the lower of two possible NOAELs.

Comparison of the ORR-specific PCB LOAEL to the exposure distributions presented in Table C.17 indicate that there is a <1% likelihood of individuals in any watershed experiencing PCB exposure >ORR-specific LOAEL. Therefore, based upon the results of the Poplar Creek mink toxicity test, PCBs are unlikely to present a significant risk to the ORR-wide otter population.

The ORR-specific mercury NOAEL, while greater than the literature-derived NOAEL (0.008 mg/kg/d; Table C.18) is still less than the literature-derived LOAEL (0.06 mg/kg/d; Table C.18). Therefore, the results of the Poplar Creek mink toxicity test do not significantly alter the conclusions derived from evaluation of the literature-based toxicity data.

Evaluation of the potential risks to a future ORR-wide population of otter indicates that cadmium in Bear Creek presents a risk to 20% of the ORR-wide population; mercury in East Fork Poplar Creek presents a risk to either 12% or 36% (Table C.21; depending upon inclusion of EFPC RI data). Because the river otter is a state threatened species, effects to any individual is significant. Therefore the weight of evidence suggests that Cd in Bear Creek, mercury in East Fork Poplar Creek, all present a significant risk to future ORR-wide river otter population (Table 4.1).

4.4.4.3 Belted kingfisher

One line of evidence, literature toxicity data, was available to evaluate potential risk to belted kingfisher. Comparison of exposure estimates to LOAELs indicates a significant risk from mercury in East Fork Poplar Creek (Table C.17). This translates into a risk to 37% of the ORR-wide kingfisher population (Table C.21). Individual kingfisher foraging from the K-901 pond may be adversely affected by chromium. The weight of evidence suggests mercury in East Fork Poplar Creek presents a significant risk to the ORR-wide belted kingfisher population (Table 4.1).

4.4.4.4 Great blue heron

Two lines of evidence, literature toxicity data and biomonitoring data, were available to evaluate ecological risk to great blue heron. Comparison of exposure estimates to LOAELs indicates a significant risk from mercury in East Fork Poplar Creek (Table C.17). This translates into a risk to 37% of the ORR-wide heron population (Table C.21). Individual heron foraging from the K-901 pond may be adversely affected by chromium. Biomonitoring data at 2 of 5 colonies around the ORR indicate that while PCBs and mercury are being accumulated in heron eggs and chicks, the levels in eggs are lower than levels reported in the literature to produce adverse effects. Observations of the two of the five colonies adjacent to the ORR indicate that reproduction is not reduced relative to colonies >10 km from the ORR. Contaminant bioaccumulation and reproductive success are unknown at the three additional colonies adjacent to the ORR. Additionally, the primary foraging locations for herons at the two studied colonies is unknown. Because herons can travel long distances in search of food (>15 km), they are likely to forage at off-site as well as on-site locations, reducing both the exposure they receive and the risk they experience. If birds from the unstudied colonies forage more extensively on the ORR, they may experience greater risk. Due to the high risk estimated for mercury exposure on the ORR, the lack of data for three of five heron colonies adjacent to the ORR, and uncertainty as to where birds from the five ORR colonies forage, a conclusion concerning whether or not great blue heron on the ORR are at risk cannot be made (Table 4.1).

4.4.5 Quality and Completeness of Data

The fish bioaccumulation data used in the piscivore assessment was considered to be of high quality. Except for the East Fork Poplar Creek RI data, all data were obtained directly from the PIs (principal investigators) who collected the data. Because these persons were available to answer questions concerning interpretation of their data, few assumptions concerning sampling methods, measurements, sampling locations, and so forth were necessary. The East Fork Poplar Creek RI data was also considered to be of high quality, but there is considerable uncertainty concerning the variation in measurements observed in these data as compared to BMAP data from East Fork. Reasons for this discrepancy will be investigated.

Most fish bioaccumulation data that we were aware of was used in this report. Data that were not included at this time but will be in future assessments include data from the Clinch River RI program, data from the WAG 1 surface impoundments, and fish data collected by the Environmental Compliance Division.

The most severe limitation of the data used in this assessment relates to contaminants analyzed for in fish tissue. While data for PCBs and mercury were available at all locations, that for other contaminants was not. Consequently, reservation-wide scale risks that these contaminants may present cannot be evaluated at this time. BMAP has performed more extensive residue analyses in fish from selected locations on the ORR. These data are reported in various BMAP reports but are not currently in a readily usable form. These data will be added to the current reservation-wide database and will be incorporated into future revisions of this report.

4.4.6 Uncertainties Concerning Risks to Piscivorous Wildlife

4.4.6.1 Bioavailability of contaminants

Bioavailability of contaminants was assumed to be comparable between fish collected from the ORR and the diets used in the literature toxicity tests. Because bioavailability may not be comparable, exposure estimates based upon the contaminant concentrations in ORR fish may either under- or overestimate the actual contaminant exposure experienced.

4.4.6.2 Extrapolation from published toxicity data

While published toxicity studies are available for mink, there are no published data for otter, kingfisher, or great blue heron. To estimate toxicity of contaminants at the site, it was necessary to extrapolate from studies performed on test species (i.e., mallard ducks, ring-necked pheasant, and rats). While it was assumed that toxicity could be estimated as a function of body size, the accuracy of the estimate is not known. For example, osprey or herons may be more or less sensitive to contaminants than ducks or pheasants, due to factors other than metabolic rate.

Additional extrapolation uncertainty exists for those contaminants for which data consisted of only LOAELs or tests were subchronic in duration. For either case, an uncertainty factor of 10 was employed to estimate NOAELs or chronic data. The uncertainty factor of 10 may either over- or underestimate the actual LOAEL-NOAEL or subchronic-chronic relationship.

Toxicity of PCBs to piscivorous wildlife was evaluated using toxicity data from studies on Aroclor 1254. Because toxicity of PCB congeners can vary dramatically, the applicability of data for Aroclor 1254 is unknown. Comparison of the results of the mink toxicity test results and the estimated LOAELs for mink, suggests the Aroclor 1254 data do not accurately reflect (i.e., overestimate) the toxicity of the PCB mixture present in Clinch River fish.

4.4.6.3 Variable food consumption

While food consumption by piscivorous wildlife was assumed to be similar to that reported for the same or related species in other locations, the validity of this assumption cannot be determined. Food consumption by wildlife on the ORR may be greater or less than that reported in the literature, resulting in either an increase or decrease in contaminant exposure.

4.4.6.4 Single contaminant tests vs exposure to multiple contaminants in the field

While piscivores on the ORR are exposed to multiple contaminants concurrently, published toxicological values only consider effects experienced by exposures to single contaminants. Because some contaminants to which wildlife are exposed can interact antagonistically, single contaminant studies may overestimate their toxic potential. Similarly, for those contaminants that interact additively or synergistically, single contaminant studies may underestimate their toxic potential.

4.4.6.5 Inorganic forms or species present in the environment

Toxicity of metal species varies dramatically depending upon the valence state or form (organic or inorganic) of the metal. For example, Arsenic (III) and methyl mercury are more toxic than arsenic (V) and inorganic mercury, respectively. The available data on the contaminant concentrations in media do not report which species or form of contaminant was observed. Because benchmarks used for comparison represented the more toxic species/forms of the metals (particularly for arsenic and mercury), if the less toxic species/form of the metal was actually present in fish from the Clinch River or Poplar Creek, potential toxicity at the sites may be overestimated.

4.4.6.6 Contaminant concentrations in aquatic prey

While fish are the primary prey of piscivores, other aquatic prey are also consumed. It was assumed that the contaminant concentration in fish was representative of that in other aquatic prey. Due to the different life histories of other aquatic prey (i.e., amphibians, crayfish, benthic invertebrates), their contaminant burdens are likely to differ from that in fish. Therefore, assuming comparability to fish may either over or underestimate exposure.

4.4.6.7 Fish size selection

Data concerning the sizes of fish consumed by piscivores were obtained from the literature. Because fish sizes consumed by piscivores on the ORR may differ from that reported in the literature, exposure may be overestimated or underestimated.

4.4.6.8 Monte Carlo simulation

To perform Monte Carlo simulations, distributions must be assigned to parameters. Because wildlife are mobile, the mean of the contaminant concentration is likely to best represent their exposure. For this report, the contaminant concentrations in fish were assumed to be normally distributed. In future revisions of this report, goodness-of-fit analyses will be performed to determine which distribution best fits the data.

The literature values used for body weights of each endpoint are nationwide values which may overestimate or underestimate the body weight of species found at the site. Similarly the proportion of fish and aquatic prey in mink diet were derived from data from northern locations (i.e., MI, Canada, etc.). The applicability of these data to the percentage of fish and aquatic prey consumed by mink in Tennessee is unknown.

4.4.6.9 Estimated whole fish concentrations

Contaminant concentrations in whole fish were estimated using contaminant specific fillet to whole fish ratios. Data to generate ratios were available only for PCBs in largemouth bass and channel catfish from the Clinch River. Ratios for metals were obtained from spotted bass samples from near the PORTS facility in Ohio. Applicability of these ratios to species other than those from which they were developed is unknown. Similarly, applicability of metal ratios from Ohio spotted bass to fish on the ORR is unknown.

5. ASSESSMENT OF RISKS TO VERMIVORES AND HERBIVORES ON THE OAK RIDGE RESERVATION

5.1 PROBLEM FORMULATION

On the ORR, while most wide-ranging wildlife species reside primarily in the uncontaminated terrestrial habitats outside of source OUs (the terrestrial integrator OU; Suter et al. 1994a), they may also use those source OUs on which suitable habitat is present. As discussed in Chap. 3, the degree to which a source OU is used (and therefore the risk that it may present) is dependant upon the availability of suitable habitat on the OU. OUs with little or no habitat will experience little use (and will present minimal risk) while those with considerable habitat are likely to experience considerable use (and depending upon the degree of contamination, may present significant risks).

While *individuals* may experience adverse effects through exposures received at source OUs, the primary concern for ecological risk assessment is for effects at the population-level (except for T&E species, for which effects to individuals are a critical concern). To evaluate effects to the reservation-wide wildlife populations, habitat suitability and population density on the ORR and within OUs must be considered. A general, 6-step, habitat-based approach was developed that is applicable to all wildlife species on the ORR. The approach is outlined here.

1. Individual-based contaminant exposure estimates are generated for each OU using the generalized exposure model outlined in Sample and Suter (1994). Data used for the exposure estimate may consist of modeled data or actual measured concentrations in food, water, or soil from the OU.
2. Contaminant exposure estimates are compared to NOAELs or LOAELs to determine the magnitude and nature of effects that may result from exposure at the OU. If the exposure estimate >LOAEL, then individuals at the OU may experience adverse effects.
3. Availability and distribution of habitat on the ORR and within each OU is determined using the ORR habitat map presented in Washington-Allen et al. (1995; see Table B.2).
4. Habitat requirements for the endpoint species of interest (from Table B.1) are compared to the ORR habitat map to determine the area of suitable habitat on the ORR and within OUs (Tables B.4, B.5, and B.6).
5. The area of suitable habitat on the ORR and within OUs is multiplied by population density values for the selected endpoints to generate estimates of the reservation-wide population and the numbers of individuals expected to reside within each OU. Population density values may be derived from the literature or may consist of site-specific data.
6. The number of individuals for a given endpoint species expected to be receiving exposures >LOAELs for each measured contaminant is totaled. This is performed using the OU-specific population estimate from step 5 and the results from step 2. This number is then compared to the reservation-wide population to determine the proportion of the reservation-wide population that is receiving hazardous exposures. Using the 20% criterion outlined in Suter et al. (1994a), if the proportion of the reservation-wide population receiving hazardous exposures $\geq 20\%$, then an adverse population-level effect is assumed to be present.

outlined in Suter et al. (1994a), if the proportion of the reservation-wide population receiving hazardous exposures $\geq 20\%$, then an adverse population-level effect is assumed to be present.

Because contaminant concentrations in soil were the most readily available type of data and contaminant concentrations in plants and earthworms can be easily estimated using soil-plant or soil-worm uptake factors, vermivores [also known as ground invertebrate feeders (Suter et al. 1994a)] and herbivores were selected as endpoint categories to demonstrate the applicability of the habitat-based approach.

5.1.1 Ecological Assessment Endpoints

5.1.1.1 Assessment endpoints

The following assessment endpoints selected for the assessment of risks to herbivorous and vermivorous wildlife: toxicity to white-tailed deer (*Odocoileus virginianus*) or wild turkey (*Meleagris gallopavo*) (as representative herbivores), American woodcock (*Scolopax minor*) or short-tailed shrew (*Blarina brevicauda*) (as representative vermivores), resulting in a reduction in population abundance or production. Deer, turkey, and woodcock are assessment endpoints agreed to be appropriate for the ORR by the FFA parties (Suter et al. 1994a). The shrew is identified as a measurement endpoint in Suter et al. (1994a). It is selected here as a surrogate for the several T&E shrew species listed in Suter et al. (1994a). The criteria for selection of the entities are those recommended by the EPA (Risk Assessment Forum 1992), plus considerations of scale and practical considerations.

The appropriate properties of the entities selected by these criteria depend on the level of organization of the entity and the criteria that led to their selection. While the primary concern for wildlife is effects at the population level, due to limited population sizes, effects to individuals are critical for T&E species. Because none of the selected endpoint species is a T&E species, the appropriate endpoint properties for populations of endpoint species are abundance and production.

Finally, the level of effects on these properties of the endpoint entities that is considered to be potentially significant is 20% as agreed by the FFA parties (Suter et al. 1994a). This level is consistent with current regulatory practice.

5.1.1.2 Measurement endpoints

Three basic types of effects data are potentially available to serve as measurement endpoints: results of biological surveys, toxicity tests performed using fish from the ORR, and literature derived toxicity test results for chemicals found on the ORR. Measurement endpoints for each assessment endpoint are presented here.

- **White-tailed deer**
 - Biological Survey Data—None.
 - Media Toxicity Data—None.

- Single Chemical Toxicity Data—These data consist of chronic toxicity thresholds for contaminants of concern in mammals with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.
- **Wild turkey**
 - Biological survey data—None.
 - Media toxicity data—None.
 - Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in birds with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.
- **American woodcock**
 - Biological survey data—None.
 - Media toxicity data—None.
 - Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in birds with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.
- **Short-tailed shrew**
 - Biological survey data—None.
 - Media toxicity data—None.
 - Single chemical toxicity data—These data consist of chronic toxicity thresholds for contaminants of concern in mammals with greater weight given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. These test endpoints are assumed to correspond to the assessment endpoint after allometric scaling.

5.1.2. Ecological Conceptual Model

The ecological conceptual model graphically represents the relationships between the contaminant sources and the endpoint receptors. It integrates the information in the other subsections of the hazard identification and presents them graphically. It is not intended to show all of the possible sources, routes of transport, modes of exposure, or effects. Rather, it includes the only identified CERCLA source, the receptors that are designated as assessment endpoint species or communities, and the major routes that result in exposure to contaminants from the ORR.

The conceptual model for exposure of herbivores and vermivores to contaminants is presented in Fig. 5.1. Components of this model include plants and soil/litter invertebrates that reside on OUs on the ORR and the herbivorous and vermivorous wildlife that feed on them. Plants and soil/litter invertebrates are exposed to contaminants from surface soil. Contaminants are

Fig. 5.1. Conceptual model for the exposure of vermivorous and herbivorous wildlife to contaminants.

bioaccumulated in lower trophic levels (i.e., plants or invertebrates) and transferred to higher trophic levels (i.e., herbivores and vermivores). Herbivorous and vermivorous wildlife are exposed to contaminants through consumption of plants and soil/litter invertebrates, respectively. These wildlife endpoint species are also exposed to contaminants through incidental ingestion of contaminated soil.

5.2 EXPOSURE ASSESSMENT FOR HERBIVOROUS AND VERMIVOROUS WILDLIFE

Potential routes of exposure for herbivorous and vermivorous wildlife inhabiting the ORR include ingestion of food (either plant or animal) and surface water. In addition, some species may ingest soil incidentally while foraging or purposefully to meet nutrient needs. The total exposure experienced by terrestrial wildlife is represented by the sum of the exposure from each individual source (e.g., vegetation or earthworms, soil, water).

The primary pathway of contaminant exposure is through oral ingestion of food and soil. Consumption of surface water, in most cases, contributes minimal contaminant exposure. Exposure from ingestion of surface water within the OU will not be included in the total exposure estimation. The surface water contaminant concentrations available in the ORR database will be compared to the water consumption benchmarks for each endpoint in the future revision of this document. Contaminant exposures were estimated for white-tailed deer, wild turkey, short-tailed shrew, and American woodcock. Exposure estimates were calculated for 12 OUs on the ORR: Bear Creek OUs 1 and 2, Lower and Upper East Fork Poplar Creek, 3 OUs at K-25 (K-1407, K-1420, K-1414), WAGs 1, 5, and 6, South Campus Facility and Chestnut Ridge OU2. Locations of these OUs on the ORR are presented in Fig. G.1.

5.2.1 Exposure Through Oral Ingestion of Vegetation/Soil Invertebrates and Soil

Exposure estimates were calculated for all contaminants detected at all ORR sampling locations within an OU using Equation 1 from Sect. 4.2.1. The 95% upper confidence limit (UCL) is used in exposure estimates.

5.2.1.1 Life history parameters for endpoint species

Species-specific parameters for herbivorous and vermivorous endpoints necessary to estimate exposure using the above equation are listed in Tables G.1 to G.4. Habitat requirements and densities for each endpoint will be used to determine the percentage of the population which is experiencing unacceptable levels of contaminant exposure.

5.2.1.2 Contaminant concentrations in biotic and abiotic media

Contaminant concentrations in soil, vegetation, and soil invertebrates are needed to estimate exposure. The surface soil 95% UCL was used to calculate incidental ingestion of soil for each endpoint species (Table G.5). However, if the contaminant was only detected in a single sample, the single concentration was used to calculate exposure. The surface soil samples which were used in the calculations were collected at a depth ranging from 0 to 2 feet. Contaminants which were not detected or do not have an associated wildlife ecotoxicological benchmark were not evaluated.

The 95% UCL soil concentrations were compared to background concentrations identified from the ORR Background Soils Characterization Project (ESD 1993: Table 6). For contaminants which exceeded background, concentrations in vegetation or earthworms within each OU were estimated using the 95% UCL soil concentration and the soil-plant or soil-earthworm uptake factors (Tables G.5, G.7, G.8, and G.9). Soil-plant uptake factors (Table G.7) were calculated for arsenic, antimony, cadmium, chromium, mercury, selenium, zinc, and uranium based on concentrations found in collocated soil and vegetation samples on Lower East Fork Poplar Creek (LEFPC) (SAIC 1993). The remaining inorganic soil-plant uptake factors were derived by Baes et al. (1984). Soil-plant uptake factors for organic contaminants were derived from the log octanol-water partition coefficient ($\log K_{ow}$) using the following equation (Travis and Arms 1988; Table G.8):

$$\text{Log soil-plant uptake factor} = 1.588 - 0.578 (\log K_{ow})$$

Additionally, soil-earthworm uptake factors were calculated using contaminant concentrations found in collocated soil and earthworms collected within WAG 5 (DOE 1995) (Table G.9). Uptake factors were multiplied by either the 95% UCL or single contaminant concentration in soil to obtain the estimated contaminant concentrations found in vegetation and earthworms within each OU.

Media concentrations, including soil, vegetation (CR OU 2 only) and earthworms (WAG 5 only), were obtained from the Baseline Ecological Risk Assessments for WAG 5 and Chestnut Ridge OU2 (Sample et al. 1995; Suter et al. 1994b).

5.2.1.3 Exposure modeling using point-estimates

To estimate contaminant exposure experienced by white-tailed deer feeding within each OU, the following assumptions were made:

- Body weight = 56.5 kg.
- Food consumption = 1.74 kg/d.
- Soil consumption = 0.0348 kg/d.
- Diet consists 100% of vegetation.

To estimate contaminant exposure experienced by wild turkey feeding within each OU, the following assumptions were made:

- Body weight = 5.8 kg.
- Food consumption = 0.174 kg/d.
- Soil consumption = 0.0162 kg/d.
- Diet consists 100% of vegetation, seeds, and fruits.
- Contaminant concentrations in seeds and fruits are similar to vegetation.

To estimate contaminant exposure experienced by short-tailed shrew feeding within each OU, the following assumptions were made:

- Body weight = 0.015 kg.
- Food consumption = 0.009 kg/d.

- Soil consumption = 0.00117 kg/d.
- Diet consists 100% of earthworms.

To estimate contaminant exposure experienced by American woodcock feeding within each OU, the following assumptions were made:

- Body weight = 0.198 kg.
- Food consumption = 0.15 kg/d.
- Soil consumption = 0.0156 kg/d.
- Diet consists 100% of earthworms.

Using the Equation 1 from Sect. 4.2.1, the assumptions and data described above, exposure to contaminants that exceeded background concentrations was estimated for the white-tailed deer (Table G.10) wild turkey (Table G.11), short-tailed shrew (Table G.12), and American woodcock (Table G.13) foraging within each OU. Short-tailed shrews and American woodcock were not assessed at Chestnut Ridge OU2 since there are no earthworms present at the site due to the unsuitable fly ash habitat.

5.3 EFFECTS ASSESSMENT FOR HERBIVOROUS AND VERMIVOROUS WILDLIFE

5.3.1 Toxicological Benchmarks

To determine if the contaminant exposures experienced by herbivores and vermivores foraging on individual OUs could produce adverse effects, exposure estimates are compared to No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs) derived according to the methods outlined by Opresko et al. (1994) and EPA (1993b). NOAELs represent the highest exposure at which no adverse effects were observed among the animals tested. LOAELs represent the lowest exposure at which significant adverse effects are observed.

Toxicological studies of the effects of contaminants observed in the soil were obtained from the open literature. Only studies of long-term, chronic oral exposures were used to estimate the NOAEL or LOAEL. To make the NOAELs and LOAELs relevant to possible population effects, preference was given to studies that evaluated effects on reproductive parameters. In the absence of a reproduction endpoint, studies that considered effects on growth, survival, and longevity were used. The NOAELs and LOAELs for each endpoint and the studies which derived them are located in Tables G.14 and G.15. These tables present only the NOAELs and LOAELs for contaminants which had NOAEL hazard quotients greater than 1. Specific details on development of the NOAELs and LOAELs for all wildlife endpoints are discussed in Sect. 4.3.1.

5.3.2 Ecotoxicological Profiles for Herbivorous and Vermivorous Wildlife

The ecotoxicological profiles for chemicals of potential ecological concern (COPECs) for herbivorous and vermivorous wildlife on the ORR may be found in Appendix D. COPECs include: acetone, aluminum, arsenic, barium, cadmium, copper, 1,2 dichloroethane, lead, mercury, methylene chloride, PCBs (1254/1260), selenium, vanadium, thallium, uranium, and zinc.

5.4 RISK CHARACTERIZATION FOR HERBIVOROUS AND VERMIVOROUS WILDLIFE

Risk characterization integrates the results of the exposure assessment (Sect. 5.2) and effects assessment (Sect. 5.3) to estimate risks (the likelihood of effects given the exposure) based on each line of evidence. A weight of evidence approach, as outlined in Suter et al. (1994a), is applied to determine the best estimate of risk to each assessment endpoint. This risk assessment is based on only one line of evidence: literature-derived single chemical toxicity data which indicates the toxic effects of media concentrations measured within each OU.

Procedurally, the risk characterization in this assessment is performed for each assessment endpoint by:

- screening all measured contaminants within each OU against background soil levels and toxicological benchmarks;
- estimating the effects of the contaminants retained by the screening analysis for individuals of each endpoint species;
- estimating the number of individuals within the ORR population;
- estimating the number of individuals within an OU that are potentially exposed based on habitat availability and population density;
- calculating the total number of individuals on the ORR that may be at risk (addition of number of animals exposed within all OUs for which data exist);
- calculating the percentage of the ORR population that may experience adverse effects from contaminant exposure;
- using the 20% exposure criteria outlined in Suter et al. (1994a), determine if reservation-wide endpoint populations are significantly at risk from contaminants present within OUs for which data is available;
- prioritizing the OUs based on the contribution of risk to the entire ORR population; and
- discussing the uncertainties in the assessment.

Data for this assessment was limited to single chemical toxicity data and habitat availability for herbivores and vermivores inhabiting the ORR.

5.4.1 Contaminant Screening of Soil to Background Levels

The initial screening for COPECs in soil begins with a comparison of the 95% UCL or single detected concentration found in surface soil in each OU with appropriate ORR background soils identified in the ORR Background Soils Characterization Project (ESD 1993). Table G.6 identifies the background levels (95% UCL) found for each formation indicative of each OU. In some cases, an OU may be located on multiple formations. Therefore, a range of the minimum

and maximum 95% UCL background values for multiple formations were used for comparison. Data were not available for certain formations indicative of an OU; thus the range of 95% UCLs of all formations was used. Chemicals were rejected from further consideration if the 95% UCL concentrations in soil were less than the 95% UCL background concentration for the specific formation.

5.4.2 Single Chemical Toxicity Data for Herbivorous and Vermivorous Wildlife (Individuals)

Exposure to endpoint species to chemicals found in concentrations greater than background were calculated. The total contaminant exposure estimates for herbivores and vermivores foraging on vegetation or earthworms within an OU were compared to estimated NOAELs to determine if adverse effects are possible. The comparison of estimated exposure and the NOAEL acts as a screening tool to identify COPECs which will be further evaluated for possible estimated effects. LOAELs are then compared to the exposure estimate. If the LOAEL is lower than the exposure, then portions of the endpoint population may experience contaminant exposures that are likely to produce adverse effects. Consequently, the *individuals* living within the OU are at risk due to hazardous exposures.

5.4.2.1 Screening point estimates of exposure

To determine if the contaminant exposures experienced by vermivores and herbivores feeding on each OU are potentially hazardous, the total exposure estimates were compared to estimated NOAELs. Hazard quotients (HQs) were calculated to quantify the magnitude of the hazard where: $HQ = \text{estimated contaminant exposure (mg/kg/d)} / \text{NOAEL}$. Hazard quotients greater than one indicate that individuals may be experiencing exposures that are in excess of NOAELs, and may suggest that adverse effects may be occurring. Hazard quotients for all endpoints are presented along with exposure estimates in Tables G.10 to G.13.

The spatial distribution of contamination and potential risks to each endpoint within each OU are illustrated in Figs. G.2 through G.5. These figures display the sum of the NOAEL-based HQs (e.g., sum of toxic units or $\sum TUs$) for many contaminants which play a role in the cumulative risk within each OU. Importance of contaminants was determined based on the magnitude of the hazard quotients. Although, there are a large number of contaminants contributing small levels to overall risk, the figures display few contaminants contributing to the high levels of risk for each endpoint species.

The $\sum TUs$ for white-tailed deer (Fig. G.2) at LEFPC, K-1407, K-1420, BCOU 2, BCOU1, and UEFPC OU2 range from 132 to 305 with cadmium, mercury, or aluminum responsible for the major contribution of risk. Deer at WAG 1 and WAG 6 are primarily at risk from cadmium with a $\sum TUs$ of 56 and 58, respectively. Chestnut Ridge OU2 and SCF has the highest level of risk associated with the site, with $\sum TUs$ of 348 and 633, respectively. The primary contaminants at SCF are aluminum, cadmium, acetone, and methylene chloride; while cadmium, selenium and thallium contribute the most risk at Chestnut Ridge OU2.

Mercury is the only major contaminant which poses a risk to wild turkey on BCVOU1, LEFPC and BCOU2 (Fig. G.3). In contrast, Fig. G.4 displays short-tailed shrews at significant risk foraging at all OUs, with the exception of WAG 5. The $\sum TUs$ for most OUs ranged from

1256 to 4747; where cadmium, mercury, PCBs, selenium, or aluminum contributed to the majority of the risk. Cadmium at WAG 6 was 368 times the NOAEL benchmark; while risk at WAG 5 is relatively low having Σ TUs less than 30.

American woodcock (Fig. G.5) at BCOU1, LEFPC and BCOU2 may experience the highest magnitude of risk relative to other OUs, with Σ TUs ranging from 12,875 to 30,776 predominantly due to mercury exposure. Additionally, woodcock foraging at K-1407, WAG 1, SCF, and K-1420 are at risk from mercury contamination (Σ TUs = 25,000, 900, 447, and 303, respectively). Woodcock foraging within UEFPC OU2 (Σ TU = 146) and WAG 6 (Σ TU = 6) are at relatively lower risk compared to other OUs.

To determine if there is a potential for occurrence of adverse effects to the individuals foraging within each OU estimated contaminant exposures experienced by each endpoint were compared to LOAELs (Tables G.16 to G.19). The contaminants at each site which may adversely impact the individual endpoints foraging within each OU are listed below. The magnitude of risk from each contaminant at the site can be evaluated from the LOAEL hazard quotient in parentheses.

With the exception of all endpoints foraging within K-1414 and herbivores at WAG 5, *individuals* of all endpoint species may experience adverse effects at all OUs from incidental ingestion of soil and consumption of vegetation or earthworms. The following is a summary of the primary COPECs for wildlife for each OU:

- **Bear Creek OU1.** Primary COPECs include cadmium, mercury, PCBs and copper. Additional COPECs for short-tailed shrew or American woodcock include arsenic, barium, lead, and zinc.
- **Lower East Fork Poplar Creek.** Primary COPECs for endpoints include cadmium and mercury. Additionally, selenium, PCBs, and zinc were COPECs for vermivorous wildlife.
- **K-1407.** Primary COPECs for endpoints include: aluminum, cadmium (white-tailed deer only), mercury, and selenium (American woodcock and short-tailed shrew only). Additionally, arsenic, uranium and zinc are COPECs for short-tailed shrews or American woodcock.
- **WAG 1.** The primary COPECs include cadmium (for all endpoints), mercury, and selenium (vermivores only). Additionally, arsenic, PCBs, thallium, and zinc are COPECs for shrews or woodcock.
- **WAG 5.** Vermivores foraging within WAG 5 may experience adverse effects from incidental ingestion of soil and consumption of earthworms. Mercury and zinc are the primary contaminants of concern. Herbivorous wildlife are not at risk on WAG 5.
- **WAG 6.** The primary COPEC is cadmium. Additionally, mercury is a COPEC for the American woodcock.

Table 5.1. COPECs for each endpoint species foraging within each OU (LOAEL HQs in parentheses)

OUs	White-tailed deer	Wild turkey	Short-tailed shrew	American woodcock
BCVOU1	Cadmium (109.9) Copper (5.9) Mercury (5.3)	Mercury (6.3)	Arsenic (3.9) Cadmium (1136.9) Copper (2.3) Mercury (250.4) Total PCBs ^a (61.8) Zinc (4.3)	Barium (1.6) Cadmium (1.1) Copper (1.6) Lead (4.3) Mercury (1299.3) Total PCBs (16.7) Zinc (17.6)
LEFPC	Cadmium (47.6) Mercury (7)	Mercury (8.2)	Arsenic (2.3) Cadmium (491.8) Mercury (327.2) Total PCBs (4.6) Selenium (41.1)	Mercury (1697.8) Selenium (29.2) Zinc (2.6)
K-1407 OU	Aluminum (13.3) Cadmium (22) Mercury (1.1)	Aluminum (7.8) Mercury (1.3)	Aluminum (114.7) Arsenic (3.8) Mercury (50.3) Selenium (33.7) Uranium (2.7)	Aluminum (89.5) Mercury (261) Selenium (24) Zinc (1)
WAG 1	Cadmium (20.1)		Arsenic (2.8) Cadmium (207.7) Mercury (14.5) Total PCBs (4.4) Selenium (79.4) Thallium (5.8)	Mercury (75.5) Selenium (56.4) Zinc (1.6)
WAG 5			Mercury (1.8)	Mercury (9.3) Zinc (2.7)
WAG 6	Cadmium (29.1)		Cadmium (301.3)	

Table 5.1 (continued)

OU's	White-tailed deer	Wild turkey	Short-tailed shrew	American woodcock
UEFPC OU2	Aluminum (30.2)	Aluminum (17.6)	Aluminum (260.5) Barium (1.3) Zinc (1.1)	Aluminum (203.3) Barium (2.2) Lead (2) Zinc (4.5)
BC OU2	Aluminum (16.6) Cadmium (8.8) Mercury (12.7)	Aluminum (9.7) Mercury (15)	Aluminum (143.4) Arsenic (10.2) Cadmium (90.8) Mercury (598) Selenium (8.4)	Aluminum (111.9) Lead (1) Mercury (3103.4) Selenium (6) Zinc (2.3)
SCF	Acetone (38.9) Aluminum (9.5) Cadmium (75.9) Methylene Chloride (6.6)	1,2-Dichloroethane (1.2) Aluminum (5.5)	Aluminum (82) Arsenic (4.2) Cadmium (785) Mercury (6.7) Selenium (14)	Mercury (34.9) Selenium (9.9) Zinc (2.3)
K-1420 OU	Aluminum (22.8)	Aluminum (13.3)	Aluminum (196.9) Mercury (3.4) PCB-1254 (11.1) Uranium (2.9) Vanadium (2)	Aluminum (153.6) Mercury (17.6) PCB-1254 (3) Zinc (2.4)
Chestnut Ridge OU2	Aluminum (8.3) Arsenic (1.3) Cadmium (17.8) Selenium (11.6) Thallium (2.2)	Aluminum (5.9)	No earthworms are present at the site because fly ash is unsuitable to support earthworms. Therefore, exposure was not calculated for vermivorous wildlife.	

^aTotal PCBs = sum of PCB-1254 and 1260.

- **Upper East Fork Poplar Creek OU2.** The primary COPEC is aluminum which exceeds background levels by 3.5 times. Additionally, barium, lead and zinc are COPECs for shrews or woodcock.
- **Bear Creek OU2.** The primary COPECs are aluminum, cadmium, and mercury. Additionally, arsenic, lead, selenium, and zinc are COPECs for shrews or woodcock.
- **South Campus Facility.** The primary COPECs are aluminum, acetone (herbivores only), cadmium, mercury, and selenium (vermivores only). Additionally, arsenic, 1,2-dichloroethane, methylene chloride, and zinc are COPECs for deer, turkey, shrews, or woodcock.
- **K-1420.** The primary COPEC for all endpoints is aluminum. Additional COPECs include: mercury, PCBs, uranium, vanadium and zinc (shrews or woodcock).
- **Chestnut Ridge OU2.** Herbivores may experience adverse effects from ingestion of vegetation and soil. Earthworms are absent from the site (ash is unsuitable for earthworms); therefore vermivorous wildlife are not at risk due to lack of exposure pathway. Primary contaminants of concern for herbivores include aluminum, arsenic, cadmium, and selenium. White-tailed deer may also be at risk from thallium.
- **K-1414.** Herbivores and vermivores are not at risk from contaminant exposure within this OU.

5.4.3 Effects of Retained Contaminants for Herbivorous and Vermivorous Wildlife

5.4.3.1 Acetone

Both the NOAEL and LOAEL for mammalian endpoints are based on a study in which liver and kidney damage was observed in rats fed acetone for 90 days (EPA 1986). Three dose levels were administered (100, 500, and 2500 mg/kg/d). Significant tubular degeneration of the kidneys and increases in kidney weights were observed at the 500 mg/kg/d dose level. No adverse effects were observed at the 100 mg/kg/d level. These doses are considered subchronic values and therefore were multiplied by the subchronic-chronic uncertainty factor of 0.1. Based on the results of EPA (1986), white-tailed deer foraging at South Campus Facility experiencing exposure $\geq$ LOAEL may display tubular degeneration of the kidneys.

Although acetone is highly volatile, the exposure experienced by white-tailed deer is 184 times the LOAEL. The presence of acetone may be a concern if it is a continuous source.

5.4.3.2 Aluminum

Both the NOAEL and LOAEL for mammalian endpoints are based on a study in which reproductive success and offspring survival was observed among mice fed aluminum chloride for three generations (Ondreicka et al. 1966). One dose level (19.3 mg/kg/d) was administered and resulted in significant reduction of growth within generations 2 and 3. There was no effect on litter size or the number of litters. Therefore, this dose was designated as the chronic LOAEL. The chronic NOAEL was estimated by multiplying the chronic LOAEL by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results obtained by Ondreicka et al. (1966) eastern cottontails, white-tailed deer, and short-tailed shrews foraging at all OUs may experience a reduction in growth.

The NOAEL for avian endpoints is based on a study in which the reproductive success of ringed doves was observed for over 4 months, which included a critical life stage (Carriere et al. 1986). One dose (109.7 mg/kg/d) was administered over this time and was designated as the NOAEL since no adverse effects were observed. The LOAEL is based on a study in which mortality was observed among 1 day-old white leghorn chicks (Storer and Nelson 1968). Of four doses administered within a 2-week duration, the highest dosage (445 mg/kg/d) resulted in 25 % mortality. Since the study considered exposure for only 2 weeks, excluding critical life stages, this dose was considered to be a subchronic LOAEL. A chronic LOAEL was estimated by multiplying the subchronic LOAEL by a subchronic-chronic uncertainty factor of 0.1 (LOAEL = 44.5 mg/kg/d). Based on the results obtained by Storer and Nelson (1968), wild turkeys and American woodcock foraging within all OUs may experience increased mortality.

Although aluminum exceeds ecotoxicological benchmarks, Al is found at high levels within all OUs and only exceeds ORR background levels within Upper East Fork Poplar Creek OU2, Bear Creek OU2, South Campus Facility, K-1420, and K-1407. The measured soil concentrations are likely much higher than levels which are bioavailable to the endpoint species due to the acid digestion procedures employed. Additionally, the predominant forms of aluminum within the OU soil and the form used in toxicity tests are likely different. Therefore, the levels of aluminum which demonstrated adverse effects may not be comparable to levels found on the OU due to form and bioavailability.

5.4.3.3 Arsenic

Both the NOAEL and LOAEL for mammalian endpoints are based upon a study in which reproductive success and offspring survival was observed among mice fed arsenite for three generations (Schroeder and Mitchner 1971). One dose level administered (1.261 mg/kg/d), designated as the chronic LOAEL, resulted in declining litter size with each successive generation. A chronic NOAEL was estimated by multiplying the chronic LOAEL by a LOAEL-NOAEL correction factor of 0.1. Based on the results of Schroeder and Mitchner (1971), short-tailed shrews foraging within most of the OUs experiencing exposures $\geq$ LOAEL are likely to display a decline in litter size.

5.4.3.4 Barium

The NOAELs for mammals are based on a study in which growth, food and water consumption, and hypertension was observed among rats fed barium chloride for 16 months (Perry et al. 1983). Three dose levels were administered. The maximum dose (5.1 mg/kg/d) did not affect growth, food or water consumption and was therefore considered to be a chronic NOAEL. The LOAEL was based on a study which observed mortality in rats fed barium for 10 days (Borzelleca et al. 1988). Four doses were administered and exposure of rats to the highest dose (300 mg/kg/d) resulted in 30% mortality to female rats. The 300 mg/kg/d dose is considered to be a subchronic LOAEL; therefore a chronic LOAEL was estimated by multiplying the subchronic LOAEL by a subchronic to chronic uncertainty factor of 0.1. Based on the results of Borzelleca et al. (1988), short-tailed shrews experiencing exposures $\geq$ LOAEL may display increased mortality.

Both the NOAELs and LOAELs for woodcock and turkeys are based on a study which observed mortality to 1-day old chicks fed eight doses of barium hydroxide for 4 weeks (Johnson et al. 1960). The NOAEL dosage (208.3 mg/kg/d) produced no mortality; while the LOAEL dosage (416.5 mg/kg) and highest dosage (40.3 mg/kg/d) resulted in 5% to 100% mortality. The NOAEL and

LOAEL were considered subchronic and was multiplied by the subchronic to chronic uncertainty factor of 0.1. Based on the results of Johnson et al. (1960), American woodcock at Bear Creek OU1 and Upper East Fork OU2 experiencing exposures $\geq$ LOAEL may display increased mortality.

5.4.3.5 Cadmium

Both the NOAEL and LOAEL for mammalian endpoints are based upon a study in which reproductive success was observed among rats fed cadmium chloride for four generations (Wills et al. 1981). Three dose levels were administered. The highest dose (.01 mg/kg/d), designated as the chronic LOAEL, resulted in a reduction in fertility. The number of litters/ number of females was reduced by 63% in rats. Fertility was not reduced at the lower dosage (.008 mg/kg/d) which was designated as the chronic NOAEL. Based on the results of Wills et al. (1981), white-tailed deer and short-tailed shrews experiencing exposure $\geq$ LOAEL may display reduced fertility.

Both the NOAEL and LOAEL for avian endpoints are based upon a study in which reproductive success was observed among mallard ducks fed cadmium chloride for 90 days (White and Finley 1978). Three dose levels were administered. The highest dosage (20.03 mg/kg/d), designated as the chronic LOAEL, produced significantly fewer eggs. A dosage of 1.45 mg/kg/d produced no adverse effects and was designated as the chronic NOAEL. Based on results of White and Finley (1978), American woodcock experiencing exposures $\geq$ LOAEL at Bear Creek OU 1 may display impaired reproduction.

5.4.3.6 Copper

Both the NOAEL and LOAEL for mammalian endpoints are based on a study in which mink were fed copper sulfate for 357 days (including a critical life stage) (Aulerich et al. 1982). While consumption of 15.14 mg/kg/d copper increased the percentage of mortality in mink kits, no adverse effects were observed at a 11.71 mg/kg/d exposure level. Based on the results of Aulerich et al. (1982), white-tailed deer and short-tailed shrews experiencing exposures $\geq$ LOAEL within Bear Creek OU1 may display a reduction in offspring survival.

Both the NOAEL and LOAEL for avian endpoints are based on a study in which 1 day old chicks were fed copper oxide for 10 weeks (Mehring et al. 1960). Eleven dose levels were administered in the study. No adverse effects were observed on the growth of chicks up to dose levels of 47 mg/kg/d. Consumption of 61.7 mg/kg/d copper in the diet, designated as the LOAEL, resulted in reduced growth by over 30% and produced 15 % mortality. Based on results of Mehring et al. (1960), American woodcock experiencing exposures $\geq$ LOAEL at Bear Creek OU1 may display a reduction in growth and survivorship.

5.4.3.7 1,2-Dichloroethane

Both the wild turkey NOAEL and LOAEL are based on a study in which chickens were fed two levels of 1,2-dichloroethane for 2 years (Alumot et al. 1976b). Egg production was reduced at a level of 34.4 mg/kg/d, which was designated as the chronic LOAEL. No adverse effects were observed at an exposure of 17.2 mg/kg/d. Based on results of Alumot et al. (1976b), wild turkeys experiencing exposures $\geq$ LOAEL at South Campus Facility may display reduced egg production.

5.4.3.8 Mercury

Both the NOAEL and LOAEL for mammalian endpoints are based upon a study in which reproductive success and offspring survival was observed among rats fed methyl mercury for three generations (Verschuuren et al. 1976c). The highest dose administered (0.16 mg/kg/d), designated as the LOAEL, resulted in reduction in offspring viability. This exposure also resulted in reduction in growth, increased kidney weight, and altered kidney histochemistry (Verschuuren et al. 1976b). No effects were observed at a dose of 0.032 mg/kg/d. The study was considered to represent chronic exposure; therefore, a subchronic-chronic correction factor was not employed. Based on the results of Verschuuren et al (1976 a,b,c), white-tailed deer and short-tailed shrews experiencing exposure $\geq$ LOAELs are likely to display impaired reproduction.

Both the wild turkey and American woodcock NOAELs and LOAELs are based on a study in which reproductive success was observed among mallard ducks which were fed methyl mercury for three generations (Heinz 1979). The study was considered to represent a chronic exposure. The only dose level administered, 0.064 mg/kg/d, caused hens to lay fewer eggs, lay more eggs outside the nest box, and produce fewer ducklings. This dose level was considered the chronic LOAEL. Because an experimental NOAEL was not established, the chronic NOAEL was estimated by multiplying the chronic LOAEL by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results of Heinz (1979), wild turkeys and American woodcock experiencing exposures $\geq$ LOAELs may display impaired reproduction.

5.4.3.9 Methylene chloride

The NOAEL and LOAEL for the mammalian endpoints was based on a study in which rats were fed methylene chloride for 2 years (NCA 1982). Rats fed a 5.85 mg/kg/d dose level did not experience adverse effects and is considered the chronic NOAEL. Rats consuming 50 mg/kg/d or greater produced histological changes in the liver. This dose level was designated as the chronic LOAEL. Based on results of the NCA (1982), white-tailed deer experiencing exposures $\geq$ LOAELs at South Campus Facility may display changes in liver histology.

5.4.3.10 PCBs

The short-tailed shrew NOAEL and LOAEL are based on a study in which oldfield mice were fed Aroclor-1254 for 12 months (McCoy et al. 1995). A dose level of 0.68 mg/kg/d, designated as the chronic LOAEL, caused a reduction in the number of litters, offspring weights, and offspring survival. Because an experimental NOAEL was not established, the chronic NOAEL was estimated by multiplying the chronic LOAEL by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results of McCoy et al. (1995), short-tailed shrews experiencing exposures $\geq$ the LOAEL may display impaired reproduction and offspring viability.

The American woodcock NOAEL and LOAEL are based on a study in which ring-necked pheasants were fed Aroclor-1254 for 17 weeks (Dahlgren et al. 1972). A dose level of 1.8 mg/kg/d, designated as the chronic LOAEL, caused a significant reduction in egg hatchability. Because an experimental NOAEL was not established, the chronic NOAEL was estimated by multiplying the chronic LOAEL by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results of Dahlgren et al. (1972), American woodcock experiencing exposures $\geq$ the LOAEL may display a reduction in egg hatchability.

5.4.3.11 Selenium

The short-tailed shrew NOAEL and LOAEL are based on a study in which selenate was fed to mice for 3 generations (Schroeder and Mitchner 1971). An administered dose level of 0.76 mg/kg/d, designated as the chronic LOAEL, caused reduced reproductive success with a high incidence of runts and failure to breed. Because an experimental NOAEL was not established, the chronic NOAEL was estimated by multiplying the chronic LOAEL by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results of Schroeder and Mitchner (1971), short-tailed shrews experiencing exposures $\geq$ the LOAEL may display a reduction in reproductive success.

The American woodcock NOAEL and LOAEL are based on a study in which mallard ducks were fed sodium selenite for 78 days (Heinz et al. 1987). Reproductive success was observed at four dose levels. A dose of 0.5 mg/kg/d produced no adverse effects and was therefore considered the chronic NOAEL. A dose as low as 1 mg/kg/d selenium in the diet resulted in a significantly larger frequency of lethally deformed embryos compared to 0.5 mg/kg/d dose level. Consumption of 2.5 mg/kg/d caused a reduction of duckling survival, while 10 mg/kg/d reduced adult survival. Since adverse effects were observed at exposures as low as 1 mg/kg/d, this level was considered the chronic LOAEL. Based on the results of Heinz et al. (1987), American woodcock experiencing exposures $\geq$ LOAEL may display a reduction in offspring viability.

5.4.3.12 Thallium

The short-tailed shrew NOAEL and LOAEL are based on a study in which rats were fed thallium sulfate for 60 days (Formigli et al. 1986). This study represents subchronic exposures since the duration of the study did not include a critical life stage. Rats exposed to a single dose, 0.074 mg/kg/d, displayed reduced sperm motility. Since this is a subchronic exposure, a subchronic-chronic uncertainty factor of 0.1 was applied to obtain a chronic LOAEL. To estimate the chronic NOAEL, the chronic LOAEL was multiplied by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results of Formigli et al. (1986), short-tailed shrews experiencing exposures $\geq$ the LOAEL may display impaired reproduction from a reduction of sperm motility.

5.4.3.13 Uranium

The short-tailed shrew NOAEL and LOAEL are based on a study in which mice were fed uranyl acetate for 60 days prior to gestation, through gestation, delivery and lactation (Paternain et al. 1989). This study represents chronic exposures since it took place during the critical life stage of the mouse. Significant effects on reproduction including increased number dead young/litter and reduction in size and weight of offspring were observed at 6.13 mg/kg/d. The lowest dose administered, 3.07 mg/kg/d, resulted in no significant differences in measured reproductive parameters. Therefore, these doses were considered the chronic LOAEL and NOAEL, respectively. Based on the results of Paternain et al. (1989), short-tailed shrews experiencing exposures $\geq$ the LOAEL may display a reduction in reproductive success.

5.4.3.14 Vanadium

The short-tailed shrew NOAEL and LOAEL are based on a study in which rats were fed sodium metavanadate for 60 days prior to gestation, through gestation, delivery and lactation (Domingo et al. 1986). This study represents chronic exposures since it took place during the rat's critical life stage. Significant effects on reproduction including increased number dead young/litter and

reduction in size and weight of offspring were observed at the lowest dose administered, 5 mg/kg/d. Therefore, this dose was considered the chronic LOAEL. To estimate the chronic NOAEL, the chronic LOAEL was multiplied by a LOAEL-NOAEL uncertainty factor of 0.1. Based on the results of Domingo et al. (1986), short-tailed shrews experiencing exposures $\geq$ the LOAEL may display a reduction in reproductive success.

5.4.4 Population Level Risks on the Oak Ridge Reservation

The COPECs within each OU, as designated by the screening process (Sect. 5.4.1), may cause adverse effects (Sect. 5.4.2) to *individuals* foraging within each OU. To consider adverse effects on the reservation-wide *population*, steps 3 through 6 within the problem formulation (Sect. 5.1) must be completed. By comparing an endpoint species habitat requirements (Table B.1), the amount of suitable habitat within each OU (Table B.3), and population densities for each endpoint (see below), the number of individuals exposed on an OU can be estimated. The densities used for each endpoint species are presented in the following table.

	White-tailed deer	Wild turkey	Short-tailed shrew	American woodcock
Density	0.1704 ^a	0.0426 ^a	23/ha (median of 2.5 to 45/ha range)	.28/ha (based on 5.6 males/100 ha; assuming 1:1 sex ratio)
No. on the ORR (if known)	2000	>500		
Source	Personal communication, Jim Evans	Personal communication, Jim Evans	Getz 1989	Stewart and Robbins 1958

^aDensity calculated based on total deer and turkey habitat on ORR (11,734.8 ha) and total number of deer and turkey estimated on ORR (2000 deer and 500 turkey).

Since contaminants found on all OUs, with the exception of K-1414, present a risk to all assessment endpoints, the number of animals present in the OU is equivalent to the number of individuals exposed at unacceptable levels. The estimated number of individual herbivores and vermivores exposed within each OU and the proportion of the reservation-wide population that are at risk are summarized in Tables 5.2 through 5.5.

Table 5.2. The number of potentially exposed white-tailed deer within each OU and the entire reservation

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{ab}	% of the ORR population exposed ^c
LEFPC	Evergreen plantation (2.62) Evergreen forest (7.37) Deciduous forest (41.06) Mixed forest (50.87) Pasture (8.5) Transitional (133.87)	244.29	42	2.1
BCVOU1	Deciduous forest (8.19) Mixed forest (0.25) Pasture (9.19) Transitional (24)	41.6	7	0.4
WAG 5	Deciduous forest (3.56) Mixed forest (6.44) Pasture (7.69) Transitional (9.06)	26.75	5	0.25
South Campus Facility	Pasture (13.25) Transitional (4.5)	17.75	3	0.15
WAG 6	Deciduous forest (5.06) Mixed forest (2.06) Pasture (0.5) Transitional (2.94)	10.56	2	0.10
Chestnut Ridge OU2	Deciduous forest (3.81) Mixed forest (0.38) Transitional (2.62)	6.81	1	0.05
WAG 1	Evergreen forest (0.81) Deciduous forest (1.25) Mixed forest (0.81) Pasture (0.94)	3.81	.7	0.04
K-1407 OU	Transitional (4.19)	4.19	0.7	0.04
BC OU2	Transitional (0.62)	0.62	0.1	0.005
UEFPC OU2	0	0	0	0.00
K-1420 OU	0	0	0	0.00
K-1414 OU ^d				

Table 5.2 (continued)

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{a,b}	% of the ORR population exposed
Total no. exposed within 12 OUs			62 ^b	
Total reservation	Evergreen plantations (323.5) Evergreen forest (704.87) Deciduous forest (4,028.62) Mixed forest (3,469) Pasture (312.44) Transitional (2,896.19)	11,734.8	2000 ^c	
Percentage of the ORR population at risk				3.1%

^aThe number of animals present within OU was calculated by multiplying the total area of suitable habitat (ha) by 0.1704 deer/ha (calculated from 2,000 deer on reservation).

^bAll white-tailed deer present on OUs are exposed at contaminant levels >LOAELs, with the exception of animals at WAG 5 and K-1414.

^cThe percentage of the ORR population exposed = (estimated no. of animals present on the OU/the total no. of animals on the reservation) x 100.

^dHabitat maps are not available for the K-1414 OU.

^eThe approximately 2,000 deer present on the ORR were estimated from deer hunts (personal communication, Jim Evans 1995).

Table 5.3. The number of potentially exposed wild turkey within each OU and the entire reservation

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{a,b}	% of ORR population exposed ^c
LEFPC	Evergreen plantation (2.62) Evergreen forest (7.37) Deciduous forest (41.06) Mixed forest (50.87) Pasture (8.5) Transitional (133.87)	244.29	10	2.0
BCVOU1	Deciduous forest (8.19) Mixed forest (0.25) Pasture (9.19) Transitional (24)	41.6	2	0.4
WAG 5	Deciduous forest (3.56) Mixed forest (6.44) Pasture (7.69) Transitional (9.06)	26.75	1	0.2

Table 5.3 (continued)

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{ab}	% of ORR population exposed ^c
South Campus Facility	Pasture (13.25) Transitional (4.5)	17.75	0.8	0.16
WAG 6	Deciduous forest (5.06) Mixed forest (2.06) Pasture (0.5) Transitional (2.94)	10.56	0.5	0.10
Chestnut Ridge OU2	Deciduous forest (3.81) Mixed forest (0.38) Transitional (2.62)	6.81	0.3	0.06
WAG 1	Evergreen forest (0.81) Deciduous forest (1.25) Mixed forest (0.81) Pasture (0.94)	3.81	0.2	0.00
K-1407 OU	Transitional (4.19)	4.19	0.2	0.04
BC OU2	Transitional (0.62)	0.62	0.03	0.006
UEFPC OU2	0	0	0	0.00
K-1420 OU	0	0	0	0.00
K-1414 OU ^d				
Total no. exposed within 12 OUs			15 ^b	
Total reservation	Evergreen plantations (323.5) Evergreen forest (704.87) Deciduous forest (4,028.62) Mixed forest (3,469) Pasture (312.44) Transitional (2,896.19)	11,734.8	500 ^e	
Percentage of ORR population at risk				3.01%

^aThe number of animals present within the OU was calculated by multiplying the total area of suitable habitat (ha) by 0.0426 wild turkey/ha (calculated from 500 turkey observed on the reservation).

^bAll wild turkey present on OUs are exposed at contaminant levels >LOAELs, with the exception of animals at WAG 1, WAG 5, and K-1414.

^cThe percentage of the ORR population exposed = (estimated no. of animals present on the OU/total no. of animals on the reservation) x 100.

^dHabitat maps are not available for the K-1414 OU.

^eApproximately 500 wild turkey are present on the ORR (personal communication, Jim Evans 1995).

Table 5.4. The number of potentially exposed short-tailed shrews within each OU and the entire reservation

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{ab}	% of the ORR population exposed ^c
LEFPC	Evergreen plantation (2.62) Evergreen forest (7.37) Deciduous forest (41.06) Mixed forest (50.87) Transitional (133.87)	235.79	5,423	2.06
BCVOU1	Deciduous forest (8.19) Mixed forest (0.25) Transitional (24)	32.41	745	0.28
WAG 5	Deciduous forest (3.56) Mixed forest (6.44) Transitional (9.06)	19.06	438	0.17
WAG 6	Deciduous forest (5.06) Mixed forest (2.06) Transitional (2.94)	10.06	231	0.09
Chestnut Ridge OU2	Deciduous forest (3.81) Mixed forest (0.38) Transitional (2.62)	6.81	157	0.06
South Campus Facility	Transitional (4.5)	4.5	104	0.04
K-1407 OU	Transitional (4.19)	4.19	96	0.04
WAG 1	Evergreen forest (0.81) Deciduous forest (1.25) Mixed forest (0.81)	2.87	66	0.03
BC OU2	Transitional (0.62)	0.62	14	0.005
UEFPC OU2	0	0	0	0.00
K-1420 OU	0	0	0	0.00
K-1414 OU ^d				
Total no. exposed within 12 OUs			7,274 ^b	
Total reservation	Evergreen plantations (323.5) Evergreen forest (704.87) Deciduous forest (4,028.62) Mixed forest (3,469) Transitional (2,896.19)	11,422.36	262,714	

Table 5.4 (continued)

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{ab}	% of the ORR population exposed ^c
Percentage of ORR population at Risk				2.78%

^aThe number of animals present within the OU was calculated by multiplying the total area of suitable habitat (ha) by 23 short-tailed shrews/ha (Getz 1989, as cited in EPA 1987).

^bAll animals present within OUs are exposed at levels exceeding LOAELs, with the exception of animals at K-1414.

^cThe percentage of the ORR population exposed = (estimated no. of animals present on the OU/total no. of animals on the reservation) x 100.

^dHabitat maps are not available for the K-1414 OU.

Table 5.5. The number of potentially exposed American woodcock within each OU and the entire reservation

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{ab}	% of the ORR population exposed ^c
LEFPC	Deciduous forest (41.06) Mixed forest (50.87) Pasture (8.5) Transitional (133.87)	234.3	66	2.2
BCVOU1	Deciduous forest (8.19) Mixed forest (0.25) Pasture (9.19) Transitional (24)	41.6	12	0.4
WAG 5	Deciduous forest (3.56) Mixed forest (6.44) Pasture (7.69) Transitional (9.06)	26.75	8	0.27
South Campus Facility	Pasture (13.25) Transitional (4.5)	17.75	5	0.17
WAG 6	Deciduous forest (5.06) Mixed forest (2.06) Pasture (0.5) Transitional (2.94)	10.56	3	0.10
Chestnut Ridge OU2	Deciduous forest (3.81) Mixed forest (0.38) Transitional (2.62)	6.81	2	0.07
WAG 1	Deciduous forest (1.25) Mixed forest (0.81) Pasture (0.94)	3	0.8	0.03

Table 5.5 (continued)

OU	Available habitat (ha)	Total suitable area (ha)	No. of animals present ^{ab}	% of the ORR population exposed ^c
K-1407 OU	Transitional (4.19)	4.19	1	0.03
BC OU2	Transitional (0.62)	0.62	0.2	0.007
UEFPC OU2	0	0	0	0.00
K-1420 OU	0	0	0	0.00
K-1414 OU ^d				
Total no. exposed within 12 OUs			98	
Total reservation	Deciduous Forest (4,028.62) Mixed Forest (3,469) Pasture (312.44) Transitional (2,896.19)	10,706.25	2,998	
Percentage of the ORR population at risk				3.27%

^aThe number of animals present within the OU was calculated by multiplying the total area of suitable habitat (ha) by 0.28 American woodcock/ha (derived from Stewart and Robbins 1958).

^bAll woodcock present within OUs are exposed at levels exceeding the LOAEL, with the exception of animals at K-1414.

^cThe percentage of the ORR population exposed = (estimated no. of animals present on the OU/total no. of animals on the reservation) × 100.

^dHabitat maps are not available for the K-1414 OU.

Although specific OUs pose unacceptable risks to the individuals, the total number of exposed individuals within the entire ORR population is minimal. Approximately 3% and 3.1% of the reservation-wide populations of turkey and deer are at risk. Only 2.78% and 3.27% of short-tailed shrews and woodcock on the ORR are at risk. Therefore, using the 20% criterion outlined by Suter et al. (1994a), the occurrence of population-level effects on the reservation are highly unlikely. However, since the short-tailed shrew is a measurement endpoint for four species of T&E shrews, 2.78% of the impacted population may represent a significant risk to the reservation-wide populations of these T&E species.

Approximately 2.78% to 3.27% of the remaining assessment endpoint populations are experiencing contaminant exposures in excess of LOAELs and may be adversely impacted. Lower East Fork Poplar Creek OU contributed, by far, the highest number of deer, shrews, woodcock, and turkeys at risk on the ORR. Contaminants of concern at Lower East Fork Poplar Creek include mercury, cadmium, and aluminum. Bear Creek OU1 ranks as the number two contributor of exposed animals within the ORR.

populations. Cadmium, aluminum, copper, and mercury are of concern at Bear Creek OU1. Additionally, WAG 5 the third ranked contributor, only poses a risk to the short-tailed shrew and woodcock populations from mercury and zinc exposure.

5.4.5 Quality and Completeness of Data

While the data used in this portion of the assessment were generally considered to be of high quality, spatial coverage of the ORR was incomplete. Soil data were only available for 12 of 37 OUs on the ORR. Consequently, the magnitude of risk to reservation-wide populations is underestimated. The actual magnitude cannot be determined without incorporating data from additional OUs.

Another limitation, discussed in Chap. 4, concerns the level of detail in the ORR habitat map. There is a need for the habitat maps to identify specific characteristics of the habitat categories. For example, identification of floodplain forests, dense forests, etc. is necessary to better determine suitable habitat for many endpoint species. Furthermore, a better estimation of the number of individuals of each endpoint species within each OU may be predicted.

Additionally, the lack of site specific vegetation and earthworm concentrations on many OUs result in the use of average calculated soil-plant or soil-earthworm uptake factors. The uptake factors have a high degree of uncertainty associated with them and may over or underestimate the risk to herbivorous or vermivorous wildlife.

5.4.6 Uncertainties Concerning Risks to Herbivorous and Vermivorous Wildlife

5.4.6.1 Limitations of habitat maps

The level of precision differs between the habitat maps and the habitat requirements data. For example, habitat type such as open forest, dense forest, or floodplain forest cannot be identified. More detailed information is necessary since the actual habitat which is used may be only portions of the habitat categories (i.e., woodcock prefer moist floodplain soils in forested areas). This may overestimate or underestimate the number of individuals present within an OU.

5.4.6.2 Soil to vegetation and earthworm uptake factors

There is a large degree of uncertainty when using soil to vegetation and earthworm uptake factors to model contaminant concentrations found in vegetation and earthworms. Uptake factors of inorganics will vary by soil condition (i.e., pH, water availability, organic matter content, texture, aeration, elemental concentrations, etc.) and plant/earthworm conditions (species and age) (Sommers et al. 1987; Chaney et al. 1984). Using plant uptake factors assumes that all species and all soil conditions will result in the same uptake rate. Also, using uptake factors assumes that the uptake rate is best estimated by taking the average of all observed values. These site specific factors within the OUs are not taken into consideration for the uptake factors which were used. Therefore, the predicted contaminant concentrations in vegetation and earthworms may be overestimated or underestimated; thus overestimating or underestimating contaminant exposure for each endpoint species.

5.4.6.3 Relative quality of habitats

It was assumed that the quality of habitat found within each land cover type was equivalent. Although specific land cover types were designated as providing suitable habitat, the usability of the areas will vary and certain habitat types may be used preferentially. This will either overestimate or underestimate the number of animals found within each OU based on the lower or higher quality of certain habitat types.

5.4.6.4 Distribution of contamination within habitats on Operable Units

It was assumed that contamination was equally distributed throughout the OU. Therefore, all available habitat that is used by the specific endpoint was assumed to be equally contaminated throughout the entire OU. Because most contamination is likely to be in less suitable habitats (urban areas, lawns, etc.), on OU contaminant exposure is likely to be overestimated.

5.4.6.5 Literature density values

The use of literature density values of endpoint species, with the exception of deer and turkey, obtained from other areas of the United States, are considered representative of the ORR. This may overestimate or underestimate the number of exposed individuals.

5.4.6.6 Bioavailability of contaminants

It was assumed that 100% of the contaminant concentrations reported in soil and modeled vegetation and earthworms were bioavailable. The double acid extraction method used to determine soil concentrations reflect the total potential pool of contaminants. The future bioavailability of these contaminants which is dependent upon the chemical (e.g., pH, organic carbon) and physical (e.g., clay, moisture content) nature of the soil can not be addressed for this assessment. Therefore, exposure estimates based upon the contaminant concentrations in media are highly conservative and are likely to overestimate the actual contaminant exposure experienced.

5.4.6.7 Extrapolation from published toxicity data

To estimate toxicity of contaminants at the site, it was necessary to extrapolate from NOAELs observed for test species (i.e., rats and mice). While it was assumed that toxicity could be estimated as a function of body size, the accuracy of the estimate is not known. For example, white-tailed deer may be more or less sensitive than rats or mice.

Additional extrapolation uncertainty exists for those contaminants for which data consisted of either LOAELs or was subchronic in duration. For either case, an uncertainty factor of 10 was employed to estimate NOAELs or chronic data. The uncertainty factor of 10 may either over- or underestimate the actual LOAEL-NOAEL or subchronic-chronic relationship.

5.4.6.8 Variable food and water consumption

While food consumption by wildlife was assumed to be similar to that reported for the same species in other locations, the validity of this assumption cannot be determined. Food consumption at the Clinch

River and Poplar Creek may be greater or less than that reported in the literature, resulting in either an increase or decrease in contaminant exposure. Similarly, water consumption was estimated according to the allometric equations of Calder and Braun (1983). The accuracy with which the estimated water consumption represents actual water consumption is unknown.

5.4.6.9 Single contaminant tests vs exposure to multiple contaminants in the field

While plants and eastern cottontails are exposed to multiple contaminants concurrently, published toxicological values only consider effects experienced by exposures to single contaminants. Because some contaminants can interact antagonistically, single contaminant studies may overestimate their toxic potential. Similarly, for those contaminants that interact additively or synergistically, single contaminant studies may underestimate their toxic potential.

5.4.6.10 Inorganic constituents or species present in the environment

Toxicity of metal species varies dramatically depending upon the valence state or form (organic or inorganic) of the metal. For example, Arsenic (III) and methyl mercury are more toxic than arsenic (V) and inorganic mercury, respectively. The available data on the contaminant concentrations in media do not report which species or form of contaminant was observed. Because benchmarks used for comparison represented the more toxic species/forms of the metals (particularly for arsenic and mercury), if the less toxic species/form of the metal was actually present in modeled vegetation or sediment from the Clinch River or Poplar Creek, potential toxicity at the sites may be overestimated.

6. CONCLUSIONS

Based upon a preliminary evaluation of the currently available data, the following conclusions may be made concerning risks to selected wide-ranging wildlife species on the ORR:

- The largest OUs on the ORR generally have the most diverse habitat and consequently can support the greatest number of potential endpoint species (Chap. 3).
- Species that can use urban habitats or have broad habitat requirements have the highest potential to experience exposure due to the large numbers of OUs that provide suitable habitat (Chapt. 3).
- Cadmium in fish presents a significant risk to mink within the Bear Creek watershed and to an estimated 17.5% of the mink population on the ORR. ORR-wide risk to mink from cadmium may be underestimated due to the lack of data from the two largest watersheds (i.e., East Fork Poplar Creek and the K-25 vicinity). Combined exposure of mink to PCBs and mercury may present a hazard to mink in East Fork Poplar Creek. Risks from contaminants in other watersheds are not significant (Chap. 4).
- Evaluation of the potential risks to a future ORR-wide population of otter indicates that cadmium in Bear Creek presents a risk to 20% of the ORR-wide population; mercury in East Fork Poplar Creek presents a risk to either 12% or 36%. Because the river otter is a state threatened species, effects to any individual is significant. Therefore the weight of evidence suggests that Cd in Bear Creek and mercury in East Fork Poplar Creek represent significant risks to establishment of a future ORR-wide river otter population (Chap. 4).
- Mercury in fish presents a significant risk to belted kingfisher within the East Fork Poplar Creek watershed and consequently to an estimated 37% of the kingfisher population on the ORR (Chap. 4).
- While mercury in fish is estimated to represent a significant risk to great blue heron within the East Fork Poplar Creek watershed and consequently to an estimated 37% of the heron population on the ORR, studies on two of five colonies adjacent to the ORR indicate that reproduction at these locations is not impaired. Contaminant bioaccumulation and reproductive success are unknown at the three additional colonies adjacent to the ORR. Additionally, the primary foraging locations for herons at the two studied colonies is unknown. Because herons can travel long distances in search of food (>15 km), they are likely to forage at offsite as well as on-site locations, reducing both the exposure they receive and the risk they experience. If birds from the unstudied colonies forage more extensively on the ORR, they may experience greater risk. Due to the high risk estimated for mercury exposure on the ORR, the lack of data for three of five heron colonies adjacent to the ORR, and uncertainty as to where birds from the five ORR colonies forage, a conclusion concerning whether or not great blue heron on the ORR are at risk cannot be made (Chap. 4).
- Based upon a habitat-based evaluation of risk, while there are significant risks to individuals of selected herbivore and vermivore endpoint species resident on OUs, the reservation-wide

populations of these endpoints are unlikely to be significantly affected (<20% of the ORR population is affected). This conclusion must be viewed with caution, however because data were evaluated for only 12 of 37 OUs. Inclusion of additional OUs is likely to increase the proportion of the ORR populations exposed and at risk. (Chap. 5).

7. RECOMMENDED REVISION SCHEDULE

This assessment is based on only a small portion of the data available on the ORR. To accurately evaluate the nature and magnitude of risks on the ORR, all available data should be incorporated and considered. It is recommended that this report be revised and updated annually until all existing data have been incorporated. Following this, revisions should be produced on a 5-year schedule to incorporate new data that become available.

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Appendix A

**DATA SURVEY FOR THE OAK RIDGE RESERVATION
ECOLOGICAL MONITORING AND ASSESSMENT PROGRAM
TERRESTRIAL WILDLIFE RISK ASSESSMENT**

**DATA SURVEY FOR THE OAK RIDGE RESERVATION ECOLOGICAL
MONITORING AND ASSESSMENT PROGRAM
TERRESTRIAL WILDLIFE RISK ASSESSMENT**

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INTRODUCTION

Staff of the Environmental Assessment and Compliance Group were asked to perform a data information survey for the Oak Ridge Reservation Ecological Monitoring and Assessment Program (ORR-EMAP). The survey's purpose was to identify datasets potentially relevant to an upcoming terrestrial wildlife ecological risk assessment.

SURVEY APPROACH

Primary datasets of interest were soil, sediment, biota, and surface water contaminant concentrations. Radiological studies and air sampling were not of interest to this project. The following Operable Units (OUs) were given priority based on their total non-urban or barren area:

K-25:	K-901 (Area 10), K-770, K-33, K-1007
ORNL:	WAG 2, WAG 3, WAG 4, WAG 5, WAG 6, WAG 7, WAG 8, WAG 11
Y-12:	Bear Creek, LEFPC, Bear Creek OU1, Chestnut Ridge OU2
Other OUs:	Freels Bend, South Campus

The survey took a "top-down" approach, starting with ER Program Managers and OU Facility and Project Managers. Most of these people referred to other individuals and programs they thought might have relevant information. (See Fig. 1: Referrals.) It was hoped that this strategy would provide good general coverage of available datasets and allow those with access to datasets the opportunity to contribute.

The survey was conducted by telephone and electronic mail from March 22 through April 6, 1995. After a brief introduction of the survey's purpose, respondents were asked if they were aware of any potentially relevant studies, reports, or research. General information requested from survey participants included the following:

- What OUs are you affiliated with?
- Are you aware of any potentially relevant studies, reports, or research?
- Do you know of any individuals or programs that may have information of interest?

For each person contacted, a survey form was filled out to the extent information was known. (See Fig. A.2: Survey Participant Form.)

If potentially relevant datasets were identified, further questions were asked regarding the nature of the data including the following:

- Have these datasets been entered into a data management system such as the Oak Ridge Environmental Information System (OREIS) or the Bechtel Environmental Information Data Management System (BEIDMS)?
- What types of samples were taken?
- Who has the data in electronic form?

If most of a dataset was thought to be in a data management system such as OREIS, no further questions regarding that dataset were asked since the findings could be obtained from the system. If a dataset was not thought to be in a data management system, a blank data survey form was faxed to those who might have relevant information. (See Fig. A.3: Dataset Information Form.) Unfortunately, many of these forms were not returned.

PERSONS CONTACTED

Persons contacted are listed in Table A.1. All are Lockheed Martin Energy Systems, Inc., employees or on-site subcontractors except where indicated.

SURVEY FINDINGS

Interviews and returned survey forms uncovered the following information regarding OUs of interest.

K-25

OREIS holds surface water, sediment, toxicity, and biota data for the K-901A holding pond. The K-25 Site Environmental Monitoring program takes monthly surface water and sediment samples from the K-901A pond. SAIC is currently collecting data for K-901. The ORNL Environmental Sciences Division (ESD) sampled Canadian geese near the K-1007 pond for PCBs. SAIC holds surface water, soil, and possibly sediment data for K-770. Additional soil and sediment data for K-25 can be found in OREIS.

ORNL

Surface water data from seeps, springs, and tributaries, and sediment and soil data including soil characterizations and core samples have been collected for WAG 2. Results from these studies are intended for inclusion in OREIS. Some Ni sampling has been conducted for WAG 4. Water and soil from Pit 1 of WAG 7 have been sampled. Bechtel holds data regarding WAG 5.

Y-12

Surface water, soil, sediment, and biological information for LEFPC are in OREIS. This data includes summaries of Hg distribution and results of tests for organics. A surface water compliance testing point is located at EFPC. OREIS holds data collected in 1992 and 1993 for the EFPC Remedial Investigation (RI). EFPC data not in OREIS includes pollutant data; old surface water data; and PCB, Hg, and pesticide data for fish and algae. SAIC is currently

conducting EFPC studies. CDM obtained Chestnut Ridge soil, sediment, and surface water data. Small mammal and vegetation bioaccumulation studies have been conducted for Chestnut Ridge OU2. Two surface water sampling points for Y-12 surface water compliance are located at Bear Creek. The Bechtel Environmental Information Data Management System (BEIDMS) contains 1994 and 1995 Bear Creek Valley surface water data. A Bear Creek OU1 soils data project being conducted by SAIC is almost complete. Future studies for Y-12 include soil and sediment sampling near Bear Creek Road.

A historical data capture being conducted by SAIC has found the following surface water datasets for Bear Creek Valley:

- USGS water quality (inorganics, nitrate), 1984;
- NPDES data (inorganics and organic), 1990-94;
- organics, inorganics, and PCBs, 1990;
- organics, PCBs, inorganics, pesticides, 1993;
- inorganics, organic, 1987; and
- GWQAR data, organics, inorganics. 1986-1994 (in BEIDMS).

The Bear Creek Valley historical data capture contains the following soil and sediment information:

- organics, inorganics, PCBs, 1990 ;
- Upper Bear Creek Valley, inorganics, organics, pesticides, PCBs, 1983-84; and
- well borings, organics, inorganics, pesticides, PCBs, 1983-(unknown).

Other OUs

Jacobs Engineering holds Freels Bend data for soil, water, organics, inorganics, pesticides, PCBs, semi-volatiles, volatiles, and metals. This information is intended for inclusion in OREIS. Vegetation, soil, sediment, volatiles, and surface water data for South Campus are in OREIS.

Table A.1. Contacts for data survey for ORR-EMAP terrestrial wildlife risk assessment

Name	Employer ¹	Phone	UserID ²	Notes/project affiliation
Jane Aiken		241-3439	XQ9	In charge of K-901
Terri Ball			TLS	WAG 6
Lisa Baron		574-7393	ISA	
Clay Bednarz		241-3926	NRZ	WAG 4 & 11 Project Manager
Donna Bennett		574-5839	DFH	UEFPC
Bud Brickeen		576-1579	WBR	WAG 3 & 8 Project Manager
Jeff Cange	Bechtel	220-2255		WAG 5 Task Manager
Jane Carr		241-3542	J5C	ORNL Document Management Center
Jennifer Chason	SAIC	481-8796		EFPC, Bear Creek
Roger Clapp		576-6619	UVA	WAG 2 Technical Lead
Mike Coffey		576-5477	C3Y	K-1007, K-901
Dennis Cope		241-3841	DGX	Y-12
Barnaby Cornaby	SAIC	481-8721		LEFPC
Chris Dearstone		576-5946, 574-7449	KTV	Y-12 Database Administrator
John Forstrom		576-5640	KAF	K-25
Don Garrett		241-3501	GA4	WAG 6, WAG 11
Patty Goddard		576-3692	PG2	K-25 ER Technical Coordinator
Steven Haase		241-5258	6SH	Y-12 Technical Support
Chuck Hadden	SAIC	481-8733		Bear Creek, LEFPC
Kim Hanzelka		574-4599	UKH	Y-12 surface water compliance
Al Hardesty		576-0311	AFQ	WAG 5
Larry Hawk		241-4874	HKV	Facility Manager (WAG 2, 3, 8, . . .)
Kelly Henry	Jacobs	482-5045		Freels Bend, South Campus
Steve Herbes		574-7336	SEH	WAG 2 Project Manager
Walter Hill		574-2828		LEFPC

Table A.1 (continued)

Name	Employer ¹	Phone	UserID ²	Notes/project affiliation
Judy Hodgins		576-2368	H9S	Project Manager for soil sampling at Bear Creek Road
Jenny Holt		574-7336, 873-4821 (beeper)	VH2	
Rick Howard		241-2812	HR5	Facility Manager (WAG 4, 7, 11)
Dale Huff		574-7859	DDH	WAG 4
Dan Jones		241-5247		Y-12 Risk Assessment Group
Dick Ketelle		574-5762	KET	X-10
Jim Loar		574-7323	LOA	
John Lyons		574-3166	L9Y	K-25 ER Program Manager
Misty Mayes	SAIC	481-4617		K-901 pond
Wayne McMahon		574-7525	EIH	Y-12 EM Manager
Jerome Miller				LEFPC
Jill Mortimore		574-1462	JAO	Freels Bend, South Campus
Allen Motley		576-5782	A4Z	K-25
John Murphy		576-7929	JMU	X-10 EM Manager
Terri Nelson		574-7033	TRX	WAG 7 Facility and Project Manager, WAG 5 Facility Manager
Rona Painter		576-5477	RR9	K-25 Groundwater Program
Robert Poling		576-5493	P8O	K-25 Groundwater Program
Tony Poole		241-3591	D6P	K-25 ambient monitoring
Rob Rich		574-0678	RA3	ambient monitoring of K-901A and K-1007A ponds; stormwater sampling for Mitchell, Poplar, Clinch
Jim Rodgers		574-8982	JGR	Environmental Compliance for all sites
Jean Shaakir-Ali		574-5359	IJL	WAG 2
Lisa Shipe		241-2590	OLG	K-25 Monitoring Group
Valerie Smith		241-3518	VD5	K-901 and other K-25 OUs

Table A.1 (continued)

Name	Employer ¹	Phone	UserID ²	Notes/project affiliation
Brian Spalding		574-7265	BPS	Pit 1 of WAG 7
Pam Stevens		576-5488	NPT	K-25 outfalls
Jane Tate	Jacobs	220-4872		South Campus
Chris Taylor		576-6813	YLO	WAG 1, WAG 7
Fred Taylor		435-3418	FGT	Former WAG 7 Project Manager
Ralph Turner		574-7856	RRT	Bear Creek
Frank Van Ryn		574-1907	XS2	K-770
Ed Vazquez		576-1930	EAV	Y-12 Data Management Program
Steve Walker				Technical Lead for future soil sampling at Bear Creek Road
Ben Watts		576-4710	BW3	K-25 Data Management Program
Don Watkins		576-9931	WST	WAG 2
Darrell West		574-7367	DAR	
Lori Wiley	CDM			UEFPC soil sampling
Jackie Williams		241-5119	XLW	K-25 Data Management Program
Kirk Wilson		576-5290	QRG	WAG 6 Facility Manager
Pam Wood		576-9925	PW7	ORNL editor, Document control
Steve Wood	CDM	482-1065		Chestnut Ridge OU2: soil, sediment, and surface water

FIG. A.2. SURVEY PARTICIPANT FORM

**PROJECT TO LOCATE DATA FOR THE OAK RIDGE RESERVATION
WHICH COULD SUPPORT ECOLOGICAL RISK ASSESSMENTS**

INFORMATION ABOUT PERSONS CONTACTED (DRAFT)

(Complete information is requested only for authorities and custodians of surface water or soil data)

Name of person contacted
(last, first, middle initial)

Job title

Three-character User ID (or E-mail name if person has no User ID)

Phone number

Fax number

How was this person identified to be contacted? (e.g., referred to by program manager; name selected from organizational chart...)

Location

Employer (MMES, SAIC, Bechtel, ...)

Programmatic affiliation (ER, Compliance, BMAP, general research, ...)

Job responsibilities (Free form and flexible)

Operable Unit affiliations (which OU's does this person work with?)

Main role in identifying or providing data (check all that apply):

1. ☐ Broad knowledge about multiple data sets
2. ☐ Broad knowledge about a major program
3. ☐ Detailed knowledge about one or more subprograms or tasks
4. ☐ Data system expert
5. ☐ Data custodian (of what data?) _____
(Add names of the data authorities)
6. ☐ Data authority (of what data?) _____
(Add the name of the person who collected the data for which this person is an authority,
or who was in charge of the field teams)

FIG. A.2. SURVEY PARTICIPANT FORM (CONTINUED)

What programs, subprograms, or data systems is this person knowledgeable about?

What subject areas (and, if relevant, specialties) (e.g., chemistry-mercury, biology-benthic macroinvertebrates, radionuclide concentrations, data management, project management...) is this person knowledgeable about?

Expected usefulness of this contact in similar future data searches

High Intermediate Low

Comments on expected usefulness:

Other comments

Contact made by:

Date(s):

Method (e.g., in person, by phone, E-mail, correspondence):

FIG. A.3. DATASET INFORMATION FORM

DRAFT ORR-EMAP-ORNL Environmental Restoration Data Inventory

**Interview Form for Relevant Data in the 3/95 search for data to support the
ORR-EMAP (Terrestrial) Ecological Risk Assessment for the Reservation
(As determined by Media/Sample Matrix meeting the filter specifications)**

1. Organization (Program/Project/Division): _____
2. SubProgram or Task: _____
3. Data File or Model Name: _____
4. Data Path or Location: _____
5. Data Purpose: _____
6. Site Area Description: _____
7. Location Description: _____
8. Approximate Date Range: [___ / ___ / ___ - ___ / ___ / ___]
9. Media/Sample Matrix: _____
10. Primary Custodian of Dataset: _____
11. Phone Numbers: _____ User ID: _____
12. Secondary Custodian of Dataset: _____
13. Phone Numbers: _____ User ID: _____
14. Primary Data Authority: _____
15. Phone Numbers: _____ User ID: _____
16. Secondary Data Authority: _____
17. Phone Numbers: _____ User ID: _____
18. Data Generator: _____
(Subcontractor, if applicable)
19. Phone Numbers: _____ User ID: _____
20. Approximate Time of Last Data Base Update: [___ / ___ / ___]
21. Intended Frequency of Data Base Update: _____
(Monthly, Quarterly, Annually, etc.)

FIG. A.3. DATASET INFORMATION FORM (CONTINUED)

22. Abstract: _____

23. Archive Software: _____
 (Current Database)

24. Hardware Used: _____
 (Original Platform)

25. Presentation Format: _____
 Tabular (Spreadsheet)
 Textual (Word Processing)
 Graphical (non-spatial raster image)
 Spatial (True Earth GIS file)

26. Grid System: _____
 (X-10, Admin, TN SP, Lat/Long)

27. Distribution Point: _____
 (ORNL Domain Name, IP Address)

28. Comments/Other Information: _____

29. Keywords: _____

30. Identifiers: _____

31. Estimated Size: _____

32. Validation/Evaluation (Yes/No): _____

33. If "Yes," Describe Type: _____

34. Data Dictionary (Yes/No): _____

35. Reports: (attach additional page, if needed)

1) DMC Number: _____ Date Published: _____
 Title: _____

2) DMC Number: _____ Date Published: _____
 Title: _____

3) DMC Number: _____ Date Published: _____
 Title: _____

FIG. A.3. DATASET INFORMATION FORM (CONTINUED)

This information SUPPLEMENTS that obtained for the Draft ORR-EMAP-ORNL Environmental Restoration Data Inventory Interview Form (from Gordie Thompson) as supported by its "Classification Scheme"

Number (hand-assigned) of the Interview Form which this sheet supplements _____

Name by which data are known, or a descriptive name for the data. (Example: "BMAP Fish Community sampling data")

Types of samples

Contaminant levels Toxicity General water quality Biota status

Other _____
—

Types of contaminants, biota, or other measurements represented by the data

(e.g., toxicity of noncharacterized water to *Ceriodaphnia dubia*; levels of n congeners of PCB's; metals; bioaccumulation study of x in blue herons; ...) (also attach a list of variables or a summary of data if available)

How many stations or locations were sampled? (approximate is OK)?

If soil samples are included, were these ____ Surface? ____ Shallow (<12")? ____ Deep (>12")?

What is/was the frequency of sampling?

Is sampling ongoing?

If ongoing, provide the scheduled end date if there is one

Sampling method(s)

FIG. A.3. DATASET INFORMATION FORM (CONTINUED)

Analysis method(s)

Are qualifiers included in the data set (Y/N)? ____ If yes, indicate type(s) included

____ Lab?

____ Validation?

____ Other? _____

Are nondetects included in the data set? ____

Please characterize the level of data assessment (QA/QC):

____ Validation/evaluation performed?

(If yes, what type of validation/evaluation was performed?)

____ Are validation/Evaluation results included in the electronic data?

____ Collected under ER standards prevailing at the time of collection?

What approximate percentage of relevant data are in the Oak Ridge Environmental Information System (OREIS)?

Recommended media for transfer (obtain from OREIS; electronically via ftp; diskette(s),...)

Cutoff date for fully validated data

Cutoff date for unvalidated but available data

Any special considerations relating to use of the data?

FIG. A.3. DATASET INFORMATION FORM (CONTINUED)

Person who compiled this information

Date information was compiled

1. All persons are thought to be employees of Lockheed Martin Energy Systems, Inc. (LMES) except where indicated.
2. E-mail address is UserID@ORNL.GOV

Appendix B

TABLES FOR CHAPTER 3: EVALUATION OF THE POTENTIAL USE OF OPERABLE UNITS ON THE OAK RIDGE RESERVATION BY WILDLIFE

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
Mallard duck	Ponds, lakes, slow-moving streams or rivers. shallow water (<41 cm) for feeding	DeGraaf and Rudis 1986
Cumberland slider	Found in shallow freshwaters with lots of aquatic vegetation. They will inhabit mainly larger bodies of water with deep water available (3 feet or more).	Meyers-Schone and Walton 1994
Mink	Streambanks, lakeshores, and marshes. Favors forested wetlands with abundant cover such as thickets, rocks, or windfalls.	DeGraaf and Rudis 1986
River otter	Borders of streams, lakes or other wetlands in forested areas.	DeGraaf and Rudis 1986
Great blue heron	All sizes and types of bodies of water that contain fish	DeGraaf and Rudis 1986
Belted kingfisher	Earthen bank for nesting; pond, lake, stream, or river for feeding.	DeGraaf and Rudis 1986
Bald eagle	Large bodies of water that contain fish, large living trees for nesting. Low human disturbance.	DeGraaf and Rudis 1986
Osprey	Near large bodies of water that support abundant fish. Along rivers and lakes	DeGraaf and Rudis 1986
Double-crested cormorant	Found on rocky coasts, beaches, inland lakes and rivers.	National Geographic Society 1987
Black-crowned night heron	Ponds, lakes, marshes, slow streams with pools, or rivers	DeGraaf and Rudis 1986
Northern water snake	Aquatic and semi aquatic habitats	DeGraaf and Rudis 1986

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
Pied-billed grebe	Lakes, rivers, or ponds with emergent vegetation and open water	DeGraaf and Rudis 1986
Leopard frog	all types of shallow freshwater habitats; includes streams, rivers, ponds, or lakes	Conant 1986
Hellbender	Almost always found in rivers and larger streams where water is running and ample shelter is available in the form of large rocks, snags, or debris.	Conant 1986
Rough-winged swallows	Nearly any open area with adequate nest sites and a water supply (usually a stream). Often river valleys and lake shores.	DeGraaf and Rudis 1986
Gray bat	Cave residents year-round, although different caves are occupied in summer and winter. Forage over lakes and rivers.	Harvey 1992
Indiana bat	Favors limestone caves with pools of water. Solitary females or small maternity colonies bear young in hollow trees or under loose bark. Forages over riparian forest and associated fields	DeGraaf and Rudis 1986 Mumford and Whitaker 1982
Eastern small footed bat	In or near woodland in caves, mine tunnels, buildings, crevices in rocks. Maternity colonies have been observed in buildings. Forages low over trees and brush	DeGraaf and Rudis 1986 Burt and Grossenheider 1976

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
Rafinesque's big-eared bat	Hibernate in caves, mines or similar habitats. Maternity colonies are usually found in abandoned buildings. Suspected to be a forest-inhabiting bat.	Harvey 1992 Mumford and Whitaker 1982
American toad	Almost any habitat: gardens, woods, yards with cover, damp soil, and a food supply Usually in moist upland woods	DeGraaf and Rudis 1986
American woodcock	Moist woodlands in early stages of succession, swamps, stream banks, bogs, rich bottomlands, brushy edges of woods, dry open woods and fields.	DeGraaf and Rudis 1986
European starling	Farm, city, orchard, gardens, parks; Prefers rural areas w/pastures or hayfields; If forests, prefers stands with low percent canopy cover. More common in vicinity of human habitations.	DeGraaf and Rudis 1986
American robin	Open woods and fields. Forages primarily in lawns, gardens, grassy fields, etc.	DeGraaf and Rudis 1986
Short-tailed shrew	Both timbered fairly open habitats: deciduous, mixed, and less often coniferous forests with moist loose humus; especially common along banks of streams and in meadows with tall rank grasses or sedges, brush piles, and stone walls. Avoids dry, warm sites.	DeGraaf and Rudis 1986
Long-tailed shrew	found in deciduous and mixed forest.	DeGraaf and Rudis 1986

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
Masked shrew	Damp deciduous and coniferous woodlands with grasses, rocks, logs, or stumps for cover; bogs and other moist areas.	DeGraaf and Rudis 1986
Smokey shrew	Damp, boulder-strewn, upland woods with thick leafmold. Typically near streams with moss-covered banks.	DeGraaf and Rudis 1986
Southeastern shrew	Open fields and woodlots	Burt and Grossenheider 1976
Six-line racerunner	Dry regions in sparse woods with loose/sandy soil and short grasses.	Smith 1967
Slender glass snake	dry grasslands or dry open woods	Conant 1986
Tennessee cave salamander	caves with water (species has external gills)	Conant 1986
Green salamander	humid rocky areas where rock faces remain moist and well protected from sun and direct rain.	Conant 1986
Raccoon	Wooded areas interrupted by fields and water courses. Not usually found in dense forests, commonly found in wetlands near human habitation.	DeGraaf and Rudis 1986
Wood duck	Shallow waters of ponds, lakes, or marshes having abundant floating and emergent vegetation. Wooded swamps or open flooded lowland forests where food is available.	DeGraaf and Rudis 1986
Muskrat	Marshes, shallow portions of lakes, ponds, swamps, sluggish streams, drainage ditches. Most abundant in areas with cattails.	DeGraaf and Rudis 1986

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
White-tailed deer	Mosaic of forests and open areas	DeGraaf and Rudis 1986
Wild turkey	Mast-producing woodlands. Ideal habitat is a network of open, mixed forests and fields.	DeGraaf and Rudis 1986
Canada goose	marshes, shores of ponds and lakes, grassy fields or agricultural lands that provide additional grazing areas.	DeGraaf and Rudis 1986
Eastern cottontail	Farmlands, pastures, fallow fields, open woodlands, thickets along fence rows and stone walls, edges of forests. swamps and marshes, suburban areas with adequate food and cover. Avoids dense woods.	DeGraaf and Rudis 1986
Groundhog	Open land. Edges of woodlands (seldom in interior), open cultivated land, pastures, meadows, open brushy hillsides.	DeGraaf and Rudis 1986
Grasshopper sparrow	Hayfields, weedy fallow fields, prairies. Avoids shrubby fields. Birds favor uplands with ground vegetation of various densities.	DeGraaf and Rudis 1986
Henslow's sparrow	Neglected weedy fields- commonly of broomsedge-wet meadows, saltmarsh edges. Occasionally in dry and cultivated uplands. May favor moist lowland habitat and may use areas with widely scattered shrubs.	DeGraaf and Rudis 1986
Lark sparrow	generally prefers sites with grasslands or open woodlands	National Geographic Society 1987

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
Vesper sparrow	Breed in short-grass meadows, pastures, hayfields, cultivated grain fields, dry open uplands, burned and cut-over areas in forests, country roadsides. Birds favor sparsely vegetated uplands and may use areas with widely scattered shrubs.	DeGraaf and Rudis 1986 Red-tailed Hawk
Red-tailed hawk	Deciduous and mixed woodlands interspersed with meadows, brushy pastures, open bogs, and swampy areas. Large openings for foraging.	DeGraaf and Rudis 1986
Golden eagle	Elevated nest sites, especially cliffs. Broad expanses of open land for hunting. 50 to 100 square mile home range.	DeGraaf and Rudis 1986
Northern harrier	Open country with herbaceous or low woody vegetation for nest concealment.	DeGraaf and Rudis 1986
Cooper's hawk	Extensive deciduous or mixed woodlands that are dense or open, scattered woodlots interspersed with open fields. Occupies similar forest niche as Sharp-shinned Hawk but has broadened its habitat by moving into more open agricultural areas. Flood plain forests and wooded swamps.	DeGraaf and Rudis 1986
Red-shouldered hawk	Moist hardwood or mixed woodlands, wooded swamps, bottomlands and wooded margins of marshes often close to cultivated fields.	DeGraaf and Rudis 1986

Table B.1. Habitat requirements for assessment and measurement endpoints on the ORR

Species	General habitat requirements	Citation
Sharp-shinned hawk	Open mixed or coniferous woodlands, clearing, edges. Extensive open mixed woodlands that are free from human disturbance.	DeGraaf and Rudis 1986
Barn owl	Almost anywhere in open country but prefers vicinity of farms and villages. Avoids woodlands and higher elevations.	DeGraaf and Rudis 1986
Black vulture	Common in open country and around human settlements, avoids heavily forested areas	Ehrlich 1988
Cougar	Found throughout all habitat types and successional stages. Requires isolation away from human disturbance. Home ranges may vary in size from 5 to 96 square miles.	DeGraaf and Rudis 1986
Red fox	A mixture of forest and open areas is preferred. Unbroken fields and dense forests avoided. Edges used heavily.	DeGraaf and Rudis 1986
Snapping turtle	Any permanent body of freshwater, large or small.	DeGraaf and Rudis 1986
Black rat snake	Variety of habitats including woodlands, thickets, field edges, farmlands, rocky hillsides, river bottoms, old barns.	DeGraaf and Rudis 1986
Northern pine snake	Flat, sandy pine barrens, sandhills, and dry mountain ridges, most often in or near pine woods.	Conant 1986

Table B.2. Summary of landcover types identified on the ORR and expected use by assessment and measurement endpoints

Species	Landcover types ^a on the ORR									
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	Other
Mallard duck		X								
Cumberland slider		X								
Mink		X			X	X				water primary; forest secondary
River otter		X			X	X				water primary; forest secondary
Great blue heron		X								
Belted kingfisher		X								
Bald eagle		X								large bodies of water
Osprey		X								large bodies of water
Double-crested cormorant		X								large bodies of water
Black-crowned night heron		X								
Northern water snake		X								
Pied-billed grebe		X								
Leopard frog		X								
Hellbender		X								
Rough-winged swallows		X					X	X		Earthen Banks

Table B.2. Summary of landcover types identified on the ORR and expected use by assessment and measurement endpoints

Species	Landcover types ^a on the ORR									
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	Other
Gray bat		X								large bodies of water, caves
Indiana bat		X			X	X	X	X		
Eastern small footed bat					X		X	X		
Rafinesque's big-eared bat	X (buildings)		X	X	X	X				Caves
American toad		X	X	X	X	X				forest primary; water secondary
American woodcock					X	X	X	X		
European starling	X		X	X	X	X	X	X		
American robin	X		X	X	X	X	X	X		
Short-tailed shrew			X	X	X	X		X		
Long-tailed shrew					X	X				
Masked shrew					X	X				
Smokey shrew					X	X				
Southeastern shrew			X	X	X	X	X	X		
Six-line racerunner			X	X	X	X	X	X		
Slender glass snake			X	X	X	X	X	X		
Tennessee cave salamander										Caves

Table B.2. Summary of landcover types identified on the ORR and expected use by assessment and measurement endpoints

Species	Landcover types ^a on the ORR									
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	Other
Green salamander										moist, rocky sites
Raccoon	X	X	X	X	X	X	X	X		
Wood duck		X			X	X				
Muskrat		X								
White-tailed deer			X	X	X	X	X	X		
Wild turkey			X	X	X	X	X	X		
Canada goose	X	X					X			
Eastern cottontail	X						X	X		
Groundhog	X						X	X		
Grasshopper sparrow							X	X		
Henslow's sparrow							X	X		
Lark sparrow					X	X	X	X		
Vesper sparrow							X	X		
Red-tailed hawk			X	X	X	X	X	X		
Golden eagle										use of ORR unlikely ^b
Northern harrier							X	X		
Cooper's hawk					X	X	X	X		

Table B.2. Summary of landcover types identified on the ORR and expected use by assessment and measurement endpoints

Species	Landcover types ^a on the ORR									
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	Other
Red-shouldered hawk					X	X				
Sharp-shinned hawk					X	X				
Barn owl	X						X	X		
Black vulture							X	X		
Cougar			X	X	X	X	X	X		use of ORR unlikely ^c
Red fox			X	X	X	X	X	X		
Snapping turtle		X								
Black rat snake	X		X	X	X	X	X	X		
Northern pine snake			X	X		X				

^a Definitions of habitat types are presented in Table 1. X in cell indicates use of habitat by listed endpoint species.

^b While golden eagles may migrate through the ORR, because the ORR does not contain large expanses of open habitat, significant use of any area on the ORR is highly unlikely.

^c Because the ORR does not contain large expanses of habitat away from human disturbance, significant use of any area on the ORR is highly unlikely.

Table B.3. Summary of landcover types identified on OUs on the ORR

OU	Area (ha) by landcover type									
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	Total
Area 10 (K-901)	15.94	3.56	1.75	0.31	6.87	7.62	3.19	38.31		77.5
K-33	65	0.12			2.94	0.87	5.06	13.94	0.37	88.3
K-1064	110.6						0.19	3.56	0.06	14.87
K-1410	3.19							0.31		3.5
K-29	25.62						0.62	0.88		27.12
K-1007	13.75	7.62					0.19	0.75		22.31
K-1413	1.31									1.31
K-1004	2.94									2.94
K-1070-C/D	6.56				1.69	0.19	0.25	4.37		13.06
K-1401	8.06									8.06
K-1420	2.31									2.31
K-1407	12.31	0 ^a						4.19		16.5
K-770	43.81	2	2.37	1.06	4.37	3.12	4.19	28	0.06	88.98
WAG 1	48.18	0 ^a	0.81		1.25	0.81	0.94			51.99
WAG 2	13	9	1		15.75	29	0.06	14.81		82.62
WAG 3	0.56		0.19		1.06	2.19	0.06	8.12		12.18
WAG 4	6.37	0 ^a			2.19	1.19	4.5	1.06		15.31

Table B.3. Summary of landcover types identified on OUs on the ORR

OU	Area (ha) by landcover type									
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	Total
WAG 5	10.19	0 ^a	0.25		3.56	6.44	7.69	9.06		37.19
WAG 6	25.5	0.75			5.06	2.06	0.5	2.94		36.81
WAG 7	5.37	0 ^a	1.44		17.25	25.31	0.12	8.31		57.8
WAG 8	17.81		3.44		1.44	3.785		5.12		31.56
WAG 9	1.37				0.25	0.06		0.31		1.99
WAG 10	0.5		0.12		0.06	0.19		0.25		1.12
WAG 11	0.31		4.56		0.81	3.81	0.37	5.12		14.98
WAG 13	0.56		0.12		0.18	0.44	0.37	1.81		3.48
Bear Creek	85.37	0 ^a	37.37	20.94	192.81	140.56	14.62	246.06	0.44	738.17
BC OU1	9.5				8.19	0.25	9.19	24	0.25	51.38
BC OU2	4.12							0.62	0.06	4.8
CR OU1	1.5					0.19	2.5	2.06		6.25
CR OU2	0.94	0.06			3.81	0.38		2.62		7.81
CR OU3	0.31						0.19			0.5
CR OU4	1.44	3.94			0.06	0.06	0.19	0.56	0.31	6.56
Lower East Fork Poplar Creek	99.81	0.19	7.37	2.62	41.06	50.87	8.5	133.87	2	344.29
UEFPC OU2	3.56									3.56

Table B.3. Summary of landcover types identified on OUs on the ORR

OU	Area (ha) by landcover type									Total
	Urban	Water	Pine forest	Pine plant.	Decid. forest	Mixed forest	Pasture	Trans.	Barren	
UEFPC OU3	5.19									5.19
Freels Bend	0.75	1.12		0.06	2.06	3.88	0.81	4.56		13.49
South Campus Facility	9.81	0.44	0.06	0.06			13.25	4.5	0.44	28.56

^a While no surface water was observed in the satellite image, surface water is known to be present at this site.

Table B.4. Summary of habitat availability for assessment and measurement endpoints at K-25 OUs *

	K-901	K-33	K-1064	K-1410	K-29	K-1007	K-1413	K-1004	K-1070-C/D	K-1401	K-1420	K-1407	K-770
Mallard duck	x	x				x						x	x
Cumberland slider	x	x				x						x	x
Mink	x	x				x						x	x
River otter	x	x				x						x	x
Great blue heron	x	x				x						x	x
Belted kingfisher	x	x				x						x	x
Bald eagle	x					x							
Osprey	x					x							
Double-crested cormorant	x					x							
Black-crowned night heron	x	x				x						x	x
Northern Water snake	x	x				x						x	x
Pied-billed grebe	x	x				x						x	x
Leopard frog	x	x				x						x	x
Hellbender													
Rough-winged swallows	x	x				x			x			x	x
Gray bat	x					x							
Indiana bat	x	x	x	x	x	x			x			x	x
Eastern small footed bat	x	x	x	x	x	x			x			x	x

Table B.4. Summary of habitat availability for assessment and measurment endpoints at K-25 OUs *

	K-901	K-33	K-1064	K-1410	K-29	K-1007	K-1413	K-1004	K-1070-C/D	K-1401	K-1420	K-1407	K-770
Rafinesque's big-eared bat	x	x	x	x	x	x	x	x	x	x	x	x	x
American toad	x	x							x				x
American woodcock	x	x	x	x	x	x			x			x	x
European starling	x	x	x	x	x	x	x	x	x	x	x	x	x
American robin	x	x	x	x	x	x	x	x	x	x	x	x	x
Short-tailed shrew	x	x							x				x
Long-tailed shrew	x	x							x				x
Masked shrew	x	x							x				x
Smokey shrew	x	x							x				x
Southeastern shrew	x	x	x	x	x	x			x			x	x
Six-line racerunner	x	x	x	x	x	x			x			x	x
Slender glass snake	x	x	x	x	x	x			x			x	x
Tennessee cave salamander													
Green salamander													
Raccoon	x	x	x	x	x	x	x	x	x	x	x	x	x
Wood duck	x	x				x						x	x
Muskrat	x	x				x						x	x
White-tailed deer	x	x	x	x	x	x			x			x	x
Wild turkey	x	x	x	x	x	x			x			x	x

Table B.4. Summary of habitat availability for assessment and measurement endpoints at K-25 OUs *

	K-901	K-33	K-1064	K-1410	K-29	K-1007	K-1413	K-1004	K-1070-C/D	K-1401	K-1420	K-1407	K-770
Canada goose	x	x	x	x	x	x	x	x	x	x	x	x	x
Eastern cottontail	x	x	x	x	x	x	x	x	x	x	x	x	x
Groundhog	x	x	x	x	x	x	x	x	x	x	x	x	x
Grasshopper sparrow	x	x	x	x	x	x			x			x	x
Henslow's sparrow	x	x	x	x	x	x			x			x	x
Lark sparrow	x	x	x	x	x	x			x			x	x
Vesper sparrow	x	x	x	x	x	x			x			x	x
Red-tailed hawk	x	x	x	x	x	x			x			x	x
Golden eagle													
Northern harrier	x	x	x	x	x	x			x			x	x
Cooper's hawk	x	x	x	x	x	x			x			x	x
Red-shouldered hawk	x	x							x				x
Sharp-shinned hawk	x	x							x				x
Barn owl	x	x	x	x	x	x	x	x	x	x	x	x	x
Black vulture	x	x	x	x	x	x			x			x	x
Cougar													
Red fox	x	x	x	x	x	x			x			x	x
Snapping turtle	x	x				x						x	x
Black rat snake	x	x	x	x	x	x	x	x	x	x	x	x	x
Northern pine snake	x	x							x				x

Table B.4. Summary of habitat availability for assessment and measurement endpoints at K-25 OUs ^a

	K-901	K-33	K-1064	K-1410	K-29	K-1007	K-1413	K-1004	K-1070-C/D	K-1401	K-1420	K-1407	K-770
Total number of endpoints/OU	52	48	26	26	26	44	9	9	35	9	9	40	48

^a X=presence of at least one habitat category preferred by the endpoint. Amount of suitable habitat not considered; only presence/absence of habitat.

Table B.5. Summary of habitat availability for assessment and measurement endpoints at X-10 OUs^a

	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6	WAG 7	WAG 8	WAG 9	WAG 10	WAG 11	WAG 13
Mallard duck	x	x		x	x	x	x					
Cumberland slider	x	x		x	x	x	x					
Mink	x	x		x	x	x	x					
River otter		x		x	x	x	x					
Great blue heron	x	x		x	x	x	x					
Belted kingfisher	x	x		x	x	x	x					
Bald eagle		x (WOL) ^b										
Osprey		x (WOL) ^b										
Double-crested cormorant		x (WOL) ^b										
Black-crowned night heron	x	x		x	x	x	x					
Northern water snake	x	x		x	x	x	x					
Pied-billed grebe	x	x		x	x	x	x					
Leopard frog	x	x		x	x	x	x					
Hellbender		x		x	x	x	x					
Rough-winged swallows	x	x	x	x	x	x	x	x	x	x	x	x
Gray bat		x (WOL) ^b										
Indiana bat	x	x	x	x	x	x	x	x	x	x	x	x
Eastern small footed bat	x	x	x	x	x	x	x	x	x	x	x	x

Table B.5. Summary of habitat availability for assessment and measurement endpoints at X-10 OUs^a

	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6	WAG 7	WAG 8	WAG 9	WAG 10	WAG 11	WAG 13
Rafinesque's big-eared bat	x	x	x	x	x	x	x	x	x	x	x	x
American toad	x	x	x	x	x	x	x	x	x	x	x	x
American woodcock	x	x	x	x	x	x	x	x	x	x	x	x
European starling	x	x	x	x	x	x	x	x	x	x	x	x
American robin	x	x	x	x	x	x	x	x	x	x	x	x
Short-tailed shrew	x	x	x	x	x	x	x	x	x	x	x	x
Long-tailed shrew	x	x	x	x	x	x	x	x	x	x	x	x
Masked shrew	x	x	x	x	x	x	x	x	x	x	x	x
Smokey shrew	x	x	x	x	x	x	x	x	x	x	x	x
Southeastern shrew	x	x	x	x	x	x	x	x	x	x	x	x
Six-line racerunner	x	x	x	x	x	x	x	x	x	x	x	x
Slender glass snake	x	x	x	x	x	x	x	x	x	x	x	x
Tennessee cave salamander												
Green salamander												
Raccoon	x	x	x	x	x	x	x	x	x	x	x	x
Wood duck	x	x		x	x	x	x					
Muskrat	x	x		x	x	x	x					
White-tailed deer	x	x	x	x	x	x	x	x	x	x	x	x
Wild turkey	x	x	x	x	x	x	x	x	x	x	x	x
Canada goose	x	x	x	x	x	x	x	x	x	x	x	x

Table B.5. Summary of habitat availability for assessment and measurement endpoints at X-10 OUs^a

[illegible]

Table B.5. Summary of habitat availability for assessment and measurement endpoints at X-10 OUs^a

	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6	WAG 7	WAG 8	WAG 9	WAG 10	WAG 11	WAG 13
Total number of endpoints/OU	47	53	35	49	49	49	49	35	35	35	35	35

^a X = presence of at least one habitat category preferred by the endpoint. Amount of suitable habitat not considered; only presence/absence of habitat.

^b WOL = suitable habitat only at White Oak Lake.

Table B.6. Summary of habitat availability for assessment and measurement endpoints at Y-12 OUs, Freels Bend, and the South Campus Facility*

	Bear Creek	BC OU1	BC OU2	CR OU1	CR OU2	CR OU3	CR OU4	LEFPC	UEFPC OU2	UEFPC OU3	Freels Bend	SCF
Mallard duck	x						x	x			x	x
Cumberland slider	x						x	x			x	x
Mink	x						x	x			x	x
River otter	x						x	x			x	x
Great blue heron	x						x	x			x	x
Belted kingfisher	x						x	x			x	x
Bald eagle												
Osprey												
Double-crested cormorant												
Black-crowned night heron	x						x	x			x	x
Northern water snake	x						x	x			x	x
Pied-billed grebe	x						x	x			x	x
Leopard frog	x						x	x			x	x
Hellbender	x							x				
Rough-winged swallows	x	x	x	x	x		x	x			x	x
Gray bat												
Indiana bat	x	x	x	x	x	x	x	x			x	x
Eastern small footed bat	x	x	x	x	x	x	x	x			x	x

Table B.6. Summary of habitat availability for assessment and measurement endpoints at Y-12 OUs, Freels Bend, and the South Campus Facility*

	Bear Creek	BC OU1	BC OU2	CR OU1	CR OU2	CR OU3	CR OU4	LEFPC	UEFPC OU2	UEFPC OU3	Freels Bend	SCF
Rafinesque's big-eared bat	x	x	x	x	x	x	x	x	x	x	x	x
American toad	x	x		x	x		x	x			x	x
American woodcock	x	x	x	x	x	x	x	x			x	x
European starling	x	x	x	x	x	x	x	x	x	x	x	x
American robin	x	x	x	x	x	x	x	x	x	x	x	x
Short-tailed shrew	x	x		x	x		x	x			x	x
Long-tailed shrew	x	x		x	x		x	x			x	
Masked shrew	x	x		x	x		x	x			x	
Smokey shrew	x	x		x	x		x	x			x	
Southeastern shrew	x	x	x	x	x	x	x	x			x	x
Six-line racerunner	x	x	x	x	x	x	x	x			x	x
Slender glass snake	x	x	x	x	x	x	x	x			x	x
Tennessee cave salamander												
Green salamander												
Raccoon	x	x	x	x	x	x	x	x	x	x	x	x
Wood duck	x						x	x			x	x
Muskrat	x						x	x			x	x
White-tailed deer	x	x	x	x	x	x	x	x			x	x

Table B.6. Summary of habitat availability for assessment and measurement endpoints at Y-12 OUs, Freels Bend, and the South Campus Facility^a

	Bear Creek	BC OU1	BC OU2	CR OU1	CR OU2	CR OU3	CR OU4	LEFPC	UEFPC OU2	UEFPC OU3	Freels Bend	SCF
Wild turkey	x	x	x	x	x	x	x	x			x	x
Canada goose	x	x	x	x	x	x	x	x	x	x	x	x
Eastern cottontail	x	x	x	x	x	x	x	x	x	x	x	x
Groundhog	x	x	x	x	x	x	x	x	x	x	x	x
Grasshopper sparrow	x	x	x	x	x	x	x	x			x	x
Henslow's sparrow	x	x	x	x	x	x	x	x			x	x
Lark sparrow	x	x	x	x	x	x	x	x			x	x
Vesper sparrow	x	x	x	x	x	x	x	x			x	x
Red-tailed hawk	x	x	x	x	x	x	x	x			x	x
Golden eagle												
Northern harrier	x	x	x	x	x	x	x	x			x	x
Cooper's hawk	x	x	x	x	x	x	x	x			x	x
Red-shouldered hawk	x	x		x	x		x	x			x	
Sharp-shinned hawk	x	x		x	x		x	x			x	
Barn owl	x	x	x	x	x	x	x	x	x	x	x	x
Black vulture	x	x	x	x	x	x	x	x			x	x
Cougar												
Red fox	x	x	x	x	x	x	x	x			x	x
Snapping turtle	x						x	x			x	x

Table B.6. Summary of habitat availability for assessment and measurement endpoints at Y-12 OUs, Freels Bend, and the South Campus Facility^a

	Bear Creek	BC OU1	BC OU2	CR OU1	CR OU2	CR OU3	CR OU4	LEFPC	UEFPC OU2	UEFPC OU3	Freels Bend	SCF
Black rat snake	x	x	x	x	x	x	x	x	x	x	x	x
Northern pine snake	x	x		x	x		x	x			x	x
Total number of endpoints/OU	49	35	27	35	35	26	48	49	9	9	48	43

^a X=presence of at least one habitat category preferred by the endpoint. Amount of suitable habitat not considered; only presence/absence of habitat.

Table B.7. Ranking of endpoint species by the number of OUs that provide at least one favored habitat type

Endpoint Species	Total OUs W/habitat	Endpoint Species	Total OUs W/habitat
Barn owl	37	American Toad	24
Groundhog	37	Long-tailed shrew	23
European starling	37	Red-shouldered hawk	23
American robin	37	Sharp-shinned hawk	23
Rafinesque's big-eared bat	37	Masked shrew	23
Raccoon	37	Smokey shrew	23
Eastern cottontail	37	Snapping turtle	16
Black rat snake	37	Mallard duck	16
Canada goose	37	Muskrat	16
American woodcock	31	Pied-billed grebe	16
Henslow's sparrow	31	Mink	16
Southeastern shrew	31	Great blue heron	16
Wild turkey	31	Belted kingfisher	16
Slender glass snake	31	Black-crowned night heron	16
Grasshopper sparrow	31	Wood duck	16
Six-line racerunner	31	Northern Water snake	16
Eastern small footed bat	31	Leopard frog	16
Indiana bat	31	Cumberland slider	16
Lark sparrow	31	River otter	15
Red fox	31	Hellbender	7
Black vulture	31	Bald eagle	3
Cooper's hawk	31	Gray bat	3
Northern harrier	31	Double-crested cormorant	3
White-tailed deer	31	Osprey	3
Red-tailed hawk	31	Green salamander	0
Vesper sparrow	31	Golden eagle	0
Rough-winged swallows	27	Tennessee cave salamander	0
Short-tailed shrew	24	Cougar	0
Northern pine snake	24		

Table B.8. Ranking of OUs on the ORR by the number of species for which they provide habitat

OU	Total species per OU	OU	Total species per OU
WAG 2	53	WAG 9	35
K-901	52	WAG 10	35
Lower East Fork Poplar Creek	49	WAG 11	35
Bear Creek	49	WAG 13	35
WAG 4	49	BC OU1	35
WAG 5	49	CR OU1	35
WAG 6	49	CR OU2	35
WAG 7	49	BC OU2	27
K-33	48	K-1064	26
K-770	48	K-1410	26
CR OU4	48	K-29	26
Freel's Bend	48	CR OU3	26
WAG 1	47	K-1413	9
K-1007	44	K-1004	9
South Campus Facility	43	K-1401	9
K-1407	40	K-1420	9
K-1070-C/D	35	UEFPC OU2	9
WAG 3	35	UEFPC OU3	9
WAG 8	35		

Appendix C

TABLES AND FIGURES FOR CHAPTER 4: ASSESSMENT OF RISK TO PISCIVORES ON THE OAK RIDGE RESERVATION

Table C.1. Life history parameters for mink

Parameter	Value	Comments	Reference
Body Weight	1.0 kg (mean $\sigma + \varphi$)		EPA 1993b
Food Consumption Rate	0.137 kg/d (mean $\sigma + \varphi$)		Bleavins and Aulerich 1981
Water Consumption Rate	0.099 L/d	estimated using allometric equation ^a assuming 1.0 kg bw	After Calder and Braun 1983
Diet Composition	Diverse diet includes: mammals, fish, aquatic invertebrates, amphibians, and birds Proportion of aquatic prey (fish, amphibians, inverts, etc.) = 0.546 ± 0.21 fish sizes: 0-10 cm = 72 % 11-20 cm = 28 %	Proportion represents means of values from five studies	Hamilton 1940, Sealander 1943, Korschgen 1958, Burgess and Bider 1980 Alexander 1977
Home Range	2.63 km (σ) 1.85 km (φ) 770 ha (σ)	stream - Sweden prairie potholes, Manitoba range size and shape depends on habitat - linear along streams, circular in marshes	Gerell 1970 Arnold and Fritzell 1987 EPA 1993a.
Habitat Requirements	aquatic habitats - streams, lakes, marshes;		Burt and Grossenheider 1976
Population Density	0.03 - 0.085 /ha 0.6/km	river - Montana river - Michigan	Mitchell 1961 EPA 1993a
Behavior	nocturnal active year-round, does not hibernate		EPA 1993a

^a Allometric equation for estimation of water consumption by mammals is:

$$W = 0.099(bw)^{0.90}$$

where: W = water consumption (L/d)
bw = body weight (kg)

Table C.2. Life history parameters for river otter

Parameter	Value	Comments	Reference
Body Weight	8.0 kg (mean ♂+♀)		EPA 1993b
Food Consumption Rate	0.9 kg/d (mean ♂+♀)		EPA 1993b
Water Consumption Rate	0.64 L/d		EPA 1993b
Diet Composition	Almost exclusively fish 2-50 cm in size; most ≥30 cm.		Melquist and Hornocker 1983
	50% large and 50% small fish		EPA 1993b
Home Range	10-78 km	river-Idaho	Melquist and Hornocker 1983
		range size and shape depends on habitat - linear along streams, circular in marshes	EPA 1993b
Habitat Requirements	aquatic habitats - streams, lakes, marshes;		EPA 1993b
Population Density	0.17 - 0.37 /km	river-Idaho	Melquist and Hornocker 1983
	0.0094-0.014/ha		EPA 1993b
Behavior	Generally most active morning and evening, but may be active at any time in day.		Melquist and Hornocker 1983
	active year-round, does not hibernate		EPA 1993b

Table C-3. Life history parameters for belted kingfisher

Parameter	Value	Comments	Reference
Body Weight	0.148 kg		Dunning 1984
Food Consumption Rate	50% bw		Alexander 1977
	0.075 kg/d	assuming 0.148 kg bw	
Water Consumption Rate	0.016 L/d	estimated using allometric equation ^a assuming 0.148 kg bw	
Soil Consumption Rate	as a piscivore, assumed to be negligible		
Diet Composition	Cyprinids - 76.4% other fish - 10.2% crayfish - 13.3%	Ohio - creek	Davis 1982
	lizards, small snakes, frogs, salamanders, and insects may be consumed if fish are unavailable		Landrum et al. 1993
Home Range	1.03 km (breeding) 0.39 km (non-breeding)	Ohio - creek	Davis 1982
	2.19 km (breeding)	Pennsylvania - stream summer	Brooks and Davis 1987
Habitat Requirements	uses a diverse aquatic habitats (stream, river, lake, marsh, coastline)		Brooks and Davis 1987
	require high vertical banks composed of >75% sand and <7% clay for nest construction		
	prefer relatively clear waters free of thick vegetation		Bent 1940.
Population Density	0.11 - 0.19 pairs/km shore	Pennsylvania - stream summer	Brooks and Davis 1987
Behavior	while most migrate from northern parts of range, some may stay in areas where water remains ice-free		Bent 1940.

^a Allometric equation for estimation of water consumption by birds is:

$$W = 0.059(bw)^{0.67}$$

where: W = water consumption (L/d)
bw = body weight (kg)

Table C.4. Life history parameters for great blue heron

Parameter	Value	Comments	Reference
Body Weight	2.576 kg (♂) 2.204 kg (♀) 2.39 kg (mean♂+♀)		Dunning 1984
Food Consumption Rate	0.42 kg/d	estimated using allometric equation ^a specific for herons and egrets assuming 2.39 kg bw	Kushlan 1978
Water Consumption Rate	0.1058 L/d	estimated using allometric equation ^b assuming 2.39 kg bw	After Calder and Braun 1983
Diet Composition	diet predominantly fish but may include crustaceans, insects, snails, amphibians, reptiles, birds, and mammals fish sizes: 0-10 cm=39.2% 11-20 cm=47.1% 21-30 cm=13.7%		Kushlan 1978 Collazo 1985 Hoffman 1978 Alexander 1977
Home Range (foraging distance from colony)	3.1 km 7 - 8 km	up to 24.2 km - S. Dakota - river N. Carolina - coastal	EPA 1993a. Short and Cooper 1985
Habitat Requirements	use both coastal and inland water-associated habitats Foraging: shallow shores of ponds, lakes, streams, wet meadows, wooded swamps, bays, and marshes breeding: trees for rookery sites. In absence of trees will use rock ledges, cliffs, and artificial structures		Short and Cooper 1985 DeGraaf et al. 1981 Short and Cooper 1985

Table C.4. Life history parameters for great blue heron

Parameter	Value	Comments	Reference
Population Density	nest colonially, therefore population density depends on availability of nest habitat and suitable foraging habitat 2.3 - 3.6 /km	North Dakota rivers and streams	EPA 1993a
Behavior	may or may not defend a feeding territory depending on local population size and food availability Migrates in northern U.S. and southern Canada; year round resident from WV, PA south.		Kushlan 1978 National Geographic Society 1987.

^a Allometric equation for estimation of food consumption by herons and egrets is:

$$\log FIR = 0.966 \log bw - 0.640$$

where: FIR = food ingestion rate (g/d)

bw = body weight (g)

^b Allometric equation for estimation of water consumption by birds is:

$$W = 0.059(bw)^{0.67}$$

where: W = water consumption (L/d)

bw = body weight (kg)

Table C.5. Fillet-to-Whole Fish Ratios from the Clinch River

Analyte	Ratio
Aldrin ^a	3.8
Aroclor-1016 ^a	3.8
Aroclor-1221 ^a	3.8
Aroclor-1232 ^a	3.8
Aroclor-1242 ^a	3.8
Aroclor-1254	3.8
Aroclor-1260	5.46
Benzo(a)pyrene ^a	3.8
BHC ^a	3.8
Bis(ethylhexyl)phthalate ^a	3.8
Chlordane, total	3.9
DDD ^a	3.8
DDE ^a	3.8
DDT ^a	3.8
Dieldrin ^a	3.8
Endrin ^a	3.8
Endosulfan ^a	3.8
Heptachlor ^a	3.8
Lindane ^a	3.8
Methoxychlor ^a	3.8
Toxaphene ^a	3.8
Arsenic ^c	1.4
Antimony ^b	1
Beryllium ^b	1
Cadmium ^c	5.03
Chromium ^c	1.2
Copper ^c	6.8
Mercury ^c	0.68
Selenium ^c	1.07
Uranium ^c	7.58
Zinc ^c	2.46

^a Specific ratios were not available for these contaminants. Because K_{ow} s for these chemicals are comparable to that for Aroclor 1254, ratios were also assumed to be comparable.

^b Specific ratio was not available. Because most inorganics had ratios ~1, assumed 1.

^c Data from spotted bass from Southworth (1994).

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Antimony	Bear Creek	BCK12.4	8	2	<30 cm	0.0140	0.0026	0.0018	0.0140	0.0000
Arsenic	Bear Creek	BCK12.4	8	8	<30 cm	0.4930	0.2509	0.0468	0.4930	0.1140
Beryllium	Bear Creek	BCK12.4	8	8	<30 cm	0.0510	0.0164	0.0067	0.0510	0.0000
Cadmium	Bear Creek	BCK12.4	8	8	<30 cm	2.7400	1.7299	0.1872	2.7400	0.9290
Chromium	Bear Creek	BCK12.4	8	8	<30 cm	1.1700	0.6960	0.0934	1.1700	0.3990
Copper	Bear Creek	BCK12.4	8	8	<30 cm	1.1500	0.8255	0.0599	1.1500	0.6200
Lead	Bear Creek	BCK12.4	8	8	<30 cm	1.1000	0.4434	0.1165	1.1000	0.0440
Lithium	Bear Creek	BCK12.4	8	8	<30 cm	0.6520	0.2376	0.0813	0.6520	0.0260
Mercury	Bear Creek	BCK12.4	8	8	<30 cm	0.1700	0.1199	0.0099	0.1700	0.0870
Nickel	Bear Creek	BCK12.4	8	8	<30 cm	5.2400	2.4488	0.5734	5.2400	0.6800
PCB,total	Bear Creek	BCK12.4	8	8	<30 cm	0.6100	0.2750	0.0655	0.0700	0.6100
Selenium	Bear Creek	BCK12.4	8	8	<30 cm	0.5380	0.4355	0.0308	0.5380	0.3140
Thallium	Bear Creek	BCK12.4	8	8	<30 cm	0.0120	0.0078	0.0008	0.0120	0.0060
Uranium	Bear Creek	BCK12.4	8	8	<30 cm	1.2200	0.7325	0.1077	1.2200	0.3670
Zinc	Bear Creek	BCK12.4	8	8	<30 cm	43.7000	40.4625	1.2578	43.7000	34.1000
Antimony	Bear Creek	BCK9.4	8	3	<30 cm	0.0130	0.0021	0.0016	0.0130	0.0000
Arsenic	Bear Creek	BCK9.4	8	8	<30 cm	0.5730	0.4333	0.0544	0.5730	0.0930

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Beryllium	Bear Creek	BCK9.4	8	8	<30 cm	0.0330	0.0198	0.0037	0.0330	0.0010
Cadmium	Bear Creek	BCK9.4	8	8	<30 cm	0.6940	0.4804	0.0603	0.6940	0.1930
Chromium	Bear Creek	BCK9.4	8	8	<30 cm	1.2600	0.9748	0.0823	1.2600	0.5440
Copper	Bear Creek	BCK9.4	8	8	<30 cm	1.3000	1.0294	0.0963	1.3000	0.4530
Lead	Bear Creek	BCK9.4	8	8	<30 cm	0.8400	0.5316	0.0911	0.8400	0.0460
Lithium	Bear Creek	BCK9.4	8	8	<30 cm	1.5000	0.7559	0.1442	1.5000	0.1100
Mercury	Bear Creek	BCK9.4	8	8	<30 cm	0.1100	0.0788	0.0058	0.1100	0.0600
Nickel	Bear Creek	BCK9.4	8	8	<30 cm	1.1900	0.8493	0.1069	1.1900	0.2790
PCB,total	Bear Creek	BCK9.4	8	8	<30 cm	4.5000	2.8550	0.4940	0.6700	4.5000
Selenium	Bear Creek	BCK9.4	8	8	<30 cm	1.1200	0.6090	0.0803	1.1200	0.3910
Thallium	Bear Creek	BCK9.4	8	8	<30 cm	0.0290	0.0115	0.0028	0.0290	0.0020
Uranium	Bear Creek	BCK9.4	8	8	<30 cm	1.4000	0.9818	0.0923	1.4000	0.5210
Zinc	Bear Creek	BCK9.4	8	8	<30 cm	59.2000	48.3125	2.8416	59.2000	36.7000
Mercury	Bear Creek	BCK4.5	36	36	<30 cm	0.3779	0.3264	0.0305	0.0816	0.8020
PCB-1254	Bear Creek	BCK4.5	36	33	<30 cm	1.6763	1.2753	0.2371	0.0381	5.7150
PCB-1260	Bear Creek	BCK4.5	36	36	<30 cm	3.5360	2.5965	0.5561	0.1092	16.3250
Antimony	Bear Creek	BCK3.3	8	8	<30 cm	0.0070	0.0035	0.0008	0.0070	0.0004

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Arsenic	Bear Creek	BCK3.3	8	8	< 30 cm	0.4010	0.3123	0.0331	0.4010	0.1130
Beryllium	Bear Creek	BCK3.3	8	8	< 30 cm	0.0240	0.0109	0.0030	0.0240	0.0020
Cadmium	Bear Creek	BCK3.3	8	8	< 30 cm	0.3150	0.1936	0.0262	0.3150	0.0870
Chromium	Bear Creek	BCK3.3	8	8	< 30 cm	1.1200	0.7934	0.0718	1.1200	0.6160
Copper	Bear Creek	BCK3.3	8	8	< 30 cm	1.1400	1.0038	0.0391	1.1400	0.7770
Lead	Bear Creek	BCK3.3	8	8	< 30 cm	0.5200	0.2260	0.0572	0.5200	0.0650
Lithium	Bear Creek	BCK3.3	8	8	< 30 cm	0.6690	0.3356	0.0794	0.6690	0.0980
Mercury	Bear Creek	BCK3.3	8	8	< 30 cm	0.0860	0.0600	0.0059	0.0860	0.0400
Nickel	Bear Creek	BCK3.3	8	8	< 30 cm	0.8960	0.5743	0.0747	0.8960	0.3380
PCB,total	Bear Creek	BCK3.3	8	8	< 30 cm	1.7500	0.9775	0.1500	0.4800	1.7500
Selenium	Bear Creek	BCK3.3	8	8	< 30 cm	0.7860	0.5640	0.0444	0.7860	0.4230
Thallium	Bear Creek	BCK3.3	8	8	< 30 cm	0.0100	0.0058	0.0009	0.0100	0.0030
Uranium	Bear Creek	BCK3.3	8	8	< 30 cm	0.5570	0.4154	0.0405	0.5570	0.2330
Zinc	Bear Creek	BCK3.3	8	8	< 30 cm	81.4000	57.8750	4.1847	81.4000	41.7000
Mercury	Bear Creek	BCK0.6	105	105	< 30 cm	0.3360	0.3144	0.0131	0.0612	0.8228
PCB-1254	Bear Creek	BCK0.6	105	89	< 30 cm	0.4895	0.3846	0.0631	0.0381	5.7150
PCB-1260	Bear Creek	BCK0.6	105	101	< 30 cm	0.7964	0.6490	0.0888	0.0546	6.0060

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Mercury	East Fork	EFK24.8	24	24	< 30 cm	1.2226	1.1277	0.0554	0.7480	1.7750
PCB-1254	East Fork	EFK24.8	24	23	< 30 cm	2.6695	2.1304	0.3114	0.0381	5.3720
PCB-1260	East Fork	EFK24.8	24	24	< 30 cm	21.3933	12.3646	5.2680	1.0920	129.4020
Aldrin	East Fork	EFK24.4	6	6	< 30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
BHC	East Fork	EFK24.4	6	6	< 30 cm	0.0109	0.0079	0.0015	0.0036	0.0122
BHC, total	East Fork	EFK24.4	6	6	< 30 cm	0.0004	0.0002	0.0002	0.0000	0.0009
Chlordane	East Fork	EFK24.4	6	6	< 30 cm	0.1741	0.1393	0.0173	0.0741	0.1886
DDT, total	East Fork	EFK24.4	6	6	< 30 cm	0.0661	0.0554	0.0053	0.0385	0.0714
Dieldrin	East Fork	EFK24.4	6	6	< 30 cm	0.0308	0.0232	0.0038	0.0112	0.0348
Endrin	East Fork	EFK24.4	6	6	< 30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
Endrin	East Fork	EFK24.4	6	6	< 30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
MIREX	East Fork	EFK24.4	6	6	< 30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
Mercury	East Fork	EFK24.4	6	6	< 30 cm	3.4840	2.7452	0.3667	1.9400	3.9762
PCB, total	East Fork	EFK24.4	6	6	< 30 cm	8.0821	7.1066	0.4841	5.4933	8.4350
Mercury	East Fork	EFK24	24	24	< 30 cm	0.4502	0.3953	0.0320	0.1360	0.8160
PCB-1254	East Fork	EFK24	24	22	< 30 cm	1.6639	1.1763	0.2813	0.0381	5.7910
PCB-1260	East Fork	EFK24	24	23	< 30 cm	3.4712	2.4342	0.6045	0.0546	12.5030

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Mercury	East Fork	EFK23.7	16	16	<30 cm	0.4872	0.4275	0.0341	0.2380	0.7620
PCB-1254	East Fork	EFK23.7	16	16	<30 cm	2.2148	1.5978	0.3520	0.0381	5.8670
PCB-1260	East Fork	EFK23.7	16	16	<30 cm	4.9993	3.7708	0.7008	1.1466	9.6640
Mercury	East Fork	EFK23.5	71	71	<30 cm	0.4799	0.4506	0.0176	0.0544	0.8840
PCB-1254	East Fork	EFK23.5	64	62	<30 cm	1.2100	0.9876	0.1332	0.0381	6.7820
PCB-1260	East Fork	EFK23.5	64	63	<30 cm	7.2214	5.6912	0.9161	0.0546	37.5650
Aldrin	East Fork	EFK23.4	6	6	<30 cm	0.0009	0.0003	0.0003	0.0000	0.0019
BHC	East Fork	EFK23.4	6	6	<30 cm	0.0082	0.0073	0.0004	0.0058	0.0084
BHC, total	East Fork	EFK23.4	6	6	<30 cm	0.0008	0.0004	0.0002	0.0000	0.0013
Chlordane	East Fork	EFK23.4	6	6	<30 cm	0.1477	0.1138	0.0169	0.0671	0.1555
DDT, total	East Fork	EFK23.4	6	6	<30 cm	0.0657	0.0629	0.0014	0.0585	0.0675
Dieldrin	East Fork	EFK23.4	6	6	<30 cm	0.0405	0.0313	0.0046	0.0172	0.0430
Endrin	East Fork	EFK23.4	6	6	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
Endrin	East Fork	EFK23.4	6	6	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
Mercury	East Fork	EFK23.4	3	3	>30 cm	0.3131	0.1541	0.0544	0.0748	0.2584
Mercury	East Fork	EFK23.4	288	288	<30 cm	0.7246	0.6850	0.0240	0.0272	2.4480
MIREX	East Fork	EFK23.4	6	6	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Mercury	East Fork	EFK23.4	6	6	< 30 cm	1.2613	0.9217	0.1685	0.4930	1.4700
PCB-1254	East Fork	EFK23.4	231	215	< 30 cm	1.3692	1.2052	0.0993	0.0381	11.0490
PCB-1254	East Fork	EFK23.4	1	1	> 30 cm	1.1811	1.1811	0.0000	1.1811	1.1811
PCB-1260	East Fork	EFK23.4	1	1	> 30 cm	1.5288	1.5288	0.0000	1.5288	1.5288
PCB-1260	East Fork	EFK23.4	1	1	> 30 cm	1.5288	1.5288	0.0000	1.5288	1.5288
PCB-1260	East Fork	EFK23.4	231	230	< 30 cm	2.2923	2.0304	0.1586	0.0546	17.5270
PCB,total	East Fork	EFK23.4	6	6	< 30 cm	6.3142	5.5991	0.3549	4.5398	6.6110
Antimony	East Fork	EFPC RI 1 ^a	4	1	< 30 cm	0.0760	0.0471	0.0228	0.0066	0.0958
Arsenic	East Fork	EFPC RI 1	4	2	< 30 cm	0.3204	0.2314	0.0474	0.1486	0.3208
Benzo(a)pyrene	East Fork	EFPC RI 1	4	4	< 30 cm	0.0276	0.0121	0.0066	0.0004	0.0240
Chlordane	East Fork	EFPC RI 1	4	4	< 30 cm	0.2633	0.1438	0.0508	0.0350	0.2400
Chromium	East Fork	EFPC RI 1	4	3	< 30 cm	2.8951	1.2912	0.6430	0.2910	2.9979
DDE	East Fork	EFPC RI 1	4	4	< 30 cm	0.2245	0.1185	0.0450	0.0210	0.2000
Dieldrin	East Fork	EFPC RI 1	4	4	< 30 cm	0.1062	0.0615	0.0190	0.0190	0.0950
Heptachlor, total	East Fork	EFPC RI 1	8	8	< 30 cm	0.2817	0.2218	0.0316	0.1210	0.3060
Lindane	East Fork	EFPC RI 1	4	4	< 30 cm	0.0065	0.0041	0.0010	0.0024	0.0060
Mercury	East Fork	EFPC RI 1	4	4	< 30 cm	3.6382	2.1096	0.6495	0.9004	3.7512

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Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95 % UCB	Mean	Standard error	Minimum	Maximum
PCB-1260	East Fork	EFPC RI 1	4	4	<30 cm	9.2285	5.3000	1.6693	1.5000	8.3000
Selenium	East Fork	EFPC RI 1	4	3	<30 cm	0.8853	0.6509	0.1024	0.4250	0.9160
Uranium	East Fork	EFPC RI 1	4	2	<30 cm	0.9076	0.5466	0.1789	0.1791	0.9112
Zinc	East Fork	EFPC RI 1	4	4	<30 cm	90.3683	54.2010	15.3683	23.0600	85.5790
Antimony	East Fork	EFPC RI 2	3	1	<30 cm	0.0114	0.0311	0.0200	0.0108	0.0712
Arsenic	East Fork	EFPC RI 2	3	2	<30 cm	0.3818	0.2893	0.0688	0.1524	0.3703
Benzo(a)pyrene	East Fork	EFPC RI 2	3	3	<30 cm	0.0251	0.0102	0.0051	0.0007	0.0180
Chlordane	East Fork	EFPC RI 2	3	3	<30 cm	0.3569	0.1643	0.0660	0.0329	0.2400
Chromium	East Fork	EFPC RI 2	3	3	<30 cm	4.9032	2.3637	0.8697	0.6292	3.3440
DDE	East Fork	EFPC RI 2	3	2	<30 cm	0.3384	0.2250	0.1361	0.0150	0.4800
Dieldrin	East Fork	EFPC RI 2	3	3	<30 cm	0.1267	0.0630	0.0218	0.0200	0.0910
Heptachlor, total	East Fork	EFPC RI 2	6	6	<30 cm	0.3114	0.2352	0.0378	0.1157	0.2960
Lindane	East Fork	EFPC RI 2	3	3	<30 cm	0.0060	0.0048	0.0004	0.0044	0.0056
Mercury	East Fork	EFPC RI 2	3	3	<30 cm	10.7515	4.6061	2.1046	1.0828	8.3622
PCB-1260	East Fork	EFPC RI 2	3	3	<30 cm	10.7310	5.6333	1.7458	2.2000	7.9000
Selenium	East Fork	EFPC RI 2	3	2	<30 cm	1.0307	0.7103	0.1045	0.5640	0.9126
Uranium	East Fork	EFPC RI 2	3	2	<30 cm	0.8444	0.5864	0.1688	0.2532	0.8007

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Zinc	East Fork	EFPC RI 2	3	3	<30 cm	93.2484	54.3127	13.3342	27.7020	69.1370
Aldrin	East Fork	EFK18.4	3	3	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
BHC	East Fork	EFK18.4	3	3	<30 cm	0.0033	0.0029	0.0002	0.0026	0.0031
BHC, total	East Fork	EFK18.4	3	3	<30 cm	0.0006	0.0002	0.0002	0.0000	0.0005
Chlordane	East Fork	EFK18.4	3	3	<30 cm	0.4386	0.3419	0.0331	0.2800	0.3931
DDT, total	East Fork	EFK18.4	3	3	<30 cm	0.1177	0.0937	0.0082	0.0817	0.1095
Dieldrin	East Fork	EFK18.4	3	3	<30 cm	0.0591	0.0466	0.0043	0.0389	0.0538
Endrin	East Fork	EFK18.4	3	3	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
Endrin	East Fork	EFK18.4	3	3	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
MIREX	East Fork	EFK18.4	3	3	<30 cm	0.0000	0.0000	0.0000	0.0000	0.0000
PCB-1254	East Fork	EFK18.4	3	3	<30 cm	2.7267	2.3463	0.1303	2.0938	2.5280
Mercury	East Fork	EFK18.2	147	147	<30 cm	0.6298	0.6039	0.0157	0.2584	1.3670
Mercury	East Fork	EFK18.2	69	69	>30 cm	0.5888	0.5469	0.0251	0.0544	1.2920
PCB-1254	East Fork	EFK18.2	69	68	>30 cm	2.1118	1.7830	0.1972	0.0381	9.4869
PCB-1254	East Fork	EFK18.2	139	130	<30 cm	0.4955	0.4408	0.0331	0.0381	1.9050
PCB-1260	East Fork	EFK18.2	139	138	<30 cm	1.3123	1.1466	0.1001	0.0546	7.0980
PCB-1260	East Fork	EFK18.2	69	69	>30 cm	5.2465	4.6695	0.3460	0.1092	12.0120

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95 % UCB	Mean	Standard error	Minimum	Maximum
PCB-1260	East Fork	EFK18.2	69	69	> 30 cm	5.2465	4.6695	0.3460	0.1092	12.0120
MN_HG	East Fork	EFK18	3	3	< 30 cm	0.5329	0.4336	0.0340	0.3910	0.5010
Antimony	East Fork	EFPC RI 3	4	1	< 30 cm	0.0108	0.0100	0.0019	0.0061	0.0148
Arsenic	East Fork	EFPC RI 3	4	2	< 30 cm	0.2883	0.2102	0.0376	0.1391	0.2892
Benzo(a)pyrene	East Fork	EFPC RI 3	4	4	< 30 cm	0.0146	0.0066	0.0034	0.0007	0.0130
Chlordane	East Fork	EFPC RI 3	4	4	< 30 cm	0.1131	0.0888	0.0104	0.0610	0.1060
Chlordane	East Fork	EFPC RI 3	1	1	> 30 cm	0.0331	0.0331	0.0000	0.0331	0.0331
Chromium	East Fork	EFPC RI 3	4	4	< 30 cm	2.4525	1.2763	0.4998	0.4016	2.1497
Chromium	East Fork	EFPC RI 3	1	1	> 30 cm	0.3710	0.3710	0.0000	0.3710	0.3710
DDE	East Fork	EFPC RI 3	4	4	< 30 cm	0.0633	0.0435	0.0084	0.0250	0.0610
DDE	East Fork	EFPC RI 3	1	1	> 30 cm	0.0035	0.0035	0.0000	0.0035	0.0035
Dieldrin	East Fork	EFPC RI 3	1	1	> 30 cm	0.0248	0.0248	0.0000	0.0248	0.0248
Dieldrin	East Fork	EFPC RI 3	4	4	< 30 cm	0.0526	0.0403	0.0053	0.0340	0.0560
Heptachlor, total	East Fork	EFPC RI 3	8	8	< 30 cm	0.1526	0.1393	0.0070	0.1210	0.1650
Lindane	East Fork	EFPC RI 3	1	1	> 30 cm	0.0099	0.0099	0.0000	0.0099	0.0099
Lindane	East Fork	EFPC RI 3	4	3	< 30 cm	0.0044	0.0267	0.0244	0.0014	0.1000
Mercury	East Fork	EFPC RI 3	4	4	< 30 cm	2.4331	1.8972	0.2278	1.3320	2.3940

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Mercury	East Fork	EFPC RI 3	1	1	> 30 cm	1.2003	1.2003	0.0000	1.2003	1.2003
PCB-1260	East Fork	EFPC RI 3	1	1	> 30 cm	3.8766	3.8766	0.0000	3.8766	3.8766
PCB-1260	East Fork	EFPC RI 3	1	1	> 30 cm	3.8766	3.8766	0.0000	3.8766	3.8766
PCB-1260	East Fork	EFPC RI 3	4	4	< 30 cm	3.0327	2.3500	0.2901	1.8000	3.1000
Selenium	East Fork	EFPC RI 3	1	1	> 30 cm	0.5331	0.5331	0.0000	0.5331	0.5331
Selenium	East Fork	EFPC RI 3	4	4	< 30 cm	0.7327	0.7027	0.0128	0.6691	0.7310
Uranium	East Fork	EFPC RI 3	4	2	< 30 cm	0.5625	0.3794	0.1022	0.1878	0.5629
Zinc	East Fork	EFPC RI 3	1	1	> 30 cm	25.2863	25.2863	0.0000	25.2863	25.2863
Zinc	East Fork	EFPC RI 3	4	4	< 30 cm	61.4327	43.8025	7.4915	30.5000	58.3100
Mercury	East Fork	EFK13.8	85	85	> 30 cm	0.5632	0.5214	0.0251	0.0204	1.3600
Mercury	East Fork	EFK13.8	159	159	< 30 cm	0.5780	0.5506	0.0165	0.0544	1.4960
PCB-1254	East Fork	EFK13.8	137	112	< 30 cm	0.3514	0.2976	0.0325	0.0381	2.5150
PCB-1254	East Fork	EFK13.8	80	79	> 30 cm	2.0442	1.6316	0.2479	0.0381	16.6497
PCB-1260	East Fork	EFK13.8	80	80	> 30 cm	4.8929	4.2547	0.3834	0.1092	14.1960
PCB-1260	East Fork	EFK13.8	80	80	> 30 cm	4.8929	4.2547	0.3834	0.1092	14.1960
PCB-1260	East Fork	EFK13.8	137	134	< 30 cm	1.0032	0.8561	0.0882	0.0546	6.5520
Aldrin	East Fork	EFPC RI 4	4	2	< 30 cm	0.0330	0.0375	0.0026	0.0330	0.0420

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Antimony	East Fork	EFPC RI 4	4	1	<30 cm	0.0123	0.0084	0.0014	0.0061	0.0123
Benzo(a)pyrene	East Fork	EFPC RI 4	4	4	<30 cm	0.0057	0.0025	0.0014	0.0001	0.0054
BHC, total	East Fork	EFPC RI 4	6	4	<30 cm	0.2075	0.3116	0.0659	0.2074	0.5200
Chlordane	East Fork	EFPC RI 4	4	4	<30 cm	0.1111	0.0903	0.0089	0.0700	0.1100
Chromium	East Fork	EFPC RI 4	4	4	<30 cm	1.5887	0.9826	0.2576	0.3516	1.4386
DDE	East Fork	EFPC RI 4	4	2	<30 cm	0.0388	0.1068	0.0481	0.0170	0.1900
Dieldrin	East Fork	EFPC RI 4	4	4	<30 cm	0.0736	0.0408	0.0140	0.0200	0.0790
Heptachlor, total	East Fork	EFPC RI 4	5	5	<30 cm	0.1523	0.0896	0.0294	0.0245	0.1560
Lindane	East Fork	EFPC RI 4	4	3	<30 cm	0.0021	0.0140	0.0120	0.0020	0.0500
Mercury	East Fork	EFPC RI 4	4	4	<30 cm	1.0854	0.7887	0.1261	0.5868	1.1438
PCB-1260	East Fork	EFPC RI 4	4	4	<30 cm	1.7740	1.2125	0.2386	0.7900	1.8000
Selenium	East Fork	EFPC RI 4	4	3	<30 cm	0.8768	0.6987	0.0870	0.4758	0.8978
Uranium	East Fork	EFPC RI 4	4	2	<30 cm	0.3843	0.2647	0.0533	0.1279	0.3879
Zinc	East Fork	EFPC RI 4	4	4	<30 cm	49.3535	34.9000	6.1417	20.1380	48.7530
Mercury	East Fork	EFK10	5	5	>30 cm	0.9385	0.7086	0.1079	0.4148	1.0880
PCB-1254	East Fork	EFK10	5	5	>30 cm	0.7255	0.4496	0.1294	0.1143	0.9144
PCB-1260	East Fork	EFK10	5	5	>30 cm	2.9147	2.1949	0.3376	1.5288	3.2214

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
PCB-1260	East Fork	EFK10	5	5	> 30 cm	2.9147	2.1949	0.3376	1.5288	3.2214
Aldrin	East Fork	EFPC RI 5	3	1	< 30 cm	0.0370	0.0263	0.0053	0.0210	0.0370
Benzo(a)pyrene	East Fork	EFPC RI 5	3	3	< 30 cm	0.0078	0.0031	0.0016	0.0004	0.0060
Benzo(a)pyrene	East Fork	EFPC RI 5	1	1	> 30 cm	0.0004	0.0004	0.0000	0.0004	0.0004
BHC, total	East Fork	EFPC RI 5	5	4	< 30 cm	0.2084	0.2180	0.0100	0.2076	0.2580
Chlordane	East Fork	EFPC RI 5	3	3	< 30 cm	0.1183	0.0917	0.0091	0.0780	0.1090
Chlordane	East Fork	EFPC RI 5	1	1	> 30 cm	0.0485	0.0485	0.0000	0.0485	0.0485
Chromium	East Fork	EFPC RI 5	1	1	> 30 cm	0.4223	0.4223	0.0000	0.4223	0.4223
Chromium	East Fork	EFPC RI 5	3	3	< 30 cm	1.6688	0.6384	0.3529	0.2304	1.3411
DDE	East Fork	EFPC RI 5	3	1	< 30 cm	0.0280	0.0727	0.0223	0.0280	0.0950
Dieldrin	East Fork	EFPC RI 5	1	1	> 30 cm	0.0419	0.0419	0.0000	0.0419	0.0419
Dieldrin	East Fork	EFPC RI 5	3	3	< 30 cm	0.0894	0.0557	0.0116	0.0330	0.0710
Heptachlor, total	East Fork	EFPC RI 5	3	3	< 30 cm	0.0870	0.0702	0.0058	0.0600	0.0799
Lindane	East Fork	EFPC RI 5	1	1	> 30 cm	0.0024	0.0024	0.0000	0.0024	0.0024
Lindane	East Fork	EFPC RI 5	3	3	< 30 cm	0.0041	0.0030	0.0004	0.0025	0.0037
Mercury	East Fork	EFPC RI 5	1	1	> 30 cm	0.4908	0.4908	0.0000	0.4908	0.4908
Mercury	East Fork	EFPC RI 5	3	3	< 30 cm	0.7939	0.5566	0.0813	0.4518	0.7166

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
PCB-1260	East Fork	EFPC RI 5	1	1	> 30 cm	0.9282	0.9282	0.0000	0.9282	0.9282
PCB-1260	East Fork	EFPC RI 5	1	1	> 30 cm	0.9282	0.9282	0.0000	0.9282	0.9282
PCB-1260	East Fork	EFPC RI 5	3	3	< 30 cm	1.1351	1.0267	0.0371	0.9800	1.1000
Selenium	East Fork	EFPC RI 5	3	3	< 30 cm	0.8339	0.5017	0.1138	0.3319	0.7178
Selenium	East Fork	EFPC RI 5	1	1	> 30 cm	0.3011	0.3011	0.0000	0.3011	0.3011
Zinc	East Fork	EFPC RI 5	3	3	< 30 cm	49.2589	28.2383	7.1989	17.6900	41.9990
Zinc	East Fork	EFPC RI 5	1	1	> 30 cm	22.4249	22.4249	0.0000	22.4249	22.4249
Mercury	East Fork	EFK6.3	105	105	> 30 cm	0.5796	0.5486	0.0187	0.0680	0.9588
Mercury	East Fork	EFK6.3	154	154	< 30 cm	0.4656	0.4457	0.0120	0.1020	0.8840
PCB-1254	East Fork	EFK6.3	97	95	> 30 cm	1.3237	1.1046	0.1319	0.0381	8.1534
PCB-1254	East Fork	EFK6.3	140	122	< 30 cm	0.3180	0.2686	0.0298	0.0381	2.5150
PCB-1260	East Fork	EFK6.3	97	96	> 30 cm	2.9854	2.6883	0.1781	0.0546	12.0120
PCB-1260	East Fork	EFK6.3	97	96	> 30 cm	2.9854	2.6883	0.1781	0.0546	12.0120
PCB-1260	East Fork	EFK6.3	140	138	< 30 cm	0.5178	0.4586	0.0358	0.0546	3.0030
Benzo(a)pyrene	East Fork	EFPC RI 6	1	1	< 30 cm	0.0005	0.0005	0.0000	0.0005	0.0005
Chlordane	East Fork	EFPC RI 6	1	1	< 30 cm	0.0560	0.0560	0.0000	0.0560	0.0560
Chromium	East Fork	EFPC RI 6	3	2	< 30 cm	0.8135	0.4608	0.1630	0.1583	0.7173

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Dieldrin	East Fork	EFPC RI 6	1	1	<30 cm	0.0430	0.0430	0.0000	0.0430	0.0430
Heptachlor, total	East Fork	EFPC RI 6	1	1	<30 cm	0.0480	0.0480	0.0000	0.0480	0.0480
Lindane	East Fork	EFPC RI 6	1	1	<30 cm	0.0037	0.0037	0.0000	0.0037	0.0037
Mercury	East Fork	EFPC RI 6	3	3	<30 cm	0.4618	0.2952	0.0570	0.1813	0.3578
PCB-1260	East Fork	EFPC RI 6	1	1	<30 cm	0.4700	0.4700	0.4700	0.4700	
Selenium	East Fork	EFPC RI 6	3	2	<30 cm	0.6063	0.4274	0.0606	0.3098	0.5114
Zinc	East Fork	EFPC RI 6	3	3	<30 cm	36.1695	21.6793	4.9624	13.6440	30.7420
Mercury	East Fork	EFK2.1	15	15	>30 cm	0.4641	0.4017	0.0354	0.0680	0.6188
Mercury	East Fork	EFK2.1	285	285	<30 cm	0.2909	0.2787	0.0074	0.0272	0.7820
PCB-1254	East Fork	EFK2.1	266	236	<30 cm	0.3326	0.2949	0.0229	0.0381	3.5810
PCB-1254	East Fork	EFK2.1	13	13	>30 cm	0.5292	0.3869	0.0799	0.0381	0.8382
PCB-1260	East Fork	EFK2.1	13	13	>30 cm	4.4971	3.1080	0.7794	0.3276	8.7360
PCB-1260	East Fork	EFK2.1	266	244	<30 cm	0.4845	0.4265	0.0351	0.0546	6.0060
PCB-1260	East Fork	EFK2.1	13	13	>30 cm	4.4971	3.1080	0.7794	0.3276	8.7360
Mercury	East Fork	EFK2	15	15	<30 cm	0.3854	0.3178	0.0384	0.1360	0.6460
PCB-1254	K-25	PCK18.2	8	7	<30 cm	0.3412	0.2048	0.0713	0.0381	0.5334
PCB-1260	K-25	PCK18.2	8	4	<30 cm	0.2990	0.1638	0.0661	0.0546	0.4914

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Mercury	K-25	PCK18.2	8	8	< 30 cm	0.0520	0.0400	0.0064	0.0272	0.0816
Mercury	K-25	PCK10.4	26	26	< 30 cm	0.1168	0.0837	0.0194	0.0204	0.4216
PCB-1254	K-25	PCK10.4	16	14	< 30 cm	0.1509	0.1024	0.0275	0.0381	0.4950
PCB-1260	K-25	PCK10.4	16	12	< 30 cm	0.2401	0.1604	0.0450	0.0546	0.7100
Mercury	K-25	PCK8.2	57	57	< 30 cm	0.3096	0.2831	0.0158	0.0476	0.5984
PCB-1254	K-25	PCK8.2	48	32	< 30 cm	0.3469	0.2461	0.0598	0.0381	1.8669
PCB-1260	K-25	PCK8.2	48	45	< 30 cm	0.3541	0.2935	0.0361	0.0546	1.3104
Mercury	K-25	MIK0.2	54	54	< 30 cm	0.1837	0.1672	0.0098	0.0612	0.3808
PCB-1254	K-25	MIK0.2	41	40	< 30 cm	3.0947	2.5239	0.3381	0.0381	10.4010
PCB-1260	K-25	MIK0.2	41	40	< 30 cm	2.5914	1.9070	0.4044	0.0546	16.6530
Mercury	K-25	PCK6.9	68	68	< 30 cm	0.3032	0.2804	0.0137	0.0340	0.5100
PCB-1254	K-25	PCK6.9	59	45	< 30 cm	0.3333	0.2641	0.0413	0.0381	1.9050
PCB-1260	K-25	PCK6.9	59	56	< 30 cm	0.6586	0.5488	0.0657	0.0546	2.0748
Mercury	K-25	PCK1.6	32	32	< 30 cm	0.1699	0.1454	0.0145	0.0408	0.3060
PCB-1254	K-25	PCK1.6	24	24	< 30 cm	0.4390	0.3318	0.0626	0.0381	1.4100
PCB-1260	K-25	PCK1.6	24	23	< 30 cm	0.5121	0.4004	0.0651	0.0546	1.5290
Arsenic	K-25	K-901	4	4	< 30 cm		0.3675	0.7587	0.2100	0.4600

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
Cadmium	K-25	K-901	1	1	> 30 cm		0.2515	ERR	0.2515	0.2515
Chromium	K-25	K-901	8	8	< 30 cm		15.2950	4.6919	0.9600	44.6000
Chromium	K-25	K-901	1	1	> 30 cm		0.2760	ERR	0.2760	0.2760
Copper	K-25	K-901	11	11	> 30 cm		2.1080	0.1645	1.4960	2.9920
Copper	K-25	K-901	8	8	< 30 cm		1.1938	0.1408	0.8500	2.1000
Lead	K-25	K-901	9	9	> 30 cm		0.6333	0.1101	0.3000	1.3800
Lead	K-25	K-901	7	7	< 30 cm		0.4100	0.0421	0.2700	0.5200
Manganese	K-25	K-901	2	2	> 30 cm		0.9950	0.1050	0.8900	1.1000
Manganese	K-25	K-901	8	8	< 30 cm		14.4625	1.9148	3.7000	20.0000
Mercury	K-25	K-901	8	8	< 30 cm		0.0350	0.0038	0.0200	0.0500
Mercury	K-25	K-901	18	18	> 30 cm		0.2070	0.0414	0.0748	0.7480
Mercury	K-25	K-1007	1	1	> 30 cm	0.0340	0.0340	0.0000	0.0340	0.0340
Mercury	K-25	K-1007	15	15	< 30 cm	0.0552	0.0476	0.0043	0.0204	0.0680
Mercury	K-25	K-710	8	8	< 30 cm	0.0909	0.0808	0.0054	0.0612	0.1020
Nickel	K-25	K-901	3	3	< 30 cm		0.9767	0.3155	0.5800	1.6000
PCB-1254	K-25	K-710	4	4	> 30 cm	0.6151	0.4001	0.0914	0.2286	0.6096
PCB-1254	K-25	K-1007	3	2	< 30 cm	0.1317	0.0762	0.0220	0.0381	0.1140

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
PCB-1254	K-25	K-1007	7	6	> 30 cm	46.9397	21.3197	13.0002	0.0381	96.8502
PCB-1260	K-25	K-1007	3	1	<30 cm	0.2184	0.1092	0.0546	0.0546	0.2180
PCB-1260	K-25	K-1007	7	6	> 30 cm	46.0656	20.8416	12.7768	0.0546	95.5500
PCB-1260	K-25	K-1007	7	6	> 30 cm	46.0656	20.8416	12.7768	0.0546	95.5500
PCB-1260	K-25	K-901	9	9	> 30 cm		2.4024	0.8010	0.8190	7.0980
PCB-1260	K-25	K-710	4	4	> 30 cm	2.9298	1.3787	0.6591	0.4368	3.3306
PCB-1260	K-25	K-710	4	4	> 30 cm	2.9298	1.3787	0.6591	0.4368	3.3306
PCB-1260	K-25	K-901	8	8	<30 cm		6.2125	1.4490	2.3000	15.0000
Selenium	K-25	K-901	13	13	> 30 cm		0.4848	0.0518	0.3210	0.9737
Selenium	K-25	K-901	8	8	<30 cm		0.3988	0.0368	0.2900	0.6000
Zinc	K-25	K-901	18	18	> 30 cm		19.1197	1.5872	11.3160	34.9320
Zinc	K-25	K-901	8	8	<30 cm		20.5750	1.8132	16.8000	32.5000
Mercury	White Oak	NTK0.2	64	64	<30 cm	0.1279	0.1155	0.0074	0.0068	0.2720
PCB-1254	White Oak	NTK0.2	48	36	<30 cm	0.7372	0.5231	0.1272	0.0381	4.0010
PCB-1260	White Oak	NTK0.2	48	39	<30 cm	0.6617	0.4334	0.1357	0.0546	5.1320
Mercury	White Oak	WCK3.5	65	65	<30 cm	0.1824	0.1670	0.0093	0.0408	0.3944
Mercury	White Oak	WCK3.5	3	3	> 30 cm	0.2256	0.2017	0.0082	0.1904	0.2176

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Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
PCB-1254	White Oak	WCK3.5	3	3	> 30 cm	2.6147	1.1430	0.5040	0.3810	2.0955
PCB-1254	White Oak	WCK3.5	57	57	< 30 cm	1.8184	1.4251	0.2352	0.1143	8.4582
PCB-1260	White Oak	WCK3.5	3	3	> 30 cm	1.0513	0.7280	0.1107	0.5460	0.9282
PCB-1260	White Oak	WCK3.5	3	3	> 30 cm	1.0513	0.7280	0.1107	0.5460	0.9282
PCB-1260	White Oak	WCK3.5	57	57	< 30 cm	1.0715	0.8458	0.1350	0.0546	6.0060
Mercury	White Oak	WCK2.9	79	79	< 30 cm	0.3032	0.2843	0.0113	0.1020	0.4896
PCB-1254	White Oak	WCK2.9	119	114	< 30 cm	1.2562	1.0751	0.1092	0.0381	6.4770
PCB-1260	White Oak	WCK2.9	119	111	< 30 cm	1.2435	0.9456	0.1796	0.0546	19.6560
Mercury	White Oak	MEK0.2	56	56	< 30 cm	0.0910	0.0816	0.0056	0.0340	0.2652
PCB-1254	White Oak	MEK0.2	44	32	< 30 cm	0.7278	0.4996	0.1352	0.0381	4.5720
PCB-1260	White Oak	MEK0.2	44	36	< 30 cm	0.5186	0.3686	0.0890	0.0546	2.6210
Mercury	White Oak	WCK2.3	64	64	< 30 cm	0.1973	0.1780	0.0116	0.0340	0.4964
PCB-1254	White Oak	WCK2.3	56	51	< 30 cm	1.1605	0.9682	0.1134	0.0381	3.8481
PCB-1260	White Oak	WCK2.3	56	56	< 30 cm	1.3191	1.0218	0.1777	0.1638	8.4630
Mercury	White Oak	WOL	65	65	< 30 cm	0.1164	0.1037	0.0076	0.0204	0.3060
Mercury	White Oak	WOL	55	55	> 30 cm	0.2663	0.2355	0.0184	0.0476	0.4828
PCB-1254	White Oak	WOL	105	101	< 30 cm	1.1031	0.9474	0.0938	0.0381	4.5720

Table C.6. Summary statistics for fish data from the ORR

Analyte	Drainage	Sampling station	N	Detects	Contaminant concentrations in fish (mg/kg)					
					Fish size	95% UCB	Mean	Standard error	Minimum	Maximum
PCB-1254	White Oak	WOL	54	54	> 30 cm	8.5336	6.4975	1.2162	0.2667	45.4533
PCB-1260	White Oak	WOL	54	54	> 30 cm	5.9626	4.7421	0.7290	0.3276	25.0614
PCB-1260	White Oak	WOL	54	54	> 30 cm	5.9626	4.7421	0.7290	0.3276	25.0614
PCB-1260	White Oak	WOL	105	104	< 30 cm	1.7266	1.4399	0.1727	0.0546	12.0120
Mercury	White Oak	WCK0.9	56	56	< 30 cm	0.0741	0.0667	0.0045	0.0204	0.1632
PCB-1254	White Oak	WCK0.9	47	44	< 30 cm	1.0569	0.7993	0.1534	0.0381	6.0960
PCB-1260	White Oak	WCK0.9	47	42	< 30 cm	0.6983	0.5623	0.0809	0.0546	2.2386
Mercury	White Oak	WCK0.3	8	8	< 30 cm	0.1275	0.1063	0.0112	0.0748	0.1768
PCB-1254	White Oak	WCK0.3	8	8	< 30 cm	0.8823	0.5334	0.1841	0.1143	1.7145
PCB-1260	White Oak	WCK0.3	8	8	< 30 cm	0.7725	0.4709	0.1592	0.0546	1.5288

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.7. Summary statistics for fish data from off-site locations

Analyte	Drainage	Source	N	Detects	Fish size	Contaminant concentrations in fish (mg/kg)				
						95% UCB	Mean	Standard error	Minimum	Maximum
Mercury	Beaver Creek	BMAP	5	5	<30 cm	0.0573	0.0408	0.00775	0.0272	0.068
Mercury	Brushy Fork	BMAP	10	10	<30 cm	0.0815	0.0592	0.01217	0.0272	0.163
Mercury	Hinds Creek	BMAP	330	330	<30 cm	0.06562	0.06221	0.00207	0	0.3604
Mercury	Hinds Creek	BCV	8	8	<30 cm	0.021	0.013	0.0015	0.009	0.021
Mercury	Hinds Creek	EFPC	3	3	<30 cm	0.05706	0.0448	0.0042	0.037	0.0514
Mercury	Brushy Fork	BMAP	7	7	>30cm	0.15	0.1156	0.0177	0.0476	0.1768
Mercury	Hinds Creek	BMAP	59	59	>30cm	0.1601	0.1476	0.0075	0.0476	0.3196
PCB-1254	Brushy Fork	BMAP	12	12	<30 cm	3.1986	2.1082	0.60715	0.381	6.858
PCB-1260	Brushy Fork	BMAP	12	12	<30 cm	1.7291	0.9691	0.42315	0.546	5.624
PCB-1254	Hinds Creek	BMAP	322	218	<30 cm	0.1342	0.1296	0.00985	0	1.143
PCB-1260	Hinds Creek	BMAP	322	139	<30 cm	0.0442	0.0683	0.00356	0	0.546
PCB,total	Hinds Creek	EFPC	3	3	<30 cm	0.0193	0.0169	0.00082	0.0154	0.018
PCB-1254	Brushy Fork	BMAP	7	7	>30cm	14.8384	6.7002	4.1881	0.5715	31.623
PCB-1260	Brushy Fork	BMAP	7	7	>30cm	3.5881	2.1372	0.7467	0.3822	6.006
PCB-1254	Hinds Creek	BMAP	56	38	>30cm	0.1058	0.0837	0.0131	0.0381	0.6858
PCB-1260	Hinds Creek	BMAP	56	53	>30cm	1.3237	0.7829	0.3231	0.0546	17.472
Chromium	Hinds Creek	BCV	8	8	<30 cm	1.02	0.719	0.082	0.382	1.02

Table C.7. Summary statistics for fish data from off-site locations

						Contaminant concentrations in fish (mg/kg)				
DDT,total	Hinds Creek	EFPC	3	3	<30 cm	0.00714	0.00566	0.00051	0.00507	0.0067
Selenium	Hinds Creek	BCV	8	8	<30 cm	0.452	0.419	0.009	0.379	0.452
Cadmium	Hinds Creek	BCV	8	8	<30 cm	0.028	0.023	0.002	0.015	0.028

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK12.4	0.0010	0.03	0.00
Arsenic	Bear Creek	BCK12.4	0.0369	0.92	0.09
Beryllium	Bear Creek	BCK12.4	0.0038	0.01	
Cadmium	Bear Creek	BCK12.4	0.2050	34.16	29.28
Chromium	Bear Creek	BCK12.4	0.0875	0.04	0.01
Copper	Bear Creek	BCK12.4	0.0860	0.01	0.01
Lead	Bear Creek	BCK12.4	0.0823	0.01	0.00
Lithium	Bear Creek	BCK12.4	0.0488	0.01	0.00
Mercury	Bear Creek	BCK12.4	0.0127	0.85	0.12
Nickel	Bear Creek	BCK12.4	0.3920	0.01	0.01
Selenium	Bear Creek	BCK12.4	0.0402	1.68	0.17
Thallium	Bear Creek	BCK12.4	0.0009	0.18	0.02
Uranium	Bear Creek	BCK12.4	0.0913	0.10	0.05
Zinc	Bear Creek	BCK12.4	3.2688	0.03	0.01
Antimony	Bear Creek	BCK9.4	0.0010	0.02	0.00
Arsenic	Bear Creek	BCK9.4	0.0429	1.07	0.11
Beryllium	Bear Creek	BCK9.4	0.0025	0.01	
Cadmium	Bear Creek	BCK9.4	0.0519	8.65	7.42
Chromium	Bear Creek	BCK9.4	0.0943	0.04	0.01
Copper	Bear Creek	BCK9.4	0.0972	0.01	0.01
Lead	Bear Creek	BCK9.4	0.0628	0.01	0.00
Lithium	Bear Creek	BCK9.4	0.1122	0.02	0.01
Mercury	Bear Creek	BCK9.4	0.0082	0.55	0.07
Nickel	Bear Creek	BCK9.4	0.0890	0.00	0.00
Selenium	Bear Creek	BCK9.4	0.0838	3.49	0.35
Thallium	Bear Creek	BCK9.4	0.0022	0.43	0.04
Uranium	Bear Creek	BCK9.4	0.1047	0.11	0.06
Zinc	Bear Creek	BCK9.4	4.4283	0.04	0.02
Mercury	Bear Creek	BCK4.5	0.0283	1.88	0.26

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK3.3	0.0005	0.01	0.00
Arsenic	Bear Creek	BCK3.3	0.0300	0.75	0.07
Beryllium	Bear Creek	BCK3.3	0.0018	0.00	
Cadmium	Bear Creek	BCK3.3	0.0236	3.93	3.37
Chromium	Bear Creek	BCK3.3	0.0838	0.04	0.01
Copper	Bear Creek	BCK3.3	0.0853	0.01	0.01
Lead	Bear Creek	BCK3.3	0.0389	0.01	0.00
Lithium	Bear Creek	BCK3.3	0.0500	0.01	0.00
Mercury	Bear Creek	BCK3.3	0.0064	0.43	0.06
Nickel	Bear Creek	BCK3.3	0.0670	0.00	0.00
Selenium	Bear Creek	BCK3.3	0.0588	2.45	0.24
Thallium	Bear Creek	BCK3.3	0.0007	0.15	0.01
Uranium	Bear Creek	BCK3.3	0.0417	0.04	0.02
Zinc	Bear Creek	BCK3.3	6.0889	0.05	0.03
Mercury	Bear Creek	BCK0.6	0.0251	1.68	0.23
Mercury	East Fork	EFK24.8	0.0915	6.10	0.83
Aldrin	East Fork	EFK24.4	0.0000	0.00	0.00
BHC, total	East Fork	EFK24.4	0.0000	0.00	0.00
Chlordane	East Fork	EFK24.4	0.0130	0.01	0.00
DDT, total	East Fork	EFK24.4	0.0049	0.01	0.00
Dieldrin	East Fork	EFK24.4	0.0023	0.16	0.02
Endrin	East Fork	EFK24.4	0.0000	0.00	0.00
MN_HG	East Fork	EFK24.4	0.2606	17.37	2.37
Mercury	East Fork	EFK24	0.0337	2.25	0.31
Mercury	East Fork	EFK23.7	0.0364	2.43	0.33
Mercury	East Fork	EFK23.5	0.0359	2.39	0.33
Aldrin	East Fork	EFK23.4	0.0001	0.00	0.00
BHC	East Fork	EFK23.4	0.0006	0.04	0.00
BHC, total	East Fork	EFK23.4	0.0001	0.00	0.00

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Chlordane	East Fork	EFK23.4	0.0110	0.01	0.00
DDT, total	East Fork	EFK23.4	0.0049	0.01	0.00
Dieldrin	East Fork	EFK23.4	0.0030	0.22	0.02
Endrin	East Fork	EFK23.4	0.0000	0.00	0.00
Mercury	East Fork	EFK23.4	0.0943	6.29	0.86
Antimony	East Fork	EFPC RI 1 ^a	0.0057	0.14	0.01
Arsenic	East Fork	EFPC RI 1	0.0240	0.60	0.06
Benzo(a)pyrene	East Fork	EFPC RI 1	0.0021	0.01	0.00
Chlordane	East Fork	EFPC RI 1	0.0197	0.01	0.01
Chromium	East Fork	EFPC RI 1	0.2166	0.09	0.02
DDE	East Fork	EFPC RI 1	0.0168	0.03	0.01
Dieldrin	East Fork	EFPC RI 1	0.0079	0.57	0.06
Heptachlor, total	East Fork	EFPC RI 1	0.0211	0.21	0.02
Lindane	East Fork	EFPC RI 1	0.0005	0.00	
Mercury	East Fork	EFPC RI 1	0.2721	18.14	2.47
Selenium	East Fork	EFPC RI 1	0.0662	2.76	0.28
Uranium	East Fork	EFPC RI 1	0.0679	0.07	0.04
Zinc	East Fork	EFPC RI 1	6.7597	0.06	0.03
Antimony	East Fork	EFPC RI 2	0.0009	0.02	0.00
Arsenic	East Fork	EFPC RI 2	0.0286	0.71	0.07
Benzo(a)pyrene	East Fork	EFPC RI 2	0.0019	0.01	0.00
Chlordane	East Fork	EFPC RI 2	0.0267	0.02	0.01
Chromium	East Fork	EFPC RI 2	0.3668	0.16	0.04
DDE	East Fork	EFPC RI 2	0.0253	0.04	0.01
Dieldrin	East Fork	EFPC RI 2	0.0095	0.68	0.07
Heptachlor, total	East Fork	EFPC RI 2	0.0233	0.23	0.02
Lindane	East Fork	EFPC RI 2	0.0004	0.00	

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Mercury	East Fork	EFPC RI 2	0.8042	53.62	7.31
Selenium	East Fork	EFPC RI 2	0.0771	3.21	0.32
Uranium	East Fork	EFPC RI 2	0.0632	0.07	0.03
Zinc	East Fork	EFPC RI 2	6.9752	0.06	0.03
Aldrin	East Fork	EFK18.4	0.0000	0.00	0.00
BHC, total	East Fork	EFK18.4	0.0000	0.00	0.00
Chlordane	East Fork	EFK18.4	0.0328	0.02	0.01
DDT, total	East Fork	EFK18.4	0.0088	0.02	0.00
Dieldrin	East Fork	EFK18.4	0.0044	0.32	0.03
Endrin	East Fork	EFK18.4	0.0000	0.00	0.00
Mercury	East Fork	EFK18.2	0.0471	3.14	0.43
MN_HG	East Fork	EFK18	0.0399	2.66	0.36
Antimony	East Fork	EFPC RI 3	0.0008	0.02	0.00
Arsenic	East Fork	EFPC RI 3	0.0216	0.54	0.05
Benzo(a)pyrene	East Fork	EFPC RI 3	0.0011	0.00	0.00
Chlordane	East Fork	EFPC RI 3	0.0085	0.01	0.00
Chromium	East Fork	EFPC RI 3	0.1835	0.08	0.02
DDE	East Fork	EFPC RI 3	0.0047	0.01	0.00
Dieldrin	East Fork	EFPC RI 3	0.0039	0.28	0.03
Heptachlor, total	East Fork	EFPC RI 3	0.0114	0.11	0.01
Lindane	East Fork	EFPC RI 3	0.0003	0.00	
Mercury	East Fork	EFPC RI 3	0.1820	12.13	1.65
Selenium	East Fork	EFPC RI 3	0.0548	2.28	0.23
Uranium	East Fork	EFPC RI 3	0.0421	0.04	0.02
Zinc	East Fork	EFPC RI 3	4.5953	0.04	0.02
Mercury	East Fork	EFK13.8	0.0432	2.88	0.39
Aldrin	East Fork	EFPC RI 4	0.0025	0.02	0.00
Antimony	East Fork	EFPC RI 4	0.0009	0.02	0.00

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Benzo(a)pyrene	East Fork	EFPC RI 4	0.0004	0.00	0.00
BHC, total	East Fork	EFPC RI 4	0.0155	1.11	0.11
Chlordane	East Fork	EFPC RI 4	0.0083	0.01	0.00
Chromium	East Fork	EFPC RI 4	0.1188	0.05	0.01
DDE	East Fork	EFPC RI 4	0.0029	0.01	0.00
Dieldrin	East Fork	EFPC RI 4	0.0055	0.39	0.04
Heptachlor, total	East Fork	EFPC RI 4	0.0114	0.11	0.01
Lindane	East Fork	EFPC RI 4	0.0002	0.00	
Mercury	East Fork	EFPC RI 4	0.0812	5.41	0.74
Selenium	East Fork	EFPC RI 4	0.0656	2.73	0.27
Uranium	East Fork	EFPC RI 4	0.0287	0.03	0.02
Zinc	East Fork	EFPC RI 4	3.6917	0.03	0.02
Aldrin	East Fork	EFPC RI 5	0.0028	0.02	0.00
Benzo(a)pyrene	East Fork	EFPC RI 5	0.0006	0.00	0.00
BHC, total	East Fork	EFPC RI 5	0.0156	1.11	0.11
Chlordane	East Fork	EFPC RI 5	0.0088	0.01	0.00
Chromium	East Fork	EFPC RI 5	0.1248	0.05	0.01
DDE	East Fork	EFPC RI 5	0.0021	0.00	0.00
Dieldrin	East Fork	EFPC RI 5	0.0067	0.48	0.05
Heptachlor, total	East Fork	EFPC RI 5	0.0065	0.07	0.01
Lindane	East Fork	EFPC RI 5	0.0003	0.00	
Mercury	East Fork	EFPC RI 5	0.0594	3.96	0.54
Selenium	East Fork	EFPC RI 5	0.0624	2.60	0.26
Zinc	East Fork	EFPC RI 5	3.6847	0.03	0.02
Mercury	East Fork	EFK6.3	0.0348	2.32	0.32
Benzo(a)pyrene	East Fork	EFPC RI 6	0.0000	0.00	0.00
Chlordane	East Fork	EFPC RI 6	0.0042	0.00	0.00

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Chromium	East Fork	EFPC RI 6	0.0609	0.03	0.01
Dieldrin	East Fork	EFPC RI 6	0.0032	0.23	0.02
Heptachlor, total	East Fork	EFPC RI 6	0.0036	0.04	0.00
Lindane	East Fork	EFPC RI 6	0.0003	0.00	
Mercury	East Fork	EFPC RI 6	0.0345	2.30	0.31
Selenium	East Fork	EFPC RI 6	0.0454	1.89	0.19
Zinc	East Fork	EFPC RI 6	2.7056	0.02	0.01
Mercury	East Fork	EFK2.1	0.0218	1.45	0.20
Mercury	East Fork	EFK2	0.0288	1.92	0.26
Mercury	K-25	PCK18.2	0.0039	0.26	0.04
Mercury	K-25	PCK10.4	0.0087	0.58	0.08
Mercury	K-25	PCK8.2	0.0232	1.54	0.21
Mercury	K-25	MIK0.2	0.0137	0.92	0.12
Mercury	K-25	PCK6.9	0.0227	1.51	0.21
Mercury	K-25	PCK1.6	0.0127	0.85	0.12
Mercury	K-25	K-710	0.0068	0.45	0.06
Mercury	K-25	K-1007	0.0041	0.28	0.04
Arsenic	K-25	K-901	0.0344	0.86	0.09
Chromium	K-25	K-901	3.3362	1.44	0.36
Copper	K-25	K-901	0.1571	0.01	0.01
Lead	K-25	K-901	0.0389	0.01	0.00
Mercury	K-25	K-901	0.0037	0.25	0.03
Nickel	K-25	K-901	0.1197	0.00	0.00
Selenium	K-25	K-901	0.0449	1.87	0.19
Zinc	K-25	K-901	2.4311	0.02	0.01
Mercury	White Oak	NTK0.2	0.0096	0.64	0.09
Mercury	White Oak	WCK3.5	0.0136	0.91	0.12
Mercury	White Oak	WCK2.9	0.0227	1.51	0.21

Table C.8. Estimated exposure of mink on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Mercury	White Oak	MEK0.2	0.0068	0.45	0.06
Mercury	White Oak	WCK2.3	0.0148	0.98	0.13
Mercury	White Oak	WOL	0.0087	0.58	0.08
Mercury	White Oak	WCK0.9	0.0055	0.37	0.05
Mercury	White Oak	WCK0.3	0.0095	0.64	0.09

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.9. Estimated exposure of mink on the ORR to PCBs

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Bear Creek	BCK12.4	0.0456	0.33	0.07
Bear Creek	BCK9.4	0.3366	2.40	0.49
Bear Creek	BCK4.5	0.3899	2.78	0.57
Bear Creek	BCK3.3	0.1309	0.94	0.19
Bear Creek	BCK0.6	0.0962	0.69	0.14
East Fork	EFK24.8	1.7999	12.86	2.61
East Fork	EFK24.4	0.6046	4.32	0.88
East Fork	EFK24	0.3841	2.74	0.56
East Fork	EFK23.7	0.5396	3.85	0.78
East Fork	EFK23.5	0.6307	4.50	0.91
East Fork	EFK23.4	0.3731	2.67	0.54
East Fork	EFPC RI 1 ^a	0.6903	4.93	1.00
East Fork	EFPC RI 2	0.8027	5.73	1.16
East Fork	EFK18.4	0.2040	1.46	0.30
East Fork	EFK18.2	0.1352	0.97	0.20
East Fork	EFPC RI 3	0.2269	1.62	0.33
East Fork	EFK13.8	0.1013	0.72	0.15
East Fork	EFPC RI 4	0.1327	0.95	0.19
East Fork	EFPC RI 5	0.0849	0.61	0.12
East Fork	EFK6.3	0.0625	0.45	0.09
East Fork	EFPC RI 6	0.0352	0.25	0.05
East Fork	EFK2.1	0.0611	0.44	0.09
K-25	PCK18.2	0.0479	0.34	0.07
K-25	PCK10.4	0.0292	0.21	0.04
K-25	PCK8.2	0.0524	0.37	0.08
K-25	MIK0.2	0.4253	3.04	0.62
K-25	PCK6.9	0.0742	0.53	0.11

Table C.9. Estimated exposure of mink on the ORR to PCBs

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
K-25	PCK1.6	0.0711	0.51	0.10
K-25	K-1007	0.0262	0.19	0.04
K-25	K-901	1.1220	8.01	1.63
White Oak	NTK0.2	0.1046	0.75	0.15
White Oak	WCK3.5	0.2162	1.54	0.31
White Oak	WCK2.9	0.1870	1.34	0.27
White Oak	MEK0.2	0.0932	0.67	0.14
White Oak	WCK2.3	0.1855	1.32	0.27
White Oak	WOL	0.2117	1.51	0.31
White Oak	WCK0.9	0.1313	0.94	0.19
White Oak	WCK0.3	0.1238	0.88	0.18

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK12.4	0.0016	0.08	0.01
Arsenic	Bear Creek	BCK12.4	0.0555	2.77	0.28
Beryllium	Bear Creek	BCK12.4	0.0057	0.02	
Cadmium	Bear Creek	BCK12.4	0.3083	102.75	77.06
Chromium	Bear Creek	BCK12.4	0.1316	0.11	0.03
Copper	Bear Creek	BCK12.4	0.1294	0.02	0.02
Lead	Bear Creek	BCK12.4	0.1238	0.04	0.00
Lithium	Bear Creek	BCK12.4	0.0734	0.02	0.01
Mercury	Bear Creek	BCK12.4	0.0191	2.39	0.32
Nickel	Bear Creek	BCK12.4	0.5895	0.04	0.02
Selenium	Bear Creek	BCK12.4	0.0605	5.04	0.50
Thallium	Bear Creek	BCK12.4	0.0014	0.45	0.05
Uranium	Bear Creek	BCK12.4	0.1373	0.29	0.14
Zinc	Bear Creek	BCK12.4	4.9163	0.09	0.04
Antimony	Bear Creek	BCK9.4	0.0015	0.07	0.01
Arsenic	Bear Creek	BCK9.4	0.0645	3.22	0.32
Beryllium	Bear Creek	BCK9.4	0.0037	0.02	
Cadmium	Bear Creek	BCK9.4	0.0781	26.03	19.52
Chromium	Bear Creek	BCK9.4	0.1418	0.12	0.03
Copper	Bear Creek	BCK9.4	0.1463	0.02	0.02
Lead	Bear Creek	BCK9.4	0.0945	0.03	0.00
Lithium	Bear Creek	BCK9.4	0.1688	0.05	0.03
Mercury	Bear Creek	BCK9.4	0.0124	1.55	0.21
Nickel	Bear Creek	BCK9.4	0.1339	0.01	0.00
Selenium	Bear Creek	BCK9.4	0.1260	10.50	1.05
Thallium	Bear Creek	BCK9.4	0.0033	1.09	0.12
Uranium	Bear Creek	BCK9.4	0.1575	0.33	0.16
Zinc	Bear Creek	BCK9.4	6.6600	0.12	0.06
Mercury	Bear Creek	BCK4.5	0.0425	5.31	0.71

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK3.3	0.0008	0.04	0.00
Arsenic	Bear Creek	BCK3.3	0.0451	2.26	0.23
Beryllium	Bear Creek	BCK3.3	0.0027	0.01	
Cadmium	Bear Creek	BCK3.3	0.0354	11.81	8.86
Chromium	Bear Creek	BCK3.3	0.1260	0.11	0.03
Copper	Bear Creek	BCK3.3	0.1283	0.02	0.02
Lead	Bear Creek	BCK3.3	0.0585	0.02	0.00
Lithium	Bear Creek	BCK3.3	0.0753	0.02	0.01
Mercury	Bear Creek	BCK3.3	0.0097	1.21	0.16
Nickel	Bear Creek	BCK3.3	0.1008	0.01	0.00
Selenium	Bear Creek	BCK3.3	0.0884	7.37	0.74
Thallium	Bear Creek	BCK3.3	0.0011	0.38	0.04
Uranium	Bear Creek	BCK3.3	0.0627	0.13	0.06
Zinc	Bear Creek	BCK3.3	9.1575	0.16	0.08
Mercury	Bear Creek	BCK0.6	0.0378	4.73	0.63
Mercury	East Fork	EFK24.8	0.1375	17.19	2.29
Aldrin	East Fork	EFK24.4	0.0000	0.00	0.00
BHC, total	East Fork	EFK24.4	0.0000	0.01	0.00
Chlordane	East Fork	EFK24.4	0.0196	0.03	0.01
DDT, total	East Fork	EFK24.4	0.0074	0.03	0.01
Dieldrin	East Fork	EFK24.4	0.0035	0.49	0.05
Endrin	East Fork	EFK24.4	0.0000	0.00	0.00
Mercury	East Fork	EFK24.4	0.3920	48.99	6.53
Mercury	East Fork	EFK24	0.0506	6.33	0.84
Mercury	East Fork	EFK23.7	0.0548	6.85	0.91
Mercury	East Fork	EFK23.5	0.0540	6.75	0.90
Aldrin	East Fork	EFK23.4	0.0001	0.00	0.00
BHC, total	East Fork	EFK23.4	0.0001	0.01	0.00
Chlordane	East Fork	EFK23.4	0.0166	0.02	0.01

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
DDT, total	East Fork	EFK23.4	0.0074	0.03	0.01
Dieldrin	East Fork	EFK23.4	0.0046	0.65	0.07
Endrin	East Fork	EFK23.4	0.0000	0.00	0.00
Mercury	East Fork	EFK23.4	0.0815	10.19	1.36
Antimony	East Fork	EFPC RI 1 ^a	0.0086	0.43	0.04
Arsenic	East Fork	EFPC RI 1	0.0360	1.80	0.18
Benzo(a)pyrene	East Fork	EFPC RI 1	0.0031	0.02	0.00
Chlordane	East Fork	EFPC RI 1	0.0296	0.04	0.02
Chromium	East Fork	EFPC RI 1	0.3257	0.28	0.07
DDE	East Fork	EFPC RI 1	0.0253	0.09	0.02
Dieldrin	East Fork	EFPC RI 1	0.0119	1.71	0.17
Heptachlor, total	East Fork	EFPC RI 1	0.0317	0.63	0.06
Lindane	East Fork	EFPC RI 1	0.0007	0.00	
Mercury	East Fork	EFPC RI 1	0.4093	51.16	6.82
Selenium	East Fork	EFPC RI 1	0.0996	8.30	0.83
Uranium	East Fork	EFPC RI 1	0.1021	0.21	0.10
Zinc	East Fork	EFPC RI 1	10.1664	0.18	0.09
Antimony	East Fork	EFPC RI 2	0.0013	0.06	0.01
Arsenic	East Fork	EFPC RI 2	0.0430	2.15	0.21
Benzo(a)pyrene	East Fork	EFPC RI 2	0.0028	0.02	0.00
Chlordane	East Fork	EFPC RI 2	0.0402	0.06	0.03
Chromium	East Fork	EFPC RI 2	0.5516	0.47	0.12
DDE	East Fork	EFPC RI 2	0.0381	0.13	0.03
Dieldrin	East Fork	EFPC RI 2	0.0143	2.04	0.20
Heptachlor, total	East Fork	EFPC RI 2	0.0350	0.70	0.07
Lindane	East Fork	EFPC RI 2	0.0007	0.00	
Mercury	East Fork	EFPC RI 2	1.2095	151.19	20.16

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Selenium	East Fork	EFPC RI 2	0.1160	9.66	0.97
Uranium	East Fork	EFPC RI 2	0.0950	0.20	0.09
Zinc	East Fork	EFPC RI 2	10.4904	0.18	0.09
Aldrin	East Fork	EFK18.4	0.0000	0.00	0.00
BHC, total	East Fork	EFK18.4	0.0001	0.01	0.00
Chlordane	East Fork	EFK18.4	0.0493	0.07	0.03
DDT, total	East Fork	EFK18.4	0.0132	0.05	0.01
Dieldrin	East Fork	EFK18.4	0.0067	0.95	0.10
Endrin	East Fork	EFK18.4	0.0000	0.00	0.00
Mercury	East Fork	EFK18.2	0.0709	8.86	1.18
Mercury	East Fork	EFK18	0.0600	7.49	1.00
Antimony	East Fork	EFPC RI 3	0.0012	0.06	0.01
Arsenic	East Fork	EFPC RI 3	0.0324	1.62	0.16
Benzo(a)pyrene	East Fork	EFPC RI 3	0.0016	0.01	0.00
Chlordane	East Fork	EFPC RI 3	0.0127	0.02	0.01
Chromium	East Fork	EFPC RI 3	0.2759	0.24	0.06
DDE	East Fork	EFPC RI 3	0.0071	0.02	0.01
Dieldrin	East Fork	EFPC RI 3	0.0059	0.85	0.08
Heptachlor, total	East Fork	EFPC RI 3	0.0172	0.34	0.03
Lindane	East Fork	EFPC RI 3	0.0005	0.00	
Mercury	East Fork	EFPC RI 3	0.2737	34.22	4.56
Selenium	East Fork	EFPC RI 3	0.0824	6.87	0.69
Uranium	East Fork	EFPC RI 3	0.0633	0.13	0.06
Zinc	East Fork	EFPC RI 3	6.9112	0.12	0.06
Mercury	East Fork	EFK13.8	0.0650	8.13	1.08
Aldrin	East Fork	EFPC RI 4	0.0037	0.05	0.01
Antimony	East Fork	EFPC RI 4	0.0014	0.07	0.01
Benzo(a)pyrene	East Fork	EFPC RI 4	0.0006	0.00	0.00

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
BHC, total	East Fork	EFPC RI 4	0.0233	3.33	0.33
Chlordane	East Fork	EFPC RI 4	0.0125	0.02	0.01
Chromium	East Fork	EFPC RI 4	0.1787	0.15	0.04
DDE	East Fork	EFPC RI 4	0.0044	0.02	0.00
Dieldrin	East Fork	EFPC RI 4	0.0083	1.18	0.12
Heptachlor, total	East Fork	EFPC RI 4	0.0171	0.34	0.03
Lindane	East Fork	EFPC RI 4	0.0002	0.00	
Mercury	East Fork	EFPC RI 4	0.1221	15.26	2.04
Selenium	East Fork	EFPC RI 4	0.0986	8.22	0.82
Uranium	East Fork	EFPC RI 4	0.0432	0.09	0.04
Zinc	East Fork	EFPC RI 4	5.5523	0.10	0.05
Aldrin	East Fork	EFPC RI 5	0.0042	0.06	0.01
Benzo(a)pyrene	East Fork	EFPC RI 5	0.0009	0.01	0.00
BHC, total	East Fork	EFPC RI 5	0.0234	3.35	0.33
Chlordane	East Fork	EFPC RI 5	0.0133	0.02	0.01
Chromium	East Fork	EFPC RI 5	0.1877	0.16	0.04
DDE	East Fork	EFPC RI 5	0.0032	0.01	0.00
Dieldrin	East Fork	EFPC RI 5	0.0101	1.44	0.14
Heptachlor, total	East Fork	EFPC RI 5	0.0098	0.20	0.02
Lindane	East Fork	EFPC RI 5	0.0005	0.00	
Mercury	East Fork	EFPC RI 5	0.0893	11.16	1.49
Selenium	East Fork	EFPC RI 5	0.0938	7.82	0.78
Zinc	East Fork	EFPC RI 5	5.5416	0.10	0.05
Mercury	East Fork	EFK6.3	0.0524	6.55	0.87
Benzo(a)pyrene	East Fork	EFPC RI 6	0.0001	0.00	0.00
Chlordane	East Fork	EFPC RI 6	0.0063	0.01	0.00
Chromium	East Fork	EFPC RI 6	0.0915	0.08	0.02

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Dieldrin	East Fork	EFPC RI 6	0.0048	0.69	0.07
Heptachlor, total	East Fork	EFPC RI 6	0.0054	0.11	0.01
Lindane	East Fork	EFPC RI 6	0.0004	0.00	
Mercury	East Fork	EFPC RI 6	0.0520	6.49	0.87
Selenium	East Fork	EFPC RI 6	0.0682	5.68	0.57
Zinc	East Fork	EFPC RI 6	4.0691	0.07	0.04
Mercury	East Fork	EFK2.1	0.0327	4.09	0.55
Mercury	East Fork	EFK2	0.0434	5.42	0.72
Mercury	K-25	PCK18.2	0.0058	0.73	0.10
Mercury	K-25	PCK10.4	0.0131	1.64	0.22
Mercury	K-25	PCK8.2	0.0348	4.35	0.58
Mercury	K-25	MIK0.2	0.0207	2.58	0.34
Mercury	K-25	PCK6.9	0.0341	4.26	0.57
Mercury	K-25	PCK1.6	0.0191	2.39	0.32
Mercury	K-25	K-1007	0.0062	0.78	0.10
Mercury	K-25	K-710	0.0102	1.28	0.17
Arsenic	K-25	K-901	0.0518	2.59	0.26
Cadmium	K-25	K-901	0.0283	9.43	7.07
Chromium	K-25	K-901	2.5243	2.14	0.53
Copper	K-25	K-901	0.2864	0.02	0.02
Lead	K-25	K-901	0.1069	0.01	0.00
Mercury	K-25	K-901	0.0449	0.35	0.05
Nickel	K-25	K-901	0.1800	0.01	0.01
Selenium	K-25	K-901	0.0885	2.81	0.28
Zinc	K-25	K-901	3.7931	0.03	0.02
Mercury	White Oak	NTK0.2	0.0144	1.80	0.24
Mercury	White Oak	WCK3.5	0.0205	2.57	0.34
Mercury	White Oak	WCK2.9	0.0341	4.26	0.57

Table C.10. Estimated exposure of river otter on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Mercury	White Oak	MEK0.2	0.0102	1.28	0.17
Mercury	White Oak	WCK2.3	0.0222	2.77	0.37
Mercury	White Oak	WOL	0.0131	1.64	0.22
Mercury	White Oak	WCK0.9	0.0083	1.04	0.14
Mercury	White Oak	WCK0.3	0.0143	1.79	0.24

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.11. Estimated exposure of river otter on the ORR to PCBs

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Bear Creek	BCK12.4	0.0686	0.98	0.20
Bear Creek	BCK9.4	0.5063	7.23	1.45
Bear Creek	BCK4.5	0.5864	8.38	1.68
Bear Creek	BCK3.3	0.1969	2.81	0.56
Bear Creek	BCK0.6	0.1447	2.07	0.41
East Fork	EFK24.8	2.7071	38.67	7.73
East Fork	EFK24.4	0.9092	12.99	2.60
East Fork	EFK24	0.5777	8.25	1.65
East Fork	EFK23.7	0.8116	11.59	2.32
East Fork	EFK23.5	0.9485	13.55	2.71
East Fork	EFK23.4	0.4330	6.19	1.24
East Fork	EFPC RI 1 ^a	1.0382	14.83	2.97
East Fork	EFPC RI 2	1.2072	17.25	3.45
East Fork	EFK18.4	0.3068	4.38	0.88
East Fork	EFK18.2	0.5156	7.37	1.47
East Fork	EFPC RI 3	0.7773	11.10	2.22
East Fork	EFK13.8	0.4664	6.66	1.33
East Fork	EFPC RI 4	0.1996	2.85	0.57
East Fork	EFK10	0.4095	5.85	1.17
East Fork	EFPC RI 5	0.1161	1.66	0.33
East Fork	EFK6.3	0.2894	4.13	0.83
East Fork	EFPC RI 6	0.0529	0.76	0.15
East Fork	EFK2.1	0.3287	4.70	0.94
K-25	PCK18.2	0.0479	0.68	0.14
K-25	PCK10.4	0.0292	0.42	0.08
K-25	PCK8.2	0.0524	0.75	0.15
K-25	MIK0.2	0.4253	6.08	1.22

Table C.11. Estimated exposure of river otter on the ORR to PCBs

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
K-25	PCK6.9	0.0742	1.06	0.21
K-25	PCK1.6	0.0711	1.02	0.20
K-25	K-1007	5.2446	74.92	14.98
K-25	K-710	0.3988	5.70	1.14
K-25	K-901	1.2430	12.05	2.41
White Oak	NTK0.2	0.1046	1.49	0.30
White Oak	WCK3.5	0.3143	4.49	0.90
White Oak	WCK2.9	0.1870	2.67	0.53
White Oak	MEK0.2	0.0932	1.33	0.27
White Oak	WCK2.3	0.1855	2.65	0.53
White Oak	WOL	0.9212	13.16	2.63
White Oak	WCK0.9	0.1313	1.88	0.38
White Oak	WCK0.3	0.1238	1.77	0.35

* EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK12.4	0.0071		
Arsenic	Bear Creek	BCK12.4	0.2498	0.03	0.01
Beryllium	Bear Creek	BCK12.4	0.0258		
Cadmium	Bear Creek	BCK12.4	1.3885	0.48	0.04
Chromium	Bear Creek	BCK12.4	0.5929	0.30	0.06
Copper	Bear Creek	BCK12.4	0.5828	0.01	0.01
Lead	Bear Creek	BCK12.4	0.5574	0.15	0.05
Lithium	Bear Creek	BCK12.4	0.3304		
Mercury	Bear Creek	BCK12.4	0.0861	7.18	0.72
Nickel	Bear Creek	BCK12.4	2.6554	0.02	0.01
Selenium	Bear Creek	BCK12.4	0.2726	0.30	0.14
Thallium	Bear Creek	BCK12.4	0.0061		
Uranium	Bear Creek	BCK12.4	0.6182	0.02	
Zinc	Bear Creek	BCK12.4	22.1453	0.65	0.07
Antimony	Bear Creek	BCK9.4	0.0066		
Arsenic	Bear Creek	BCK9.4	0.2904	0.03	0.01
Beryllium	Bear Creek	BCK9.4	0.0167		
Cadmium	Bear Creek	BCK9.4	0.3517	0.12	0.01
Chromium	Bear Creek	BCK9.4	0.6385	0.32	0.06
Copper	Bear Creek	BCK9.4	0.6588	0.01	0.01
Lead	Bear Creek	BCK9.4	0.4257	0.12	0.04
Lithium	Bear Creek	BCK9.4	0.7601		
Mercury	Bear Creek	BCK9.4	0.0557	4.65	0.46
Nickel	Bear Creek	BCK9.4	0.6030	0.00	0.00
Selenium	Bear Creek	BCK9.4	0.5676	0.63	0.30
Thallium	Bear Creek	BCK9.4	0.0147		
Uranium	Bear Creek	BCK9.4	0.7095	0.02	
Zinc	Bear Creek	BCK9.4	30.0000	0.88	0.10
Mercury	Bear Creek	BCK4.5	0.1915	15.96	1.60

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK3.3	0.0035		
Arsenic	Bear Creek	BCK3.3	0.2032	0.02	0.01
Beryllium	Bear Creek	BCK3.3	0.0122		
Cadmium	Bear Creek	BCK3.3	0.1596	0.06	0.00
Chromium	Bear Creek	BCK3.3	0.5676	0.28	0.06
Copper	Bear Creek	BCK3.3	0.5777	0.01	0.01
Lead	Bear Creek	BCK3.3	0.2635	0.07	0.02
Lithium	Bear Creek	BCK3.3	0.3390		
Mercury	Bear Creek	BCK3.3	0.0436	3.63	0.36
Nickel	Bear Creek	BCK3.3	0.4541	0.00	0.00
Selenium	Bear Creek	BCK3.3	0.3983	0.44	0.21
Thallium	Bear Creek	BCK3.3	0.0051		
Uranium	Bear Creek	BCK3.3	0.2823	0.01	
Zinc	Bear Creek	BCK3.3	41.2500	1.22	0.13
Mercury	Bear Creek	BCK0.6	0.1703	14.19	1.42
Mercury	East Fork	EFK24.8	0.6196	51.63	5.16
Aldrin	East Fork	EFK24.4	0.0000	0.00	
BHC, total	East Fork	EFK24.4	0.0002	0.00	0.00
Chlordane	East Fork	EFK24.4	0.0882	0.05	0.01
DDT, total	East Fork	EFK24.4	0.0335	4.18	0.42
Dieldrin	East Fork	EFK24.4	0.0156	0.14	
Endrin	East Fork	EFK24.4	0.0000	0.00	0.00
Mercury	East Fork	EFK24.4	1.7656	147.13	14.71
Mercury	East Fork	EFK24	0.2281	19.01	1.90
Mercury	East Fork	EFK23.7	0.2469	20.57	2.06
Mercury	East Fork	EFK23.5	0.2432	20.27	2.03
Aldrin	East Fork	EFK23.4	0.0005	0.00	
BHC, total	East Fork	EFK23.4	0.0004	0.00	0.00
Chlordane	East Fork	EFK23.4	0.0749	0.05	0.01

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
DDT, total	East Fork	EFK23.4	0.0333	4.16	0.42
Dieldrin	East Fork	EFK23.4	0.0205	0.18	
Endrin	East Fork	EFK23.4	0.0000	0.00	0.00
Mercury	East Fork	EFK23.4	0.6391	53.26	5.33
Antimony	East Fork	EFPC RI 1*	0.0385		
Arsenic	East Fork	EFPC RI 1	0.1624	0.02	0.01
Benzo(a)pyrene	East Fork	EFPC RI 1	0.0140		
Chlordane	East Fork	EFPC RI 1	0.1334	0.08	0.02
Chromium	East Fork	EFPC RI 1	1.4671	0.73	0.15
DDE	East Fork	EFPC RI 1	0.1138	14.22	1.42
Dieldrin	East Fork	EFPC RI 1	0.0538	0.48	
Heptachlor, total	East Fork	EFPC RI 1	0.1428		
Lindane	East Fork	EFPC RI 1	0.0033	0.00	0.00
Mercury	East Fork	EFPC RI 1	1.8437	153.64	15.36
Selenium	East Fork	EFPC RI 1	0.4486	0.50	0.24
Uranium	East Fork	EFPC RI 1	0.4599	0.01	
Zinc	East Fork	EFPC RI 1	45.7947	1.35	0.15
Antimony	East Fork	EFPC RI 2	0.0058		
Arsenic	East Fork	EFPC RI 2	0.1935	0.02	0.01
Benzo(a)pyrene	East Fork	EFPC RI 2	0.0127		
Chlordane	East Fork	EFPC RI 2	0.1809	0.11	0.02
Chromium	East Fork	EFPC RI 2	2.4847	1.24	0.25
DDE	East Fork	EFPC RI 2	0.1715	21.44	2.14
Dieldrin	East Fork	EFPC RI 2	0.0642	0.57	
Heptachlor, total	East Fork	EFPC RI 2	0.1578		
Lindane	East Fork	EFPC RI 2	0.0030	0.00	0.00
Mercury	East Fork	EFPC RI 2	5.4484	454.03	45.40

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Selenium	East Fork	EFPC RI 2	0.5223	0.58	0.27
Uranium	East Fork	EFPC RI 2	0.4279	0.01	
Zinc	East Fork	EFPC RI 2	47.2543	1.39	0.15
Aldrin	East Fork	EFK18.4	0.0000	0.00	
BHC, total	East Fork	EFK18.4	0.0003	0.00	0.00
Chlordane	East Fork	EFK18.4	0.2223	0.14	0.03
DDT, total	East Fork	EFK18.4	0.0597	7.46	0.75
Dieldrin	East Fork	EFK18.4	0.0300	0.27	
Endrin	East Fork	EFK18.4	0.0000	0.00	0.00
Mercury	East Fork	EFK18.2	0.3192	26.60	2.66
Mercury	East Fork	EFK18	0.2701	22.50	2.25
Antimony	East Fork	EFPC RI 3	0.0055		
Arsenic	East Fork	EFPC RI 3	0.1461	0.02	0.01
Benzo(a)pyrene	East Fork	EFPC RI 3	0.0074		
Chlordane	East Fork	EFPC RI 3	0.0573	0.04	0.01
Chromium	East Fork	EFPC RI 3	1.2428	0.62	0.12
DDE	East Fork	EFPC RI 3	0.0321	4.01	0.40
Dieldrin	East Fork	EFPC RI 3	0.0267	0.24	
Heptachlor, total	East Fork	EFPC RI 3	0.0773		
Lindane	East Fork	EFPC RI 3	0.0022	0.00	0.00
Mercury	East Fork	EFPC RI 3	1.2330	102.75	10.27
Selenium	East Fork	EFPC RI 3	0.3713	0.41	0.20
Uranium	East Fork	EFPC RI 3	0.2851	0.01	
Zinc	East Fork	EFPC RI 3	31.1314	0.92	0.10
Mercury	East Fork	EFK13.8	0.2929	24.41	2.44
Aldrin	East Fork	EFPC RI 4	0.0167	0.15	
Antimony	East Fork	EFPC RI 4	0.0062		
Benzo(a)pyrene	East Fork	EFPC RI 4	0.0029		

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
BHC, total	East Fork	EFPC RI 4	0.1052	0.19	0.05
Chlordane	East Fork	EFPC RI 4	0.0563	0.03	0.01
Chromium	East Fork	EFPC RI 4	0.8051	0.40	0.08
DDE	East Fork	EFPC RI 4	0.0197	2.46	0.25
Dieldrin	East Fork	EFPC RI 4	0.0373	0.33	
Heptachlor, total	East Fork	EFPC RI 4	0.0772		
Lindane	East Fork	EFPC RI 4	0.0011	0.00	0.00
Mercury	East Fork	EFPC RI 4	0.5500	45.84	4.58
Selenium	East Fork	EFPC RI 4	0.4443	0.49	0.23
Uranium	East Fork	EFPC RI 4	0.1947	0.01	
Zinc	East Fork	EFPC RI 4	25.0102	0.74	0.08
Aldrin	East Fork	EFPC RI 5	0.0188	0.17	
Benzo(a)pyrene	East Fork	EFPC RI 5	0.0040		
BHC, total	East Fork	EFPC RI 5	0.1056	0.19	0.05
Chlordane	East Fork	EFPC RI 5	0.0599	0.04	0.01
Chromium	East Fork	EFPC RI 5	0.8457	0.42	0.08
DDE	East Fork	EFPC RI 5	0.0142	1.77	0.18
Dieldrin	East Fork	EFPC RI 5	0.0453	0.40	
Heptachlor, total	East Fork	EFPC RI 5	0.0441		
Lindane	East Fork	EFPC RI 5	0.0021	0.00	0.00
Mercury	East Fork	EFPC RI 5	0.4023	33.53	3.35
Selenium	East Fork	EFPC RI 5	0.4226	0.47	0.22
Zinc	East Fork	EFPC RI 5	24.9623	0.74	0.08
Mercury	East Fork	EFK6.3	0.2359	19.66	1.97
Benzo(a)pyrene	East Fork	EFPC RI 6	0.0003		
Chlordane	East Fork	EFPC RI 6	0.0284	0.02	0.00
Chromium	East Fork	EFPC RI 6	0.4122	0.21	0.04

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Dieldrin	East Fork	EFPC RI 6	0.0218	0.19	
Heptachlor, total	East Fork	EFPC RI 6	0.0243		
Lindane	East Fork	EFPC RI 6	0.0019	0.00	0.00
Mercury	East Fork	EFPC RI 6	0.2340	19.50	1.95
Selenium	East Fork	EFPC RI 6	0.3072	0.34	0.16
Zinc	East Fork	EFPC RI 6	18.3291	0.54	0.06
Mercury	East Fork	EFK2.1	0.1474	12.28	1.23
Mercury	East Fork	EFK2	0.1953	16.28	1.63
Mercury	K-25	PCK18.2	0.0263	2.20	0.22
Mercury	K-25	PCK10.4	0.0592	4.93	0.49
Mercury	K-25	PCK8.2	0.1569	13.07	1.31
Mercury	K-25	MIK0.2	0.0931	7.76	0.78
Mercury	K-25	PCK6.9	0.1537	12.81	1.28
Mercury	K-25	PCK1.6	0.0861	7.17	0.72
Mercury	K-25	K-710	0.0461	3.84	0.38
Mercury	K-25	K-1007	0.0280	2.33	0.23
Arsenic	K-25	K-901	0.2331	0.02	0.01
Chromium	K-25	K-901	22.6014	11.30	2.24
Copper	K-25	K-901	1.0642	0.01	0.01
Lead	K-25	K-901	0.2635	0.07	0.02
Mercury	K-25	K-901	0.0253	2.11	0.21
Nickel	K-25	K-901	0.8108	0.01	0.00
Selenium	K-25	K-901	0.3041	0.34	0.16
Zinc	K-25	K-901	16.4696	0.49	0.05
Mercury	White Oak	NTK0.2	0.0648	5.40	0.54
Mercury	White Oak	WCK3.5	0.0924	7.70	0.77
Mercury	White Oak	WCK2.9	0.1536	12.80	1.28
Mercury	White Oak	MEK0.2	0.0461	3.84	0.38

Table C.12. Estimated exposure of belted kingfisher on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Mercury	White Oak	WCK2.3	0.1000	8.33	0.83
Mercury	White Oak	WOL	0.0590	4.91	0.49
Mercury	White Oak	WCK0.9	0.0376	3.13	0.31
Mercury	White Oak	WCK0.3	0.0646	5.38	0.54

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.13. Estimated exposure of belted kingfisher on the ORR to PCBs

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Bear Creek	BCK12.4	0.3091	0.91	0.09
Bear Creek	BCK9.4	2.2804	6.71	0.67
Bear Creek	BCK4.5	2.6414	7.77	0.78
Bear Creek	BCK3.3	0.8868	2.61	0.26
Bear Creek	BCK0.6	0.6516	1.92	0.19
East Fork	EFK24.8	12.1940	35.86	3.59
East Fork	EFK24.4	4.0957	12.05	1.20
East Fork	EFK24	2.6022	7.65	0.77
East Fork	EFK23.7	3.6558	10.75	1.08
East Fork	EFK23.5	4.2727	12.57	1.26
East Fork	EFK23.4	2.5276	7.43	0.74
East Fork	EFPC RI 1 ^a	4.6766	13.75	1.38
East Fork	EFPC RI 2	5.4380	15.99	1.60
East Fork	EFK18.4	1.3818	4.06	0.41
East Fork	EFK18.2	0.9161	2.69	0.27
East Fork	EFPC RI 3	1.5368	4.52	0.45
East Fork	EFK13.8	0.6865	2.02	0.20
East Fork	EFPC RI 4	0.8990	2.64	0.26
East Fork	EFPC RI 5	0.5752	1.69	0.17
East Fork	EFK6.3	0.4235	1.25	0.12
East Fork	EFPC RI 6	0.2382	0.70	0.07
East Fork	EFK2.1	0.4141	1.22	0.12
K-25	PCK18.2	0.3244	0.95	0.10
K-25	PCK10.4	0.1981	0.58	0.06
K-25	PCK8.2	0.3552	1.04	0.10
K-25	MIK0.2	2.8815	8.47	0.85
K-25	PCK6.9	0.5026	1.48	0.15

Table C.13. Estimated exposure of belted kingfisher on the ORR to PCB

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
K-25	PCK1.6	0.4820	1.42	0.14
K-25	K-1007	0.1774	0.52	0.05
K-25	K-901	7.6014	22.36	2.24
White Oak	NTK0.2	0.7089	2.09	0.21
White Oak	WCK3.5	1.4645	4.31	0.43
White Oak	WCK2.9	1.2667	3.73	0.37
White Oak	MEK0.2	0.6316	1.86	0.19
White Oak	WCK2.3	1.2565	3.70	0.37
White Oak	WOL	1.4340	4.22	0.42
White Oak	WCK0.9	0.8895	2.62	0.26
White Oak	WCK0.3	0.8385	2.47	0.25

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C.14. Estimated exposure of great blue heron on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK12.4	0.0071		
Arsenic	Bear Creek	BCK12.4	0.2498	0.03	0.01
Beryllium	Bear Creek	BCK12.4	0.0258		
Cadmium	Bear Creek	BCK12.4	1.3885	0.48	0.04
Chromium	Bear Creek	BCK12.4	0.5929	0.30	0.06
Copper	Bear Creek	BCK12.4	0.5828	0.01	0.01
Lead	Bear Creek	BCK12.4	0.5574	0.15	0.05
Lithium	Bear Creek	BCK12.4	0.3304		
Mercury	Bear Creek	BCK12.4	0.0861	7.18	0.72
Nickel	Bear Creek	BCK12.4	2.6554	0.02	0.01
Selenium	Bear Creek	BCK12.4	0.2726	0.30	0.14
Thallium	Bear Creek	BCK12.4	0.0061		
Uranium	Bear Creek	BCK12.4	0.6182	0.02	
Zinc	Bear Creek	BCK12.4	22.1453	0.65	0.07
Antimony	Bear Creek	BCK9.4	0.0066		
Arsenic	Bear Creek	BCK9.4	0.2904	0.03	0.01
Beryllium	Bear Creek	BCK9.4	0.0167		
Cadmium	Bear Creek	BCK9.4	0.3517	0.12	0.01
Chromium	Bear Creek	BCK9.4	0.6385	0.32	0.06
Copper	Bear Creek	BCK9.4	0.6588	0.01	0.01
Lead	Bear Creek	BCK9.4	0.4257	0.12	0.04
Lithium	Bear Creek	BCK9.4	0.7601		
Mercury	Bear Creek	BCK9.4	0.0557	4.65	0.46
Nickel	Bear Creek	BCK9.4	0.6030	0.00	0.00
Selenium	Bear Creek	BCK9.4	0.5676	0.63	0.30
Thallium	Bear Creek	BCK9.4	0.0147		
Uranium	Bear Creek	BCK9.4	0.7095	0.02	
Zinc	Bear Creek	BCK9.4	30.0000	0.88	0.10
Mercury	Bear Creek	BCK4.5	0.1915	15.96	1.60

Table C.14. Estimated exposure of great blue heron on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Antimony	Bear Creek	BCK3.3	0.0035		
Arsenic	Bear Creek	BCK3.3	0.2032	0.02	0.01
Beryllium	Bear Creek	BCK3.3	0.0122		
Cadmium	Bear Creek	BCK3.3	0.1596	0.06	0.00
Chromium	Bear Creek	BCK3.3	0.5676	0.28	0.06
Copper	Bear Creek	BCK3.3	0.5777	0.01	0.01
Lead	Bear Creek	BCK3.3	0.2635	0.07	0.02
Lithium	Bear Creek	BCK3.3	0.3390		
Mercury	Bear Creek	BCK3.3	0.0436	3.63	0.36
Nickel	Bear Creek	BCK3.3	0.4541	0.00	0.00
Selenium	Bear Creek	BCK3.3	0.3983	0.44	0.21
Thallium	Bear Creek	BCK3.3	0.0051		
Uranium	Bear Creek	BCK3.3	0.2823	0.01	
Zinc	Bear Creek	BCK3.3	41.2500	1.22	0.13
Mercury	Bear Creek	BCK0.6	0.1703	14.19	1.42
Mercury	East Fork	EFK24.8	0.6196	51.63	5.16
Aldrin	East Fork	EFK24.4	0.0000	0.00	
BHC, total	East Fork	EFK24.4	0.0002	0.00	0.00
Chlordane	East Fork	EFK24.4	0.0882	0.05	0.01
DDT, total	East Fork	EFK24.4	0.0335	4.18	0.42
Dieldrin	East Fork	EFK24.4	0.0156	0.14	
Endrin	East Fork	EFK24.4	0.0000	0.00	0.00
Mercury	East Fork	EFK24.4	1.7656	147.13	14.71
Mercury	East Fork	EFK24	0.2281	19.01	1.90
Mercury	East Fork	EFK23.7	0.2469	20.57	2.06
Mercury	East Fork	EFK23.5	0.2432	20.27	2.03
Aldrin	East Fork	EFK23.4	0.0005	0.00	
BHC, total	East Fork	EFK23.4	0.0004	0.00	0.00
Chlordane	East Fork	EFK23.4	0.0749	0.05	0.01

Table C.14. Estimated exposure of great blue heron on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
DDT, total	East Fork	EFK23.4	0.0333	4.16	0.42
Dieldrin	East Fork	EFK23.4	0.0205	0.18	
Endrin	East Fork	EFK23.4	0.0000	0.00	0.00
Mercury	East Fork	EFK23.4	0.6391	53.26	5.33
Antimony	East Fork	EFPC RI 1*	0.0385		
Arsenic	East Fork	EFPC RI 1	0.1624	0.02	0.01
Benzo(a)pyrene	East Fork	EFPC RI 1	0.0140		
Chlordane	East Fork	EFPC RI 1	0.1334	0.08	0.02
Chromium	East Fork	EFPC RI 1	1.4671	0.73	0.15
DDE	East Fork	EFPC RI 1	0.1138	14.22	1.42
Dieldrin	East Fork	EFPC RI 1	0.0538	0.48	
Heptachlor, total	East Fork	EFPC RI 1	0.1428		
Lindane	East Fork	EFPC RI 1	0.0033	0.00	0.00
Mercury	East Fork	EFPC RI 1	1.8437	153.64	15.36
Selenium	East Fork	EFPC RI 1	0.4486	0.50	0.24
Uranium	East Fork	EFPC RI 1	0.4599	0.01	
Zinc	East Fork	EFPC RI 1	45.7947	1.35	0.15
Antimony	East Fork	EFPC RI 2	0.0058		
Arsenic	East Fork	EFPC RI 2	0.1935	0.02	0.01
Benzo(a)pyrene	East Fork	EFPC RI 2	0.0127		
Chlordane	East Fork	EFPC RI 2	0.1809	0.11	0.02
Chromium	East Fork	EFPC RI 2	2.4847	1.24	0.25
DDE	East Fork	EFPC RI 2	0.1715	21.44	2.14
Dieldrin	East Fork	EFPC RI 2	0.0642	0.57	
Heptachlor, total	East Fork	EFPC RI 2	0.1578		
Lindane	East Fork	EFPC RI 2	0.0030	0.00	0.00
Mercury	East Fork	EFPC RI 2	5.4484	454.03	45.40
Selenium	East Fork	EFPC RI 2	0.5223	0.58	0.27
Uranium	East Fork	EFPC RI 2	0.4279	0.01	

Table C.14. Estimated exposure of great blue heron on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Zinc	East Fork	EFPC RI 2	47.2543	1.39	0.15
Aldrin	East Fork	EFK18.4	0.0000	0.00	
BHC, total	East Fork	EFK18.4	0.0003	0.00	0.00
Chlordane	East Fork	EFK18.4	0.2223	0.14	0.03
DDT, total	East Fork	EFK18.4	0.0597	7.46	0.75
Dieldrin	East Fork	EFK18.4	0.0300	0.27	
Endrin	East Fork	EFK18.4	0.0000	0.00	0.00
Mercury	East Fork	EFK18.2	0.3192	26.60	2.66
MN_HG	East Fork	EFK18	0.2701	22.50	2.25
Antimony	East Fork	EFPC RI 3	0.0055		
Arsenic	East Fork	EFPC RI 3	0.1461	0.02	0.01
Benzo(a)pyrene	East Fork	EFPC RI 3	0.0074		
Chlordane	East Fork	EFPC RI 3	0.0573	0.04	0.01
Chromium	East Fork	EFPC RI 3	1.2428	0.62	0.12
DDE	East Fork	EFPC RI 3	0.0321	4.01	0.40
Dieldrin	East Fork	EFPC RI 3	0.0267	0.24	
Heptachlor, total	East Fork	EFPC RI 3	0.0773		
Lindane	East Fork	EFPC RI 3	0.0022	0.00	0.00
Mercury	East Fork	EFPC RI 3	1.2330	102.75	10.27
Selenium	East Fork	EFPC RI 3	0.3713	0.41	0.20
Uranium	East Fork	EFPC RI 3	0.2851	0.01	
Zinc	East Fork	EFPC RI 3	31.1314	0.92	0.10
Mercury	East Fork	EFK13.8	0.2929	24.41	2.44
Aldrin	East Fork	EFPC RI 4	0.0167	0.15	
Antimony	East Fork	EFPC RI 4	0.0062		
Benzo(a)pyrene	East Fork	EFPC RI 4	0.0029		
BHC, total	East Fork	EFPC RI 4	0.1052	0.19	0.05
Chlordane	East Fork	EFPC RI 4	0.0563	0.03	0.01
Chromium	East Fork	EFPC RI 4	0.8051	0.40	0.08

Table C.14. Estimated exposure of great blue heron on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
DDE	East Fork	EFPC RI 4	0.0197	2.46	0.25
Dieldrin	East Fork	EFPC RI 4	0.0373	0.33	
Heptachlor, total	East Fork	EFPC RI 4	0.0772		
Lindane	East Fork	EFPC RI 4	0.0011	0.00	0.00
Mercury	East Fork	EFPC RI 4	0.5500	45.84	4.58
Selenium	East Fork	EFPC RI 4	0.4443	0.49	0.23
Uranium	East Fork	EFPC RI 4	0.1947	0.01	
Zinc	East Fork	EFPC RI 4	25.0102	0.74	0.08
Aldrin	East Fork	EFPC RI 5	0.0188	0.17	
Benzo(a)pyrene	East Fork	EFPC RI 5	0.0040		
BHC, total	East Fork	EFPC RI 5	0.1056	0.19	0.05
Chlordane	East Fork	EFPC RI 5	0.0599	0.04	0.01
Chromium	East Fork	EFPC RI 5	0.8457	0.42	0.08
DDE	East Fork	EFPC RI 5	0.0142	1.77	0.18
Dieldrin	East Fork	EFPC RI 5	0.0453	0.40	
Heptachlor, total	East Fork	EFPC RI 5	0.0441		
Lindane	East Fork	EFPC RI 5	0.0021	0.00	0.00
Mercury	East Fork	EFPC RI 5	0.4023	33.53	3.35
Selenium	East Fork	EFPC RI 5	0.4226	0.47	0.22
Zinc	East Fork	EFPC RI 5	24.9623	0.74	0.08
Mercury	East Fork	EFK6.3	0.2359	19.66	1.97
Benzo(a)pyrene	East Fork	EFPC RI 6	0.0003		
Chlordane	East Fork	EFPC RI 6	0.0284	0.02	0.00
Chromium	East Fork	EFPC RI 6	0.4122	0.21	0.04
Dieldrin	East Fork	EFPC RI 6	0.0218	0.19	
Heptachlor, total	East Fork	EFPC RI 6	0.0243		
Lindane	East Fork	EFPC RI 6	0.0019	0.00	0.00
Mercury	East Fork	EFPC RI 6	0.2340	19.50	1.95
Selenium	East Fork	EFPC RI 6	0.3072	0.34	0.16

Table C.14. Estimated exposure of great blue heron on the ORR to non-PCB contaminants

Analyte	Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Zinc	East Fork	EFPC RI 6	18.3291	0.54	0.06
Mercury	East Fork	EFK2.1	0.1474	12.28	1.23
Mercury	East Fork	EFK2	0.1953	16.28	1.63
Mercury	K-25	PCK18.2	0.0263	2.20	0.22
Mercury	K-25	PCK10.4	0.0592	4.93	0.49
Mercury	K-25	PCK8.2	0.1569	13.07	1.31
Mercury	K-25	MIK0.2	0.0931	7.76	0.78
Mercury	K-25	PCK6.9	0.1537	12.81	1.28
Mercury	K-25	PCK1.6	0.0861	7.17	0.72
Mercury	K-25	K-710	0.0461	3.84	0.38
Mercury	K-25	K-1007	0.0280	2.33	0.23
Arsenic	K-25	K-901	0.0808	0.02	0.01
Chromium	K-25	K-901	7.8377	9.80	1.96
Copper	K-25	K-901	0.3690	0.01	0.01
Lead	K-25	K-901	0.0914	0.06	0.02
Mercury	K-25	K-901	0.0088	1.76	0.18
Nickel	K-25	K-901	0.2812	0.01	0.00
Selenium	K-25	K-901	0.1054	0.26	0.13
Zinc	K-25	K-901	5.7113	0.42	0.05
Mercury	White Oak	NTK0.2	0.0648	5.40	0.54
Mercury	White Oak	WCK3.5	0.0924	7.70	0.77
Mercury	White Oak	WCK2.9	0.1536	12.80	1.28
Mercury	White Oak	MEK0.2	0.0461	3.84	0.38
Mercury	White Oak	WCK2.3	0.1000	8.33	0.83
Mercury	White Oak	WOL	0.0590	4.91	0.49
Mercury	White Oak	WCK0.9	0.0376	3.13	0.31
Mercury	White Oak	WCK0.3	0.0646	5.38	0.54

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

**Table C.15. Estimated exposure of great blue heron
on the ORR to PCBs**

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Bear Creek	BCK12.4	0.1072	0.77	0.08
Bear Creek	BCK9.4	0.7908	5.65	0.59
Bear Creek	BCK4.5	0.9160	6.54	0.68
Bear Creek	BCK3.3	0.3075	2.20	0.23
Bear Creek	BCK0.6	0.2260	1.61	0.17
East Fork	EFK24.8	4.2286	30.20	3.13
East Fork	EFK24.4	1.4203	10.14	1.05
East Fork	EFK24	0.9024	6.45	0.67
East Fork	EFK23.7	1.2677	9.06	0.94
East Fork	EFK23.5	1.4817	10.58	1.10
East Fork	EFK23.4	0.8765	6.26	0.65
East Fork	EFPC RI 1 ^a	1.6217	11.58	1.20
East Fork	EFPC RI 2	1.8858	13.47	1.40
East Fork	EFK18.4	0.4792	3.42	0.35
East Fork	EFK18.2	0.3177	2.27	0.24
East Fork	EFPC RI 3	0.5329	3.81	0.39
East Fork	EFK13.8	0.2380	1.70	0.18
East Fork	EFPC RI 4	0.3117	2.23	0.23
East Fork	EFPC RI 5	0.1995	1.42	0.15
East Fork	EFK6.3	0.1469	1.05	0.11
East Fork	EFPC RI 6	0.0826	0.59	0.06
East Fork	EFK2.1	0.1436	1.03	0.11
K-25	PCK18.2	0.1125	0.80	0.08
K-25	PCK10.4	0.0687	0.49	0.05
K-25	PCK8.2	0.1232	0.88	0.09
K-25	MIK0.2	0.9992	7.14	0.74

**Table C.15. Estimated exposure of great blue heron
on the ORR to PCBs**

Drainage	Sampling station	Dietary exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
K-25	PCK6.9	0.1743	1.25	0.13
K-25	PCK1.6	0.1671	1.19	0.12
K-25	K-1007	0.0615	0.44	0.05
K-25	K-901	2.6360	18.83	1.95
White Oak	NTK0.2	0.2458	1.76	0.18
White Oak	WCK3.5	0.5079	3.63	0.38
White Oak	WCK2.9	0.4393	3.14	0.33
White Oak	MEK0.2	0.2190	1.56	0.16
White Oak	WCK2.3	0.4357	3.11	0.32
White Oak	WOL	0.4973	3.55	0.37
White Oak	WCK0.9	0.3084	2.20	0.23
White Oak	WCK0.3	0.2908	2.08	0.22

^a EFPC RI 1 to 6 indicates data from East Fork Poplar Creek RI sampling locations 1 to 6. These locations are presented in the appropriate order relative to their distance from the confluence with Poplar Creek.

Table C-16. Estimated exposure of piscivores at off-site locations

Endpoint	Analyte	Drainage	Dietary Exposure (mg/kg-d)	NOAEL HQ	LOAEL HQ
Mink	Mercury	Beaver Creek	0.0043	0.29	0.04
Mink	Mercury	Brushy Fork	0.0061	0.41	0.06
Mink	Mercury	Hinds Creek	0.0031	0.20	0.03
Otter	Mercury	Beaver Creek	0.0516	6.45	0.86
Otter	Mercury	Brushy Fork	0.1042	13.02	1.74
Otter	Mercury	Hinds Creek	0.0510	6.37	0.85
Belted Kingfisher	Mercury	Beaver Creek	0.0290	2.42	0.24
Belted Kingfisher	Mercury	Brushy Fork	0.0413	3.44	0.34
Belted Kingfisher	Mercury	Hinds Creek	0.0207	2.41	0.24
Great Blue Heron	Mercury	Beaver Creek	0.0101	2.01	0.21
Great Blue Heron	Mercury	Brushy Fork	0.0143	2.86	0.30
Great Blue Heron	Mercury	Hinds Creek	0.0100	1.44	0.15
Mink	PCB	Brushy Fork	0.3686	2.63	0.53
Mink	PCB	Hinds Creek	0.0074	0.05	0.01
Otter	PCB	Brushy Fork	1.3137	18.77	3.75
Otter	PCB	Hinds Creek	0.0463	0.66	0.13
Belted Kingfisher	PCB	Brushy Fork	2.4971	7.34	0.73
Belted Kingfisher	PCB	Hinds Creek	0.0501	0.15	0.01
Great Blue Heron	PCB	Brushy Fork	0.8660	6.19	0.64
Great Blue Heron	PCB	Hinds Creek	0.0174	0.12	0.01
Mink	Selenium	Hinds Creek	0.0338	1.41	0.14
Mink	Cadmium	Hinds Creek	0.0021	0.35	0.30
Otter	Selenium	Hinds Creek	0.0509	4.24	0.42
Otter	Cadmium	Hinds Creek	0.0032	1.05	0.79
Belted Kingfisher	DDT	Hinds Creek	0.5169	0.26	0.05
Belted Kingfisher	Chromium	Hinds Creek	0.0036	0.45	0.05
Great Blue Heron	DDT	Hinds Creek	0.1792	0.22	0.04
Great Blue Heron	Chromium	Hinds Creek	0.0013	0.39	0.04

Table C.17. Results of Monte Carlo simulation of exposure for piscivores on the ORR

Location	Analyte	Species	Number of sampling locations	Mean	Standard deviation	80th percentile	% > NOAEL	% > LOAEL
Bear Creek	Cadmium	Mink	3	0.064	0.031	0.086	>99%	>99%
White Oak Creek	Cadmium	Mink	3	0.001	0.001	0.002	<1%	<1%
Hinds Creek	Cadmium	Mink	1	0.002	0.001	0.002	<1%	<1%
Bear Creek	Mercury	Mink	5	0.013	0.006	0.017	30%	<1%
East Fork Poplar Creek	Mercury	Mink	20	0.067	0.029	0.089	~99%	5-10%
East Fork Poplar Creek (w/o EFPC RI data)	Mercury	Mink	14	0.056	0.026	0.077	>95%	<5%
K-25	Mercury	Mink	8	0.011	0.005	0.014	15-20%	<1%
White Oak Creek	Mercury	Mink	8	0.011	0.005	0.015	~20%	<1%
Beaver Creek	Mercury	Mink	1	0.003	0.002	0.004	<1%	<1%
Brushy Fork	Mercury	Mink	1	0.005	0.003	0.007	<5%	<1%
Hinds Creek	Mercury	Mink	1	0.003	0.001	0.004	<5%	<1%
Bear Creek	PCB	Mink	5	0.145	0.068	0.195	45-50%	<1%
East Fork Poplar Creek	PCB	Mink	20	0.307	0.147	0.409	90%	<5%
East Fork Poplar Creek (w/o EFPC RI data)	PCB	Mink	14	0.352	0.165	0.476	90-95%	<5%
K-25	PCB	Mink	8	0.137	0.067	0.181	40-45%	<1%
White Oak Creek	PCB	Mink	8	0.130	0.061	0.174	35-40%	<1%
Brushy Fork	PCB	Mink	1	0.247	0.135	0.350	80%	<5%
Hinds Creek	PCB	Mink	1	0.009	0.004	0.012	<1%	<1%
Bear Creek	Selenium	Mink	3	0.043	0.020	0.059	80-85%	<1%
Hinds Creek	Selenium	Mink	1	0.033	0.015	0.045	70-75%	<1%
Bear Creek	Cadmium	Otter	3	0.101	0.012	0.111	>99%	>99%
White Oak Creek	Cadmium	Otter	3	0.002	0.000	0.003	~1%	<1%
Hinds Creek	Cadmium	Otter	1	0.003	0.000	0.003	15%	<5%

Table C.17. Results of Monte Carlo simulation of exposure for piscivores on the ORR

Location	Analyte	Species	Number of sampling locations	Mean	Standard deviation	80th percentile	% > NOAEL	% > LOAEL
Bear Creek	Mercury	Otter	5	0.018	0.002	0.020	>99%	<1%
East Fork Poplar Creek	Mercury	Otter	20	0.077	0.013	0.088	>99%	90-95%
East Fork Poplar Creek (w/o EFPC RI data)	Mercury	Otter	14	0.059	0.007	0.065	>99%	40%
K-25	Mercury	Otter	8	0.013	0.002	0.014	>99%	<1%
White Oak Creek	Mercury	Otter	8	0.013	0.002	0.015	>99%	<1%
Beaver Creek	Mercury	Otter	1	0.005	0.001	0.005	<1%	<1%
Brushy Fork	Mercury	Otter	1	0.010	0.002	0.011	85%	<1%
Hinds Creek	Mercury	Otter	1	0.006	0.001	0.006	<1%	<1%
Bear Creek	PCB	Otter	5	0.204	0.031	0.230	>99%	<1%
East Fork Poplar Creek	PCB	Otter	20	0.488	0.069	0.544	>99%	>95%
East Fork Poplar Creek (w/o EFPC RI data)	PCB	Otter	14	0.542	0.083	0.614	>99%	>99%
K-25	PCB	Otter	8	0.411	0.125	0.514	>95%	65-70%
White Oak Creek	PCB	Otter	8	0.202	0.056	0.245	>95%	<5%
Brushy Fork	PCB	Otter	1	0.680	0.257	0.895	90-95%	>99%
Hinds Creek	PCB	Otter	1	0.031	0.010	0.040	<1%	<1%
Bear Creek	Selenium	Otter	3	0.061	0.008	0.068	>99%	<1%
Hinds Creek	Selenium	Otter	1	0.047	0.006	0.052	>99%	<1%
K-901	Chromium	Belted Kingfisher	1	7.860	2.776	9.916	>95%	15-20%
Hinds Creek	Chromium	Belted Kingfisher	1	0.373	0.070	0.425	<1%	<1%

Table C.17. Results of Monte Carlo simulation of exposure for piscivores on the ORR

Location	Analyte	Species	Number of sampling locations	Mean	Standard deviation	80th percentile	% > NOAEL	% > LOAEL
East Fork Poplar Creek	DDT	Belted Kingfisher	8	0.051	0.013	0.061	>99%	<5%
Hinds Creek	DDT	Belted Kingfisher	1	0.003	0.001	0.003	<1%	<1%
Bear Creek	Mercury	Belted Kingfisher	5	0.081	0.013	0.090	>99%	<1%
East Fork Poplar Creek	Mercury	Belted Kingfisher	20	0.501	0.101	0.577	>99%	>99%
East Fork Poplar Creek (w/o EFPC RI data)	Mercury	Belted Kingfisher	14	0.372	0.060	0.415	>99%	>99%
K-25	Mercury	Belted Kingfisher	8	0.067	0.011	0.075	>99%	<1%
White Oak Creek	Mercury	Belted Kingfisher	8	0.072	0.011	0.080	>99%	<1%
Beaver Creek	Mercury	Belted Kingfisher	1	0.021	0.005	0.025	>95%	<1%
Brushy Fork	Mercury	Belted Kingfisher	1	0.031	0.008	0.037	>95%	<1%
Hinds Creek	Mercury	Belted Kingfisher	1	0.018	0.003	0.020	>95%	<1%
Bear Creek	PCB	Belted Kingfisher	5	0.932	0.157	1.055	>99%	<1%
East Fork Poplar Creek	PCB	Belted Kingfisher	20	1.936	0.328	2.205	>99%	<1%
East Fork Poplar Creek (w/o EFPC RI data)	PCB	Belted Kingfisher	14	2.293	0.443	2.635	>99%	<5%
K-25	PCB	Belted Kingfisher	8	0.874	0.165	0.999	>99%	<1%
White Oak Creek	PCB	Belted Kingfisher	8	0.825	0.121	0.916	>99%	<1%
Brushy Fork	PCB	Belted Kingfisher	1	1.588	0.441	1.952	>99%	<1%

Table C.17. Results of Monte Carlo simulation of exposure for piscivores on the ORR

Location	Analyte	Species	Number of sampling locations	Mean	Standard deviation	80th percentile	% > NOAEL	% > LOAEL
Hinds Creek	PCB	Belted Kingfisher	1	0.056	0.008	0.062	<1%	<1%
K-901	Chromium	Great Blue Heron	1	2.926	1.070	3.792	>95%	15-20%
Hinds Creek	Chromium	Great Blue Heron	1	0.142	0.029	0.162	<1%	<1%
East Fork Poplar Creek	DDT	Great Blue Heron	8	0.019	0.005	0.023	>99%	<5%
Hinds Creek	DDT	Great Blue Heron	1	0.001	0.000	0.001	<1%	<1%
Bear Creek	Mercury	Great Blue Heron	5	0.030	0.005	0.034	>99%	<5%
East Fork Poplar Creek	Mercury	Great Blue Heron	20	0.187	0.039	0.216	>99%	>99%
East Fork Poplar Creek (w/o EFPC RI data)	Mercury	Great Blue Heron	14	0.140	0.024	0.158	>99%	>99%
K-25	Mercury	Great Blue Heron	8	0.025	0.004	0.028	>99%	<5%
White Oak Creek	Mercury	Great Blue Heron	8	0.027	0.005	0.030	>99%	<5%
Beaver Creek	Mercury	Great Blue Heron	1	0.008	0.002	0.009	>95%	<1%
Brushy Fork	Mercury	Great Blue Heron	1	0.012	0.003	0.014	>95%	<1%
Hinds Creek	Mercury	Great Blue Heron	1	0.007	0.001	0.008	>95%	<1%
Bear Creek	PCB	Great Blue Heron	5	0.353	0.067	0.402	>99%	<1%
East Fork Poplar Creek	PCB	Great Blue Heron	20	0.739	0.143	0.851	>99%	<1%

Table C.17. Results of Monte Carlo simulation of exposure for piscivores on the ORR

Location	Analyte	Species	Number of sampling locations	Mean	Standard deviation	80th percentile	% > NOAEL	% > LOAEL
East Fork Poplar Creek (w/o EFPC RI data)	PCB	Great Blue Heron	14	0.856	0.169	0.973	> 99%	< 5%
K-25	PCB	Great Blue Heron	8	0.331	0.067	0.380	> 99%	< 1%
White Oak Creek	PCB	Great Blue Heron	8	0.315	0.051	0.350	> 99%	< 1%
Brushy Fork	PCB	Great Blue Heron	1	0.597	0.178	0.735	> 99%	< 1%
Hinds Creek	PCB	Great Blue Heron	1	0.021	0.004	0.024	< 1%	< 1%

Table C.18. Estimated NOAELs and LOAELs for mink and river otter

Contaminant	Experimental information						Estimated NOAEL (mg/kg/d)		Estimated LOAEL (mg/kg/d)	
	Form	Test species	NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	mink	otter	mink	otter
Antimony	antimony potassium tartrate	mouse	0.125 lifetime	1.25 lifetime	reproduction	Schroeder et al. 1968	0.04	0.02	0.4	0.2
Arsenic	As + 3	mouse	0.126 ¹ 3 gen.	1.26 3 gen.	reproduction	Schroeder and Mitchner 1971	0.04	0.02	0.4	0.2
Beryllium	sulfate	rat	0.66 1126 d		longevity/ wt. loss	Schroeder and Mitchner 1975	0.47	0.24		
Cadmium	CdCl ₂	rat	0.008 4 gen.	0.01 4 gen.	reproduction	Wills et al. 1981	0.006	0.003	0.007	0.004
Chromium	Cr ⁺⁶	rat	3.28 1 yr		wt. loss, food consumption	Mackenzie et al. 1958	2.32	1.17		
Chromium	Cr ⁺⁶	rat		13.14 ² 3 mo.	Mortality	Steven et al. 1976			9.3	4.7
Copper	sulfate	mink	11.71 1 yr	15.14 1 yr	reproduction	Aulerich et al. 1982	11.7	5.9	15.1	7.6
Lead	acetate	rat	8 3 gen.	80 3 gen.	reproduction	Azar et al. 1973	5.7	2.8	57	28
Lithium	carbonate	rat	9.4 gest	18.8 gest	reproduction	Marathe and Thomas 1986	6.6	3.3	13	6.7
Mercury	methyl	mink	0.015 ² 93 d		mortality	Wobeser et al. 1976	0.015	0.008		

Table C.18. Estimated NOAEL's and LOAEL's for mink and river otter

Contaminant	Experimental information						Estimated NOAEL (mg/kg/d)		Estimated LOAEL (mg/kg/d)	
	Form	Test species	NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	mink	otter	mink	otter
Mercury	methyl	rat		0.16 3 gen.	reproduction	Verschuuren et al. 1976			0.11	0.06
Nickel	sulfate	rat	40 3 gen.	80 3 gen.	reproduction	Ambrose et al. 1976	28.3	14.2	57	28.5
Selenium	selenate	mouse	0.075 ¹ 3 gen	0.75 3 gen	reproduction	Schroeder and Mitchner 1971	0.024	0.012	0.24	0.12
Thallium	sulfate	rat	0.0074 ^{1,2} 60 d	0.074 ^{1,2} 60 d	reproduction	Formigli et al. 1986	0.005	0.003	0.053	0.027
Uranium	acetate	mouse	3.07 gest.	6.13 gest.	reproduction.	Paternain et al. 1989	0.94	0.48	1.9	1
Zinc	oxide	rat	160 gestation	320 gestation	reproduction	Schlicker and Cox 1968	113.2	57	226.3	114
Aldrin		rat	0.2 3 gen	1.0 3 gen	reproduction	Treon and Cleveland 1955	0.14	0.07	0.7	0.36
Benzo(a)pyrene		mouse	1 gest.	10 gest.	reproduction	Mackenzie and Angevine 1981	0.31	0.16	3.1	1.6
BHC (mixed isomers)		mink	0.014 331 d	0.14 331 d.	reproductionre production	Bleavins et al. 1984	0.014	0.007	0.14	0.07
Chlordane		mouse	4.6 6 gen	9.2 6 gen	reproduction	WHO 1984	1.4	0.73	2.9	1.5
DDT and metabolites		rat	0.8 2 yr	4.0 2 yr	reproduction	Fitzhugh 1948	0.57	0.29	2.8	1.4

Table C.18. Estimated NOAEL's and LOAEL's for mink and river otter

Contaminant	Experimental information						Estimated NOAEL (mg/kg/d)		Estimated LOAEL (mg/kg/d)	
	Form	Test species	NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	mink	otter	mink	otter
Dieldrin		rat	0.02 3 gen	0.2 3 gen.	reproduction	Treon and Cleveland 1955	0.014	0.007	0.14	0.07
Endosulfan		rat	0.15 ² 30 d		reproduction	Dikshith et al. 1984	0.11	0.053		
Endrin		mouse	0.092 ¹ 120 d	0.92 120 d	reproduction	Good and Ware 1969	0.029	0.015	0.29	0.15
Heptachlor		mink	0.1 ¹ 181 d	1 181 d.	reproduction	Crum et al. 1993	0.1	0.05	1	0.5
Lindane		rat	8 3 gen.		reproduction	Palmer et al. 1978	5.7	2.8		
PCB's	Aroclor 1254	mink	0.137 4.5 mo.	0.685 4.5 mo.	reproduction	Aulerich and Ringer 1987	0.14	0.07	0.69	0.35

¹ Estimated NOAEL: LOAEL to NOAEL factor of 10 applied.² Estimated NOAEL: subchronic to chronic factor of 10 applied.

Table C.19. Estimated NOAEL's and LOAEL's for belted kingfisher and great blue heron

Contaminant	Experimental information						Estimated NOAEL (mg/kg/d)		Estimated LOAEL (mg/kg/d)	
	Form	Test species	NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	Belted king- fisher	Great blue heron	Belted king- fisher	Great blue heron
Arsenic	arsenite	mallard duck	5.14 128d	12.84 128d	mortality	USFWS 1964	9.65	3.9	24.1	9.6
Cadmium	CdCl ₂	mallard duck	1.45 90 d	20 90 d	reproduction	White and Finley 1978	2.9	1.1	39	16
Chromium	Cr ⁺³	black duck	1 10 mo.	5 10 mo.	reproduction	Haseltine et al., unpubl. data	2	0.8	10.1	4
Copper	oxide	chicken	33.2 10 wk	46.97 10 wk	growth/ mortality	Mehring et al. 1960		20.25		28.6
Lead	metal	American Kestrel	3.85 7 mo.		reproduction	Pattee 1984	3.69	1.47		
Lithium	acetate	Japanese quail		11.3 12 wk	reproduction	Edens et al. 1976			11	5
Mercury	methyl	mallard duck	0.0064 ² 3 gen.	0.064 3 gen.	reproduction	Heinz 1979	0.012	0.005	0.12	0.048
Nickel	sulfate	mallard duck	77.4 90 d	107 90 d	mortality, growth, behavior	Cain and Pafford 1981	134.1	53.5	185	74
Selenium	selenite	mallard duck	0.5 10 wk	1.0 10 wk	reproduction	Heinz et al. 1987	0.9	0.4	1.9	0.8
Uranium	depleted metal	black duck	16 ² 6 wk		mortality, growth, behavior	Haseltine and Sileo 1983	32	13		

Table C.19. Estimated NOAEL's and LOAEL's for belted kingfisher and great blue heron

Contaminant	Experimental information					Citation	Estimated NOAEL (mg/kg/d)		Estimated LOAEL (mg/kg/d)	
	Form	Test species	NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint		Belted king- fisher	Great blue heron	Belted king- fisher	Great blue heron
Zinc	zinc sulfate	chicken	14.5 44 wk	130.9 44 wk	reproduction	Stahl et al. 1990	33.9	13.5	306	122
BHC (mixed isomers)		Japanese Quail	0.56 90 d	2.25 90 d	reproduction	Vos et al. 1971	0.56	0.22	2.26	0.9
Chlordane		redwinged blackbird	2.14 84 d	10.7 84 d	mortality	Stickel et al. 1983	1.62	0.65	8.1	3.2
DDT and metabolites		Brown Pelican	0.0028 ³ > 1 yr	0.028 ³ > 1 yr	reproduction	Anderson et al. 1975	0.008	0.003	0.08	0.03
Dieldrin		barn owl	0.077 2 yr		reproduction	Mendenhall et al. 1983	0.045	0.045		
Endosulfan		gray partridge	10 4 wk		reproduction	Abiola 1992	14	6		
Endrin		screech owl	0.01 ¹ 83 d	0.1 83 d	reproduction	Fleming et al. 1982	0.011	0.004	0.11	0.04
Lindane		mallard duck	2 ¹ 8 wk	20 8 wk	reproduction	Chakravarty and Lahiri 1986	3.8	1.5	38	15
PCB's	Aroclor 1254	Ring-necked Pheasant	0.18 ² 17 wk	0.18 17 wk	reproduction	Dahlgren et al. 1972	0.34	0.14	3.4	1.4

¹ Estimated NOAEL; LOAEL to NOAEL factor of 10 applied.² Estimated NOAEL; subchronic to chronic factor of 10 applied.

Table C.20. Summary of analytes where HQs > 1 were observed

Watershed	Endpoint	Analyte	No. locations where NOAEL-based HQ > 1	No. locations where LOAEL-based HQ > 1
Bear Creek	Mink	As	1	0
		Cd	3	3
		Hg	2	0
		Se	3	0
		PCBs	2	0
	River Otter	As	3	0
		Cd	3	3
		Hg	5	0
		Se	3	1
		Tl	1	0
		PCBs	4	2
	Kingfisher	Hg	4	1
		Zn	1	0
		PCBs	4	0
	Heron	Hg	5	2
		Zn	1	0
		PCBs	4	0
East Fork Poplar Creek	Mink	Hg	18	4
		Se	6	0
		BHC	2	0
		PCBs	10	3
	Otter	As	3	0
		Hg	19	10
		Se	6	0
		BHC	2	0
		Dieldrin	4	0
		PCBs	17	12
	Kingfisher	Cr	1	0

Table C.20. Summary of analytes where HQs > 1 were observed

Watershed	Endpoint	Analyte	No. locations where NOAEL-based HQ > 1	No. locations where LOAEL-based HQ > 1
K-25	Heron	Hg	18	18
		Zn	2	0
		DDT	8	2
		PCBs	16	6
		Cr	.1	0
		Hg	18	18
		Zn	2	0
		DDT	8	2
	Mink	PCBs	16	5
		Cr	1	0
		Hg	2	0
		Se	1	0
		PCBs	2	1
	Otter	As	1	0
		Cd	1	1
		Cr	1	0
		Hg	6	0
		Se	1	0
		PCBs	6	4
	Kingfisher	Cr	1	1
		Hg	9	2
		PCBs	5	1
White Oak Creek	Heron	Cr	1	1
		Hg	9	3
		PCBs	4	1
	Mink	Hg	1	0
	Otter	PCBs	4	0
		Hg	8	0

Table C.20. Summary of analytes where HQs > 1 were observed

Watershed	Endpoint	Analyte	No. locations where NOAEL-based HQ > 1	No. locations where LOAEL-based HQ > 1	
Beaver Creek	Kingfisher	PCBs	8	1	
		Hg	8	1	
		PCBs	8	0	
	Heron	Hg	8	1	
		PCBs	8	0	
	Otter	Hg	1	0	
		Kingfisher	Hg	1	0
		Heron	Hg	1	0
	Brushy Fork	Mink	PCB	1	0
		Otter	Hg	1	1
			PCB	1	1
	Hinds Creek	Kingfisher	Hg	1	0
PCB			1	0	
Heron			Hg	1	0
		PCB	1	0	
		Mink	Se	1	0
		Otter	Cd	1	0
Kingfisher			Hg	1	0
			Se	1	0
			Hg	1	0
			Hg	1	0
		Heron	Hg	1	0
			Hg	1	0

Table C.21. Summary of number of individuals of piscivore endpoint species estimated to be experiencing adverse effects by watershed and for the ORR

Location	Analyte	Species	% > LOAEL	Number in watershed	Number adversely affected	Percent adversely affected
Bear Creek	Cadmium	Mink	>99%	7	7	100
White Oak Creek	Cadmium	Mink	<1%	4	0	0
ORR-wide	Cadmium	Mink		40	7	17.5
Bear Creek	Mercury	Mink	<1%	7	0	0
East Fork Poplar Creek	Mercury	Mink	5-10%	15	0	0
K-25	Mercury	Mink	<1%	14	0	0
White Oak Creek	Mercury	Mink	<1%	4	0	0
ORR-wide	Mercury	Mink		40	0	0
Bear Creek	PCB	Mink	<1%	7	0	0
East Fork Poplar Creek	PCB	Mink	<5%	15	0	0
K-25	PCB	Mink	<1%	14	0	0
White Oak Creek	PCB	Mink	<1%	4	0	0
ORR-wide	PCB	Mink		40	0	0
Bear Creek	Selenium	Mink	<1%	7	0	0
ORR-wide	PCB	Mink		40	0	0
Bear Creek	Cadmium	Otter	>99%	5	5	100
White Oak Creek	Cadmium	Otter	<1%	2	0	0
ORR-wide	Cadmium	Otter		25	5	20
Bear Creek	Mercury	Otter	<1%	5	0	0
East Fork Poplar Creek	Mercury	Otter	90-95%	9	9	100
East Fork Poplar Creek (w/o EFPC RI data)	Mercury	Otter	40%	9	3	33
K-25	Mercury	Otter	<1%	9	0	0

Table C.21. Summary of number of individuals of piscivore endpoint species estimated to be experiencing adverse effects by watershed and for the ORR

Location	Analyte	Species	% > LOAEL	Number in watershed	Number adversely affected	Percent adversely affected
White Oak Creek	Mercury	Otter	<1%	2	0	0
ORR-wide	Mercury	Otter		25	3 or 9	12 or 36
Bear Creek	PCB	Otter	<1%	5	0	0
East Fork Poplar Creek	PCB	Otter	>95%	9	9	100
K-25	PCB	Otter	65-70%	9	6	66
White Oak Creek	PCB	Otter	<5%	2	0	0
ORR-wide	PCB	Otter		25	15	60
Bear Creek	Selenium	Otter	<1%	5	0	0
ORR-wide	Selenium	Otter		25	0	0
East Fork Poplar Creek	DDT	Belted Kingfisher	<5%	10	0	0
ORR-wide	DDT	Belted Kingfisher		27	0	0
Bear Creek	Mercury	Belted Kingfisher	<1%	5	0	0
East Fork Poplar Creek	Mercury	Belted Kingfisher	>99%	10	10	100
K-25	Mercury	Belted Kingfisher	<1%	9	0	0
White Oak Creek	Mercury	Belted Kingfisher	<1%	3	0	0
ORR-wide	Mercury	Belted Kingfisher		27	10	37
Bear Creek	PCB	Belted Kingfisher	<1%	5	0	0

Table C.21. Summary of number of individuals of piscivore endpoint species estimated to be experiencing adverse effects by watershed and for the ORR

Location	Analyte	Species	% > LOAEL	Number in watershed	Number adversely affected	Percent adversely affected
East Fork Poplar Creek	PCB	Belted Kingfisher	<1%	10	0	0
K-25	PCB	Belted Kingfisher	<1%	9	0	0
White Oak Creek	PCB	Belted Kingfisher	<1%	3	0	0
ORR-wide	PCB	Belted Kingfisher		27	0	0
East Fork Poplar Creek	DDT	Great Blue Heron	<5%	57	0	0
ORR-wide	DDT	Great Blue Heron		155	0	0
Bear Creek	Mercury	Great Blue Heron	<5%	29	0	0
East Fork Poplar Creek	Mercury	Great Blue Heron	>99%	57	57	100
K-25	Mercury	Great Blue Heron	<5%	34	0	0
White Oak Creek	Mercury	Great Blue Heron	<5%	15	0	0
Beaver Creek	Mercury	Great Blue Heron	<1%	155	57	37
Bear Creek	PCB	Great Blue Heron	<1%	29	0	0
East Fork Poplar Creek	PCB	Great Blue Heron	<1%	57	0	0
K-25	PCB	Great Blue Heron	<1%	34	0	0
White Oak Creek	PCB	Great Blue Heron	<1%	15	0	0

Table C.21. Summary of number of individuals of piscivore endpoint species estimated to be experiencing adverse effects by watershed and for the ORR

Location	Analyte	Species	% > LOAEL	Number in watershed	Number adversely affected	Percent adversely affected
Brushy Fork	PCB	Great Blue Heron	<1%	155	0	0

Table C.22. Simulation of exposure of mink to mercury and PCBs in toxicity test diets

Diet	Analyte	Concentration in diet				Distribution used in simulation	Modeled exposure (mg/kg-d)			% > NOAEL ^a	% > LOAEL ^a
		Mean	STD	Min	Max		Mean	STD	80th percentile		
A	Mercury	0.02	0	0.02	0.03	Triangular	0.0034	0.0009	0.0042	<1%	0%
B	Mercury	0.05	0	0.04	0.06	Triangular	0.0074	0.0019	0.0088	1-5%	<0.01 %
C	Mercury	0.09	0	0.08	0.11	Triangular	0.0138	0.0035	0.016	30%	<0.01 %
D	Mercury	0.15	0.01			Normal	0.022	0.0059	0.026	90-95%	<0.01 %
E	Mercury	0.22	0.01			Normal	0.033	0.008	0.038	>99%	<1%
A	PCB 1260	0.169	0.002			Normal	0.025	0.0063	0.029	<1%	<1%
B	PCB 1260	11.44	0.327			Normal	1.70	0.43	1.97	>99%	>99%
C	PCB 1260	4.697	0.174			Normal	0.698	0.18	0.82	>99%	40-45 %
D	PCB 1260	10.41	0.25			Normal	1.54	0.39	1.79	>99%	>99%
E	PCB 1260	20.67	0.458			Normal	3.07	0.77	3.55	>99%	>99%

^a PCB 1260 evaluated by comparison to NOAEL and LOAEL for Aroclor 1254.

C-84

Fig. C.1. The Bear Creek fish sampling locations used in the ORR-wide ecological risk assessment. The map projection is Tennessee State Plane (TSP) meters, Zone 5301, and NAD 83. The study site location data is from BMAP and OREIS spatial database. The map was prepared by R.A. Washington-Allen, Environmental Sciences Division (ESD) ORNL on July 27, 1995.

Fig. C.2. The East Fork Poplar Creek fish and ecological sampling locations (from EFPC RI) used in the ORR-wide ecological risk assessment. The map projection is Tennessee State Plane (TSP) meters, Zone 5301, and NAD 83. The study site location data is from SAIC, BMAP and OREIS spatial database. The map was prepared by R.A. Washington-Allen, Environmental Sciences Division (ESD) ORNL on July 27, 1995.

C-86

Fig. C.3. The Poplar Creek sampling locations and ponds used to evaluate risks in the K-25 vicinity for the ORR-wide ecological risk assessment. The map projection is Tennessee State Plane (TSP) meters, Zone 5301, and NAD 83. The study site location data is from BMAP and OREIS spatial database. The map was prepared by R.A. Washington-Allen, Environmental Sciences Division (ESD) ORNL on July 27, 1995.

Fig. C.4. The White Oak Creek fish sampling locations used in the ORR-wide ecological risk assessment. The map projection is Tennessee State Plane (TSP) meters, Zone 5301, and NAD 83. The study site location data is from BMAP and OREIS spatial database. The map was prepared by R.A. Washington-Allen, Environmental Sciences Division (ESD) ORNL on July 27, 1995.

Fig. C.5. The reference streams used in the ORR-wide ecological risk assessment. The map projection is Tennessee State Plane (TSP) meters, Zone 5301, and NAD 83. The location data is from BMAP and OREIS spatial databases. The map was prepared by R.A. Washington-Allen, Environmental Sciences Division (ESD) ORNL on July 27, 1995.

Fig. C.6. Sum of NOAEL-based toxic units for evaluation of risks to piscivores in the Bear Creek Watershed.

Fig. C.7. Sum of NOAEL-based toxic units for evaluation of risks to piscivores in the East Fork Poplar Creek Watershed. Locations in parentheses represent EFPC RI sampling locations.

Fig. C.8. Sum of NOAEL-based toxic units for evaluation of risks to piscivores in the K-25 vicinity. MIK = Mitchell Branch kilometer. K-710, K-901, and K-1007 represent ponds in K-25 area

Fig. C.9. Sum of NOAEL-based toxic units for evaluation of risks to piscivores in the White Oak Creek Watershed. NTK = Northwest Tributary kilometer; MEK = Melton Branch kilometer; and WOL = White Oak Lake.

Fig. C.10. Cumulative binomial probability of river otter experiencing exposure to mercury in East Fork Poplar Creek in excess of the LOAEL.
Data do not include EFPC RI observations.

Fig. C.11. Cumulative binomial probability of river otter experiencing exposure to PCBs in the K-25 vicinity in excess of the LOAEL.

Appendix D
TOXICOLOGICAL PROFILES

Aluminum. Aluminum is an ubiquitous metal, being the third most abundant element in the earth's crust (Krueger et al., 1984). Relative to other metals, the toxicity of aluminum is low (Sorensen et al., 1974). The oral LD₅₀ for mice ranges from 770 to 980 mg aluminum/kg body weight (Ondreicka et al., 1966). The principal effect of aluminum is to interfere with phosphorous metabolism; in the alimentary canal, aluminum forms insoluble compounds with phosphorous resulting in an imbalance of calcium and phosphorous (Carrerie et al., 1986). Other effects of aluminum include neurotoxicity. Rats exposed to aluminum display behavioral abnormalities and have reduced acetylcholinesterase activity (Krueger et al., 1984). Mice consuming diets containing 500 to 1000 ppm aluminum displayed ataxia and paralysis of the hind limbs (Golub et al., 1987). In humans, aluminum has been associated with several degenerative diseases of the nervous system, including Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis (Ganrot, 1986).

Ondreicka et al. (1966) evaluated the effects of aluminum on mammalian reproduction. Mice received 19.3 mg aluminum/kg bodyweight/day (as AlCl₃) in drinking water for three generations. While the number of litters and offspring per litter was not reduced, growth was significantly reduced among all offspring in the second and third generations. In a similar study, rats received daily intragastric doses of 0, 180, 360, or 720 mg aluminum/kg body weight/day (Domingo et al., 1987) for one generation. Growth and survival of young was reduced among the groups that received 360 and 720 mg aluminum/kg/day. Other studies also report that while aluminum does not appear to affect the number of litters or number of offspring/litter, growth and survival of offspring of aluminum exposed parents is reduced (Golub et al., 1987; Paternain et al. 1988).

Due to its interference with phosphorous and calcium metabolism, it has been suggested that aluminum may impair eggshell formation by birds, resulting in eggshell thinning (Nyholm, 1981). To test this hypothesis, Carriere et al. (1986) fed breeding ring doves (*Streptopelia risoria*) a diet containing 1000 ppm aluminum (and adequate but reduced calcium and phosphorous) and observed reproduction. While no reproductive effects or embryonic malformations were observed at this dosage level, significant reproductive effects resulted when birds were fed a diet deficient in calcium and phosphorous that contained 750 ppm aluminum. Therefore, among birds it appears that the manifestation of toxic effects of aluminum are dependent upon the nutritional quality of their diet.

Arsenic. Arsenic is present in the earth's crust at approximately 2 ppm, but tissues of animals generally contain an average of <0.5 ppm (Venugopal and Luckey, 1978). Arsenic may be a required micronutrient; growth, survival, and reproduction of goats is poor if the diet contains <0.05 ppm As (NAS, 1977).

Arsenic is a carcinogen and teratogen. Other effects include reduced growth, hearing/sight loss, liver/kidney damage, and death (Eisler, 1988a). Inorganic arsenic is usually more toxic than organic arsenic compounds. Wildlife mortality and malformations have been observed for chronic doses of 1-10 mg As/kg bw and dietary concentrations of 5-50 ppm (Eisler, 1988a). Acute LD₅₀s for mammals of 35-100 mg calcium arsenate/kg body weight and 10-50 mg lead arsenate/kg body weight have been reported (NRCC, 1978).

Schroeder and Mitchner (1971) exposed mice to 5 ppm sodium arsenite in drinking water

for three generations. While mice fed arsenic survived well, litter size decreased in subsequent generations. A dose of 0.38 mg arsenic/kg over a lifetime was sufficient to cause a slight decrease in the median lifespan of laboratory mice (Schroeder and Balassa, 1967), but it had no effect on growth. As little as 3 mg arsenic trioxide/kg body weight or 1 mg sodium arsenite/kg body weight can be lethal (NAS, 1977).

Because metabolism of arsenic in rats is unlike that in other animals, results of toxicity studies using rats generally should not be extrapolated to other species (Eisler, 1988a).

Among birds, LD₅₀s for arsenic compounds range from 17.4 to 3300 mg/kg bw (Eisler, 1988a). While no mortality was observed among mallard ducks fed a diet containing 100 ppm sodium arsenite for 128 days, 12% to 92% mortality was observed for ducks fed diets containing 250 to 1000 ppm arsenite (USFWS, 1964). Camardese et al. (1990) and Whitworth et al. (1991) fed mallards diets containing 30, 100, or 300 ppm sodium arsenate. While no effects were observed on behavior, growth was reduced for male ducks consuming 300 ppm arsenic and for female ducks at all exposure levels.

Barium. The soluble salts of barium, an alkaline earth metal, are toxic in mammalian systems. At low doses, barium acts as a muscle stimulant and at higher doses affects the nervous system eventually leading to paralysis. The LD₅₀ for rats is listed as 630 mg/kg for barium carbonate, 118 mg/kg for barium chloride, and 921 mg/kg for barium acetate (Lewis and Sweet, 1984).

Schroeder and Mitchener (1975a, b) exposed rats and mice to 5 mg barium/L in drinking water for their lifetime. There was a slight but significant reduction in longevity of treated male mice when measured as the mean age at death of the last surviving 10% of animals. The overall average life span of the group, however, was about the same as the control group. In another study, Perry et al. (1983) exposed rats to 0, 1, 10, or 100 ppm barium for up to 16 months. A significant increase in average blood pressure was observed in the highest dose group; a slight but statistically significant increase was seen in the 10 ppm dose group. Information on developmental and reproductive toxicity of barium to mammals is not available.

The LD₅₀ of barium to chickens is 623 mg/kg (Johnson et al., 1960). Johnson et al. (1960) report that while chickens will tolerate 1000 ppm barium in their diet without adverse effects, 2000 ppm reduces growth, 8000 ppm produces 50% mortality in 4 weeks, and diets containing 16,000 or 32,000 ppm barium are 100% lethal.

Cadmium. While there is little information to indicate that this relatively rare metal is biologically essential or beneficial, Cd has been suggested as the cause of various deleterious effects to wildlife (Eisler 1985a). Mammals and birds are comparatively resistant to the biocidal properties of Cd, which include growth retardation, anemia, and testicular damage. Cd tends to bioaccumulate in the liver and kidney, eventually acting as a cumulative toxin. Cd residues of 2 ppm whole body fresh weight are evidence of Cd contamination, and residues >5 ppm whole animal fresh weight may be life-threatening (Eisler 1985a).

The lowest oral dose resulting in death for rats was 250 mg Cd/kg body weight (EPA 1980a). Weigel et al. (1987) fed rats 0.24, 0.85, or 2.25 mg/kg Cd in diet for 8 weeks. Concentrations

≥ 0.85 mg/kg resulted in reduced food intake, reduced body weights, and reduced enzyme activity, but no hematological effects were noted. Ma et al. (1991) determined that an average cadmium intake of 15 mg/kg/day corresponded with critical renal metal loads of 120 mg/kg, a level indicative of adverse health effects. Rats on a diet with 5 ppm Cd suffered shortened lifespans (Schroeder et al. 1965). Cd at 50 ppm in the diet depleted iron from rat livers (Whanger 1973). Rats eating diets with 7.15 ppm Cd (as CdO) exhibited growth reductions, but those consuming a diet with 2.80 ppm Cd did not (Weigel et al. 1984). In a 3 generation reproductive study, the population of mice exposed to 1 ppm CdCl₂ in their drinking water died out after the second generation (Schroeder and Mitchner 1971). Rats receiving > 6 mg Cd/kg body weight daily during pregnancy gave birth to malformed fetuses (Ferm and Layton 1981).

No mortality was observed among adult mallard ducks fed diets containing 0, 2, 20, and 200 ppm Cd, however egg production was significantly reduced in the group consuming 200 ppm Cd (White and Finley 1978). In addition, the testes of males in the 200 ppm Cd group atrophied and the spermatogenic process was disrupted (White et al. 1978). Among mallard ducklings, 20 ppm Cd in the diet produces mild to severe kidney lesions, reduces packed cell volume and hemoglobin concentrations in the blood (Cain et al. 1983). Avoidance behavior of black ducklings is impaired by diets containing 40 ppm Cd (Heinz and Haseltine 1983).

Copper. Copper occurs naturally in elemental form and as a component of many minerals. It is an essential nutrient that is normally present in a wide variety of tissues (ATSDR, 1990; EPA, 1987c). Because of its high electrical and thermal conductivity, it is widely used in the manufacture of electrical equipment. Common copper salts, such as the sulfate, carbonate, cyanide, oxide, and sulfide are used as fungicides, as components of ceramics and pyrotechnics, for electroplating, and for numerous other industrial applications (ACGIH, 1986). The largest anthropogenic releases of copper to the environment result from mining operations, agriculture, solid waste, and sludge from sewage treatment plants. Natural discharges to air and water, such as windblown dust and volcanic eruptions, may be significant (ATSDR, 1990).

Copper is a component of a number of metalloenzymes such as catalase, peroxidases, and cytochrome oxidase and is essential for the utilization of iron (Goyer, 1991; Stokinger, 1981). Although most copper salts occur in two valence states, as cuprous (Cu⁺) or cupric (Cu²⁺) ions, the biological availability and toxicity of copper is most likely associated with the divalent state (ATSDR, 1990). Copper sulfate is the most common copper salt. Copper is soluble in nitric acid and hot sulfuric acid, very slightly soluble in hydrochloric acid and ammonia, and insoluble in water (Stokinger, 1981).

The metabolism of copper involves mainly its transfer to and from various organic ligands, most notably sulfhydryl and imidazole groups on amino acids and proteins (ATSDR, 1990). The liver is one of the main organs involved in the storage and metabolism of copper. Absorption of ingested copper occurs primarily in the upper gastrointestinal tract (EPA, 1987c). Soluble copper compounds (oxides, hydroxides, citrates) are readily absorbed but water-insoluble compounds (sulfides) are poorly absorbed (Venugopal and Luckey, 1978). Zinc, molybdenum, and other metals may decrease dietary copper absorption (USAF, 1990).

In animal studies, oral exposure to copper caused hepatic and renal accumulation of copper, liver and kidney necrosis at doses of ≥ 100 mg/kg/day, and hematological effects at

doses of 40 mg/kg/day (EPA, 1986; Haywood, 1985; Rana and Kumar, 1978; Gopinath et al., 1974; Kline et al., 1971). Oral or intravenous administration of copper sulfate can increase fetal mortality and developmental abnormalities in experimental animals (Lecyk, 1980; Ferm and Hanlon, 1974). Rat oral LD₅₀ values for various copper compounds are 140 mg/kg for copper chloride (CuCl₂); 470 mg/kg for copper oxide (Cu₂O); 940 mg/kg for copper nitrate (Cu(NO₃)₂·3H₂O); and 960 mg/kg for copper sulfate (CuSO₄·5 H₂O) (Stokinger, 1981). Deaths in animals given lethal doses of copper have been attributed to extensive hepatic centrilobular necrosis (USAF 1990).

In a 90-day subchronic study with copper cyanide (CuCN), high mortality, attributed to hemolytic anemia, was seen in both male and female rats receiving 50 mg/kg/day by gavage, but not in those receiving $\leq$ 5 mg/kg/day (EPA 1986c). In general, male rats appeared to be more sensitive to the effects of CuCN than female rats. Rats receiving 500 ppm copper in their diet (about 5 mg/day) appeared normal, while rats receiving 1000 ppm exhibited depressed growth, those at 2000 ppm hardly grew at all, and those on a 4000 ppm diet lost weight rapidly and died (Boyden et al. 1938). Salt licks containing 5–9% copper sulfate caused anorexia, hemolytic anemia, icterus, and hemoglobinuria, followed by death within 2 days in sheep using the licks (Gopinath et al. 1974). The estimated ingested dose was 40–49 g over a 25- to 86-day period. Lecyk (1980) observed reduced litter size, decreased fetal weights, and skeletal abnormalities in the offspring of mice fed diets supplemented with 3000 or 4000 ppm copper sulfate (155 or 207 mg copper/kg/day, respectively) for one month prior to gestation and on days 0–19 of gestation.

Aulerich et al. (1982) reported an increased mortality rate in the offspring of minks fed a diet supplemented with > 3 mg copper/kg/day as copper sulfate for 50 weeks. Although kit mortality was greater and litter mass was reduced relative to controls, reproductive performance of mink fed diets supplemented with up to 200 ppm copper for 357 days was within the normal range for the species (Aulerich et al., 1982). Lifetime exposure to 42.4 mg copper/kg/day (as copper gluconate) in drinking water caused a 12.8% decrease in the maximal lifespan in mice (Massie and Aiello, 1984).

Domestic chicks on diets ≥ 324 ppm copper grew slowly; mortality increased with dietary copper concentrations of 1270 ppm (Mayo et al. 1956). Arthur et al. (1958) observed no ill effects in chicks fed ≤ 500 ppm copper in diet up to 8 weeks of age. Dietary copper levels from 588–1176 ppm for 10 weeks exerted a toxic effect on chick growth; the minimum toxic level of copper appeared to be about 500 ppm (Mehring et al., 1960). Turkey poults tolerated 676 ppm copper in starter diets for 21 days with no deleterious effects, but copper was definitely toxic at levels > 1620 ppm (Vohra and Kratzer, 1968). Chickens given a daily dose of > 70 mg/kg of CuCO₃ died while those receiving < 60 mg/kg exhibited slight symptoms of copper poisoning but survived (Pullar, 1940). No symptoms of copper poisoning were observed in domestic mallards ingesting ≤ 29 mg/kg/day of CuCO₃, but daily intakes ≥ 55 mg/kg/day were toxic (Pullar, 1940).

Lead. Lead is a comparatively rare metal, averaging 16 ppm in the earth's crust, that is neither essential nor beneficial in living organisms (Eisler, 1988b). Lead has adverse effects on survival, growth, reproduction, development, behavior, learning, and metabolism. In general, organic lead compounds are more toxic than inorganic compounds, biomagnification of lead is minimal, and younger organisms are more susceptible to lead toxicity (Eisler, 1988b).

Acute oral doses of 5–108 mg lead/kg bw reduced rat survival (Eisler, 1988b), and rats fed diets with 5 ppm lead had shortened life spans (Schroeder et al., 1965). An acute LD₅₀ based on a single oral dose of 12 mg tetraethyllead/kg body weight was reported by Branica and Konrad (1980). Rats fed 0.5, 5, 25, or 250 ppm inorganic lead in diets over two generations exhibited no substantial developmental effects (Kimmel et al., 1980). In another study, Azar et al. (1973) fed rats a diet containing 0, 10, 50, 100, 1000, or 2000 ppm lead acetate for three generations. While the number of litters and young/litter was not affected by any dose level, growth was reduced and kidney histopathologies were observed among offspring in the 1000 and 2000 ppm treatments. Frequency of pregnancy was reduced in mice ingesting 3 mg/kg body weight tetraethyllead daily, and daily ingestion of 1.5 mg/kg tetraethyllead chloride resulted in a reduction in the success of implanted ova (Clark, 1979).

Anemia and other hematological effects were induced among pigeons orally dosed with 6.25 mg lead/kg bw/day (Anders et al., 1982). Kendall and Scanlon (1981) exposed ring doves to drinking water containing 0 or 100 ppm lead and observed no effects on time to produce eggs, egg production, or fertility. However, testes weight and sperm count was decreased among lead-exposed males. Grandjean (1976) correlated eggshell thickness and eggshell lead levels in European kestrels (*Falco tinnunculus*), suggesting that lead may cause eggshell thinning. Among American kestrels (*Falco sparverius*) fed diets containing 0, 10, or 50 ppm lead, no adverse effects survival, egg-laying, initiation of incubation, egg fertility, or eggshell thickness were observed (Pattee, 1984).

Mercury. Mercury has no known biological function and is potentially toxic to fish and wildlife. Mercury is a mutagen, teratogen, and carcinogen that adversely affects the central nervous, renal, and reproductive systems of wildlife (Eisler, 1987). Inorganic mercury compounds in aquatic systems are readily converted to organomercury by microbial action (Berlin, 1979), with organomercury compounds being more toxic than inorganic mercury compounds. Biota bioconcentrate mercury compounds which can be further biomagnified through food chains (Wren, 1986).

Daily doses of 0.1–0.5 mg/kg bw/day and dietary concentrations of 1.0–5.0 ppm are lethal to sensitive mammals (Eisler, 1987). Central nervous system toxicity, weight loss, and mortality were observed among rats fed a diet containing 250 ppm methyl mercury (MeHg) for 2 weeks (Verschuuren et al., 1976a). Rats consuming 2.5 ppm MeHg in the diet for 2 years displayed reduced growth, increased kidney weight, and altered kidney histochemistry (Verschuuren et al., 1976b). To study effects on reproduction, Verschuuren et al. (1976c) fed rats a diet containing 0, 0.1, 0.5, and 2.5 ppm MeHg for three generations. While no effects were observed among rats fed 0.1 or 0.5 ppm MeHg, offspring viability was reduced among rats in the 2.5 ppm treatment. Among mink, 93-day consumption of diets containing 1.8 to 15.0 ppm MeHg produced mortality, ataxia, anorexia, and paralysis (Wobeser et al., 1976), with the highest exposures showing the greatest effects.

The LD₅₀ for MeHg for *Coturnix* quail ranges from 14.4 to 33.7 mg/kg bw (Eisler, 1987). Growth was decreased and mortality increased among leghorn cockerels fed diets containing 6 to 18 ppm MeHg (Fimreite, 1970). Ring-necked pheasants fed diets of MeHg-treated grains displayed reduced egg production and hatchability and laid more shell-less eggs than controls (Fimreite, 1971). Heinz (1979) fed mallard ducks a diet containing 0.5 ppm MeHg

for three generations. While MeHg consumption did not affect adult weights or weight change during the reproductive season, MeHg-exposed females laid fewer eggs (with more eggs outside the nest box), produced fewer young, and displayed slightly thinner eggshells. Young of MeHg-treated adults were less responsive to maternal calls and hyper-responsive to fright stimuli.

PCBs: Polychlorinated biphenyls (PCBs) are a family of man-made chemicals consisting of 209 individual compounds with varying toxicity (ATSDR 1989). Aroclor is the trade name for PCBs made by Monsanto. Because of their insulating and nonflammable properties, PCBs were widely used in industrial applications such as coolants and lubricants in transformers, capacitors, and electrical equipment (ATSDR 1989). The United States stopped manufacturing PCBs in 1977 due to evidence that they accumulate in the environment. PCBs have become widespread environmental contaminants.

Most exposures to PCBs are oral. Absorption of PCBs following oral exposure is often >90% (ATSDR 1989). PCBs are preferentially stored in adipose tissues in animals. They may cross the placenta or be transferred to offspring through milk. PCBs with higher chlorine content (the last 2 digits of the Aroclor designation indicate the percent Cl content of the compound) tend to persist in the environment longer than those with lower Cl content, and PCBs are known to bioaccumulate and biomagnify to toxic concentrations in animals (Eisler 1986, ATSDR 1989). Chronic exposures are of particular concern. PCBs with high K_{ow} values and high numbers of chlorines in adjacent positions are generally the most toxic. Although relatively insoluble in water, PCBs are generally freely soluble in nonpolar organic solvents and in biological lipids (U.S. EPA 1980).

Sixty percent of mice fed diets containing 1,000 ppm Aroclor 1254 for 14 days died within 15 days, but none of the mice fed diets with only 250 ppm Aroclor for 14 days died (Sanders et al. 1974). These diets translate to doses of 130 and 32.5 mg/kg/day, respectively (ATSDR 1989). White-footed mice fed 10 ppm Aroclor 1254 for 18 months had fewer offspring produced and a longer time between litters than control mice (Linzey, 1987).

Feeding studies suggest a total intake of 500-2,000 mg/kg of Aroclor 1254 obtained through the diet over 1 to 7 weeks is lethal in rats (Hudson et al. 1984). Male rats consuming diets containing 0-100 ppm Aroclor 1254 for 104 weeks suffered dose-related reduced survival (NCI 1978); however, there was no effect on similarly treated female rats. Dietary concentrations of ≥ 20 ppm Aroclor 1254 reduced litter sizes in one- and two-generation reproduction studies with rats; concentrations <5 ppm had no effect (Linder et al. 1974).

Mink are one of the most susceptible mammals; dietary levels as low as 0.1 ppm fresh weight have caused death and reproductive toxicity (Eisler 1986). Diets containing 20 ppm Aroclor 1242 were lethal to mink in a 247-day experiment. The LC_{50} for chronic exposures is 6.65 ppm Aroclor 1254 for mink over a 8 month period (Ringer et al. 1981). Diets containing 5 ppm Aroclor 1242 caused complete reproductive failure (Bleavins et al., 1980). Exposure for 160 days to 3.57 ppm Aroclor 1254 resulted in 100% mortality of adult mink (Platonow and Karstad, 1973).

A chronic study was conducted over 4.5 months exposing mink to 1, 5 and 15 ppm Aroclor 1254 in the diet. There was a significant reduction in the number of offspring born alive at the 5 and 15 mg/kg exposures (Aulerich and Ringer 1977). Mink fed carp containing

1.5 ppm Aroclor 1254 for 6 months produced no offspring that survived to 24 hours (Hornshaw et al., 1983). No effects were observed in mink fed 0.64 ppm Aroclor 1254 for 160 days (Platonow and Karstad, 1973). Exposure of mink for 6 months to 1 ppm Aroclor 1254 resulted in no significant difference from controls in number of offspring, or offspring mortality (Wren et al., 1987). Therefore, the 1 ppm dose was considered to be a chronic NOAEL.

A dietary dose of 25 ppm Aroclor 1254 fed for at least a month before egg-laying in mallard ducks had no detrimental effect on reproductive success (Custer and Heinz, 1980). Dietary exposure of 5 ppm Aroclor 1254 for 39 weeks to laying hens and roosters resulted in reduced egg production, although hatchability of fertile eggs was not affected (Platonow and Reinhart, 1973). Screech owls fed 3 ppm Aroclor 1248 through two breeding seasons did not have significantly different reproductive success, relative to controls (McLane and Hughes, 1980). Exposure of pheasants to 12.5 mg/bird/week (1.8 mg/kg/d) of Aroclor 1254 for 17 weeks resulted in significantly reduced egg hatchability (Dahlgren et al. 1972). Because this study considered exposure throughout a critical lifestage (reproduction), the 12.5 mg/bird/week dose was considered to be a chronic LOAEL.

Selenium. While selenium is an essential nutrient that interacts with Vitamin E and maintains muscle integrity, it has a very narrow tolerance range; in humans, while 0.04-0.1 ppm is required in diet, 4 ppm may produce toxic effects (Eisler, 1985b). In mammals, chronic selenium poisoning is induced by diets containing 1-44 ppm selenium (Harr, 1978). Symptoms include liver cirrhosis, lameness, loss of hair, emaciation, reduced conception, and increased fetal resorption. Plants convert inorganic selenium to organic selenium compounds, thereby increasing their biological availability (Lo and Sandi, 1980).

To evaluate the effects of selenium on reproduction, Schroeder and Mitchner (1971) exposed mice to 3 ppm selenate in drinking water for three generations. This dosage level increased juvenile mortality, number of runts, and resulted in reproductive failure by the third generation. In another study, exposure to 3 ppm selenate or selenite in water for a lifetime had no effect on mouse longevity and no tumorigenicity was observed (Schroeder and Mitchner, 1972).

Selenium is both embryotoxic and teratogenic to birds, with organic selenium (selenomethionine) being more toxic than inorganic selenium (Hoffman and Heinz, 1988). Mallard ducks were fed diets containing 1, 5, 10, 25, or 100 ppm selenite (Heinz et al., 1987) or 1, 2, 4, 8, or 16 ppm selenomethionine (Heinz et al., 1989) for about 10 weeks. Exposure to 1, 5, or 10 ppm selenite or 1, 2, or 4 ppm selenomethionine in the diet had no effect on survival, growth, or reproductive success of adults. The diet containing 100 ppm selenite killed 11 of 12 adults. While only one adult receiving the 25 ppm diet died, time to laying, interval between eggs was increased, and duckling survivorship was reduced in this treatment (Heinz et al., 1987). Diets containing 8 and 16 ppm selenomethionine resulted in 6.8% and 67.9% malformed embryos, respectively. In addition, duckling survival was significantly reduced (Heinz et al., 1989).

The most visible incident of environmental selenium toxicity occurred at the Kesterson National Wildlife Refuge in California. Agricultural wastewater containing approximately 0.3 ppm selenium was used for marsh management at the refuge (Ohlendorf et al., 1986). Mean

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selenium concentrations in plants, invertebrates, and fish at the site were 22–175 ppm (dry weight). As a result, reproductive success among water birds was poor, and the incidence of embryo mortality and developmental abnormalities was dramatically increased. Raccoons on the refuge were found to bioaccumulate selenium (Clark et al., 1989). While peak births at the refuge was 2 months later than reported at other locations, no adverse effects on raccoon reproduction were observed.

Metabolism of selenium may be significantly modified through interactions with heavy metals, and selenium may provide some protection from adverse effects associated with various metals, including cadmium and mercury (Eisler, 1985). Arsenite inhibits methylation of selenium but increases fecal excretion of selenite (Venugopal and Luckey, 1978).

Thallium. Thallium is a widely distributed metal, occurring at concentrations of approximately 1 ppm in the earth's crust (Kazantzis 1979). Principal systems affected by Tl exposure include nervous and digestive; renal damage and hair loss have also been observed. Thallium sulfate, which has been widely used as a rodenticide, has an acute oral LD_{50} of 16 mg/kg (Ware 1978).

In chronic studies, rats tolerated a dose of 10 mg Tl acetate/kg, while 30 mg/kg was lethal to males by 15 weeks. All rats fed a daily dose of 0.45 mg Tl/kg died after 4 months (Kazantzis 1979). Rats exposed to 10 ppm Tl in drinking water for 2 mo accumulated Tl in testis and exhibited signs of testicular toxicity including reduced sperm motility (Formigli et al. 1986).

Bean and Hudson (1976) orally dosed 3 golden eagles with 60 and 120 mg Tl_2SO_4 /kg bw; the bird receiving 60 mg Tl_2SO_4 /kg survived while the two dosed with 120 mg Tl_2SO_4 /kg died, suggesting an LD_{50} between the doses. Oral LD_{50} 's for quail, geese, and ducks are 12, 15, and 30 mg/kg respectively (Shaw 1933). No long-term studies of thallium toxicity to birds are currently available.

Zinc. Zinc makes up about 0.002% of the earth's crust (NAS 1980). Zinc is an essential trace element in all living organisms; it assures the stability of biological molecules and structures such as DNA, membranes, and ribosomes (Eisler, 1993). It is used commercially primarily in galvanized metals and metal alloys, but zinc compounds also have wide applications as chemical intermediates, catalysts, pigments, vulcanization activators and accelerators in the rubber industry, UV stabilizers, and supplements in animal feeds and fertilizers. Zinc compounds are also used in rayon manufacture, smoke bombs, soldering fluxes, mordants for printing and dyeing, wood preservatives, mildew inhibitors, deodorants, antiseptics, and astringents (Lloyd, 1984; ATSDR, 1989). In addition, zinc phosphide is used as a rodenticide.

Zinc occurs in nature as a sulfide, oxide, or carbonate (Eisler, 1993). It is divalent in solution. In freshwater with pH >4 and <7 it exists almost exclusively as the aquo ion $(Zn(H_2O)_6)^{2+}$ (Campbell and Stokes, 1985). Zinc interacts with many chemicals, and it may diminish the toxic effects of cadmium and protects against lead toxicosis in terrestrial animals (Eisler, 1993). Background concentrations seldom exceed 0.040 mg/L in water or 200 mg/kg in soil or sediment (Eisler, 1993).

Although it is essential for normal growth and reproduction (Prasad, 1979; Stahl et al., 1989) and important to central nervous system function (Eisler, 1993), the primary toxic effect of zinc is on zinc-dependent enzymes that regulate RNA and DNA. It is most harmful to aquatic

life in conditions of low pH, low alkalinity, low dissolved oxygen, and elevated temperature. Zinc is relatively nontoxic in mammals, but excessive intake can cause a variety of effects. It is not known to be carcinogenic by normal exposure routes (Eisler, 1993).

Gastrointestinal absorption of zinc is variable (20–80%) and depends on the chemical compound as well as on zinc levels in the body and on dietary concentrations of other nutrients (EPA, 1984). Information on pulmonary absorption is limited and complicated by the potential for gastrointestinal absorption due to mucociliary clearance from the respiratory tract and subsequent swallowing. Pulmonary inflammation and changes in lung function have been observed in inhalation studies on animals (Amur et al., 1982; Lam et al., 1985; Drinker and Drinker, 1928). Zinc is present in all tissues with the highest concentrations in the prostate, kidney, liver, heart, and pancreas. Zinc is a vital component of many metalloenzymes such as carbonic anhydrase, which regulates CO₂ exchange (Stokinger, 1981).

In animals, gastrointestinal and hepatic lesions (Allen et al., 1983; Brink et al., 1959), pancreatic lesions (Maita et al., 1981; Drinker et al., 1927), anemia (ATSDR, 1989; Fox and Jacobs, 1986; Maita et al., 1981), and diffuse nephrosis (Maita et al., 1981; Allen et al., 1983) have been observed following subchronic oral exposures. Anemia and pancreatitis were the major adverse effects observed in chronic animal studies (Aughey et al., 1977; Drinker et al., 1927; Walters and Roe, 1965; Sutton and Nelson, 1937). Teratogenic effects have not been seen in animals exposed to zinc; however, high oral doses can affect reproduction and fetal growth (Ketcheson et al., 1969; Schlicker and Cox, 1967, 1968; Sutton and Nelson, 1937).

Livestock and small mammals are tolerant of extended dietary loadings > 100 times the minimum recommended daily zinc requirement (Eisler, 1993). No adverse effects on general health or reproduction were observed in dairy cows fed 1310 mg zinc/kg food (Miller et al., 1989). A diet of 4000–5000 mg zinc/kg food for 18 days resulted in fetotoxicity and poor reproduction in rats (NAS, 1979). Acute oral LD₅₀ doses of 350–800 mg zinc/kg body weight have been reported for rats (Eisler, 1993). Wlostowski et al. (1988) recommended 30 mg zinc/kg in the diet of bank voles.

Dogs on diets with up to 1000 mg zinc/kg of food for up to one year showed no measurable signs of damage (NAS, 1979). Horses ingesting > 90 mg zinc/kg body weight daily in the vicinity of a lead-zinc smelter exhibited decreased growth and death (NAS, 1979). No effects were observed in mice fed < 682 mg zinc/kg food (< 109 mg zinc/kg body weight daily) for 13 weeks, but at 6820 mg zinc/kg food adverse effects on growth and survival were documented (Maita et al., 1981). In a 37-day study involving rats, doses of 97 mg/kg-day administered as zinc carbonate in the diet had no adverse effects on the reproductivity of rats (Kinnamon, 1963). European ferrets (*Mustela putorius furo*) fed up to 500 mg zinc/kg for up to 197 days all survived with no significant histopathologies, but those fed 1500 or 3000 mg/kg diet died within 21 days (Straube et al., 1980; Reece et al., 1986). Reproduction ceased entirely in female rats ingesting a diet with 500 mg zinc/kg/day (Sutton and Nelson, 1937), possibly a result of zinc-induced anemia.

Mallards (*Anas platyrhynchos*) fed diets containing > 3000 mg zinc/kg for 30 or 60 days suffered leg paralysis, decreased food consumption, and high mortality (Gasaway and Buss, 1972; NAS, 1979). Egg production in Japanese quail (*Coturnix coturnix japonica*) hens fed 15,000 mg zinc (as ZnO)/kg feed for 7 days decreased to near zero within 3 days (Hussein et al., 1988).

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Seven percent of 14-day old quail fed 600 mg zinc (as zinc phosphide)/kg feed over 5 days died, 53% of those fed 990 mg/kg died, and 93% of those fed 1634 mg/kg died (Hill and Camardese, 1986). Domestic chicken pullets and hens on a diet with 20,000 mg zinc/kg feed for 5 days were lighter weight by day 5 and produced significantly fewer eggs for 4 weeks following treatment (Palafox and Ho-A, 1980). Eggs collected 14–28 days post-treatment had reduced fertility and hatchability. However, normal growth, egg production, fertility, and hatchability was observed 4–12 weeks post-treatment. Acute oral LD₅₀ values for zinc phosphide, a rodenticide, were between 16 and 47 mg/kg body weight in ring-necked pheasants (*Phasianus colchicus*), golden eagles (*Aquila chrysaetos*), mallards, and horned larks (*Eremophila alpestris*) (Hudson et al., 1984), but much of the biocidal action is attributed to the phosphide rather than the zinc (Eisler, 1993).

Diets containing 28, 48, 228, or 2028 mg zinc/kg for 12–44 weeks had no effect on overall egg production by domestic chickens although zinc levels were elevated in hens on the highest zinc diet (Stahl et al., 1990). All day-old chicks fed diets containing 16,000 mg zinc/kg feed for 5 weeks and 80% of those fed 8000 mg/kg died; those on a 4000 mg zinc/kg diet showed no significant reductions in growth or survival (Oh et al., 1979). In a 60-day study, doses of 170 mg/kg-day administered as zinc carbonate in the diet caused increased mortality and altered blood chemistry in mallards (Gasaway and Buss, 1972).

In chickens, adverse effects associated with zinc deficiency have been observed at <38 mg zinc/kg dry weight feed (Blamberg et al., 1960; Westmoreland and Hoekstra, 1969; Stahl et al., 1989), but concentrations of 93–120 mg/kg are suggested as adequate in the diet (Blamberg et al., 1960; Westmoreland and Hoekstra, 1969). Greater than 178 mg/kg dry weight feed is considered excessive (Stahl et al., 1989), and dietary concentrations >2000 mg/kg dry weight feed are considered toxic (NAS, 1979; Oh et al., 1979; Stahl et al., 1990). Turkey poults tolerated zinc levels up to 2000 ppm in starter diets for 21 days with no deleterious effects, but levels ≥4000 ppm resulted in marked growth depression (Vohra and Kratzer, 1968). No mortality was observed in poults on a diet containing 10,000 ppm zinc (Vohra and Kratzer, 1968), but increased mortality has been observed for chickens on diets with 3000 ppm zinc (Roberson and Schaible, 1960).

Appendix E

REPRODUCTIVE PERFORMANCE OF MINK

REPRODUCTIVE PERFORMANCE OF MINK

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1. INTRODUCTION

Plant operations and waste disposal at the Oak Ridge National Laboratory (ORNL), the Gaseous Diffusion Plant (ORGDP), and the Weapons Plant (Y-12) have introduced an assortment of potentially harmful contaminants into the surrounding environment (Ashwood et al. 1986, Suter 1990). The potential for off-reservation transport of contaminants by streams on the Oak Ridge Reservation (ORR) that empty into the Clinch and Tennessee River systems is a concern.

Contaminants of special concern include mercury (Hg) and polychlorinated biphenyls (PCB's) (Suter 1990). Elevated concentrations of Hg and PCB's have been found in fish collected from East Fork Poplar Creek (EFPC) and Bear Creek, and elevated concentrations of PCB's also have been found in fish from White Oak Creek (Loar 1990). East Fork Poplar Creek and Bear Creek originate within the Y-12 Plant and flow into Poplar Creek north of the K-25 Plant and White Oak Creek flows through ORNL. Both creeks empty into the Clinch River on the upper reach of Watts Bar Lake. In the Screening Level Risk Assessment for the Off-Site Ecological Effects in Surface Waters Downstream from the U.S. Department of Energy Oak Ridge Reservation, Suter (1990) indicated that piscivorous wildlife along the Clinch River are at risk.

Mink (*Mustela vison*) have been shown to be among the most sensitive, if not the single most sensitive, mammalian species to polychlorinated biphenyl (PCB) toxicity (Aulerich and Ringer 1977). Feeding studies conducted by Aulerich *et al.* (1971, 1973), Hornshaw *et al.* (1983), and Heaton (1992) have demonstrated the extreme sensitivity of mink to chlorinated hydrocarbon contaminants, especially PCBs, contained in fish taken from the Great Lakes. Additional studies have shown this species also to be sensitive to other halogenated hydrocarbons, including polybrominated biphenyls (Aulerich and Ranger 1979), hexachlorobenzene (Bleavins *et al.* 1988) and mercury (Hg) (Aulerich et al. 1974, Wobeser and Swift 1976, Wobeser et al. 1976). Numerous other toxicological studies with mink have been reported in the literature (Scientifur 1987, Sundqvist 1989, Leonards et al. 1994) and summarized by Calabrese *et al.* (1992). In addition, mink have been recommended as an indicator species for the goal of virtual elimination of persistent toxic substances in the Great Lakes by the International Joint Commission Virtual Elimination Task Force Biomarker Workshop (personal communication from Glen Fox, Environment Canada, Ottawa, Ontario).

Because mink are sensitive to PCB and Hg toxicity and inhabit wetland areas, they are potentially good indicators of environmental effects of these chemicals in aquatic habitats. However, mink are secretive and population densities tend to be low (male home ranges average 2,600 m in stream length, Dunstone 1993), making assessment of environmental contaminant effects in natural populations difficult. Since it is known that fish inhabiting aquatic systems downstream from the Oak Ridge Reservation (ORR) contain elevated concentrations of PCBs and Hg (Sect. 3.5.1), and that fish

are a major food item of mink, the objectives of this study were to compare biological accumulation of environmental contaminants and reproductive effects in mink fed fish collected on the ORR to accumulation and effects in mink fed fish collected from the Clinch River above the ORR, or from the ocean.

2. MATERIALS AND METHODS

2.1 Fish Collection and Diet Preparation

Fish used in mink diets were collected from the reach of Poplar Creek between East Fork Poplar Creek and the confluence of Poplar Creek with the Clinch River (on the ORR) and from the Clinch River above Melton Hill Dam near Bull Run Power Plant (above the ORR), or were ocean fish (mackerel) obtain from a commercial supplier. Fish collected on the ORR and above the ORR were identified, weighted, placed in labeled plastic bags, frozen and shipped on dry ice for overnight delivery to the Michigan State University (MSU) Experimental Fur Farm. Ocean fish were frozen and shipped directly to MSU by a commercial supplier. At MSU, fish collected from the same location were ground through a 3/8 inch plate and mixed in a paddle mixer. This process was repeated until all fish from the same location were ground and mixed together so that a homogeneous mixture was obtained. Ten aliquots of the homogeneous mixture were placed in whirlpac bags, labelled, and frozen for contaminant analyses. This process was repeated for fish collected from each source.

Five diets, each composed of 75% fish and 25% normal ranch mink chow, were prepared. Appropriate proportions of homogenized fish from prescribed locations were blended with components of normal mink diet (eggs, liver, vitamin and mineral premix, d-biotin, and cereal). The fish portion of 2 diets (A and B) contained 75% ocean fish and 75% fish collected above the ORR (Clinch River above Melton Hill Dam), respectively. These served as reference diets for this study. The fish portion of the remaining 3 diets (C, D, and E) contained 25, 50 and 75% fish collected on the ORR and 50, 25, and 0% ocean fish, respectively. All diets were formulated to meet the nutrient requirements of the mink (NRC, 1982). Diet proximate analyses were determined by MSU. Ten aliquots of each diet were placed in whirlpac bags, labelled, and frozen for contaminant analyses.

2.2 Mink Feeding Experiment

Fifty adult, natural dark mink from the MSU Experimental Fur Farm, Michigan State University (MSU), East Lansing, Michigan were uniquely identified and randomly divided into 5 groups of 2 males and 8 females per group. Mink were housed individually in wire cages (61 x 76 x 46 cm) with attached nest boxes (38 x 28 x 27 cm). Cages were suspended above the ground in open-sided sheds. Throughout the study, mink were provided food and drinking water *ad libitum* and exposed to ambient temperature and photoperiod. Mink were immunized against canine distemper, virus enteritis, infectious pneumonia, and botulism, and provided thiamine daily to prevent thiamine deficiency resulting from thiaminase in fish. Mink were acclimated to the test facilities for at least one week prior to the definitive test.

Each mink group was fed one of the prepared diets from December 1, 1993 (approximately 3 months prior to breeding) through approximately June 30, 1993 (6 weeks postpartum). Mink were weighed at the beginning of the feeding trials and at monthly intervals thereafter (except during the gestation period). They were observed daily and any behavioral changes or clinical signs of toxicity recorded.

Mating began March 1, 1994 and was confined within the respective groups. Females were given an opportunity to mate every fourth day until a confirmed mating (presence of motile spermatozoa in vaginal aspirations) was obtained. The mated females were given an opportunity for a second mating the day following the initial mating or eight days later (a standard commercial mink ranch practice). The bred females were checked daily during gestation for evidence of whelping. The gestation period of mink averages 51 days but is highly variable (42 to 65 days) due to delayed implantation. Whelped kits were counted, sexed, and weighed on the day of birth and at three and six weeks of age. Mink kits begin to consume solid feed at 21 to 24 days of age and are weaned at 6 weeks. Thus, kit body weight at 3 weeks of age provides a good indication of the lactational performance of the female. Reproductive indices measured included: number of females mated; number of females whelping; length of gestation; number of kits whelped (alive, dead); kit sex ratio; average kit body weight at birth, 3, and 6 weeks of age; and kit survival to 3 and 6 weeks of age.

Adult mink with > 30 % decrease in original body weight and all adults at the termination of the study were euthanized (CO₂). All adult mink were necropsied, organ (brain, liver, kidneys, heart, lungs, gonads, and adrenal glands) weights were recorded and samples of adipose, liver, kidney, and hair collected for residue analysis. At 6 weeks of age, 3 kits each from 3 randomly selected females from dietary groups A, B, C, and E were euthanized, liver, spleen, and kidneys weighed, and samples (liver, kidney, and remaining carcass) collected for residue analyses. Tissue samples (brain, liver, kidney, heart, lungs, and adrenal gland) also were collected from adult mink and preserved in 10% formalin for histopathologic examination.

Ten aliquots, each, of homogenized fish and mink diets, and collected mink tissues were shipped frozen to the Southwest Research Institute, San Antonio, TX for PCB (Aroclors), CB (congeners) and mercury concentration determination. Adult mink liver and fat tissues and kidney, liver, and hair tissues were analyzed for Aroclor and CB concentrations, and mercury concentration, respectively. Liver tissue also was analyzed for ethoxyresorufin-o-deethylase (EROD) activity. Kit whole carcass and liver tissue, and whole carcass and kidney tissues were analyzed for PCB and CB concentrations, and mercury concentration, respectively. Lipid concentration (% lipid) was determined for all samples analyzed for PCBs

PCB Aroclor and congener results were adjusted for lipid concentration (tissue concentrations divided by the % lipid) prior to statistical analysis. Results of contaminant analyses, physiological measurements, and reproductive parameters were statistically evaluated for differences among diet groups and between diet groups A or B and E using non-parametric (Wilcoxon or Kruskal-Wallis) and gaussian (t-test or ANOVA) tests.

3. RESULTS

The species composition of fish collected from the ORR and the Clinch River above Melton Hill Dam were similar and consisted mostly of benthic species (Table E.1). Mean mercury concentrations were significantly different among fish collected from the ORR, Clinch River, or ocean (Table E.2). Mean mercury concentrations in mink diets increased progressively from diet A through diet E (Table E.2). Correspondingly, mercury concentrations in liver, kidney, and hair of adult female mink increased progressively in mink fed diets A through E (Table E.3). Mercury concentrations in kit kidney tissue and homogenized carcass were not significantly different in offspring of mink fed diets A, B, or C, but were significantly greater ($P < 0.05$) in offspring of mink fed diet E (Table E.3).

3.1 PCB and Congener Profiles in Fish and Mink Diets

Aroclor 1260 was the dominant Aroclor detected in aliquots of homogenized fish, mink diets, and tissues of adult mink and kits, although Aroclor 1254 also was quantified in several tissue samples. Aroclor 1260 was quantified in aliquots of all diets except for diet A (75% ocean fish), in fat tissue from mink in all diet groups except diet group C, and in liver tissue of mink from diet groups D and E. Twenty-three specific congeners, including 8 coplanar congeners (non-ortho or mono-ortho congeners), were evaluated in homogenized fish, diets, liver and fat tissues of adult mink, and liver tissue and carcass of kits. Ninety-six percent of congener concentrations were significantly different among ocean, ORR, and Clinch River homogenized fish, including all but one coplanar congeners (Table E.4). In all cases where significant differences existed in homogenized fish congener concentrations among collection sites, the greatest concentrations were in fish collected from the ORR. Aroclor 1260 and 87% of the congener evaluated also were quantified in mink diets (Table E.5). Mean Aroclor 1260 concentration was significantly greater ($P < 0.01$) in diet E compared to concentrations other diets. Coplanar CBs 126 and 189 were not detected in any diets, CB 156 was detected in low concentrations in diets B, C, and D, and CBs 77 and 81 were quantified in low concentrations in diets C, D, and E, while CB 167 was only quantified in diets D and E. Concentrations of coplanar CB 118 were significantly greater ($P < 0.01$) in aliquots of diet E compared to aliquots of the other diets. Mean concentrations of CB 123 progressively increased from diet C to D, however, quantified concentrations in diet E were surprisingly lower than concentrations in diet C. Low concentrations of this CB in diet E are thought to result from matrix interference in this diet. Similarly, lower than expected concentrations were quantified for CBs 99, 101, 156, and 171 in diet E. The remaining non-planar congener concentrations were generally greatest in aliquots from diet E (Table E.5).

3.2 PCB and Congener Profile in Mink Tissues

Mean Aroclor 1260 concentration was significantly greater in liver tissue of female mink fed diet E (Table E.6). Coplanar CB 189 was quantified at low concentrations (< 21 ppb) in liver tissue from all mink fed diet E, 50% of those fed diet D, and less than 10% of those fed diets A, B, or C. Liver concentrations of CB 126 were significantly greater ($P < 0.01$) in samples collected from female mink fed diet E. Low concentrations (< 32 ppb) of CB 126 also were quantified in liver tissue from female mink fed diets B and D. Mean liver concentrations of coplanar CBs 77 and 81 were ≤ 6 ppb in all female mink regardless of diet. Mean concentrations of CBs 156 and 167 increased progressive in liver tissue from female mink fed diets A - E and were significantly greater ($P < 0.01$) in mink fed diet E compared to those fed diets A or B. Mean concentration of coplanar CBs 118 and

123 were significantly greater in liver tissue from female mink on diet E compared to concentrations in liver tissue from mink fed diets A or B. There were significant differences ($P < 0.05$) in all female mink liver tissue non-planar congener concentrations among diet groups. For all non-planar congener in female liver tissue, concentrations were significantly greater ($P < 0.05$) in tissues from diet E mink compared to diet A mink, except for concentrations of CBs 195 and 196 which were not significantly different. Similarly, mean female mink liver concentrations of all non-planar congeners were significantly greater in female mink liver from diet group E mink compared to diet group B mink, except for CBs 146, 153, 170, 180, 183, and 201 which were not significantly different between these diet groups.

Mean Aroclor 1260 concentration in fat tissue from female mink fed diet E were significantly greater than mean concentrations from female mink fed diets A or B (Table E.7). Mean concentrations of all coplanar CBs were significantly greater ($P < 0.05$) in fat tissue from female mink fed diet E compared to mean concentrations in mink fed diets A or B, except that there was no difference in CB 126 fat concentration between female mink fed diets E and B. Non-planar CB mean concentrations were significantly greater ($P < 0.05$) in fat tissue from female mink fed diet E compared to mean concentrations in mink fed diets A or B, except CBs 170, 194, and 195. There was no difference between CB 170 or 194 mean fat concentrations between female mink fed diets B or E, and mean fat concentration of CB 195 in female mink was significantly greater ($P < 0.05$) in female mink fed diet B compared to diet E.

Concentrations of coplanar CBs 77, 81, 123, 156, and 189 were < 20 ppb in liver tissue from kits in all diet groups (Table E.8). Concentrations of coplanar CBs 118, 126, and 167 were significantly greater ($P < 0.05$) in liver from diet E kits compared to those from diets A, B, or C. Concentrations of non-planar CBs 101, 151, 171, and 195 were < 15 ppb in liver tissue from kits in all diet groups. Concentrations of the remaining non-planar CBs quantified were greater in liver tissue of diet E kits.

The pattern of concentrations of coplanar CBs in kit carcass homogenates from the various diets were similar to those observed in kit liver tissue (Table E.9). Except, the concentration of coplanar CB 126 was < 25 ppb in kit carcass homogenates and the concentration of CB 156 was significantly greater ($P < 0.05$) in kit carcass homogenates from diet group E compared to other diet groups. Concentration patterns of non-planar CBs in the various diet groups also were similar in carcass homogenates compared to concentrations in liver tissue. Except concentrations of CBs 151 and 196 were the only CBs with concentrations < 25 ppb. Concentrations of all other CBs quantified were greater in homogenized carcasses of kits from diet group E.

3.3 Physiological and Reproductive Effects

Two mink from diet group A, one male and one female, died during the experimental period. The male died on March 18, 1994 from hemorrhagic and necrotizing cystitis and the female died on April 24, 1994 due to complications during parturition. In addition to these adult mink, kits from one female in diet group B developed staph infections and all but one diet prior to 6 weeks of age.

One, 2, and 4 females did not whelp in diet groups A and B, D, and C, respectively (Table E.10). Two females that did not whelp (1 from diet group A and 1 from diet group C) had cyst in

the reproductive tracts that probably interfered with normal reproduction. Two females that did not whelp (1 from diet group C and 1 from diet group D) had no placental scars in the uterus and therefore probably were not pregnant. The reason the remaining 4 females did not whelp is unknown.

Mean whole body weights of female mink were not significantly different among diet groups at the beginning of the experimental period, however, mean weights of females in diet group E were significantly less ($P=0.03$) than mean weights of females in diet group A at the end of the experimental period (Table E.10). Mean female relative organ weights (organ weights/body weight) were not significantly different among diet groups. At 6 weeks of age, mean whole body weights were significantly lower ($P=0.004$) in male kits from diet group E compared to those from diet group A. A similar trend was observed in 6 week old female kits, although differences were not statistically significant. Mean relative kidney weights were significantly lower ($P=0.003$) in kits from diet group B ($\bar{x} = 1.0$ g) compared to those from diet group E ($\bar{x} = 1.3$ g). Kit mean relative liver and spleen weights were not significantly different among diet groups. No histological lesions were attributed to diets.

Mean litter size was significantly reduced ($P=0.01$) in diet group E compared to diet groups A, B, and C but not diet group D (Table E.10). Liver EROD activity was significantly increased in adult female mink from diet groups D and E compared to those from diet group A (Table E.10).

Although concentrations of mercury and PCBs were greater in fish collected from streams located on the ORR and these contaminants were higher in diets fed to mink with increasing percentage of ORR fish, reproductive effects were only noted in mink fed 75% ORR fish. Liver EROD activity, a sensitive biomarker of exposure to PCBs increased in mink fed diets containing 50% and 75% fish collected from the ORR.

Although fish are a major food item in the diet of wild mink, the proportion of fish in their diets normally does not exceed 40-60%. However, in addition to fish, concentrations of contaminants in other food items (crayfish, frogs, muskrat, ducks, and rodents) need to be evaluated in assessing effects of contaminants on mink living on the ORR.

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E-11**Table E.1. Percent by weight of the most common fish species collected from the ORR
and Clinch River above Melton Hill Dam**

Common name	ORR %	Weight kg	Clinch River %	Weight kg
Sucker	17	280	3	12
Carp	20	330	24	97
Catfish	15	248	13	53
Shad	7	116	6	24
Buffalo	17	280	42	170
Other species	24	396	12	49
TOTALS	100	1,650	100	405

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Table E.2. Mean mercury concentrations (ppm, wet wt) in homogenized fish¹ collected on the ORR², Clinch River above the ORR³, and from the ocean⁴ and diets fed to mink

	N ⁵	MEAN ⁶	SE	MIN	MAX
LOCATION					
On the ORR	10	0.35 ^a	0.03	0.17	0.43
Clinch River	10	0.07 ^b	0.00	0.05	0.09
Ocean	10	0.03 ^c	0.00	0.02	0.04
DIET					
A ⁷	10	0.02 ^a	0.00	0.02	0.03
B ⁸	10	0.05 ^b	0.00	0.04	0.06
C ⁹	10	0.09 ^c	0.00	0.08	0.11
D ¹⁰	10	0.15 ^d	0.01	0.12	0.18
E ¹¹	10	0.22 ^c	0.01	0.16	0.24

¹Various fish species.

²Poplar Creek between East Fork Poplar Creek and confluence with the Clinch River.

³Above Melton Hill Dam near Bull Run Power Plant.

⁴Mackerel purchased from commercial supplier.

⁵Number of aliquots analyzed.

⁶Means followed by different letters are significantly different, $P < 0.05$.

⁷75% ocean fish, 25% ranch mink diet.

⁸75% fish collected from the Clinch River above the Oak Ridge Reservation (ORR), 25% ranch mink diet.

⁹25% fish collected from Poplar Creek on the ORR, 50% ocean fish, 25% ranch mink diet.

¹⁰50% fish collected from Poplar Creek on the ORR, 25% ocean fish, 25% ranch mink diet.

¹¹75% fish collected from Poplar Creek on the ORR, 25% ranch mink diet.

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Table E.3. Mercury concentration (ppm, wet wt) in tissues from female mink fed (n=8/diet) various diets¹ and their 6-week-old kits

		Diet A	Diet B	Diet C	Diet D	Diet E
ADULT FEMALE MINK						
Liver Hg	Mean ²	0.41 ^a	0.61 ^a	1.06 ^a	1.93 ^b	3.67 ^c
	SE	0.07	0.06	0.10	0.15	0.32
	Range	0.17-0.8	0.47-0.87	0.74-1.49	1.26-2.47	2.52-5.20
Kidney Hg	Mean	0.84 ^a	1.25 ^{ab}	2.22 ^{bc}	3.47 ^{cd}	4.35 ^d
	SE	0.13	0.18	0.35	0.52	0.34
	Range	0.25-1.46	0.53-1.96	1.24-4.22	2.38-7.00	3.33-6.25
Hair Hg	Mean	3.79 ^a	7.43 ^b	7.71 ^b	13.44 ^c	19.03 ^d
	SE	0.26	0.55	0.63	0.79	0.57
	Range	2.20-4.61	5.05-9.70	4.38-9.62	10.2-15.6	16.8-21.4
KITS						
Carcass	Mean	0.02 ^a	0.03 ^a	0.05 ^a		0.20 ^b
	SE	0.004	0.003	0.003		0.02
	Range	0.01-0.05	0.02-0.05	0.04-0.06		0.10-0.30
	N	9	9	8		9
Kidney Hg	Mean	0.03 ^a	0.03 ^a	0.06 ^a		0.19 ^b
	SE	0.001	0.003	0.003		0.02
	Range	0.02-0.04	0.02-0.04	0.05-0.07		0.11-0.31
	N	9	9	8		9

¹Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet D = 50% fish collected on the Oak Ridge Reservation and 25% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

²Means with different superscripts are significantly different, P<0.05.

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Table E.4. Mean¹ ± SE lipid adjusted Aroclor 1260 and PCB congener concentrations (ppm, wet wt) in homogenized fish² collected on the ORR³, Clinch River above the ORR⁴, and from the ocean⁵

	Ocean	Clinch River	ORR
CB 77	0.022 ^a ± 0.000 (10)	0.039 ^b ± 0.001 (10)	0.190 ^c ± 0.004 (10)
CB 81	0.053 ^a ± 0.001 (10)	0.592 ^b ± 0.062 (10)	1.419 ^c ± 0.262 (9)
CB 99	0.022 ^a ± 0.000 (10)	0.076 ^b ± 0.011 (10)	0.894 ^c ± 0.015 (10)
CB 101	0.022 ^a ± 0.000 (10)	0.142 ^b ± 0.022 (10)	0.609 ^c ± 0.010 (10)
CB 118	0.022 ^a ± 0.000 (10)	0.468 ^{ab} ± 0.219 (10)	1.150 ^b ± 0.030 (9)
CB 123	0.022 ^a ± 0.000 (10)	0.039 ^{ab} ± 0.001 (10)	0.051 ^b ± 0.010 (10)
CB 126	0.022 ^a ± 0.000 (10)	0.039 ^b ± 0.001 (10)	0.041 ^b ± 0.001 (10)
CB 128	0.022 ^a ± 0.000 (10)	0.178 ^b ± 0.003 (10)	0.636 ^c ± 0.012 (10)
CB 138	0.022 ^a ± 0.000 (10)	0.706 ^b ± 0.014 (10)	1.611 ^c ± 0.052 (9)
CB 146	0.022 ^a ± 0.000 (10)	0.388 ^b ± 0.007 (10)	0.822 ^c ± 0.023 (10)
CB 151	0.039 ^a ± 0.002 (10)	0.496 ^b ± 0.008 (10)	1.731 ^c ± 0.048 (10)
CB 153	0.074 ^a ± 0.002 (10)	2.813 ^b ± 0.082 (10)	4.733 ^c ± 0.123 (9)
CB 156	0.022 ^a ± 0.000 (10)	0.039 ^b ± 0.001 (10)	0.078 ^b ± 0.037 (10)
CB 167	0.022 ^a ± 0.000 (10)	0.044 ^b ± 0.003 (10)	0.193 ^c ± 0.003 (10)
CB 170	0.022 ^a ± 0.000 (10)	0.455 ^b ± 0.010 (10)	1.315 ^c ± 0.025 (10)
CB 171	0.022 ^a ± 0.000 (10)	0.039 ^b ± 0.001 (10)	0.041 ^b ± 0.001 (10)
CB 180	0.022 ^a ± 0.000 (10)	3.021 ^b ± 0.099 (10)	3.592 ^c ± 0.088 (10)
CB 183	0.022 ^a ± 0.000 (10)	0.690 ^b ± 0.012 (10)	1.000 ^c ± 0.016 (10)
CB 189	0.022 ^a ± 0.000 (10)	0.039 ^b ± 0.001 (10)	0.041 ^b ± 0.001 (10)
CB 194	0.022 ^a ± 0.000 (10)	0.376 ^b ± 0.009 (10)	0.430 ^c ± 0.006 (10)
CB 195	0.022 ^a ± 0.000 (10)	0.042 ^b ± 0.002 (10)	0.043 ^b ± 0.002 (10)
CB 196	0.022 ^a ± 0.000 (10)	0.570 ^b ± 0.014 (10)	1.660 ^c ± 0.041 (10)
CB 201	0.022 ^a ± 0.000 (10)	0.486 ^b ± 0.009 (10)	0.605 ^c ± 0.008 (10)
Aroclor 1260	0.379 ^a ± 0.008 (10)	21.917 ^b ± 0.681 (10)	28.997 ^c ± 0.659 (10)

¹Means with different superscripts are significantly different, P < 0.05.

²Various fish species.

³Poplar Creek between East Fork Poplar Creek and confluence with the Clinch River.

⁴Above Melton Hill Dam near Bull Run Power Plant.

⁵Mackerel purchased from commercial supplier.

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Table E.5. Mean $\pm$ SE lipid adjusted Aroclor 1260 and PCB congener concentrations (ppm, wet wt) in mink diets¹ (n=10/diet)

	Diet A	Diet B	Diet C	Diet D	Diet E
CB 77	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.046 $\pm$ 0.003	0.102 $\pm$ 0.002	0.116 $\pm$ 0.005
CB 81	0.027 $\pm$ 0.002	0.337 $\pm$ 0.051	0.507 $\pm$ 0.011	0.873 $\pm$ 0.022	1.158 $\pm$ 0.033
CB 99	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.276 $\pm$ 0.011	0.531 $\pm$ 0.014	0.520 $\pm$ 0.013
CB 101	0.031 $\pm$ 0.004	0.239 $\pm$ 0.032	0.288 $\pm$ 0.009	0.585 $\pm$ 0.012	0.396 $\pm$ 0.020
CB 118	0.025 $\pm$ 0.000	0.117 $\pm$ 0.010	0.192 $\pm$ 0.007	0.405 $\pm$ 0.007	0.668 $\pm$ 0.021
CB 123	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.212 $\pm$ 0.008	0.446 $\pm$ 0.008	0.076 $\pm$ 0.003
CB 126	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.027 $\pm$ 0.001	0.038 $\pm$ 0.003	0.033 $\pm$ 0.001
CB 128	0.025 $\pm$ 0.000	0.085 $\pm$ 0.003	0.104 $\pm$ 0.004	0.228 $\pm$ 0.005	0.351 $\pm$ 0.013
CB 138	0.080 $\pm$ 0.002	0.791 $\pm$ 0.087	0.331 $\pm$ 0.011	0.690 $\pm$ 0.009	1.048 $\pm$ 0.020
CB 146	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.141 $\pm$ 0.006	0.335 $\pm$ 0.007	0.501 $\pm$ 0.015
CB 151	0.025 $\pm$ 0.000	0.314 $\pm$ 0.010	0.254 $\pm$ 0.009	0.555 $\pm$ 0.009	1.058 $\pm$ 0.039
CB 153	0.025 $\pm$ 0.000	1.862 $\pm$ 0.025	0.766 $\pm$ 0.029	1.772 $\pm$ 0.026	3.126 $\pm$ 0.056
CB 156	0.025 $\pm$ 0.000	0.139 $\pm$ 0.013	0.065 $\pm$ 0.002	0.094 $\pm$ 0.015	0.033 $\pm$ 0.001
CB 167	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.027 $\pm$ 0.001	0.061 $\pm$ 0.003	0.103 $\pm$ 0.004
CB 170	0.025 $\pm$ 0.000	1.847 $\pm$ 0.964	0.154 $\pm$ 0.007	0.346 $\pm$ 0.008	0.798 $\pm$ 0.016
CB 171	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.061 $\pm$ 0.002	0.127 $\pm$ 0.003	0.033 $\pm$ 0.001
CB 180	0.025 $\pm$ 0.000	1.011 $\pm$ 0.266	0.507 $\pm$ 0.019	1.091 $\pm$ 0.018	2.292 $\pm$ 0.040
CB 183	0.025 $\pm$ 0.000	0.276 $\pm$ 0.053	0.170 $\pm$ 0.006	0.355 $\pm$ 0.007	0.573 $\pm$ 0.019
CB 189	0.025 $\pm$ 0.000	0.037 $\pm$ 0.001	0.027 $\pm$ 0.001	0.031 $\pm$ 0.000	0.033 $\pm$ 0.001
CB 194	0.025 $\pm$ 0.000	0.058 $\pm$ 0.022	0.072 $\pm$ 0.008	0.149 $\pm$ 0.020	0.245 $\pm$ 0.009
CB 195	0.025 $\pm$ 0.000	0.039 $\pm$ 0.003	0.027 $\pm$ 0.001	0.033 $\pm$ 0.002	0.033 $\pm$ 0.001
CB 196	0.025 $\pm$ 0.000	1.081 $\pm$ 0.084	0.184 $\pm$ 0.008	0.415 $\pm$ 0.008	1.071 $\pm$ 0.024
CB 201	0.025 $\pm$ 0.000	0.230 $\pm$ 0.034	0.060 $\pm$ 0.002	0.131 $\pm$ 0.003	0.338 $\pm$ 0.010
Aroclor 1260	0.169 $\pm$ 0.002	11.440 $\pm$ 0.327	4.697 $\pm$ 0.174	10.405 $\pm$ 0.250	20.670 $\pm$ 0.458

¹Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet D = 50% fish collected on the Oak Ridge Reservation and 25% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

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Table E.6. Mean $\pm$ SE lipid adjusted Aroclor 1260 and PCB congener concentrations (ppm, wet wt) in liver tissue from female mink (n=8/diet) fed various diets¹

	Diet A	Diet B	Diet C	Diet D	Diet E
CB 77	0.048 $\pm$ 0.016	0.081 $\pm$ 0.010	0.033 $\pm$ 0.004	0.095 $\pm$ 0.040	0.028 $\pm$ 0.005
CB 81	0.048 $\pm$ 0.016	0.054 $\pm$ 0.010	0.033 $\pm$ 0.004	0.095 $\pm$ 0.040	0.197 $\pm$ 0.117
CB 99	0.048 $\pm$ 0.016	0.117 $\pm$ 0.014	0.420 $\pm$ 0.061	0.962 $\pm$ 0.123	0.823 $\pm$ 0.215
CB 101	0.048 $\pm$ 0.016	0.053 $\pm$ 0.011	0.033 $\pm$ 0.004	0.145 $\pm$ 0.019	0.154 $\pm$ 0.015
CB 118	0.141 $\pm$ 0.008	0.590 $\pm$ 0.040	1.066 $\pm$ 0.153	2.157 $\pm$ 0.406	1.656 $\pm$ 0.332
CB 123	0.048 $\pm$ 0.016	0.041 $\pm$ 0.006	0.033 $\pm$ 0.004	0.095 $\pm$ 0.040	1.598 $\pm$ 0.228
CB 126	0.048 $\pm$ 0.016	0.224 $\pm$ 0.023	0.033 $\pm$ 0.004	0.095 $\pm$ 0.040	1.703 $\pm$ 0.251
CB 128	0.048 $\pm$ 0.016	0.174 $\pm$ 0.023	0.151 $\pm$ 0.024	0.353 $\pm$ 0.054	0.691 $\pm$ 0.097
CB 138	0.136 $\pm$ 0.023	2.063 $\pm$ 0.479	2.083 $\pm$ 0.224	4.816 $\pm$ 0.915	5.649 $\pm$ 0.465
CB 146	0.059 $\pm$ 0.015	0.627 $\pm$ 0.051	0.545 $\pm$ 0.055	1.188 $\pm$ 0.113	0.604 $\pm$ 0.111
CB 153	0.206 $\pm$ 0.020	5.075 $\pm$ 0.445	3.858 $\pm$ 0.365	8.063 $\pm$ 1.195	7.242 $\pm$ 1.658
CB 156	0.048 $\pm$ 0.016	0.228 $\pm$ 0.074	0.193 $\pm$ 0.037	0.480 $\pm$ 0.102	0.648 $\pm$ 0.102
CB 167	0.048 $\pm$ 0.016	0.125 $\pm$ 0.013	0.166 $\pm$ 0.020	0.244 $\pm$ 0.077	0.776 $\pm$ 0.100
CB 170	0.057 $\pm$ 0.015	2.249 $\pm$ 0.219	0.774 $\pm$ 0.144	1.971 $\pm$ 0.444	1.878 $\pm$ 0.194
CB 171	0.048 $\pm$ 0.016	0.041 $\pm$ 0.006	0.093 $\pm$ 0.013	0.217 $\pm$ 0.027	0.774 $\pm$ 0.065
CB 180	0.131 $\pm$ 0.015	6.576 $\pm$ 0.772	3.117 $\pm$ 0.390	6.980 $\pm$ 1.296	7.752 $\pm$ 0.815
CB 183	0.048 $\pm$ 0.016	0.412 $\pm$ 0.032	0.229 $\pm$ 0.024	0.479 $\pm$ 0.097	0.527 $\pm$ 0.086
CB 189	0.048 $\pm$ 0.016	0.044 $\pm$ 0.007	0.042 $\pm$ 0.007	0.137 $\pm$ 0.038	0.106 $\pm$ 0.013
CB 194	0.050 $\pm$ 0.016	1.887 $\pm$ 0.208	0.803 $\pm$ 0.086	1.795 $\pm$ 0.202	1.218 $\pm$ 0.174
CB 195	0.048 $\pm$ 0.016	0.041 $\pm$ 0.006	0.192 $\pm$ 0.018	0.457 $\pm$ 0.035	0.115 $\pm$ 0.015
CB 196	0.068 $\pm$ 0.015	2.998 $\pm$ 0.302	0.033 $\pm$ 0.004	0.095 $\pm$ 0.040	1.863 $\pm$ 0.985
CB 201	0.048 $\pm$ 0.016	2.085 $\pm$ 0.261	0.245 $\pm$ 0.084	1.448 $\pm$ 0.459	2.794 $\pm$ 0.356
Aroclor 1260	0.344 $\pm$ 0.132	0.270 $\pm$ 0.039	0.230 $\pm$ 0.021	0.723 $\pm$ 0.329	79.486 $\pm$ 8.112

¹Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet D = 50% fish collected on the Oak Ridge Reservation and 25% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

Table E.7. Mean $\pm$ SE Aroclor 1260 and PCB congener concentrations (ppm, wet wt) in fat tissue from female mink (n=8/diet) fed various diets¹

	Diet A	Diet B	Diet C	Diet D	Diet E
CB 77	0.011 $\pm$ 0.005	0.035 $\pm$ 0.006	0.046 $\pm$ 0.006	0.083 $\pm$ 0.019	0.138 $\pm$ 0.011
CB 81	0.120 $\pm$ 0.042	0.339 $\pm$ 0.061	0.280 $\pm$ 0.052	0.429 $\pm$ 0.023	0.696 $\pm$ 0.078
CB 99	0.050 $\pm$ 0.018	0.169 $\pm$ 0.029	0.786 $\pm$ 0.168	1.447 $\pm$ 0.265	1.708 $\pm$ 0.272
CB 101	0.016 $\pm$ 0.006	0.098 $\pm$ 0.020	0.107 $\pm$ 0.018	0.263 $\pm$ 0.029	0.311 $\pm$ 0.037
CB 118	0.163 $\pm$ 0.066	0.464 $\pm$ 0.089	1.461 $\pm$ 0.276	2.943 $\pm$ 0.388	3.175 $\pm$ 0.299
CB 123	0.130 $\pm$ 0.036	0.458 $\pm$ 0.088	0.033 $\pm$ 0.006	0.063 $\pm$ 0.006	2.375 $\pm$ 0.330
CB 126	0.064 $\pm$ 0.029	1.171 $\pm$ 0.212	0.196 $\pm$ 0.032	0.481 $\pm$ 0.035	1.511 $\pm$ 0.160
CB 128	0.033 $\pm$ 0.020	0.299 $\pm$ 0.048	0.352 $\pm$ 0.059	0.781 $\pm$ 0.080	1.210 $\pm$ 0.097
CB 138	0.267 $\pm$ 0.135	2.800 $\pm$ 0.609	3.464 $\pm$ 0.638	9.543 $\pm$ 1.036	9.925 $\pm$ 0.833
CB 146	0.041 $\pm$ 0.015	0.500 $\pm$ 0.104	0.600 $\pm$ 0.097	1.421 $\pm$ 0.111	1.771 $\pm$ 0.179
CB 153	0.405 $\pm$ 0.230	5.538 $\pm$ 1.069	5.195 $\pm$ 0.988	15.714 $\pm$ 1.686	15.375 $\pm$ 1.349
CB 156	0.009 $\pm$ 0.003	0.469 $\pm$ 0.084	0.409 $\pm$ 0.073	0.914 $\pm$ 0.086	1.188 $\pm$ 0.077
CB 167	0.040 $\pm$ 0.019	0.350 $\pm$ 0.055	0.621 $\pm$ 0.109	1.347 $\pm$ 0.126	1.500 $\pm$ 0.125
CB 170	0.093 $\pm$ 0.051	2.278 $\pm$ 0.471	0.800 $\pm$ 0.157	2.043 $\pm$ 0.238	3.013 $\pm$ 0.168
CB 171	0.035 $\pm$ 0.017	0.521 $\pm$ 0.093	0.488 $\pm$ 0.086	1.083 $\pm$ 0.100	1.393 $\pm$ 0.084
CB 180	0.290 $\pm$ 0.188	7.175 $\pm$ 1.544	5.264 $\pm$ 1.034	14.571 $\pm$ 1.325	14.750 $\pm$ 1.161
CB 183	0.019 $\pm$ 0.012	0.559 $\pm$ 0.102	0.368 $\pm$ 0.069	0.899 $\pm$ 0.073	1.114 $\pm$ 0.143
CB 189	0.005 $\pm$ 0.001	0.090 $\pm$ 0.019	0.041 $\pm$ 0.006	0.130 $\pm$ 0.015	0.186 $\pm$ 0.018
CB 194	0.060 $\pm$ 0.035	2.103 $\pm$ 0.475	0.918 $\pm$ 0.174	2.386 $\pm$ 0.201	2.688 $\pm$ 0.351
CB 195	0.011 $\pm$ 0.007	0.419 $\pm$ 0.078	0.033 $\pm$ 0.006	0.063 $\pm$ 0.006	0.133 $\pm$ 0.021
CB 196	0.021 $\pm$ 0.014	0.778 $\pm$ 0.163	0.426 $\pm$ 0.091	1.064 $\pm$ 0.105	1.645 $\pm$ 0.295
CB 201	0.031 $\pm$ 0.019	0.889 $\pm$ 0.151	0.477 $\pm$ 0.080	1.226 $\pm$ 0.101	1.813 $\pm$ 0.178
Aroclor 1260	3.169 $\pm$ 1.849	61.250 $\pm$ 12.560	0.261 $\pm$ 0.044	105.86 $\pm$ 11.26	128.63 $\pm$ 7.73

¹Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet D = 50% fish collected on the Oak Ridge Reservation and 25% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

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Table E.8. Mean¹ ±SE Aroclor 1260 and PCB congener concentrations (ppm, wet wt) in liver tissue from 6-week-old mink kits from dams fed diets of fish collected from various sources²

	Diet A	Diet B	Diet C	Diet E
CB 77	0.003±0.000 (9)	0.006±0.001 (9)	0.007±0.001 (8)	0.006±0.001 (9)
CB 81	0.004±0.000 (9)	0.006±0.001 (9)	0.007±0.001 (8)	0.007±0.001 (9)
CB 99	0.003 ^a ±0.000 (9)	0.006 ^a ±0.001 (9)	0.016 ^a ±0.005 (8)	0.049 ^b ±0.012 (9)
CB 101	0.004±0.000 (9)	0.006±0.001 (9)	0.007±0.001 (8)	0.006±0.001 (9)
CB 118	0.012 ^a ±0.001 (9)	0.012 ^a ±0.002 (9)	0.068 ^b ±0.014 (8)	0.138 ^c ±0.025 (9)
CB 123	0.008±0.001 (9)	0.007±0.000 (9)	0.007±0.001 (8)	0.006±0.001 (9)
CB 126	0.003 ^a ±0.000 (9)	0.007 ^a ±0.001 (9)	0.007 ^a ±0.001 (8)	0.014 ^b ±0.003 (9)
CB 128	0.003 ^a ±0.000 (9)	0.006 ^a ±0.001 (9)	0.020 ^a ±0.005 (8)	0.092 ^b ±0.034 (9)
CB 138	0.015 ^a ±0.002 (9)	0.058 ^a ±0.011 (9)	0.141 ^a ±0.033 (8)	0.547 ^b ±0.200 (9)
CB 146	0.004 ^a ±0.000 (9)	0.011 ^a ±0.002 (9)	0.033 ^a ±0.006 (8)	0.143 ^b ±0.042 (9)
CB 151	0.004±0.000 (9)	0.006±0.001 (9)	0.007±0.001 (8)	0.006±0.001 (9)
CB 153	0.011 ^a ±0.002 (9)	0.065 ^a ±0.010 (9)	0.157 ^a ±0.039 (8)	0.509 ^b ±0.137 (9)
CB 156	0.003±0.000 (9)	0.008±0.001 (9)	0.009±0.001 (8)	0.006±0.001 (9)
CB 167	0.004 ^a ±0.000 (9)	0.007 ^a ±0.001 (9)	0.009 ^a ±0.002 (8)	0.028 ^b ±0.007 (9)
CB 170	0.004 ^a ±0.000 (9)	0.054 ^a ±0.009 (9)	0.078 ^b ±0.014 (8)	0.294 ^b ±0.118 (9)
CB 171	0.003±0.000 (9)	0.008±0.001 (9)	0.007±0.001 (8)	0.006±0.001 (9)
CB 180	0.006 ^a ±0.001 (9)	0.109 ^a ±0.018 (9)	0.194 ^b ±0.040 (8)	0.629 ^b ±0.235 (9)
CB 183	0.004 ^a ±0.000 (9)	0.007 ^a ±0.000 (9)	0.013 ^a ±0.004 (8)	0.035 ^b ±0.009 (9)
CB 189	0.003±0.000 (9)	0.006±0.001 (9)	0.007±0.001 (8)	0.008±0.002 (9)
CB 194	0.004 ^a ±0.000 (9)	0.019 ^a ±0.003 (9)	0.041 ^b ±0.008 (8)	0.146 ^b ±0.055 (9)
CB 195	0.003±0.000 (9)	0.006±0.001 (9)	0.007±0.001 (8)	0.006±0.001 (9)
CB 196	0.004 ^a ±0.000 (9)	0.052 ^a ±0.011 (9)	0.084 ^b ±0.015 (8)	0.319 ^b ±0.128 (9)
CB 201	0.003 ^a ±0.000 (9)	0.014 ^a ±0.002 (9)	0.027 ^a ±0.005 (8)	0.142 ^b ±0.032 (9)
Aroclor 1260	0.099±0.016 (9)	0.151±0.099 (9)	0.058±0.009 (8)	0.048±0.008 (9)

¹Means with different superscripts are significantly different, $P \leq 0.05$.

²Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

Table E.9. Mean¹ ±SE Aroclor 1260 and PCB congener concentrations (ppm, wet wt) in carcass² of 6-week-old mink kits from dams fed diets of fish collected from various sources³

	Diet A	Diet B	Diet C	Diet E
CB 77	0.003±0.000 (9)	0.003±0.000 (9)	0.003±0.000 (8)	0.003±0.000 (9)
CB 81	0.003±0.000 (9)	0.003±0.000 (9)	0.003±0.000 (8)	0.005±0.001 (9)
CB 99	0.003 ^a ±0.000 (9)	0.009 ^a ±0.003 (9)	0.017 ^a ±0.003 (8)	0.096 ^b ±0.023 (9)
CB 101	0.003 ^a ±0.000 (9)	0.004 ^a ±0.001 (9)	0.006 ^a ±0.001 (8)	0.017 ^b ±0.002 (9)
CB 118	0.008 ^a ±0.001 (9)	0.030 ^a ±0.009 (9)	0.071 ^a ±0.018 (7)	0.245 ^b ±0.036 (9)
CB 123	0.003±0.000 (9)	0.011±0.005 (9)	0.003±0.000 (8)	0.008±0.001 (9)
CB 126	0.003±0.000 (9)	0.011±0.001 (9)	0.005±0.001 (8)	0.003±0.000 (9)
CB 128	0.003 ^a ±0.000 (9)	0.011 ^a ±0.004 (9)	0.012 ^a ±0.002 (8)	0.054 ^b ±0.007 (9)
CB 138	0.008 ^a ±0.001 (9)	0.112 ^a ±0.016 (9)	0.106 ^a ±0.021 (7)	0.634 ^b ±0.110 (9)
CB 146	0.003 ^a ±0.000 (9)	0.013 ^a ±0.002 (9)	0.019 ^a ±0.003 (8)	0.103 ^b ±0.017 (9)
CB 151	0.003±0.000 (9)	0.003±0.000 (9)	0.003±0.000 (8)	0.005±0.001 (9)
CB 153	0.009 ^a ±0.001 (9)	0.141 ^a ±0.024 (9)	0.119 ^a ±0.025 (7)	0.619 ^b ±0.096 (9)
CB 156	0.003 ^a ±0.000 (9)	0.017 ^{ab} ±0.003 (9)	0.022 ^b ±0.003 (8)	0.058 ^c ±0.008 (9)
CB 167	0.003 ^a ±0.000 (9)	0.014 ^{bc} ±0.002 (9)	0.010 ^{ab} ±0.002 (8)	0.022 ^c ±0.003 (9)
CB 170	0.003 ^a ±0.000 (9)	0.073 ^a ±0.012 (9)	0.047 ^a ±0.007 (8)	0.238 ^b ±0.036 (9)
CB 171	0.003 ^a ±0.000 (9)	0.021 ^a ±0.003 (9)	0.008 ^a ±0.004 (8)	0.017 ^b ±0.002 (9)
CB 180	0.004 ^a ±0.000 (9)	0.203 ^a ±0.026 (9)	0.121 ^a ±0.019 (7)	0.611 ^b ±0.080 (9)
CB 183	0.003 ^a ±0.000 (9)	0.011 ^a ±0.001 (9)	0.007 ^a ±0.002 (8)	0.031 ^b ±0.005 (9)
CB 189	0.003±0.000 (9)	0.003±0.000 (9)	0.003±0.000 (8)	0.008±0.001 (9)
CB 194	0.003 ^a ±0.000 (9)	0.025 ^a ±0.003 (9)	0.019 ^a ±0.004 (8)	0.089 ^b ±0.010 (9)
CB 195	0.003 ^a ±0.000 (9)	0.003 ^a ±0.000 (9)	0.004 ^a ±0.001 (8)	0.023 ^b ±0.003 (9)
CB 196	0.003±0.000 (9)	0.014±0.002 (9)	0.005±0.002 (8)	0.005±0.001 (9)
CB 201	0.003 ^a ±0.000 (9)	0.013 ^a ±0.002 (9)	0.012 ^a ±0.002 (8)	0.050 ^b ±0.009 (9)
Aroclor 1260	0.082±0.005 (9)	1.791±0.282 (9)	0.353±0.245 (8)	0.049±0.006 (9)

¹Means with different superscripts are significantly different, P<0.05. Diet groups were separated based on lipid adjusted concentrations.

²Whole body minus liver tissue.

³Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

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Table E.10. Reproductive performance of female mink fed diets of 75% fish from various sources¹

	Diet A	Diet B	Diet C	Diet D	Diet E
Females whelping	6	7	4	6	8
Female weights					
December ²	1269±64 ³	1245±63	1374±64	1258±64	1230±64
June ⁴	1168±84 ^a	1016±81	1134±81	1020±81	935±81 ^b
Gestation (days)	44.6	46.4	44.3	47.5	44.9
Kit wts (6 wks)	328±14	311±10	333±20	307±12	295±11
Females	296±38				268±37
Males	376±42 ^a				312±44 ^b
Litter size ⁵	6.9 ^a	7.3 ^a	7.8 ^a	6.0 ^{ab}	4.3 ^b
EROD ⁶	51±13 ^a	134±26 ^{ab}	124±32 ^{ab}	276±33 ^b	262.54±31 ^b

¹Diet A = 75% ocean fish, Diet B = 75% fish collected above the Oak Ridge Reservation, Diet C = 25% fish collected on the Oak Ridge Reservation and 50% ocean fish, Diet D = 50% fish collected on the Oak Ridge Reservation and 25% ocean fish, Diet E = 75% fish collected on the Oak Ridge Reservation.

²Beginning of study.

³Means followed by different superscripts are significantly different, P<0.05.

⁴End of study.

⁵Kits/female.

⁶Ethoxyresorufin-o-deethylase, pmoles/mg protein/min.

Appendix F

**CONTAMINANT ACCUMULATION AND EFFECTS
IN GREAT BLUE HERON**

CONTAMINANT ACCUMULATION AND EFFECTS IN GREAT BLUE HERON

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1. INTRODUCTION

Plant operations and waste disposal at the Oak Ridge National Laboratory (ORNL), Gaseous Diffusion Plant (ORGDP), and Weapons Plant (Y-12) have introduced an assortment of harmful contaminants into the surrounding environment (Ashwood et al. 1986, Suter 1990). The potential exist for off-reservation transport of contaminants by streams on the Oak Ridge Reservation (ORR) that empty into the Clinch River. Elevated levels of Hg and PCB's have been found in fish collected from East Fork Poplar Creek (EFPC) and from Bear Creek, and elevated levels of PCB's have been found in fish from the White Oak Creek area (Loar 1990). East Fork Poplar Creek and Bear Creek originate within the Y-12 Plant and flow into Poplar Creek north of the K-25 Plant and White Oak Creek flows through ORNL. Both empty into the Clinch River at upper Watts Bar Lake. In the Screening Level Risk Assessment for the Off-Site Ecological Effects in Surface Waters Downstream from the U.S. Department of Energy Oak Ridge Reservation, Suter (1990) identified piscivorous wildlife along the Clinch River as being at risk.

In response to this assessment, monitoring of great blue heron (*Ardea herodias*) was begun in 1991. The great blue heron was chosen as an indicator species because it (1) is predominantly piscivorous foraging along the major waterways on and downstream of the ORR, (2) is at the top of the aquatic food chain, (3) has been suggested to be a good indicator of aquatic health, (3) is well represented in the scientific literature, including toxicological literature, and, (4) satisfies necessary logistical sampling considerations. Important logistical considerations were the presence of study and reference colonies on or in close proximity to ORR and population densities to meet sampling requirements. In addition, great blue heron are highly visible, facilitating direct observation and site location.

This ongoing study seeks to assess the general health and fecundity of the ORR great blue heron population and document any contaminant-induced effects, particularly with respect to Hg and PCB exposure. Reproductive health is of particular concern, and the potential for off-site transportation of contaminants through heron body burdens is addressed.

2. STUDY SITES

Four colonies have been utilized for heron chick and egg collection. Two colonies (K25 and Melton Hill colonies) are located within 3 km of ORR and herons utilizing these colonies are potentially exposed to contaminants occurring on the reservation. The remaining two colonies (Long Island and Looney Island colonies) are located > 10 Km from the ORR and heron utilizing these colonies are assumed not to be exposed to contaminants that occur on the ORR. In general, there has been an increase in heron colonies in eastern Tennessee resulting from recent range expansion of the great blue heron in the upper Tennessee Valley (Pullin, 1990).

The K-25 colony is located within the boundaries of Oak Ridge Gaseous Diffusion Plant adjacent to Poplar Creek, which flows through this facility. The colony is located on the west bank of Poplar Creek approximately 2 km from the confluence of Poplar Creek and the Clinch River. Fluctuation of the creek water level is dependent on operations at Watts Bar Dam. Areal surveys by the Tennessee Valley Authority (TVA) established nesting activity at K-25 in 1986 and an estimated 31 nests were active in 1988 (Pullin 1990). The number of nest at this colony have remained at 25 - 50 during the 4 years of this study.

The second colony is located among three small islands in Melton Hill Lake approximately 2 km above Melton Hill Dam. This colony has been active for at least four years (personal communication, Jim Evans, TWRA, Oak Ridge National Laboratory). This colony is composed of approximately 40 active nest.

Colonies on Long Island and Looney Island served as off-site reference locations each greater than 10 km from ORR. Long Island is approximately 3 km from the confluence of the Tennessee and Clinch Rivers in the Tennessee River arm of Watts Bar Lake. The colony has been active since at least 1983 and 141 great blue heron nests were active in 1988 (Pullin 1990). Approximately 200 active nests have been observed during each year of the current study.

Looney Island is located in the Tennessee River approximately 30 km upstream of Long Island in upper Fort Loudon Reservoir. The colony has been active since at least 1992 and an estimated 100 active great blue heron nests were observed on the island during the 1993 and 1994 nesting seasons. Black-crowned night herons also were found nesting on this island during both seasons.

3. METHODS

During March - June 1992 - 1994 eggs and chicks were collected from great blue heron colonies. Nest were accessed by climbing trees using ropes and ascenders or using tree climbing spikes.

Egg collection and processing

Collected eggs were individually marked at both ends and transported to the laboratory in styrofoam containers. In the laboratory, egg length, width or

circumference, and weights were recorded. Eggs were opened by etching the shell along the greatest circumference of the longitudinal axes using a small tooth file. Contents were transferred to acid washed glass containers and examined for embryonic development. Following examination, egg contents were homogenized using a Waring Blender and 2 approximately 20 g aliquots were collected in scintillation vials for metal and PCB analyses. Vials were individually labeled and frozen prior to analyses. Egg shells were dried for >3 days at room temperature and shell weight (± 0.1 g) was recorded. Shell thickness (± 0.001 mm) was recorded as the average of 6 shell thickness measurements taken at 3 locations on each shell half using a digametic micrometer.

Mercury concentrations in homogenized egg samples collected in 1992 were analyzed by the Analytical Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, TN. Mercury concentration in homogenized egg samples collected in 1993 and 1994 and PCB concentration in homogenized egg samples collected in 1992, 1993, and 1994 was determined by Southwest Research Institute, San Antonio, TX.

Chick collection and necropsy

Collected chicks were lowered to the ground using backpacks. On the ground, a uniquely numbered tag was attached to the leg of each chick. Collected chicks were transported to the laboratory in ventilated turkey boxes prior to weighing, euthanasia, and necropsy. When possible, U.S. Fish and Wildlife bands and ORNL numbered and color coded bands were attached to chicks that were not collected.

In the laboratory, total weight (± 0.1 kg) was measured using a 5 kg spring scale and 3 hematocrit tubes of blood were taken from wing veins followed by euthanasia by asphyxiation with CO₂. Total length (from bill tip to end of tail feathers), bill length (from tip to base along dorsal ridge), wing length (from wrist to end of last primary), and tarsometatarsus length (± 1 mm) were recorded. Feathers along the dorsal feather tracts were removed and stored in zip lock plastic bags or aluminum foil prior to metal analysis. An incision was made along the abdomen and the liver, spleen, and heart were removed and weighed (± 0.01 g). Two 1 g liver samples were taken for enzyme and DNA analysis and the remaining liver was divided into two samples, approximately 20 g each, for Hg and PCB analysis. Abdominal fat samples (5 - 10 g) were collected for PCB analysis and 2 approximately 20 g muscle samples were collected from along the tibiotarsus bone for Hg and PCB analysis. All collected tissues were wrapped in aluminum foil, quick frozen in liquid N₂, and stored in permanent liquid N₂ storage containers or in -80°C freezers. Hematocrits were determined by averaging the pack cell volume of the 3 hematocrit tubes collected from each chick after centrifugation for 15 min.

To assess heron food preference and availability, fish regurgitated from chicks or found beneath nests were collected and crop contents were examined. Recognizable fish samples were archived prior to PCB and Hg analysis. Abnormalities were noted and organ somatic indices were computed.

Results of contaminant analyses, physiological measurements, and reproductive parameters were statistically evaluated for differences between colonies located on and

off the ORR. Aroclor 1260 and individual congener differences were evaluated when concentrations in at least one location (on or off ORR) were greater than 30 ppb. For congeners that were evaluated, any concentrations below detection limits were assigned a value equal to half the detection limit. Differences between locations were evaluated using a Student's t-test and, when appropriate, differences among colonies were evaluated using an ANOVA or Kruskal-Wallis test.

4. RESULTS

Mercury and chromium concentrations were significantly greater in fish collected from colonies located on the ORR compared to colonies located off the ORR (Table F.1). Although Aroclor 1260 concentrations were quantified in collected fish, no significant differences existed between on and off ORR colonies and all congener concentrations were < 20 ppb.

Egg and Chick Metal concentrations

Thirty-three and 34 eggs and 38 and 35 chicks, respectively, were collected from heron colonies on and off the ORR from 1992 - 1994. Extreme Hg concentrations were quantified in one egg from the Melton Hill colony (KE022, Hg concentration = 0.601 ppm) and one egg from the Long Island colony (LE513, Hg concentration = 0.596 ppm). The egg from the Melton Hill colony was collected from a nest with 2 chicks approximately 2 weeks of age and this egg did not show signs of development. Egg LE513 was collected from a nest that contained 3 eggs and was in an early stage of development. Both concentrations were rejected as outliers by the Dixon and Grubbs test for outlying observations and were eliminated from the data set (Taylor 1987).

No difference existed between mean mercury concentrations in eggs collected from the Long Island and Looney Island colonies (Table F.2), therefore, data from both colonies were used in calculating differences between on and off ORR mercury concentrations in eggs. However, mean mercury concentration in eggs collected from the K25 colony ($\bar{x} \pm \text{SE} = 0.17 \pm 0.02$, ppm) was significantly greater ($P < 0.001$) than the mean concentration in eggs collected from the Melton Hill colony ($\bar{x} \pm \text{SE} = 0.07 \pm 0.01$, ppm). Therefore, only mercury data from eggs collected from the K25 colony was used in statistical test for differences between on and off ORR mercury concentrations in eggs.

Mean mercury concentration in eggs collected on the ORR was significantly greater than the mean concentration in eggs collected off the ORR (Table F.2). Mean concentrations were greatest in eggs collected from the K25 colony followed in decreasing order in eggs collected from the Long Island ($\bar{x} = 0.12$ ppm) and Looney Island ($\bar{x} = 0.12$ ppm) colonies, and the Melton Hill colony ($\bar{x} = 0.07$ ppm).

Mean chromium concentration in eggs collected on the ORR was significantly greater ($P = 0.046$) than the mean concentration in eggs collected off the ORR

(Table F.2). Concentrations were greatest in eggs collected from the Melton Hill colony ($\bar{x}$ = 0.22 ppm) followed in decreasing order by concentrations in the K25 ($\bar{x}$ = 0.15 ppm), Long Island ($\bar{x}$ = 0.11 ppm), and Looney Island ($\bar{x}$ = 0.11 ppm) colonies. Arsenic was quantified in only one egg and the concentration was below the contract required detection limit.

Mean mercury concentrations were significantly greater ($P < 0.05$) in feathers and liver tissue of chicks collected on the ORR compared to those collected off the ORR (Table F.3). Mean feather mercury concentration was significantly greater in chicks collected from the K25 colony ($\bar{x}$ = 2.02 ppm) compared to feathers from chicks collected from the Melton Hill ($\bar{x}$ = 1.02 ppm), Looney Island ($\bar{x}$ = 0.97 ppm), and Long Island ($\bar{x}$ = 0.87 ppm) colonies. Mean liver mercury concentration was not significantly different between chicks collected from the K25 colony ($\bar{x}$ = 0.29 ppm) and the Looney Island colony ($\bar{x}$ = 0.25 ppm). However, mean liver mercury concentration was significantly greater in chicks collected from the K25 colony compared to chicks collected from the Melton Hill ($\bar{x}$ = 0.15 ppm) and Long Island ($\bar{x}$ = 0.12 ppm) colonies. No significant differences existed between muscle liver concentrations between colonies located on or off the ORR. Mean muscle mercury concentration was significantly greater in chicks collected from the K25 colony ($\bar{x}$ = 0.09 ppm) compared to chicks collected from the Melton Hill colony ($\bar{x}$ = 0.05 ppm). No significant differences in mean liver, muscle, or feather concentrations of arsenic or chromium were detected between chick collected on and off ORR, or among colonies (Table F.3).

Egg and Chick PCB and Congener concentrations

Mean concentrations of Aroclor 1260 and 76% of the quantified congeners were significantly greater ($P < 0.05$) in eggs collected from the K25 colony compared to those collected from the Melton Hill colony, while, no significant differences were detected in Aroclor 1260 or congener concentrations between Long Island and Looney Island eggs. Therefore, for statistical analysis between on and off ORR colonies, PCB concentrations in K25 eggs were compared to concentrations in Long Island and Looney Island eggs combined. Mean concentrations of Aroclor 1260 and 10 congeners were significantly greater in eggs collected on the ORR compared to concentrations in eggs collected off the ORR (Table F.4). Concentrations of 47% of the 30 congeners evaluated in egg homogenates were below 30 ppb. Concentrations of congeners 123 and 167 were the only coplanar congeners that differed between eggs from colonies located on and off the ORR.

Aroclor 1260 and a majority of congener concentrations were significantly greater ($P < 0.05$) in fat, liver, and muscle tissue from heron chicks collected from the K25 colony compared to those collected from the Melton Hill colony, while no differences existed between chicks collected from the Long Island and Looney Island colonies. Therefore, comparison of PCB results between on and off ORR was between the K25 colony, and Long Island and Looney Island colonies combined. Aroclor 1260 concentration was significantly greater ($P < 0.05$) in fat, liver, and muscle tissue from chicks collected on the ORR compared to concentrations in chicks collected off the

ORR. Although concentrations of all congeners were greater in fat tissue from chicks collected on the ORR, this difference was significant in only 30% of the congeners quantified (Table F.5). Congener 156 was the only coplanar congener that was significantly different in fat tissue between on and off ORR colonies.

Of the 30 congeners evaluated, 77 and 73% of the concentrations in chick muscle and liver tissue, respectively, were below 30 ppb. In chick liver tissue, concentrations of congeners 110, 118, 151, 153 and 180 differed significantly between on and off ORR colonies (Table F.6). In chick muscle tissue, concentrations of congeners 110, 118, 138, 153, and 180 differed significantly between on and off ORR colonies (Table F.7). Congener 110 and 118 were the only coplanar congener that differed between on and off ORR colonies in liver and muscle tissue, although concentrations of coplanar congeners ranged from below detection to 18 ppm in chick fat tissue.

Physiological and Reproductive Effects

No significant differences were observed in the number of eggs or chicks per nest between on and off ORR colonies (Table F.8). The mean weight of eggs collected from colonies on the ORR were significantly heavier than eggs collected off the ORR, however, there was no difference in shell thickness.

Chick weight/length ratios, liver somatic indexes, and hematocrit measurements were not different in chicks collected on and off the ORR. However, liver EROD activity and DNA F values (fraction of double stranded DNA) were significantly greater ($P < 0.05$) in chicks collected from colonies off the ORR compared to those collected on the ORR (Table F.8).

Although herons occupying the K25 colony have elevated body burdens of mercury and PCBs compared to herons occupying colonies off the ORR, the contaminant levels in tissues do not appear to effect the number of eggs laid or survival of chicks to fledging. Effects on chick survival from fledging to reproductive maturity is yet to be determined. Contaminant data from one adult heron collected on the ORR in August 1992 suggest that body burdens are much greater in adults than in chicks. Mercury concentration in muscle tissue and feathers of this adult were 1.48 and 18.2 ppm, respectively, which is greater than the maximum found in chicks collected during this study (maximum chick muscle Hg = 0.68 ppm; maximum chick feather Hg = 6.35 ppm). Similarly, Aroclor 1260 concentration in muscle tissue of this adult (89 and 38 ppm, respectively) was greater than concentrations detected in chicks (maximum chick muscle Aroclor 1260 = 4.0 ppm). Congener concentrations in this adult also were greater than concentrations found in chicks. Muscle concentrations of coplanar congeners 77, 81, 110, 118, and 123 were 1.0, 2.0, 5.0, 5.0, and 3.8, respectively, which are at least one order of magnitude greater than the maximum concentrations detected in chick muscle tissue (0.07, 0.36, 0.29, 0.21, and 0.15, respectively). This suggests that some individuals may continue to feed on the ORR after fledging, however, it is not know if the chicks that are born on the ORR return to their birth colony to reproduce. Concentrations of mercury and PCBs in eggs collected on the ORR were greater than concentrations in eggs collected off the ORR, which suggest

that at least some adults are exposed prior to egg laying. Monitoring movements of chicks after fledging as well as observations for bands placed on chicks during 1993 and 1994 will provide additional data from addressing this issue.

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Table F.1. Mean $\pm$ SE (N) concentrations (ppm, wet wt) of elements and Aroclor 1260¹ from homogenized fish² collected from great blue heron colonies located on³ and off⁴ the ORR

	ON ORR	OFF ORR	P ⁵
Mercury	0.06 $\pm$ 0.02 (13)	0.02 $\pm$ 0.00 (15)	0.030
Arsenic	0.30 $\pm$ 0.05 (13)	0.23 $\pm$ 0.03 (15)	0.238
Chromium	1.52 $\pm$ 0.54 (12)	0.37 $\pm$ 0.08 (15)	0.030
Aroclor 1260	0.20 $\pm$ 0.04 (13)	0.15 $\pm$ 0.03 (15)	0.269

¹All congeners concentration were <20 ppb.

²Various fish species collected from active nest or stomachs of collected great blue heron chicks.

³Includes the K25 and Melton Hill colonies.

⁴Includes the Long Island and Looney Island colonies.

⁵T-test P value.

Table F.2. Metal¹ concentrations (ppm, wet wt) detected in great blue heron eggs from colonies located on² and off³ the ORR during 1992-1994

	ON ORR	OFF ORR	P ⁴
Mercury			
Mean	0.17	0.12	0.009
SE	0.02	0.02	
Min	0.04	0.04	
Max	0.31	0.29	
N	24	34	
Chromium			
Mean	0.18	0.11	0.046
SE	0.03	0.01	
Min	0.05	0.06	
Max	0.84	0.21	
N	25	26	

¹Arsenic was quantified in one egg at a concentration below the contract required detection limit.

²Includes K25 colony.

³Includes Long Island and Looney Island colonies.

⁴T-test P value.

Table F.3. Metal concentrations (Mean $\pm$ SE) detected in tissues collected from great blue heron chicks from colonies located on¹ (N=38) and off² (N=35) the ORR during 1992-1994

	ON ORR	OFF ORR	P ³
Mercury			
Feather	1.71 $\pm$ 0.21	0.91 $\pm$ 0.08	0.001
Liver	0.24 $\pm$ 0.03	0.16 $\pm$ 0.02	0.028
Muscle	0.08 $\pm$ 0.01	0.09 $\pm$ 0.02	0.66
Chromium			
Feather	0.96 $\pm$ 0.17	1.16 $\pm$ 0.19	0.429
Liver	1.49 $\pm$ 0.48	1.26 $\pm$ 0.49	0.739
Muscle	1.86 $\pm$ 0.56	2.84 $\pm$ 0.81	0.322
Arsenic			
Feather	0.10 $\pm$ 0.01	0.10 $\pm$ 0.01	0.977
Liver	0.13 $\pm$ 0.03	0.12 $\pm$ 0.02	0.771
Muscle	0.15 $\pm$ 0.05	0.15 $\pm$ 0.04	0.938

¹Includes K25 and Melton Hill colonies.

²Includes Long Island and Looney Island colonies.

³T-test P value.

Table F.4. Mean $\pm$ SE (N) Aroclor 1260 and congener concentrations¹ (ppm, wet wt) in great blue heron eggs collected from colonies located on² and off³ the ORR

	ON ORR	OFF ORR	P ⁴
Aroclor 1260	1.68 $\pm$ 0.48 (24)	0.27 $\pm$ 0.08 (34)	0.008
CB 81	0.13 $\pm$ 0.04 (16)	0.08 $\pm$ 0.02 (26)	0.365
CB 99	0.09 $\pm$ 0.03 (16)	0.02 $\pm$ 0.01 (26)	0.030
CB 101	0.04 $\pm$ 0.02 (16)	0.00 $\pm$ 0.00 (26)	0.018
CB 118	0.17 $\pm$ 0.04 (16)	0.08 $\pm$ 0.02 (26)	0.062
CB 123	0.11 $\pm$ 0.04 (16)	0.01 $\pm$ 0.00 (26)	0.015
CB 138	0.29 $\pm$ 0.05 (16)	0.14 $\pm$ 0.03 (26)	0.025
CB 146	0.09 $\pm$ 0.03 (16)	0.03 $\pm$ 0.01 (26)	0.036
CB 149	0.09 $\pm$ 0.05 (8)	0.03 $\pm$ 0.01 (14)	0.288
CB 153	0.37 $\pm$ 0.07 (16)	0.16 $\pm$ 0.04 (26)	0.019
CB 158	0.04 $\pm$ 0.02 (16)	0.06 $\pm$ 0.02 (26)	0.128
CB 167	0.05 $\pm$ 0.01 (16)	0.01 $\pm$ 0.00 (26)	0.008
CB 170	0.09 $\pm$ 0.02 (16)	0.04 $\pm$ 0.01 (26)	0.012
CB 180	0.27 $\pm$ 0.06 (16)	0.11 $\pm$ 0.02 (26)	0.021
CB 183	0.06 $\pm$ 0.01 (16)	0.02 $\pm$ 0.00 (26)	0.020
CB 194	0.04 $\pm$ 0.01 (16)	0.02 $\pm$ 0.00 (26)	0.076
CB 196	0.07 $\pm$ 0.02 (16)	0.03 $\pm$ 0.01 (26)	0.059

¹Concentrations of CBs 66, 76, 77, 95, 105, 110, 114, 126, 128, 132, 151, 156, 171, and 201 were <30 ppb and are not included.

²Includes the K25 colony.

³Includes the Long Island and Looney Island colonies.

⁴T-test P value.

Table F.5. Mean $\pm$ SE (N) Aroclor 1260 and congener concentrations (ppm, wet wt) in abdominal fat from great blue heron chicks collected from colonies located on¹ and off² the ORR

	ON ORR	OFF ORR	P ³
Aroclor 1260	48.63 $\pm$ 11.71 (16)	15.70 $\pm$ 2.64 (24)	0.014
CB 66	1.21 $\pm$ 0.75 (16)	0.23 $\pm$ 0.03 (24)	0.210
CB 76	0.78 $\pm$ 0.55 (16)	0.12 $\pm$ 0.02 (24)	0.250
CB 77	0.27 $\pm$ 0.10 (16)	0.20 $\pm$ 0.04 (24)	0.556
CB 81	1.54 $\pm$ 0.44 (16)	1.28 $\pm$ 0.30 (24)	0.761
CB 95	0.84 $\pm$ 0.54 (16)	0.14 $\pm$ 0.04 (24)	0.216
CB 99	2.70 $\pm$ 1.36 (16)	0.56 $\pm$ 0.15 (24)	0.138
CB 101	2.65 $\pm$ 1.37 (16)	0.47 $\pm$ 0.15 (24)	0.134
CB 105	0.73 $\pm$ 0.36 (16)	0.13 $\pm$ 0.02 (24)	0.115
CB 110	2.40 $\pm$ 1.16 (16)	0.49 $\pm$ 0.10 (24)	0.122
CB 114	0.07 $\pm$ 0.04 (16)	0.00 $\pm$ 0.00 (24)	0.999
CB 118	1.95 $\pm$ 0.82 (16)	0.79 $\pm$ 0.11 (24)	0.182
CB 123	2.53 $\pm$ 1.09 (16)	0.63 $\pm$ 0.11 (24)	0.102
CB 126	0.54 $\pm$ 0.13 (16)	0.33 $\pm$ 0.08 (24)	0.195
CB 128	0.95 $\pm$ 0.37 (16)	0.19 $\pm$ 0.02 (24)	0.058
CB 132	0.76 $\pm$ 0.41 (16)	0.14 $\pm$ 0.02 (24)	0.146
CB 138	5.13 $\pm$ 1.44 (16)	1.70 $\pm$ 0.23 (24)	0.032
CB 146	1.70 $\pm$ 0.37 (16)	0.75 $\pm$ 0.11 (24)	0.024
CB 149	2.76 $\pm$ 0.54 (7)	1.04 $\pm$ 0.24 (12)	0.018
CB 151	0.98 $\pm$ 0.35 (16)	0.33 $\pm$ 0.06 (24)	0.084
CB 153	6.24 $\pm$ 1.35 (16)	2.47 $\pm$ 0.45 (24)	0.016
CB 156	0.31 $\pm$ 0.09 (16)	0.12 $\pm$ 0.02 (24)	0.043

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CB 158	0.19±0.14 (16)	0.21±0.08 (24)	0.905
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Table F.5.
Continued

	ON ORR	OFF ORR	P ³
CB 167	0.86±0.30 (16)	0.29±0.04 (24)	0.078
CB 170	1.57±0.34 (16)	0.54±0.07 (24)	0.010
CB 171	0.22±0.09 (16)	0.17±0.05 (24)	0.621
CB 180	4.27±0.95 (16)	1.37±0.25 (24)	0.009
CB 183	0.88±0.25 (16)	0.35±0.05 (24)	0.054
CB 194	0.63±0.12 (16)	0.38±0.05 (31)	0.078
CB 196	0.93±0.21 (16)	0.37±0.06 (24)	0.018
CB 201	0.53±0.11 (16)	0.22±0.03 (24)	0.012

¹Includes the K25 colony.

²Includes the Long Island and Looney Island colonies.

³T-test P value.

Table F.6. Mean $\pm$ SE (N) Aroclor 1260 and congener concentrations¹ (ppm, wet wt) in liver tissue from great blue heron chicks collected from colonies located on² and off³ the ORR

	ON ORR	OFF ORR	P ⁴
Aroclor 1260	0.77 $\pm$ 0.23 (18)	0.23 $\pm$ 0.03 (22)	0.029
CB 110	0.06 $\pm$ 0.02 (18)	0.02 $\pm$ 0.00 (22)	0.050
CB 118	0.05 $\pm$ 0.02 (18)	0.01 $\pm$ 0.00 (22)	0.049
CB 138	0.07 $\pm$ 0.03 (18)	0.02 $\pm$ 0.00 (22)	0.077
CB 149	0.06 $\pm$ 0.03 (8)	0.02 $\pm$ 0.00 (10)	0.209
CB 151	0.04 $\pm$ 0.02 (18)	0.01 $\pm$ 0.00 (22)	0.048
CB 153	0.10 $\pm$ 0.03 (18)	0.03 $\pm$ 0.00 (22)	0.017
CB 180	0.07 $\pm$ 0.02 (18)	0.02 $\pm$ 0.00 (22)	0.021

¹Concentrations of CBs 66, 76, 77, 95, 99, 101, 105, 114, 123, 126, 128, 132, 146, 156, 158, 167, 170, 171, 183, 194, 196, and 201 were <30 ppb and are not included.

²Includes the K25 colony.

³Includes the Long Island and Looney Island colonies.

⁴T-test P value.

Table F.7. Mean $\pm$ SE (N) Aroclor 1260 and congener concentrations¹ (ppm, wet wt) in muscle tissue from great blue heron chicks collected from colonies located on² and off³ the ORR

	ON ORR	OFF ORR	P ⁴
Aroclor 1260	1.05 $\pm$ 0.25 (18)	0.35 $\pm$ 0.08 (24)	0.015
CB 81	0.04 $\pm$ 0.01 (18)	0.04 $\pm$ 0.02 (24)	0.795
CB 110	0.06 $\pm$ 0.02 (18)	0.01 $\pm$ 0.00 (24)	0.027
CB 118	0.06 $\pm$ 0.01 (18)	0.02 $\pm$ 0.01 (24)	0.015
CB 138	0.09 $\pm$ 0.02 (18)	0.04 $\pm$ 0.01 (24)	0.033
CB 149	0.09 $\pm$ 0.03 (8)	0.03 $\pm$ 0.01 (12)	0.086
CB 153	0.16 $\pm$ 0.03 (18)	0.05 $\pm$ 0.01 (24)	0.009
CB 180	0.10 $\pm$ 0.02 (18)	0.03 $\pm$ 0.01 (24)	0.008

¹Concentrations of CBs 66, 76, 77, 95, 99, 101, 105, 114, 123, 126, 128, 132, 146, 151, 156, 167, 170, 171, 183, 194, 196, and 201 were <30 ppb and are not included.

²Includes the K25 colony.

³Includes the Long Island and Looney Island colonies.

⁴T-test P value, based on lipid adjusted concentrations.

Table F.8. Reproductive, physiological, and biomarker measurements [Mean $\pm$ SE (N)] in great blue heron from colonies located on¹ and off² the ORR during 1992-1994

	ON ORR	OFF ORR
Mean eggs/nest	3.5 $\pm$ 0.2 (26)	3.2 $\pm$ 0.2 (27)
Egg shell thickness (mm)	0.427 $\pm$ 0.01 (33)	0.410 $\pm$ 0.01 (34)
Egg weight (g) ³	69.16 $\pm$ 0.97 (33)	66.36 $\pm$ 0.97 (34)
Mean chicks/nest	2.7 $\pm$ 0.1 (55)	2.7 $\pm$ 0.2 (30)
Chick weight/length ratio	2.06 $\pm$ 0.05 (38)	2.12 $\pm$ 0.06 (35)
Liver somatic index	4.50 $\pm$ 0.16 (38)	4.64 $\pm$ 0.23 (35)
Liver EROD activity ⁴	31.9 $\pm$ 2.7 (12)	41.3 $\pm$ 3.2 (12)
DNA double-strandedness (F) ⁵	73 $\pm$ 0.03 (26)	84 $\pm$ 0.02 (27)
Hematocrit	32 $\pm$ 0.8 (38)	31 $\pm$ 0.7 (26)

¹Includes K25 and Melton Hill colonies.

²Includes Long Island and Looney Island colonies.

³Means significantly different (T-test, P=0.048).

⁴1994 data; ethoxyresorufin-o-deethylase activity (pmole/mq protein/min); means significantly different (T-test, P=0.033).

⁵Means significantly different (T-test, P=0.006), F = fraction of double-stranded DNA.

Appendix G

TABLES AND FIGURES FOR CHAPTER 5: ASSESSMENT OF RISK TO VERMIVORES AND HERBIVORES ON THE OAK RIDGE RESERVATION

Table G.1. Life history parameters for the white-tailed deer (*Odocoileus virginianus*)

Parameter	Value ^a	Comments	Reference
Body weight	68 kg (♂) 45 kg (♀) 56.5 kg (mean♂ + ♀)		Smith 1991
Food consumption rate	1.74 kg/d		Mautz et al. 1976
Water consumption rate	3.7 L/d	estimated using allometric equation ^b assuming 56.5 kg bw	
Soil consumption rate	<2% 0.0348 kg/d	assuming 2% soil and 1.74 kg/d food consumption rates	Beyer et al. 1994
Diet composition	exclusively herbivorous diet diverse and variable, depends on availability. major foods: - buds and twigs of trees and shrubs - grasses and forbs (summer) - mast and fruits (fall)		Zim et al. 1951 Smith 1991
Home range	59 - 520 ha		Marchinton and Hirth 1984
Habitat requirements	uses a wide variety of habitats; favors forest-field-farmland mosaic; population density directly related to number and distribution of forest openings		Smith 1991
Population density	0.06 /ha 0.39 - 0.78 /ha 0.1704/ha (calculated based on 2000 deer on ORR and available habitat)	eastern mixed deciduous forest - Tennessee oak-hickory forest - midwest Oak Ridge Reservation	Barber 1984 Torgerson and Porath 1984 personal communication, Jim Evans 1995

Table G.1 (continued)

Parameter	Value ^a	Comments	Reference
Behavior	generally crepuscular		Smith 1991
	active year-round; does not hibernate		

^a Suggested values for use in exposure assessment are in bold.

^b Allometric equation for estimation of water consumption for deer is:

$$WIR = 0.099(BW)^{0.90}$$

where:

WIR = water ingestion rate (L water/individual/day).

Table G.2. Life history parameters for the wild turkey (*Meleagris gallopavo*)

Parameter	Value ^a	Comments	Reference
Body weight	7.400 kg (♂) 4.222 kg (♀) 5.8 kg (mean♂ + ♀)		Dunning 1984
Food consumption rate	13.6 g/lb bw/d 0.174 kg/d	assuming 5.8 kg bw	Korschgen 1967
Water consumption rate	0.19 L/d	estimated using allometric equation ^c assuming 5.8 kg bw	
Soil consumption rate	9.3 % 0.0162 kg/d	assuming 0.174 kg/d food consumption rates	Beyer et al. 1994
Diet composition	plant material (mast, fruit, seeds, some foliage) - 90.3 % animal material (insects, crayfish, snails, salamanders) - 9.7 %		Korschgen 1967
Home range	150 - 190 ha		Pough 1951 ^b
Habitat requirements	mast-producing woodlands with associated fields and abundant water		Schorger 1966 ^b
Population density	0.03 /ha 0.06 - 0.076 /ha 0.0426 /ha (calculated based on @ 500 turkey observed on ORR and suitable habitat)	West Virginia in 'ideal' habitat Oak Ridge Reservation	Uhling 1950 ^b Pough 1951 ^b Personal Communication, Jim Evans 1995
Behavior	forage primarily on the ground roost in trees at night year-round resident; does not migrate		National Geographic Society 1987

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Table G.2 (continued)

^a Suggested values for use in exposure assessment are in bold.

^b Cited in DeGraaf et al. 1981.

^c Allometric equation for estimation of water consumption for birds is:

$$WIR = 0.059(BW)^{0.67}$$

where:

WIR= water ingestion rate (L water/individual/day).

Table G.3. Life history parameters for the short-tailed shrew (*Blarina brevicauda*)

Parameter	Value ^a	Comments	Reference
Body weight	0.015 ± 0.00078 kg	New Hampshire (field)	Schlessinger and Potter 1974
Food consumption rate	0.01 kg/d	larch sawfly diet (lab)	Buckner 1964
	0.00795 ± 0.00017 kg/d	mealworm diet (lab)	Barrett and Stueck 1976
	mean = 0.009 kg/d		
Water consumption rate	0.223 ml/g bw/d		Chew 1951
	0.033 L/d	assuming a 0.015 kg bw	
Soil consumption rate	13% of diet		Talmage and Walton 1993
	0.00117 kg/d	assuming diet of 0.009 kg/d	
Diet composition	earthworms 31.4% slugs/snails 27.1% soil/litter invert 13.2% fungi 8.4% misc. animals 8.1% coleoptera 5.9% vegetation 5.4%	percent volume in diet in summer in New York	Whitaker and Ferraro 1963
Home range	0.39 ± 0.036 ha	Manitoba bog	Buckner 1966
Habitat requirements	broad and variable but requires > 50% herbaceous cover		Miller and Getz 1977
	forest, wetlands, and grasslands. most abundant in hardwood forests with deep litter and humus.		van Zyll de Jong 1983

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Table G.3 (continued)

Parameter	Value ^a	Comments	Reference
Population density	2.3 /ha - winter 5.2 /ha - spring 9.3 /ha -summer 8.1 /ha - fall 2.5-45 /ha (median= 23 /ha)	Illinois - alfalfa, tallgrass, and bluegrass; means derived from graph. range depending on the habitat	Getz 1989
Behavior	nocturnal, semifossorial, spends little time above surface active year-round - does not hibernate		George et al. 1986 EPA 1993a
Other	appear to be unpalatable to most predators due to lateral gland		van Zyll de Jong 1983

^a Suggested values for use in exposure assessment are in bold.

Table G.4. Life history parameters for the American woodcock (*Scolopax minor*)

Parameter	Value ^a	Comments	Reference
Body weight	0.176 kg (♂) 0.219 kg (♀) 0.198 kg (mean♂+♀)		Dunning 1984
Food consumption rate	0.15 kg/d		Sheldon 1971
Water consumption rate	0.02 L/d	estimated using allometric equation ^b assuming 0.198 kg bw	
Soil consumption rate	10.4% 0.0156 kg/d	assuming diet of 0.15 kg/d	Beyer et al. 1994
Diet composition	primarily earthworms (58 % - ~99 %) plus other ground- dwelling invertebrates		Sperry 1940 Krohn 1970 Miller and Causey 1985 Stribling and Doerr 1985
Home range	10.5 ha (singing ♂) 73.6 ha (active ♂) 3.1 ha (inactive ♂)	Pennsylvania - mixed forest fields	Hudgins et al. 1985
Habitat requirements	Breeding: moist early successional woodlands, swamps, river bottoms, alder thickets feeding: moist open pasture, cultivated fields, stream banks		DeGraaf et al. 1981
Population density	3.4 /ha 0.2 /ha 0.034 /ha 0.21 nests/ha 0.28 /ha	North Carolina - winter untilled soy stubble untilled corn stubble rebedded corn Pennsylvania - mixed pine hardwoods based on 5.6 males/40 ha; assuming 1:1 sex ration	Connors and Doerr 1982 Coon et al. 1982 Stewart and Robbins 1958

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Table G.4 (continued)

Parameter	Value ^a	Comments	Reference
Behavior	migrate from northern breeding range to wintering range in south Atlantic and gulf coast states. early migrants; leave wintering grounds in February, arrive at northern breeding grounds 1st March.		Sheldon 1971

^a Suggested values for use in exposure assessment are in bold.

^b Allometric equation for estimation of water consumption for birds is:

$$WIR = 0.059(BW)^{0.67}$$

where:

WIR = water ingestion rate (L water/individual/day).

Table G.5. Contaminant concentrations in soil (mg/kg) on the ORR

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95 % UCB
BCVOU1	1,1,1-trichlorethane	22	0	22	0.0119	NA	0.006	0.032	NA ^b
BCVOU1	1,1,2,2-Tetrachloroethane	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	1,1-Dichlorethane	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	1,2-Dichlorethane	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	1,2-Dichlorethane	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	4,4-DDD	20	0	20	0.1083	NA	0.0038	0.48	NA
BCVOU1	4,4-DDE	20	1	19	0.1081	0.0390	0.0009	0.48	NA
BCVOU1	4,4-DDT	20	1	19	0.1081	0.0390	0.001	0.48	NA
BCVOU1	Acetone	22	14	8	0.0361	0.0075	0.012	0.17	0.0432
BCVOU1	Aldrin	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	Aluminum	13	13	0	12636.1538	1233.5552	7660	23100	14834.7
BCVOU1	Antimony	13	8	5	1.0308	0.3807	0.21	4.4	1.7371
BCVOU1	Arsenic	13	13	0	9.2692	2.2909	1.1	28.8	13.3522
BCVOU1	Barium	13	13	0	264.3154	77.8175	63.2	1100	403.009
BCVOU1	Benzene	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	Benzo(a)Pyrene	20	12	8	10.8110	5.0073	0.39	76	19.9008
BCVOU1	Beryllium	13	13	0	1.0508	0.2118	0.42	3.3	1.4283
BCVOU1	Bis(2-ethylhexyl) phthalate	20	11	9	3.3329	2.1316	0.051	43	0.5873

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
BCVOU1	Cadmium	13	6	7	5.3800	2.4685	0.33	31.3	10.7364
BCVOU1	Carbon tetrachloride	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	Chloroform	22	1	21	0.0116	0.0021	0.001	0.032	NA
BCVOU1	Chromium	13	13	0	48.9769	10.8778	15.9	140	68.3643
BCVOU1	Copper	13	13	0	972.0615	453.3139	7.8	5210	1779.9973
BCVOU1	Cyanide	13	0	13	0.6838	NA	0.6	0.99	NA
BCVOU1	Di-n-butylPhthalate	20	16	4	2.9991	2.1474	0.061	43	0.3164
BCVOU1	Dibenzofuran	20	10	10	1.3689	0.5334	0.068	10	2.1155
BCVOU1	Dieldrin	20	0	20	0.1083	NA	0.0038	0.48	NA
BCVOU1	DiethylPhthalate	20	0	20	3.3570	NA	0.39	43	NA
BCVOU1	Endosulfan I	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	Endosulfan II	20	0	20	0.1083	NA	0.0038	0.48	NA
BCVOU1	Endrin	20	0	20	0.1083	NA	0.0038	0.48	NA
BCVOU1	HePtachlor	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	Lead	13	13	0	287.4615	143.5150	9.7	1870	543.2465
BCVOU1	Lindane	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	Manganese	13	13	0	910.1000	141.5051	79.3	1690	1162.3027
BCVOU1	Mercury	13	12	1	18.9815	7.1889	0.06	77.7	31.8423
BCVOU1	Methoxychlor	20	0	20	0.5431	NA	0.019	2.4	NA

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
BCVOU1	Methylene chloride	22	22	0	0.0175	0.0034	0.004	0.05	0.0233
BCVOU1	Molybdenum	13	6	7	8.8554	4.0350	0.57	44.9	18.2024
BCVOU1	Nickel	13	13	0	85.1077	29.4124	8.3	339	137.5290
BCVOU1	PCB-1016	20	0	20	1.0827	NA	0.038	4.8	NA
BCVOU1	PCB-1242	20	0	20	1.0827	NA	0.038	4.8	NA
BCVOU1	PCB-1248	20	0	20	1.0827	NA	0.038	4.8	NA
BCVOU1	PCB-1254	20	13	7	1.7904	0.6140	0.022	10	2.6646
BCVOU1	PCB-1260	20	6	14	3.6508	1.8962	0.038	36	6.7408
BCVOU1	Pentachlorophenol	20	0	20	8.5035	NA	0.97	110	NA
BCVOU1	Selenium	13	11	2	1.7500	0.2889	0.6	4.1	2.2682
BCVOU1	Tetrachloroethene	22	1	21	0.0117	0.0021	0.003	0.032	NA
BCVOU1	Thallium	13	0	13	0.4531	NA	0.4	0.7	NA
BCVOU1	Tin	13	8	5	20.5231	7.3485	2.4	88.4	34.4281
BCVOU1	Toluene	22	22	0	0.3137	0.0497	0.021	0.7	0.3992
BCVOU1	Toxaphene	20	0	20	5.4305	NA	0.19	24	NA
BCVOU1	Trichloroethene	22	0	22	0.0119	NA	0.006	0.032	NA
BCVOU1	Vanadium	13	13	0	26.9462	2.7098	15	50.4	31.7758
BCVOU1	Vinyl chloride	22	0	22	0.0240	NA	0.012	0.065	NA
BCVOU1	Zinc	13	13	0	668.9077	260.5632	27.1	2850	1133.3062

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
BCVOU1	Alpha-BHC	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	alpha-chlordane	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	beta-BHC	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	Delta-BHC	20	0	20	0.0543	NA	0.0019	0.24	NA
BCVOU1	gamma-chlordane	20	0	20	0.0543	NA	0.0019	0.24	NA
LEFPC	1,1,1-trichlorethane	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	1,1-Dichlorethene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	1,2-Dichlorethene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	1,2-Dichlorethene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	4,4-DDD	115	6	109	0.0166	0.0023	0.0001	0.22	0.0006
LEFPC	4,4-DDE	114	36	78	0.0154	0.0023	0.0002	0.22	0.00228
LEFPC	4,4-DDT	115	5	110	0.0168	0.0023	0.0002	0.22	0.0014
LEFPC	Acetone	12	12	0	0.2536	0.1800	0.003	2.2	0.5768
LEFPC	Aldrin	115	11	104	0.0083	0.0012	8e-05	0.11	0.0004
LEFPC	Aluminum	150	150	0	12605.6667	377.0456	0	27900	13229.731
LEFPC	Antimony	1590	1316	274	1.2837	0.0656	0.13	53.9	0.7872
LEFPC	Arsenic	1289	1275	14	7.7788	0.1166	1.1	77.3	7.9621
LEFPC	Barium	150	150	0	121.3567	5.2507	33.7	454	130.0473

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
LEFPC	Benzene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	Benzo(a)Pyrene	113	70	43	0.4917	0.0476	0.05	3.5	0.4838
LEFPC	Beryllium	150	146	4	0.9165	0.0383	0.25	4.6	0.9781
LEFPC	Bis(2-ethylhexyl)Phthalate	113	62	51	0.3343	0.0229	0.045	1.3	0.2007
LEFPC	Cadmium	150	100	50	4.0894	0.3975	0.73	41.3	4.6446
LEFPC	Carbon tetrachloride	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	Chloroform	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	Chromium	1698	1698	0	64.6076	0.5609	6.9	217	65.5307
LEFPC	Copper	150	150	0	78.0333	7.0314	2.6	397	89.6714
LEFPC	Cyanide	36	22	14	3.0242	1.7695	0	62.6	5.8240
LEFPC	Di-n-butylPhthalate	113	33	80	0.4212	0.0190	0.045	1.3	0.1841
LEFPC	Dibenzofuran	113	9	104	0.4390	0.0158	0.052	1.3	0.1178
LEFPC	Dieldrin	115	9	106	0.0169	0.0023	0.0002	0.22	0.0015
LEFPC	DiethylPhthalate	113	2	111	0.4612	0.0134	0.16	1.3	0.1733
LEFPC	Endosulfan I	115	3	112	0.0084	0.0012	0.0001	0.11	0.0009
LEFPC	Endosulfan II	115	5	110	0.0167	0.0023	0.0003	0.22	0.0010
LEFPC	Endrin	115	9	106	0.0166	0.0023	0.0001	0.22	0.0007
LEFPC	Heptachlor	115	19	96	0.0081	0.0012	8e-05	0.11	0.0002
LEFPC	Lead	148	148	0	53.7993	4.6434	5.2	625	61.4855

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
LEFPC	Lindane	115	4	111	0.0085	0.0012	0.0002	0.11	0.0007
LEFPC	Manganese	150	150	0	1110.0367	51.1151	25.6	4270	1194.6395
LEFPC	Mercury	1720	589	1131	38.4880	3.0932	0.11	1870	41.6088
LEFPC	Methoxychlor	115	12	103	0.0835	0.0117	0.0003	1.1	0.0059
LEFPC	Methylene chloride	12	12	0	0.0373	0.0087	0.01	0.11	0.0529
LEFPC	Nickel	150	146	4	34.3673	2.1702	3.7	174	37.9061
LEFPC	PCB-1016	146	9	137	0.0896	0.0092	0.033	1.1	0.0499
LEFPC	PCB-1221	146	9	137	0.1201	0.0098	0.067	1.1	0.1005
LEFPC	PCB-1232	146	9	137	0.0896	0.0092	0.033	1.1	0.0499
LEFPC	PCB-1242	146	9	137	0.0896	0.0092	0.033	1.1	0.0499
LEFPC	PCB-1248	146	9	137	0.0896	0.0092	0.033	1.1	0.0499
LEFPC	PCB-1254	146	23	123	0.2579	0.0412	0.033	3	0.2239
LEFPC	PCB-1260	145	91	54	0.4311	0.0587	0.003	3.8	0.4655
LEFPC	Pentachlorophenol	113	2	111	1.6920	0.0927	0.067	6.4	0.3767
LEFPC	Selenium	1716	439	1277	13.5663	0.2453	0.61	110	8.7045
LEFPC	Tetrachloroethene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	Thallium	146	1	145	0.8092	0.1281	0.43	19.3	NA
LEFPC	Toluene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	Toxaphene	115	0	115	0.2729	NA	0.18	2.2	NA

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95 % UCB
LEFPC	Trichloroethene	12	0	12	0.0090	NA	0.006	0.02	NA
LEFPC	Uranium	24	24	0	9.7083	1.2757	1.98	25.59	11.8948
LEFPC	Vanadium	150	150	0	26.8927	0.8537	9.6	92.7	28.3057
LEFPC	Vinyl chloride	12	0	12	0.0182	NA	0.012	0.04	NA
LEFPC	Zinc	1701	521	1180	179.9126	15.5480	14	7640	166.1992
LEFPC	Alpha-BHC	115	0	115	0.0085	NA	0.0018	0.11	NA
LEFPC	Alpha-chlordane	115	39	76	0.0730	0.0121	0.0001	1.1	0.0025
LEFPC	Beta-BHC	115	0	115	0.0085	NA	0.0018	0.11	NA
LEFPC	Delta-BHC	115	5	110	0.0084	0.0012	6e-05	0.11	0.0003
LEFPC	Gamma-chlordane	115	33	82	0.0727	0.0121	8e-05	1.1	0.0014
K-1407 OU	1,1,1-trichlorethane	37	1	36	0.0155	0.0005	0.001	0.02	NA
K-1407 OU	1,1-Dichlorethane	37	0	37	0.0159	NA	0.012	0.02	NA
K-1407 OU	1,2-Dichlorethane	37	0	37	0.0159	NA	0.012	0.02	NA
K-1407 OU	1,2-Dichlorethane	37	3	34	0.0171	0.0007	0.012	0.033	0.0277
K-1407 OU	Acetone	37	11	26	0.0285	0.0015	0.008	0.042	0.0188
K-1407 OU	Aluminum	81	81	0	26562.9630	1298.3185	7600	69000	28723.527
K-1407 OU	Antimony	81	1	80	7.1506	0.7359	4.8	50	NA
K-1407 OU	Arsenic	81	35	46	12.4333	1.1038	5	50	13.0681

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
K-1407 OU	Barium	81	81	0	110.4938	8.8823	25	600	125.2752
K-1407 OU	Benzene	37	0	37	0.0159	NA	0.012	0.02	NA
K-1407 OU	Beryllium	81	81	0	1.0159	0.0667	0.25	4.9	1.1269
K-1407 OU	Boron	81	38	43	6.4191	1.1358	0.4	59	8.3996
K-1407 OU	Cadmium	81	70	11	1.8799	0.1743	0.3	8.5	2.1492
K-1407 OU	Carbon tetrachloride	37	0	37	0.0159	NA	0.012	0.02	NA
K-1407 OU	Chloroform	37	4	33	0.0156	0.0004	0.006	0.024	0.0119
K-1407 OU	Chromium	81	81	0	61.0370	5.3044	18	240	69.8642
K-1407 OU	Copper	81	79	2	40.8537	4.6847	0.51	190	48.6398
K-1407 OU	Di-n-butylphthalate	6	6	0	0.0172	0.0007	0.016	0.02	0.0185
K-1407 OU	Lead	81	78	3	30.6753	1.5668	5.8	72	32.9964
K-1407 OU	Manganese	81	81	0	1184.7778	102.4519	86	3900	1355.2705
K-1407 OU	Mercury	64	28	36	4.7250	0.9668	1	40	6.3965
K-1407 OU	Methylene chloride	37	37	0	0.0175	0.0022	0.003	0.036	0.0212
K-1407 OU	Molybdenum	81	28	53	1.8006	0.1551	0.96	10	1.5498
K-1407 OU	Nickel	81	81	0	192.1790	35.4005	5	1500	251.0899
K-1407 OU	Selenium	81	1	80	7.1519	0.7359	4.8	50	NA
K-1407 OU	Strontium	81	81	0	18.1420	1.5188	1.8	64	20.6695
K-1407 OU	Tetrachloroethene	37	8	29	0.0232	0.0046	0.005	0.17	0.0243

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
K-1407 OU	Toluene	37	11	26	0.0115	0.0012	0.0009	0.02	0.0010
K-1407 OU	Trichloroethene	37	11	26	0.0246	0.0040	0.009	0.13	0.0281
K-1407 OU	Uranium	386	353	33	143.6944	68.1672	0.108	26190	255.8501
K-1407 OU	Vanadium	81	81	0	38.9753	1.4213	14	75	41.3405
K-1407 OU	Vinyl chloride	37	0	37	0.0317	NA	0.025	0.04	NA
K-1407 OU	Zinc	81	81	0	59.7778	2.8203	11	140	64.4711
WAG 1	1,1,1-trichlorethane	168	12	156	0.0077	0.0005	0.002	0.034	0.0033
WAG 1	1,1-Dichlorethane	168	2	166	0.0076	0.0004	0.005	0.034	0.0060
WAG 1	1,2-Dichlorethane	168	2	166	0.0076	0.0004	0.005	0.034	0.0060
WAG 1	1,2-Dichlorethane	168	4	164	0.0076	0.0004	0.002	0.034	0.0023
WAG 1	4,4-DDD	63	1	62	0.0214	0.0013	0.017	0.09	NA
WAG 1	4,4-DDE	63	1	62	0.0218	0.0014	0.017	0.09	NA
WAG 1	4,4-DDT	65	3	62	0.0211	0.0012	0.0076	0.09	0.0101
WAG 1	Acetone	168	107	61	0.0278	0.0024	0.002	0.23	0.0293
WAG 1	Aldrin	67	0	67	0.0105	NA	0.0083	0.045	NA
WAG 1	Aluminum	136	135	1	12152.1588	558.6427	13.6	35200	13085.439
WAG 1	Antimony	49	25	24	6.1265	0.3790	2.5	17.4	6.0617
WAG 1	Arsenic	136	132	4	9.0118	0.5659	1.2	29.4	9.7694

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 1	Barium	136	135	1	107.4636	4.7336	0.45	410	115.3482
WAG 1	Benzene	168	3	165	0.0076	0.0004	0.003	0.034	0.0031
WAG 1	Benzo(a)Pyrene	123	58	65	0.6776	0.1273	0.039	12	0.7257
WAG 1	Beryllium	137	131	6	0.9493	0.0369	0.19	2.6	1.0127
WAG 1	Bis(2-ethylhexyl)Phthalate	123	85	38	0.4584	0.0746	0.022	8.5	0.4414
WAG 1	Boron	40	37	3	1204.9650	329.8646	4.8	7000	1761.2341
WAG 1	Cadmium	137	66	71	1.7696	0.1478	0.22	10.3	1.9618
WAG 1	Carbon tetrachloride	168	2	166	0.0076	0.0004	0.005	0.034	0.0060
WAG 1	Chloroform	168	44	124	0.0098	0.0017	0.001	0.24	0.0090
WAG 1	Chromium	136	135	1	28.9507	2.4147	2.3	189	32.9578
WAG 1	Copper	136	132	4	19.6249	1.5910	0.72	125	22.2562
WAG 1	Cyanide	65	1	64	4.6813	0.3108	0.0001	8	NA
WAG 1	Di-n-butylphthalate	122	73	49	0.7199	0.0595	0.044	2.9	0.7003
WAG 1	Dibenzofuran	123	10	113	0.5403	0.0512	0.029	5.5	0.1746
WAG 1	Dieldrin	64	0	64	0.0213	NA	0.017	0.09	NA
WAG 1	Diethylphthalate	123	10	113	0.5785	0.0578	0.022	5.5	0.0481
WAG 1	Endosulfan I	67	0	67	0.0111	NA	0.0083	0.045	NA
WAG 1	Endosulfan II	64	0	64	0.0214	NA	0.017	0.09	NA
WAG 1	Endrin	66	1	65	0.0210	0.0012	0.0028	0.09	NA

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 1	Heptachlor	67	1	66	0.0105	0.0006	0.0083	0.045	NA
WAG 1	Lead	134	133	1	40.8739	3.3078	2.9	337	46.3236
WAG 1	Lindane	67	0	67	0.0107	NA	0.0083	0.045	NA
WAG 1	Manganese	136	135	1	841.9415	40.8851	0.45	2970	909.9661
WAG 1	Mercury	93	49	44	1.3060	0.3266	0.1	16.4	1.8496
WAG 1	Methoxychlor	67	0	67	0.1049	NA	0.083	0.45	NA
WAG 1	Methylene chloride	168	152	16	0.0310	0.0035	0.001	0.36	0.0366
WAG 1	Molybdenum	40	0	40	2.2000	NA	1.7	3.1	NA
WAG 1	Nickel	136	135	1	19.2610	0.7882	3.3	47.7	20.5598
WAG 1	PCB-1016	67	0	67	0.1049	NA	0.083	0.45	NA
WAG 1	PCB-1221	67	0	67	0.1049	NA	0.083	0.45	NA
WAG 1	PCB-1232	67	0	67	0.1049	NA	0.083	0.45	NA
WAG 1	PCB-1242	67	0	67	0.1049	NA	0.083	0.45	NA
WAG 1	PCB-1248	67	0	67	0.1049	NA	0.083	0.45	NA
WAG 1	PCB-1254	66	10	56	0.3505	0.0922	0.08	5.8	0.4403
WAG 1	PCB-1260	67	10	57	0.2473	0.0289	0.088	1.9	0.2270
WAG 1	Pentachlorophenol	123	5	118	2.9574	0.2817	0.053	26	0.2800
WAG 1	Selenium	102	48	54	14.5650	1.6571	0.39	52.1	16.8413
WAG 1	Tetrachloroethene	168	5	163	0.0076	0.0004	0.002	0.034	0.0043

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 1	Thallium	133	35	98	14.1675	2.1681	0.22	127	15.8509
WAG 1	Tin	40	40	0	50.7300	2.0604	31.8	83.9	54.2015
WAG 1	Toluene	168	41	127	0.0071	0.0004	0.0006	0.034	0.0035
WAG 1	Toxaphene	67	0	67	0.2127	NA	0.17	0.9	NA
WAG 1	Trichloroethene	168	14	154	0.0074	0.0005	0.001	0.034	0.0023
WAG 1	Uranium	90	90	0	7.9570	3.9183	0.52	323	14.4699
WAG 1	Vanadium	137	136	1	21.5983	0.7594	0.47	54.5	22.8507
WAG 1	Vinyl chloride	168	2	166	0.0155	0.0009	0.01	0.068	0.0120
WAG 1	Zinc	136	135	1	91.9930	8.2040	0.45	514	105.6279
WAG 1	Alpha-BHC	67	1	66	0.0118	0.0013	0.0083	0.084	NA
WAG 1	Alpha-chlordane	67	1	66	0.1049	0.0060	0.083	0.45	NA
WAG 1	Beta-BHC	66	0	66	0.0105	NA	0.0083	0.045	NA
WAG 1	Delta-BHC	67	0	67	0.0105	NA	0.0083	0.045	NA
WAG 1	Gamma-chlordane	67	1	66	0.1043	0.0060	0.055	0.45	NA
WAG 6	1,1,1-trichlorethane	37	0	37	0.0065	NA	0.006	0.008	NA
WAG 6	1,1-Dichlorethane	37	0	37	0.0065	NA	0.006	0.008	NA
WAG 6	1,2-Dichlorethane	37	0	37	0.0065	NA	0.006	0.008	NA
WAG 6	1,2-Dichlorethane	37	1	36	0.0068	0.0002	0.006	0.015	NA

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 6	1,4-Dioxane	4	2	2	6.6750	0.3198	6.2	7.6	7.5588
WAG 6	4,4-DDD	32	0	32	0.0213	NA	0.018	0.025	NA
WAG 6	4,4-DDE	32	0	32	0.0213	NA	0.018	0.025	NA
WAG 6	4,4-DDT	32	0	32	0.0213	NA	0.018	0.025	NA
WAG 6	Acetone	37	23	14	0.0139	0.0010	0.006	0.044	0.0147
WAG 6	Aldrin	32	0	32	0.0106	NA	0.009	0.013	NA
WAG 6	Aluminum	32	32	0	15837.8125	813.9395	7380	24600	17217.862
WAG 6	Arsenic	32	27	5	1.7666	0.1659	0.37	4.2	2.0874
WAG 6	Barium	32	32	0	132.8125	6.2860	70.6	228	143.4706
WAG 6	Benzene	37	0	37	0.0065	NA	0.006	0.008	NA
WAG 6	Benzo(a)pyrene	32	0	32	0.4425	NA	0.37	0.52	NA
WAG 6	Beryllium	32	32	0	1.3834	0.0605	0.97	2.4	1.4859
WAG 6	Bis(2-ethylhexyl)phthalate	32	27	5	0.3983	0.0530	0.066	1.7	0.4624
WAG 6	Cadmium	32	28	4	2.5013	0.1860	0.58	4	2.8456
WAG 6	Carbon tetrachloride	37	0	37	0.0065	NA	0.006	0.008	NA
WAG 6	Chloroform	37	21	16	0.0114	0.0017	0.002	0.064	0.0128
WAG 6	Chromium	32	32	0	24.6031	1.0401	13.1	34.8	26.3667
WAG 6	Copper	32	32	0	16.5219	0.9470	7.1	27.5	18.1276
WAG 6	Cyanide	32	1	31	23.8172	13.0661	0.01	250	NA

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 6	Di-n-butylphthalate	32	0	32	0.4425	NA	0.37	0.52	NA
WAG 6	Dibenzofuran	32	0	32	0.4425	NA	0.37	0.52	NA
WAG 6	Dieldrin	32	0	32	0.0213	NA	0.018	0.025	NA
WAG 6	Diethylphthalate	32	0	32	0.4425	NA	0.37	0.52	NA
WAG 6	Endosulfan I	32	0	32	0.0106	NA	0.009	0.013	NA
WAG 6	Endosulfan II	32	0	32	0.0213	NA	0.018	0.025	NA
WAG 6	Endrin	32	0	32	0.0213	NA	0.018	0.025	NA
WAG 6	Heptachlor	32	0	32	0.0106	NA	0.009	0.013	NA
WAG 6	Kepone	4	0	4	0.0210	NA	0.019	0.023	NA
WAG 6	Lead	31	30	1	15.4981	1.7097	0.54	46.2	18.4334
WAG 6	Lindane	32	0	32	0.0106	NA	0.009	0.013	NA
WAG 6	Manganese	32	32	0	1037.6594	116.8054	54.1	3530	1235.7050
WAG 6	Mercury	30	4	26	0.1007	0.0080	0	0.14	0.0374
WAG 6	Methoxychlor	32	0	32	0.1060	NA	0.09	0.13	NA
WAG 6	Methylene chloride	37	37	0	0.0283	0.0057	0.006	0.2	0.0378
WAG 6	Nickel	32	32	0	38.2844	1.9707	18.7	59.7	41.6257
WAG 6	PCB-1016	32	0	32	0.1060	NA	0.09	0.13	NA
WAG 6	PCB-1221	32	0	32	0.1060	NA	0.09	0.13	NA
WAG 6	PCB-1232	32	0	32	0.1060	NA	0.09	0.13	NA

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 6	PCB-1242	32	0	32	0.1060	NA	0.09	0.13	NA
WAG 6	PCB-1248	32	0	32	0.1060	NA	0.09	0.13	NA
WAG 6	PCB-1254	32	0	32	0.2125	NA	0.18	0.25	NA
WAG 6	PCB-1260	32	0	32	0.2125	NA	0.18	0.25	NA
WAG 6	Pentachloronitrobenzene	4	0	4	0.8725	NA	0.82	1	NA
WAG 6	Pentachlorophenol	32	0	32	2.1438	NA	1.8	2.5	NA
WAG 6	Selenium	14	0	14	0.4479	NA	0.28	0.55	NA
WAG 6	Tetrachlorodibenzofuran	3	0	3	0.0001	NA	0	1e-04	NA
WAG 6	Tetrachloroethene	37	2	35	0.0063	0.0002	0.002	0.008	0.0033
WAG 6	Thallium	32	0	32	0.4422	NA	0.23	0.57	NA
WAG 6	Tin	4	4	0	55.0250	14.5400	25.7	87.1	89.2430
WAG 6	Toluene	37	17	20	0.0044	0.0004	0.001	0.008	0.0025
WAG 6	Toxaphene	32	0	32	0.2125	NA	0.18	0.25	NA
WAG 6	Trichloroethene	37	13	24	0.0055	0.0005	0.001	0.017	0.0036
WAG 6	Uranium	4	4	0	0.8183	0.0800	0.687	1.05	1.0065
WAG 6	Vanadium	32	32	0	17.1344	0.8968	5.7	32.5	18.6549
WAG 6	Vinyl chloride	37	0	37	0.0129	NA	0.011	0.015	NA
WAG 6	Zinc	32	32	0	57.4594	3.0367	23.5	103	62.6082
WAG 6	Alpha-BHC	32	0	32	0.0106	NA	0.009	0.013	NA

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
WAG 6	Alpha-chlordane	32	0	32	0.1060	NA	0.09	0.13	NA
WAG 6	Beta-BHC	32	0	32	0.0106	NA	0.009	0.013	NA
WAG 6	Delta-BHC	32	0	32	0.0106	NA	0.009	0.013	NA
WAG 6	Gamma-chlordane	32	0	32	0.1060	NA	0.09	0.13	NA
UEFPC OU 2	Aluminum	2	2	0	29900.0000	5600.0000	24300	35500	65257.009
UEFPC OU 2	Antimony	2	0	2	2.6500	NA	2.6	2.7	NA
UEFPC OU 2	Arsenic	2	2	0	1.4600	1.1400	0.32	2.6	8.6577
UEFPC OU 2	Barium	2	2	0	149.8500	66.1500	83.7	216	567.5047
UEFPC OU 2	Beryllium	2	2	0	1.2500	0.1500	1.1	1.4	2.1971
UEFPC OU 2	Cadmium	2	0	2	0.6200	NA	0.61	0.63	NA
UEFPC OU 2	Chromium	2	2	0	39.7000	5.9000	33.8	45.6	76.9511
UEFPC OU 2	Copper	2	2	0	22.1000	5.2000	16.9	27.3	54.9315
UEFPC OU 2	Lead	2	2	0	36.6000	33.8000	2.8	70.4	250.0048

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
UEFPC OU 2	Lithium	2	2	0	22.7000	1.4000	21.3	24.1	31.5393
UEFPC OU 2	Manganese	2	2	0	484.0000	334.0000	150	818	2592.7930
UEFPC OU 2	Molybdenum	2	0	2	1.4000	NA	1.4	1.4	NA
UEFPC OU 2	Nickel	2	2	0	36.2000	3.3000	32.9	39.5	57.0354
UEFPC OU 2	Nitrate	2	2	0	0.5850	0.0850	0.5	0.67	1.1217
UEFPC OU 2	Selenium	2	0	2	19.5500	NA	19.2	19.9	NA
UEFPC OU 2	Strontium	2	2	0	21.1000	15.3000	5.8	36.4	117.7004
UEFPC OU 2	Thallium	2	0	2	4.1500	NA	4.1	4.2	NA
UEFPC OU 2	Uranium	2	2	0	1.5650	0.7350	0.83	2.3	6.2056
UEFPC OU 2	Vanadium	2	2	0	26.0000	1.4000	24.6	27.4	34.8393
UEFPC OU 2	Zinc	2	2	0	86.2000	31.8000	54.4	118	286.9773
BC OU 2	1,1,1-trichlorethane	9	9	0	0.0077	0.0002	0.007	0.009	0.0081

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN*	SEM	MIN	MAX	PLE 95% UCB
BC OU 2	1,1-Dichlorethene	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	1,2-Dichlorethane	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	1,2-Dichlorethene	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	4,4-DDD	9	9	0	0.0052	0.0002	0.0044	0.007	0.0056
BC OU 2	4,4-DDE	9	9	0	0.0052	0.0002	0.0044	0.007	0.0056
BC OU 2	4,4-DDT	9	9	0	0.0052	0.0002	0.0044	0.007	0.0056
BC OU 2	Acetone	9	9	0	0.0514	0.0288	0.013	0.28	0.1051
BC OU 2	Aldrin	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Aluminum	13	13	0	26143.8462	5485.3630	6840	63900	35920.340
BC OU 2	Antimony	9	9	0	0.3089	0.0259	0.23	0.49	0.3570
BC OU 2	Arsenic	13	9	4	33.3692	2.6757	15.6	50.3	35.0930
BC OU 2	Barium	13	13	0	101.4000	29.5003	17.9	340	153.9779
BC OU 2	Benzene	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	Benzo(a)pyrene	9	9	0	0.4989	0.0162	0.43	0.6	0.5290
BC OU 2	Beryllium	13	13	0	1.0246	0.1631	0.29	2	1.3154
BC OU 2	Bis(2-ethylhexyl)Phthalate	9	9	0	0.4989	0.0162	0.43	0.6	0.5290
BC OU 2	Boron	4	4	0	65.5000	5.9090	50	78	79.4061
BC OU 2	Cadmium	13	9	4	1.2469	0.4118	0.11	3.5	0.8571
BC OU 2	Carbon tetrachloride	9	9	0	0.0077	0.0002	0.007	0.009	0.0081

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
BC OU 2	Chloroform	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	Chromium	13	13	0	37.3308	3.8723	16.5	60	44.2323
BC OU 2	Copper	13	13	0	39.2231	10.1792	10.3	131	57.3653
BC OU 2	Di-n-butylphthalate	9	9	0	0.4989	0.0162	0.43	0.6	0.5290
BC OU 2	Dibenzofuran	9	9	0	0.4989	0.0162	0.43	0.6	0.5290
BC OU 2	Dieldrin	9	9	0	0.0052	0.0002	0.0044	0.007	0.0056
BC OU 2	Diethylphthalate	9	9	0	0.4989	0.0162	0.43	0.6	0.5290
BC OU 2	Endosulfan I	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Endosulfan II	9	9	0	0.0052	0.0002	0.0044	0.007	0.0056
BC OU 2	Endrin	9	9	0	0.0052	0.0002	0.0044	0.007	0.0056
BC OU 2	Heptachlor	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Lead	13	12	1	81.0154	25.6587	18.3	370	126.8223
BC OU 2	Lindane	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Lithium	4	4	0	39.2500	3.3758	33	48	47.1944
BC OU 2	Manganese	13	13	0	1021.5231	425.208	55.8	6060	1779.3673
BC OU 2	Mercury	24	24	0	49.0188	15.775	0.1	300	76.0554
BC OU 2	Methoxychlor	9	9	0	0.0261	0.0012	0.022	0.033	0.0284
BC OU 2	Methylene chloride	9	9	0	0.0161	0.0010	0.013	0.023	0.0179
BC OU 2	Molybdenum	4	0	4	5.8000	NA	5.3	6	NA

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN*	SEM	MIN	MAX	PLE 95% UCB
BC OU 2	Nickel	13	13	0	32.6000	9.9436	5.8	147	50.3224
BC OU 2	Niobium	4	1	3	9.8500	0.4699	8.7	11	NA
BC OU 2	PCB-1016	9	9	0	0.0521	0.0023	0.044	0.065	0.0565
BC OU 2	PCB-1221	9	9	0	0.1040	0.0045	0.088	0.13	0.1124
BC OU 2	PCB-1232	9	9	0	0.0521	0.0023	0.044	0.065	0.0565
BC OU 2	PCB-1242	9	9	0	0.0521	0.0023	0.044	0.065	0.0565
BC OU 2	PCB-1248	9	9	0	0.0521	0.0023	0.044	0.065	0.0565
BC OU 2	PCB-1254	9	9	0	0.0521	0.0023	0.044	0.065	0.0565
BC OU 2	PCB-1260	9	9	0	0.0416	0.0032	0.021	0.05	0.0475
BC OU 2	Pentachlorophenol	9	9	0	1.2111	0.0455	1	1.5	1.2957
BC OU 2	Selenium	9	9	0	1.0944	0.3730	0.24	3.3	1.7881
BC OU 2	Strontium	4	4	0	109.9250	10.1746	82.7	126	133.8695
BC OU 2	Tetrachloroethene	9	9	0	0.0074	0.0002	0.007	0.008	0.0078
BC OU 2	Thallium	9	9	0	0.3144	0.0269	0.21	0.44	0.3644
BC OU 2	Toluene	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	Toxaphene	9	9	0	0.2611	0.0122	0.22	0.33	0.2838
BC OU 2	Trichloroethene	9	9	0	0.0077	0.0002	0.007	0.009	0.0081
BC OU 2	Uranium	20	20	0	2.0408	0.2752	0.52	5.29	2.5166
BC OU 2	Vanadium	13	13	0	54.8385	4.3422	33	82.5	62.5775

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
BC OU 2	Vinyl chloride	9	9	0	0.0153	0.0005	0.013	0.018	0.0162
BC OU 2	Zinc	13	13	0	113.2077	20.3168	41	302	149.4180
BC OU 2	Zirconium	4	4	0	59.2500	6.4727	46	77	74.4826
BC OU 2	Alpha-BHC	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Alpha-chlordane	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Beta-BHC	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Delta-BHC	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
BC OU 2	Gamma-chlordane	9	9	0	0.0026	0.0001	0.0022	0.003	0.0028
SCF	1,1,1-trichlorethane	84	13	71	0.4363	0.3034	4e-05	19.21	0.9550
SCF	1,1-Dichlorethane	154	9	145	10.4636	5.2994	0.002	518.1	19.6786
SCF	1,2-Dichlorethane	84	4	80	60.8926	42.2368	0.01	2591	157.2160
SCF	1,2-Dichlorethane	14	0	14	0.0186	NA	0.01	0.042	NA
SCF	4,4-DDD	23	5	18	0.0045	0.0006	9e-05	0.011	0.0015
SCF	4,4-DDE	23	13	10	0.0030	0.0006	0.0002	0.014	0.0018
SCF	4,4-DDT	23	9	14	0.0058	0.0015	0.0002	0.03	0.0065
SCF	Acetone	84	16	68	97.9546	67.5711	0.011	4145	212.9860
SCF	Aldrin	23	3	20	0.0026	0.0004	0.0001	0.007	0.0004
SCF	Aluminum	22	22	0	16294.0455	2471.5459	149	47000	20546.941

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
SCF	Antimony	103	91	12	3.1252	0.7214	0.094	38	1.2148
SCF	Arsenic	113	111	2	12.7714	1.0468	0.8	103.7	14.5344
SCF	Barium	22	20	2	111.6045	15.9635	0.4	322	139.7386
SCF	Benzene	84	7	77	0.9165	0.6335	0.0003	38.86	2.0400
SCF	Benzo(a)pyrene	22	7	15	0.4829	0.0640	0.058	1.1	0.3224
SCF	Beryllium	22	12	10	1.4800	0.1716	0.25	3.9	1.6114
SCF	Bis(2-ethylhexyl)phthalate	22	7	15	0.4390	0.0690	0.05	1.1	0.1756
SCF	Cadmium	113	91	22	6.1319	0.9122	0	85.99	7.4130
SCF	Carbon tetrachloride	84	6	78	0.0031	0.0009	0	0.042	0.0001
SCF	Chloroform	84	6	78	0.8859	0.6124	0.0003	37.56	1.9872
SCF	Chromium	113	110	3	56.8916	2.4701	2	204.7	61.1572
SCF	Copper	22	18	4	20.5545	3.9385	3	81.2	27.8990
SCF	Di-n-butylphthalate	22	4	18	0.4705	0.0686	0.061	1.4	0.1183
SCF	Dibenzofuran	22	1	21	0.5218	0.0487	0.29	1.1	NA
SCF	Dieldrin	23	7	16	0.0041	0.0007	0.0002	0.011	0.0013
SCF	Diethylphthalate	22	0	22	0.5723	NA	0.33	1.4	NA
SCF	Endosulfan I	23	1	22	0.0028	0.0003	0.0009	0.007	NA
SCF	Endosulfan II	23	0	23	0.0056	NA	0.0033	0.014	NA
SCF	Endrin	23	4	19	0.0046	0.0006	7e-05	0.011	0.0011

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
SCF	Heptachlor	23	1	22	0.0028	0.0003	0.0005	0.007	NA
SCF	Lead	22	22	0	41.5059	6.2219	0.43	135	52.2122
SCF	Lindane	23	0	23	0.0029	NA	0.0017	0.007	NA
SCF	Manganese	22	21	1	1392.0923	265.3807	0.8	4080	1849.2636
SCF	Mercury	113	102	11	0.6817	0.1102	0	6.6	0.8542
SCF	Methoxychlor	23	3	20	0.0266	0.0030	0.0024	0.071	0.0142
SCF	Methylene chloride	154	8	146	136.1755	68.9493	0.011	6736	281.1491
SCF	Nickel	22	15	7	18.4182	1.8591	5.6	37.2	20.3718
SCF	PCB-1016	23	0	23	0.0564	NA	0.033	0.14	NA
SCF	PCB-1221	23	0	23	0.1152	NA	0.066	0.28	NA
SCF	PCB-1232	23	0	23	0.0564	NA	0.033	0.14	NA
SCF	PCB-1242	23	0	23	0.0564	NA	0.033	0.14	NA
SCF	PCB-1248	23	0	23	0.0564	NA	0.033	0.14	NA
SCF	PCB-1254	23	3	20	0.0567	0.0064	0.02	0.14	0.0375
SCF	PCB-1260	23	4	19	0.0665	0.0126	0.033	0.31	0.0694
SCF	Pentachlorophenol	103	82	21	0.2657	0.0571	0	2.7	0.0052
SCF	Selenium	110	91	19	2.7963	0.1575	0.0387	7.903	2.9646
SCF	Tetrachloroethene	155	10	145	0.5462	0.3456	3e-05	38.86	1.1422
SCF	Thallium	22	0	22	1.3600	NA	0.6	3.3	NA

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
SCF	Toluene	84	7	77	0.9167	0.6335	0.0003	38.86	2.0452
SCF	Toxaphene	23	0	23	0.2917	NA	0.17	0.71	NA
SCF	Trichloroethene	154	14	140	0.7824	0.4186	0.0001	44.04	1.4930
SCF	Uranium	91	91	0	3.1277	0.1117	1.1902	6.008	3.3133
SCF	Vanadium	20	18	2	31.4000	4.3587	2	67.3	38.9609
SCF	Vinyl chloride	14	0	14	0.0186	NA	0.01	0.042	NA
SCF	Zinc	113	111	2	114.1718	19.2046	1.9	1524	146.0309
SCF	AlPha-BHC	23	0	23	0.0029	NA	0.0017	0.007	NA
SCF	Alpha-chlordane	23	5	18	0.0026	0.0004	0.0001	0.007	0.0013
SCF	Beta-BHC	23	0	23	0.0029	NA	0.0017	0.007	NA
SCF	Delta-BHC	23	4	19	0.0026	0.0004	8e-05	0.007	0.0004
SCF	Gamma-chlordane	23	3	20	0.0027	0.0003	0.0005	0.007	0.0010
K-1420 OU	1,1,1-trichlorethane	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	1,1-Dichlorethene	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	1,2-Dichlorethene	5	3	2	0.0054	0.0012	0.002	0.009	0.0074
K-1420 OU	1,2-Dichlorethene	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	4,4-DDD	4	0	4	0.0203	NA	0.019	0.022	NA
K-1420 OU	4,4-DDE	4	0	4	0.0203	NA	0.019	0.022	NA

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
K-1420 OU	4,4-DDT	4	0	4	0.0630	NA	0.019	0.19	NA
K-1420 OU	Acetone	5	3	2	0.0190	0.0028	0.012	0.025	0.0249
K-1420 OU	Aldrin	4	1	3	0.0114	0.0012	0.0096	0.015	NA
K-1420 OU	Aluminum	2	2	0	19950.0000	4650.0000	15300	24600	49308.945
K-1420 OU	Antimony	2	0	2	3.9500	NA	3.9	4	NA
K-1420 OU	Arsenic	4	4	0	18.4700	3.6054	8.38	25.5	26.9549
K-1420 OU	Barium	2	2	0	31.8500	8.2500	23.6	40.1	83.9384
K-1420 OU	Benzene	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	Benzo(a)pyrene	5	2	3	0.3780	0.0659	0.12	0.48	0.3862
K-1420 OU	Beryllium	2	2	0	0.3750	0.1450	0.23	0.52	1.2905
K-1420 OU	Bis(2-ethylhexyl)phthalate	5	4	1	0.2150	0.0637	0.075	0.4	0.2892
K-1420 OU	Boron	2	1	1	2.7000	1.4000	1.3	4.1	NA
K-1420 OU	Cadmium	2	0	2	0.6600	NA	0.66	0.66	NA
K-1420 OU	Carbon tetrachloride	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	Chloroform	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	Chromium	3	2	1	15.2000	7.4505	0.4	24.1	25.4717
K-1420 OU	Chromium(+6)	1	0	1	0.4000	NA	0.4	0.4	NA
K-1420 OU	Copper	2	2	0	26.2000	3.3000	22.9	29.5	47.0354
K-1420 OU	Di-n-butylphthalate	5	0	5	0.5080	NA	0.39	0.86	NA

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
K-1420 OU	Dibenzofuran	5	0	5	0.5080	NA	0.39	0.86	NA
K-1420 OU	Dieldrin	4	0	4	0.0203	NA	0.019	0.022	NA
K-1420 OU	Diethylphthalate	5	0	5	0.5080	NA	0.39	0.86	NA
K-1420 OU	Endosulfan I	4	0	4	0.0100	NA	0.0095	0.011	NA
K-1420 OU	Endosulfan II	4	0	4	0.0203	NA	0.019	0.022	NA
K-1420 OU	Endrin	4	0	4	0.0203	NA	0.019	0.022	NA
K-1420 OU	Fluoride	4	2	2	40.0150	23.0854	0.03	80	0.0300
K-1420 OU	Heptachlor	4	0	4	0.0100	NA	0.0095	0.011	NA
K-1420 OU	Lead	4	4	0	66.2500	10.3119	48.2	93.2	90.5177
K-1420 OU	Lindane	4	0	4	0.0100	NA	0.0095	0.011	NA
K-1420 OU	Lithium	2	2	0	52.2000	27.9000	24.3	80.1	228.3537
K-1420 OU	Manganese	2	2	0	470.0000	236.0000	234	706	1960.0454
K-1420 OU	Mercury	4	3	1	0.2025	0.0936	0.03	0.45	0.4301
K-1420 OU	Methoxychlor	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	Methylene chloride	5	4	1	0.0070	0.0011	0.004	0.01	0.0093
K-1420 OU	Molybdenum	2	0	2	1.3000	NA	1.3	1.3	NA
K-1420 OU	Nickel	2	2	0	24.0500	1.5500	22.5	25.6	33.8363
K-1420 OU	14681631	6	0	6	0.0600	NA	0.03	0.12	NA
K-1420 OU	Nitrate	4	2	2	20.0075	11.5427	0.01	40	0.0268

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Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN*	SEM	MIN	MAX	PLE 95% UCB
K-1420 OU	PCB-1016	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	PCB-1221	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	PCB-1232	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	PCB-1242	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	PCB-1248	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	PCB-1254	4	3	1	0.6625	0.4128	0.22	1.9	1.6934
K-1420 OU	PCB-1260	4	0	4	0.2025	NA	0.19	0.22	NA
K-1420 OU	Pentachlorophenol	5	1	4	2.1060	0.6458	0.13	4.2	NA
K-1420 OU	Selenium	1	0	1	0.2600	NA	0.26	0.26	NA
K-1420 OU	Strontium	2	2	0	38.2500	34.4500	3.8	72.7	255.7587
K-1420 OU	Tetrachloroethene	5	1	4	0.0060	0.0003	0.005	0.007	NA
K-1420 OU	Thallium	2	1	1	0.7200	0.2800	0.44	1	NA
K-1420 OU	Toluene	5	0	5	0.0062	NA	0.006	0.007	NA
K-1420 OU	Toxaphene	4	0	4	0.2025	NA	0.19	0.22	NA
K-1420 OU	Trichloroethene	5	1	4	0.0410	0.0348	0.006	0.18	NA
K-1420 OU	Uranium	12	12	0	139.1092	79.8794	1.98	929	282.5634
K-1420 OU	Vanadium	2	2	0	48.9000	14.6000	34.3	63.5	141.0808
K-1420 OU	Vinyl chloride	5	0	5	0.0128	NA	0.012	0.014	NA
K-1420 OU	Zinc	2	2	0	84.3500	11.0500	73.3	95.4	154.1170

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
K-1420 OU	Alpha-BHC	4	0	4	0.0100	NA	0.0095	0.011	NA
K-1420 OU	Alpha-chlordane	4	0	4	0.1003	NA	0.095	0.11	NA
K-1420 OU	Beta-BHC	4	1	3	0.0137	0.0035	0.0096	0.024	NA
K-1420 OU	Delta-BHC	4	0	4	0.0100	NA	0.0095	0.011	NA
K-1420 OU	Gamma-chlordane	4	0	4	0.1003	NA	0.095	0.11	NA
K-1414	1,1,1-trichlorethane	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	1,1-Dichlorethene	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	1,2-Dichlorethene	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	1,2-Dichlorethene	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	Acetone	2	1	1	0.0310	0.0190	0.012	0.05	NA
K-1414	Benzene	4	0	4	0.0065	NA	0.006	0.007	NA
K-1414	Benzo(a)pyrene	2	1	1	0.2870	0.1930	0.094	0.48	NA
K-1414	Bis(2-ethylhexyl)phthalate	2	1	1	0.2235	0.1665	0.057	0.39	NA
K-1414	Carbon tetrachloride	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	Chloroform	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	Di-n-butylphthalate	2	2	0	0.7400	0.2600	0.48	1	2.3816
K-1414	Dibenzofuran	2	0	2	0.4350	NA	0.39	0.48	NA
K-1414	Diethylphthalate	2	0	2	0.4350	NA	0.39	0.48	NA

Table G.5 (continued)

LOCATION	ANALYTE	OBS	# DET	# NONDET	MEAN ^a	SEM	MIN	MAX	PLE 95% UCB
K-1414	Methylene chloride	2	2	0	0.0380	0.0190	0.019	0.057	0.1580
K-1414	Pentachlorophenol	2	0	2	1.0700	NA	0.94	1.2	NA
K-1414	Tetrachloroethene	2	1	1	0.0040	0.0020	0.002	0.006	NA
K-1414	Toluene	4	0	4	0.0065	NA	0.006	0.007	NA
K-1414	Trichloroethene	2	0	2	0.0065	NA	0.006	0.007	NA
K-1414	Vinyl chloride	2	0	2	0.0130	NA	0.012	0.014	NA

^a Mean: In cases where only a single detected value was observed at that location, the single detected concentration is presented. The PLE 95% UCB is designated with NA.

^b NA = Not Available.

Table G.6. Contaminant concentrations in soil (mg/kg) on the ORR compared with background soil levels (ESD 1993)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
BCVOU1	DG, NL	Aluminum	25000	23200	12636.1538	14834.7039	NO
BCVOU1	NL	Antimony	0.485	NA	1.0308	1.7371	YES
BCVOU1	DG, NL	Arsenic	8.18	7.97	9.2692	13.3522	YES
BCVOU1	DG, NL	Barium	129	97.8	264.3154	403.0086	YES
BCVOU1	DG, NL	Beryllium	0.964	0.957	1.0508	1.4283	YES
BCVOU1		Cadmium	NA	NA	5.3800	10.7364	YES
BCVOU1	DG, NL	Chromium	34.0	29.2	48.9769	68.3643	YES
BCVOU1	DG, NL	Copper	20.50	14.90	972.0615	1779.9973	YES
BCVOU1	DG, NL	Lead	27.7	25.1	287.4615	543.2465	YES
BCVOU1	DG, NL	Manganese	1370	895	910.1000	1162.3027	NO
BCVOU1	DG, NL	Mercury	0.3700	0.2170	18.9815	31.8423	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
BCVOU1		Molybdenum	NA	NA	8.8554	18.2024	YES
BCVOU1	DG, NL	Nickel	36.10	26.60	85.1077	137.5290	YES
BCVOU1	DG, NL	Vanadium	39.1	37.1	26.9462	31.7758	NO
BCVOU1	DG, NL	Zinc	62.6	46.8	668.9077	1133.3062	YES
LEFPC	CHI	Aluminum	18600	NA	12605.6667	13229.7316	NO
LEFPC		Antimony	NA	NA	1.2837	0.7872	YES
LEFPC	CHI	Arsenic	9.73	NA	7.7788	7.9621	NO
LEFPC	CHI	Barium	99.6	NA	121.3567	130.0473	YES
LEFPC	CHI	Beryllium	1.120	NA	0.9165	0.9781	NO
LEFPC		Cadmium	NA	NA	4.0894	4.6446	YES
LEFPC	CHI	Chromium	38.5	NA	64.6076	65.5307	YES
LEFPC	CHI	Copper	14.50	NA	78.0333	89.6714	YES
LEFPC	CHI (DG ^c)	Cyanide	.583	NA	3.0242	5.8240	YES
LEFPC	CHI	Lead	43.2	NA	53.7993	61.4855	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
LEFPC	CHI	Manganese	2290	NA	1110.0367	1194.6395	NO
LEFPC	CHI	Mercury	0.5790	NA	38.4880	41.6088	YES
LEFPC	CHI	Nickel	21.30	NA	34.3673	37.9061	YES
LEFPC	CHI	Selenium	0.962	NA	13.5663	8.7045	YES
LEFPC		Thallium	NA	NA	0.8092	NA	YES
LEFPC	CHI	Vanadium	42.0	NA	26.8927	28.3057	NO
LEFPC	CHI	Zinc	56.9	NA	179.9126	166.1992	YES
K-1407 OU	CHI	Aluminum	18600	NA	26562.9630	28723.5267	YES
K-1407 OU	CHI	Antimony	NA	NA	7.1506	NA	YES
K-1407 OU	CHI	Arsenic	9.73	NA	12.4333	13.0681	YES
K-1407 OU	CHI	Barium	99.6	NA	110.4938	125.2752	YES
K-1407 OU	CHI	Beryllium	1.120	NA	1.0159	1.1269	YES
K-1407 OU	CHI	Boron	NA	NA	6.4191	8.3996	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
K-1407 OU	CHI	Cadmium	NA	NA	1.8799	2.1492	YES
K-1407 OU	CHI	Chromium	38.5	NA	61.0370	69.8642	YES
K-1407 OU	CHI	Copper	14.50	NA	40.8537	48.6398	YES
K-1407 OU	CHI	Lead	43.2	NA	30.6753	32.9964	NO
K-1407 OU	CHI	Manganese	2290	NA	1184.7778	1355.2705	NO
K-1407 OU	CHI	Mercury	0.5790	NA	4.7250	6.3965	YES
K-1407 OU	CHI	Molybdenum	3.20	NA	1.8006	1.5498	NO
K-1407 OU	CHI	Nickel	21.30	NA	192.1790	251.0899	YES
K-1407 OU	CHI	Selenium	0.962	NA	7.1519	NA	YES
K-1407 OU	CHI	Strontium	16.000	NA	18.1420	20.6695	YES
K-1407 OU	CHI	Vanadium	42.0	NA	38.9753	41.3405	NO

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
K-1407 OU	CHI	Zinc	56.9	NA	59.7778	64.4711	YES
WAG 1	DG, NL	Aluminum	25000	232000	12152.1588	13085.4391	NO
WAG 1	NL	Antimony	0.485	NA	6.1265	6.0617	YES
WAG 1	DG, NL	Arsenic	8.18	7.97	9.0118	9.7694	YES
WAG 1	DG, NL	Barium	129.0	97.8	107.4636	115.3482	NO
WAG 1	DG, NL	Beryllium	0.964	0.957	0.9493	1.0127	YES
WAG 1	DG	Boron	22.70	NA	1204.9650	1761.2341	YES
WAG 1		Cadmium	NA	NA	1.7696	1.9618	YES
WAG 1	DG, NL	Chromium	34.0	29.2	28.9507	32.9578	YES
WAG 1	DG, NL	Copper	20.50	14.90	19.6249	22.2562	YES
WAG 1	DG	Cyanide	0.398	NA	4.6813	NA	YES
WAG 1	DG, NL	Lead	27.7	25.1	40.8739	46.3236	YES
WAG 1	DG, NL	Manganese	1370	895	841.9415	909.9661	NO
WAG 1	DG, NL	Mercury	0.3700	0.2170	1.3060	1.8496	YES
WAG 1	DG, NL	Nickel	21.40	16.70	19.2610	20.5598	NO
WAG 1	DG, NL	Selenium	0.931	0.718	14.5650	16.8413	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
WAG 1	DG	Thallium	0.556	NA	14.1675	15.8509	YES
WAG 1	DG, NL	Vanadium	39.1	37.1	21.5983	22.8507	NO
WAG 1	DG, NL	Zinc	62.6	46.8	91.9930	105.6279	YES
WAG 6	DG, NL	Aluminum	25000	23200	15837.8125	17217.8622	NO
WAG 6	DG, NL	Arsenic	8.18	7.97	1.7666	2.0874	NO
WAG 6	DG, NL	Barium	129.0	97.8	132.8125	143.4706	YES
WAG 6	DG, NL	Beryllium	0.964	0.957	1.3834	1.4859	YES
WAG 6		Cadmium	NA	NA	2.5013	2.8456	YES
WAG 6	DG, NL	Chromium	34.0	29.2	24.6031	26.3667	NO
WAG 6	DG, NL	Copper	20.50	14.90	16.5219	18.1276	NO
WAG 6	DG, NL	Cyanide	0.281	NA	23.8172	NA	YES
WAG 6	DG, NL	Lead	27.7	25.1	15.4981	18.4334	NO
WAG 6	DG, NL	Manganese	1370	895	1037.6594	1235.7050	NO
WAG 6	DG, NL	Mercury	0.3700	0.2170	0.1007	0.0374	NO
WAG 6	DG, NL	Nickel	36.10	26.60	38.2844	41.6257	YES
WAG 6	DG, NL	Vanadium	39.1	37.1	17.1344	18.6549	NO
WAG 6	DG, NL	Zinc	62.6	46.8	57.4594	62.6082	NO

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
UEFPC OU 2	CHI	Aluminum	18600	NA	29900.0000	65257.0085	YES
UEFPC OU 2	CHI	Arsenic	9.73	NA	1.4600	8.6577	NO
UEFPC OU 2	CHI	Barium	99.6	NA	149.8500	567.5047	YES
UEFPC OU 2	CHI	Beryllium	1.120	NA	1.2500	2.1971	YES
UEFPC OU 2	CHI	Chromium	38.5	NA	39.7000	76.9511	YES
UEFPC OU 2	CHI	Copper	14.50	NA	22.1000	54.9315	YES
UEFPC OU 2	CHI	Lead	43.2	NA	36.6000	250.0048	YES
UEFPC OU 2	CHI	Lithium	17.40	NA	22.7000	31.5393	YES
UEFPC OU 2	CHI	Manganese	2290	NA	484.0000	2592.7930	YES
UEFPC OU 2	CHI	Nickel	21.30	NA	36.2000	57.0354	YES
UEFPC OU 2	CHI	Strontium	16.000	NA	21.1000	117.7004	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95 % UCB	
UEFPC OU 2	CHI	Vanadium	42.0	NA	26.0000	34.8393	NO
UEFPC OU 2	CHI	Zinc	56.9	NA	86.2000	286.9773	YES
BC OU 2	CR	Aluminum	11800	NA	26143.8462	35920.3403	YES
BC OU 2		Antimony	NA	NA	0.3089	0.3570	YES
BC OU 2	CR	Arsenic	30.70	NA	33.3692	35.0930	YES
BC OU 2	CR	Barium	93.2	NA	101.4000	153.9779	YES
BC OU 2	CR	Beryllium	0.634	NA	1.0246	1.3154	YES
BC OU 2	CR	Boron	NA	NA	65.5000	79.4061	YES
BC OU 2	CR	Cadmium	NA	NA	1.2469	0.8571	YES
BC OU 2	CR	Chromium	18.3	NA	37.3308	44.2323	YES
BC OU 2	CR	Copper	8.19	NA	39.2231	57.3653	YES
BC OU 2	CR	Lead	23.00	NA	81.0154	126.8223	YES
BC OU 2	CR	Lithium	3.48	NA	39.2500	47.1944	YES
BC OU 2	CR	Manganese	1460	NA	1021.5231	1779.3673	YES
BC OU 2	CR	Mercury	0.184	NA	49.0188	76.0554	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
BC OU 2	CR	Nickel	9.71	NA	32.6000	50.3224	YES
BC OU 2	CR	Selenium	0.803	NA	1.0944	1.7881	YES
BC OU 2	CR	Strontium	4.810	NA	109.9250	133.8695	YES
BC OU 2	CR	Thallium	1.370	NA	0.3144	0.3644	NO
BC OU 2	CR	Vanadium	30.3	NA	54.8385	62.5775	YES
BC OU 2	CR	Zinc	43.2	NA	113.2077	149.4180	YES
SCF	CHI	Aluminum	18600	NA	16294.0455	20546.9405	YES
SCF	CHI	Antimony	NA	NA	3.1252	1.2148	YES
SCF	CHI	Arsenic	7.99	NA	12.7714	14.5344	YES
SCF	CHI	Barium	103.0	NA	111.6045	139.7386	YES
SCF	CHI	Beryllium	1.250	NA	1.4800	1.6114	YES
SCF	CHI	Cadmium	NA	NA	6.1319	7.4130	YES
SCF	CHI	Chromium	40.2	NA	56.8916	61.1572	YES
SCF	CHI	Copper	20.60	NA	20.5545	27.8990	YES
SCF	CHI	Lead	51.1	NA	41.5059	52.2122	YES
SCF	CHI	Manganese	1440	NA	1392.0923	1849.2636	YES
SCF	CHI	Mercury	0.1880	NA	0.6817	0.8542	YES

Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
SCF	CHI	Nickel	16.70	NA	18.4182	20.3718	YES
SCF	CHI	Selenium	0.931	NA	2.7963	2.9646	YES
SCF	CHI	Vanadium	41.9	NA	31.4000	38.9609	NO
SCF	CHI	Zinc	55.5	NA	114.1718	146.0309	YES
K-1420 OU	CK ^d	Aluminum	15300	9510	19950.0000	49308.9445	YES
K-1420 OU	CK	Arsenic	30.70	11.80	18.4700	26.9549	NO
K-1420 OU	CK	Barium	151.0	69.5	31.8500	83.9384	YES
K-1420 OU	CK	Beryllium	0.911	0.460	0.3750	1.2905	YES
K-1420 OU	CK	Boron	4.87	NA	2.7000	NA	NO
K-1420 OU	CK	Chromium	23.9	15.0	15.2000	25.4717	YES
K-1420 OU	CK	Copper	11.6	5.26	26.2000	47.0354	YES
K-1420 OU	CK	Lead	52.2	24.6	66.2500	90.5177	YES

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
K-1420 OU	CK	Lithium	9.17	3.48	52.2000	228.3537	YES
K-1420 OU	CK	Manganese	3060	1170	470.0000	1960.0454	NO
K-1420 OU	CK	Mercury	0.1840	0.1300	0.2025	0.4301	YES
K-1420 OU	CK	Nickel	10.70	6.06	24.0500	33.8363	YES
K-1420 OU	CK	Strontium	7.68	3.33	38.2500	255.7587	YES
K-1420 OU	CK	Thallium	1.370	NA	0.7200	NA	NO
K-1420 OU	CK	Vanadium	39.4	26.4	48.9000	141.0808	YES
K-1420 OU	CK	Zinc	54.5	43.2	84.3500	154.1170	YES
CR OU2	CR, CK, CG, CHE	Aluminum	18600	9510	NA	21900	YES
CR OU2	CR, CK, CG, CHE	Arsenic	30.70	9.73	NA	131.0	YES
CR OU2	CR, CK, CG, CHE	Barium	151.0	69.5	NA	450.0	YES
CR OU2	CR, CK, CG, CHE	Chromium	38.5	15.0	NA	25.1	NO
CR OU2	CR, CK, CG, CHE	Copper	20.6	5.26	NA	69.1	YES
CR OU2	CR, CK, CG, CHE	Lead	52.2	24.6	NA	18.8	NO

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Table G.6 (continued)

LOCATION	FORMATION ^a	ANALYTE	BACKGROUND		OU SOIL		Retained ^b - Exceeds Background?
			95% UCB HIGH	95% UCB LOW	MEAN	95% UCB	
CR OU2	CR, CK, CG, CHE	Manganese	3060	1710	NA	152.0	NO
CR OU2	CR, CK, CG, CHE	Mercury	0.184	0.130	NA	0.705	YES
CR OU2	CR, CK, CG, CHE	Nickel	16.70	6.06	NA	36.0	YES
CR OU2	CR, CK, CG, CHE	Selenium	1.310	0.621	NA	14.8	YES
CR OU2	CR, CK, CG, CHE	Vanadium	42.0	26.4	NA	84.9	YES
CR OU2	CR, CK, CG, CHE	Zinc	55.5	43.2	NA	53.9	NO

NA= Not Available.

If data on formation of OU is not available, then the range of background levels in all formations was used for comparison.

^a **Formations and Groups:** CHI = Chickamauga Group; C (R) = Conasauga Group (Remaining) = Dismal Gap Formation and Nolichucky Formation; CK = Knox Group = Copper Ridge Formation and Chepultepec Formation; MN = Maynardville; Formation; CK(R) = Knox Group Remaining; NL = Nolichucky Formation; CHE = Chepultepec Formation; DG = Dismal Gap Formation; CR = Copper Ridge Formation; R = Rome Formation

Operable Units and Corresponding Formations or Groups:

BCVOU1 = C(R), DG, NL, MN SCF = CHI

BCOU2 = MN, CR K1420 = CK

WAG 1 = C(R), DG K1407 = CR, CHI

WAG 6 = NL, DG LEFPC/UEFPC = CHI, CK, CK(R)

CR OU2 = CR, CK, CG, CHE

^b Retained COPCs either exceed background or background values were not available for comparison.

^c Cyanide background levels only available for Dismal Gap formation.

Table G.7. Soil-plant uptake factors from collocated soil and plant samples collected from Lower East Fork Poplar Creek (SAIC 1994)

Analyte	Soil (mg/kg)	Foliage (mg/kg)	Uptake factor	Average uptake factor
Antimony	0.4439	0.00122	0.0027	0.04
Arsenic	2.9215	0.0047	0.0016	0.004
Cadmium	0.4600	0.5806	1.2622	0.645
Chromium	28.809	1.0190	0.0354	0.041
Mercury	8.3102	0.2950	0.0355	0.143
Selenium	2.0139	0.0712	0.0354	0.033
Zinc	6.2234	9.4148	1.5128	0.3701
Uranium	8.3374	0.0755	0.0091	0.0063
Antimony	0.3720	0.0166	0.0446	
Arsenic	2.0655	0.0392	0.0190	
Cadmium	0.3560	0.5674	1.5938	
Chromium	25.778	3.480	0.1350	
Mercury	0.0593	0.1106	1.8651	
Selenium	1.3405	0.0833	0.0621	
Zinc	13.828	10.563	0.7639	
Uranium	4.3656	0.0730	0.0167	
Antimony	0.5533	0.0250	0.0452	
Arsenic	4.2834	0.0407	0.0095	
Cadmium	0.00	0.2017	ERR	
Chromium	28.925	1.1763	0.0407	
Mercury	64.407	1.4212	0.0221	
Selenium	2.1316	0.0709	0.0333	
Zinc	13.403	13.174	0.9829	
Uranium	17.625	0.2357	0.0134	
Antimony	1.2014	0.479	0.3987	

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Table G.7 (continued)

Analyte	Soil (mg/kg)	Foliage (mg/kg)	Uptake factor	Average uptake factor
Arsenic	11.348	0.2244	0.0198	
Cadmium	0.00	0.00	ERR	
Chromium	74.619	5.0518	0.0677	
Mercury	459.04	10.559	0.0230	
Selenium	4.9966	0.1554	0.0311	
Zinc	46.411	9.9251	0.2139	
Uranium	43.546	1.5275	0.0351	
Antimony	1.9831	0.0105	0.0053	
Arsenic	15.103	0.0134	0.0009	
Cadmium	0.4791	0.0480	0.1002	
Chromium	139.95	1.5751	0.0113	
Mercury	302.44	0.1176	0.0004	
Selenium	6.6564	0.0599	0.0090	
Zinc	0.00	11.459	ERR	
Uranium	128.83	0.0924	0.0007	
Antimony	1.4792	0.0108	0.0073	
Arsenic	15.729	0.0284	0.0018	
Cadmium	0.00	0.2406	ERR	
Chromium	132.46	2.1597	0.0163	
Mercury	215.49	0.0901	0.0004	
Selenium	7.2919	0.0538	0.0074	
Zinc	276.39	27.298	0.0988	
Uranium	126.04	0.0715	0.0006	
Antimony	0.4731	0.0080	0.0169	
Arsenic	5.0973	0.0056	0.0011	
Cadmium	0.00	0.0154	ERR	
Chromium	101.04	0.6662	0.0066	
Mercury	115.70	0.0680	0.0006	

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Table G.7 (continued)

Analyte	Soil (mg/kg)	Foliage (mg/kg)	Uptake factor	Average uptake factor
Selenium	4.9574	0.0477	0.0096	
Zinc	171.66	4.021	0.0234	
Uranium	25.843	0.0391	0.0015	
Antimony	0.7320	0.0061	0.0083	
Arsenic	10.253	0.00	0.0000	
Cadmium	0.00	0.0031	ERR	
Chromium	74.002	3.254	0.0440	
Mercury	156.12	0.0384	0.0002	
Selenium	2.8336	0.014	0.0049	
Zinc	157.86	7.783	0.0493	
Uranium	36.533	0.0413	0.0011	
Antimony	0.9154	0.0062	0.0068	
Arsenic	7.2894	0.0110	0.0015	
Cadmium	0.00	0.0949	ERR	
Chromium	74.783	0.8638	0.0116	
Mercury	443.27	0.064	0.0001	
Selenium	2.6560	0.0186	0.0070	
Zinc	125.94	10.767	0.0855	
Uranium	33.524	0.0778	0.0023	
Antimony	1.4493	0.0070	0.0048	
Arsenic	18.145	0.0039	0.0002	
Cadmium	0.00	0.2343	ERR	
Chromium	88.982	0.5460	0.0061	
Mercury	1043.5	0.1274	0.0001	
Selenium	8.0090	0.0200	0.0025	
Zinc	159.59	7.2600	0.0455	
Uranium	68.217	0.0211	0.0003	

Table G.7 (continued)

Analyte	Soil (mg/kg)	Foliage (mg/kg)	Uptake factor	Average uptake factor
Antimony	1.2713	0.0074	0.0058	
Arsenic	20.289	0.0118	0.0006	
Cadmium	0.00	0.0473	ERR	
Chromium	74.985	2.4308	0.0324	
Mercury	894.37	0.0992	0.0001	
Selenium	4.1923	0.0512	0.0122	
Zinc	136.04	6.8167	0.0501	
Uranium	58.647	0.0078	0.0001	
Antimony	0.6456	0.0114	0.0177	
Arsenic	7.2085	0.00	0.0000	
Cadmium	0.00	0.2337	ERR	
Chromium	48.513	0.6256	0.0129	
Mercury	15.358	0.1953	0.0127	
Selenium	5.0364	0.0067	0.0013	
Zinc	0.00	14.986	ERR	
Uranium	16.070	0.0592	0.0037	
Antimony	1.0175	0.0082	0.0081	
Arsenic	7.4064	0.0140	0.0019	
Cadmium	0.4957	0.0299	0.0603	
Chromium	52.997	4.0416	0.0763	
Mercury	6.7074	0.0998	0.0149	
Selenium	3.2376	0.0417	0.0129	
Zinc	98.463	14.254	0.1448	
Uranium	14.210	0.0453	0.0032	
Antimony	0.8955	0.0143	0.0160	
Arsenic	11.190	0.0351	0.0031	
Cadmium	0.3930	0.1587	0.4038	
Chromium	36.128	2.0822	0.0576	

G-56**Table G.7 (continued)**

Analyte	Soil (mg/kg)	Foliage (mg/kg)	Uptake factor	Average uptake factor
Mercury	2.8981	0.0774	0.0267	
Selenium	2.9368	0.6130	0.2087	
Zinc	72.808	8.3377	0.1145	
Uranium	7.3750	0.0509	0.0069	
Antimony	0.6773	0.0116	0.0171	
Arsenic	10.997	0.0091	0.0008	
Cadmium	0.1590	0.0719	0.4522	
Chromium	26.298	1.5607	0.0593	
Mercury	0.00	0.0589	ERR	
Selenium	1.4524	0.0743	0.0512	
Zinc	13.815	10.023	0.7255	
Uranium	3.8349	0.00	0.0000	

Table G.8. Soil-plant organic contaminant uptake factors using octanol water partition coefficients (Travis and Arms 1988)

Chemical	K_{ow} ^a	$\log B_v$	Soil-plant uptake factor
Acetone	-0.24	1.7267	53.297
4,4'DDT	6.38	-2.0996	0.00795
4,4'DDD	5.9	-1.8222	0.015059
Benzo(a)pyrene	6.1	-1.9378	0.01154
Bis(2ethylhexyl)phthalate	9.6	-3.9608	0.000109
Chloroform	2.0	0.432	2.704
Di-N-Butylphthalate	4.1	-0.781	0.16558
Dibenzofuran	4.12	-0.79336	0.16093
Methylene Chloride	1.3	0.8366	6.864
PCBs- 1221/1232/1242/1248/1260	7.14	-2.5389	0.00289
PCB-1254	6.03	-1.897	0.01268
Tetrachloroethylene/ethene	3.4	-0.3772	0.41957
Toluene	2.7	0.0274	1.0651
Aldrin	5.52 ^b	-1.6026	0.02497
Endrin	4.92	-1.25576	0.05549
Heptachlor	4.3	-0.8974	0.12665
Lindane (gamma BHC)	3.72	-0.56216	0.27406
1,2 Dichloroethylene	1.90	0.4898	3.0889
1,1,1 Trichlorethane	2.50	0.143	1.3899
1,2 Dichloroethane	1.5	0.721	5.2602
Trichloroethene/ethylene	2.4	0.2008	1.5878
Dieldrin	5.34	-1.4985	0.03173
Diethylphthalate	2.5	0.143	1.3899
Chlordane	5.5	-1.591	0.025645
Benzene	2.1	0.3742	2.367
Vinyl Chloride	1.4	0.7788	6.00896

Soil-Plant Uptake Factors calculated using the following equation: $\log B_v = 1.588 - 0.578 \log K_{ow}$

Where:

B_v = Bioaccumulation factor for vegetation = soil-plant uptake factor

K_{ow} = Octanol Water Partitioning Coefficient.

^a K_{ow} Source: Hull and Suter 1994.

^b K_{ow} for Aldrin Source: Travis and Arms 1988.

Table G.9. Soil-earthworm contaminant uptake factors for earthworms from WAG 5^a

Analyte	Media	Mean (mg/kg)	Uptake factor	STD
Aluminum	soil worm	16116.7 497.8	0.0317	0.0161
Aroclor- 1260	soil worm	0.19 1.6	7.1065	8.7613
Arsenic	soil worm	4.07 2.4	0.6322	0.2168
Barium	soil worm	159 12.3	0.0777	0.0319
Beryllium	soil worm	0.99 1.25	1.3052	0.1745
Cadmium	soil worm	0.070 3.5	4.8118	1.9357
Chromium	soil worm	31.07 8.7	0.2892	0.1208
Mercury	soil worm	0.52 0.87	5.7669	7.194
Selenium	soil worm	2.9 7.8	7.4157	8.9345
Zinc	soil worm	70.4 371.8	5.5897	1.477

^a Uptake factor expressed as dry weight soil to dry weight earthworm.

Table G.10. Total contaminant exposure and NOAEL HQs for white-tailed deer on the ORR

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BCVOU1	4,4-DDE	0.108	NA	0.1047	0.0113	0.0003	0.0001	0.0004	0.15	0.00
BCVOU1	4,4-DDT	0.108	NA	0.0080	0.0009	0.0000	0.0001	0.0001	0.15	0.00
BCVOU1	Acetone	0.036	0.043	53.2970	2.3048	0.0710	0.0000	0.0710	1.9	0.04
BCVOU1	Antimony	1.031	1.737	0.0400	0.0695	0.0021	0.0011	0.0032	0.01	0.32
BCVOU1	Arsenic	9.269	13.352	0.0040	0.0534	0.0016	0.0082	0.0099	0.01	0.99
BCVOU1	Barium	264.315	403.009	0.1500	60.4513	1.8617	0.2482	2.1099	1	2.11
BCVOU1	Benzo(a)pyrene	10.811	19.901	0.0115	0.2297	0.0071	0.0123	0.0193	0.08	0.24
BCVOU1	Beryllium	1.051	1.428	0.0100	0.0143	0.0004	0.0009	0.0013	0.12	0.01
BCVOU1	Bis(2-ethylhexyl) phthalate	3.333	0.587	0.0001	0.0001	0.0000	0.0004	0.0004	1.5	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BCVOU1	Cadmium	5.380	10.736	0.6450	6.9250	0.2133	0.0066	0.2199	0.001	219.88
BCVOU1	Chloroform	0.012	NA	2.7040	0.0315	0.0010	0.0000	0.0010	2.8	0.00
BCVOU1	Chromium	48.977	68.364	0.0410	2.8029	0.0863	0.0421	0.1284	0.61	0.21
BCVOU1	Copper	972.062	1779.997	0.4000	711.9989	21.9270	1.0964	23.0234	3.1	7.43
BCVOU1	Di-n-butylphthalate	2.999	0.316	0.1656	0.0524	0.0016	0.0002	0.0018	46	0.00
BCVOU1	Lead	287.462	543.246	0.0450	24.4461	0.7529	0.3346	1.0875	1.5	0.72
BCVOU1	Mercury	18.982	31.842	0.1430	4.5534	0.1402	0.0196	0.1598	0.006	26.64
BCVOU1	Methylene chloride	0.017	0.023	6.8640	0.1601	0.0049	0.0000	0.0049	1.09	0.00
BCVOU1	Molybdenum	8.855	18.202	NA	NA	NA	0.0112	0.0112	0.02	0.56
BCVOU1	Nickel	85.108	137.529	0.0600	8.2517	0.2541	0.0847	0.3388	7.5	0.05
BCVOU1	PCB-1254	1.790	2.665	0.0127	0.0338	0.0010	0.0016	0.0027	0.004	0.67

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BCVOU1	PCB-1260	3.651	6.741	0.0029	0.0195	0.0006	0.0042	0.0048	0.004	1.19
BCVOU1	Selenium	1.750	2.268	0.0330	0.0748	0.0023	0.0014	0.0037	0.006	0.62
BCVOU1	Tetrachloroethene	0.012	NA	0.4196	0.0049	0.0002	0.0000	0.0002	0.1	0.00
BCVOU1	Tin	20.523	34.428	NA	NA	NA	0.0212	0.0212	1.9	0.01
BCVOU1	Toluene	0.314	0.399	1.0651	0.4252	0.0131	0.0002	0.0133	2.2	0.01
BCVOU1	Zinc	668.908	1133.306	0.3701	419.4366	12.9172	0.6980	13.6152	30	0.45
LEFPC	4,4-DDD	0.017	0.001	0.0151	0.0000	0.0000	0.0000	0.0000	0.15	0.00
LEFPC	4,4-DDE	0.015	0.002	0.1047	0.0002	0.0000	0.0000	0.0000	0.15	0.00
LEFPC	4,4-DDT	0.017	0.001	0.0080	0.0000	0.0000	0.0000	0.0000	0.15	0.00
LEFPC	Acetone	0.254	0.577	53.2970	30.7414	0.9467	0.0004	0.9471	1.9	0.50
LEFPC	Aldrin	0.008	0.000	0.0250	0.0000	0.0000	0.0000	0.0000	0.04	0.00
LEFPC	Antimony	1.284	0.787	0.0400	0.0315	0.0010	0.0005	0.0015	0.01	0.15

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
LEFPC	Barium	121.357	130.047	0.1500	19.5071	0.6007	0.0801	0.6808	1	0.68
LEFPC	Benzo(a)pyrene	0.492	0.484	0.0115	0.0056	0.0002	0.0003	0.0005	0.08	0.01
LEFPC	Bis(2-ethylhexyl) phthalate	0.334	0.201	0.0001	0.0000	0.0000	0.0001	0.0001	1.5	0.00
LEFPC	Cadmium	4.089	4.645	0.6450	2.9957	0.0923	0.0029	0.0951	0.001	95.12
LEFPC	Chromium	64.608	65.531	0.0410	2.6868	0.0827	0.0404	0.1231	0.61	0.20
LEFPC	Copper	78.033	89.671	0.4000	35.8685	1.1046	0.0552	1.1599	3.1	0.37
LEFPC	Cyanide	3.024	5.824	NA	NA	NA	0.0036	0.0036	11.8	0.00
LEFPC	Di-n-butylphthalate	0.421	0.184	0.1656	0.0305	0.0009	0.0001	0.0011	46	0.00
LEFPC	Dieldrin	0.017	0.002	0.0317	0.0000	0.0000	0.0000	0.0000	0.004	0.00
LEFPC	Diethylphthalate	0.461	0.173	1.3899	0.2409	0.0074	0.0001	0.0075	381	0.00
LEFPC	Endosulfan I	0.008	0.001	NA	NA	NA	0.0000	0.0000	0.03	0.00
LEFPC	Endosulfan II	0.017	0.001	NA	NA	NA	0.0000	0.0000	0.03	0.00
LEFPC	Endrin	0.017	0.001	0.0555	0.0000	0.0000	0.0000	0.0000	0.008	0.00
LEFPC	Heptachlor	0.008	0.000	0.1267	0.0000	0.0000	0.0000	0.0000	0.03	0.00
LEFPC	Lead	53.799	61.485	0.0450	2.7668	0.0852	0.0379	0.1231	1.5	0.08
LEFPC	Lindane	0.008	0.001	0.2741	0.0002	0.0000	0.0000	0.0000	1.5	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
LEFPC	Mercury	38.488	41.609	0.1430	5.9501	0.1832	0.0256	0.2089	0.006	34.81
LEFPC	Methoxychlor	0.083	0.006	NA	NA	NA	0.0000	0.0000	0.7	0.00
LEFPC	Methylene chloride	0.037	0.053	6.8640	0.3634	0.0112	0.0000	0.0112	1.09	0.01
LEFPC	Nickel	34.367	37.906	0.0600	2.2744	0.0700	0.0233	0.0934	7.5	0.01
LEFPC	PCB-1016	0.090	0.050	NA	NA	NA	0.0000	0.0000	0.36	0.00
LEFPC	PCB-1242	0.090	0.050	0.0029	0.0001	0.0000	0.0000	0.0000	0.018	0.00
LEFPC	PCB-1248	0.090	0.050	0.0029	0.0001	0.0000	0.0000	0.0000	0	0.00
LEFPC	PCB-1254	0.258	0.224	0.0127	0.0028	0.0001	0.0001	0.0002	0.004	0.06
LEFPC	PCB-1260	0.431	0.465	0.0029	0.0013	0.0000	0.0003	0.0003	0.004	0.08
LEFPC	Pentachlorophenol	1.692	0.377	NA	NA	NA	0.0002	0.0002	0.04	0.01
LEFPC	Selenium	13.566	8.704	0.0330	0.2872	0.0088	0.0054	0.0142	0.006	2.37
LEFPC	Thallium	0.809	NA	NA	NA	NA	0.0005	0.0005	0.001	0.50
LEFPC	Uranium	9.708	11.895	0.0063	0.0749	0.0023	0.0073	0.0096	0.25	0.04
LEFPC	Zinc	179.913	166.199	0.3701	61.5103	1.8943	0.1024	1.9967	30	0.07
LEFPC	Alpha-chlordane	0.073	0.003	0.0257	0.0001	0.0000	0.0000	0.0000	0.4	0.00
LEFPC	Delta-BHC	0.008	0.000	0.4340	0.0001	0.0000	0.0000	0.0000	0.3	0.00

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
LEFPC	Gamma-chlordane	0.073	0.001	0.0257	0.0000	0.0000	0.0000	0.0000	0.4	0.00
K-1407 OU	1,1,1-trichlorethane	0.015	NA	1.3899	0.0215	0.0007	0.0000	0.0007	87	0.00
K-1407 OU	1,2-Dichlorethane	0.017	0.028	3.0889	0.0856	0.0026	0.0000	0.0027	3.8	0.00
K-1407 OU	Acetone	0.028	0.019	53.2970	1.0007	0.0308	0.0000	0.0308	1.9	0.02
K-1407 OU	Aluminum	26562.963	28723.527	0.0040	114.8941	3.5383	17.6917	21.2300	0.16	132.69
K-1407 OU	Antimony	7.151	NA	0.0400	0.2860	0.0088	0.0044	0.0132	0.01	1.32
K-1407 OU	Arsenic	12.433	13.068	0.0040	0.0523	0.0016	0.0080	0.0097	0.01	0.97
K-1407 OU	Barium	110.494	125.275	0.1500	18.7913	0.5787	0.0772	0.6559	1	0.66
K-1407 OU	Beryllium	1.016	1.127	0.0100	0.0113	0.0003	0.0007	0.0010	0.12	0.01
K-1407 OU	Boron	6.419	8.400	NA	NA	NA	0.0052	0.0052	5.2	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1407 OU	Cadmium	1.880	2.149	0.6450	1.3863	0.0427	0.0013	0.0440	0.001	44.02
K-1407 OU	Chloroform	0.016	0.012	2.7040	0.0322	0.0010	0.0000	0.0010	2.8	0.00
K-1407 OU	Chromium	61.037	69.864	0.0410	2.8644	0.0882	0.0430	0.1312	0.61	0.22
K-1407 OU	Copper	40.854	48.640	0.4000	19.4559	0.5992	0.0300	0.6291	3.1	0.20
K-1407 OU	Di-n-butylphthalate	0.017	0.018	0.1656	0.0031	0.0001	0.0000	0.0001	46	0.00
K-1407 OU	Lead	30.675	32.996	0.0450	1.4848	0.0457	0.0203	0.0661	1.5	0.04
K-1407 OU	Mercury	4.725	6.396	0.1430	0.9147	0.0282	0.0039	0.0321	0.006	5.35
K-1407 OU	Methylene chloride	0.018	0.021	6.8640	0.1457	0.0045	0.0000	0.0045	1.09	0.00
K-1407 OU	Nickel	192.179	251.090	0.0600	15.0654	0.4640	0.1547	0.6186	7.5	0.08
K-1407 OU	Selenium	7.152	NA	0.0330	0.2360	0.0073	0.0044	0.0117	0.006	1.95
K-1407 OU	Strontium	18.142	20.670	NA	NA	NA	0.0127	0.0127	49	0.00

G-65

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1407 OU	Tetrachloroethene	0.023	0.024	0.4196	0.0102	0.0003	0.0000	0.0003	0.1	0.00
K-1407 OU	Toluene	0.011	0.001	1.0651	0.0011	0.0000	0.0000	0.0000	2.2	0.00
K-1407 OU	Trichloroethene	0.025	0.028	1.5878	0.0446	0.0014	0.0000	0.0014	0.06	0.02
K-1407 OU	Uranium	143.694	255.850	0.0063	1.6119	0.0496	0.1576	0.2072	0.25	0.83
K-1407 OU	Zinc	59.778	64.471	0.3701	23.8607	0.7348	0.0397	0.7745	30	0.03
WAG 1	1,1,1-trichlorethane	0.008	0.003	1.3899	0.0045	0.0001	0.0000	0.0001	87	0.00
WAG 1	1,1-Dichlorethane	0.008	0.006	NA	NA	NA	0.0000	0.0000	5.6	0.00
WAG 1	1,2-Dichlorethane	0.008	0.006	5.2602	0.0316	0.0010	0.0000	0.0010	4	0.00
WAG 1	1,2-Dichlorethane	0.008	0.002	3.0889	0.0070	0.0002	0.0000	0.0002	3.8	0.00
WAG 1	4,4-DDD	0.021	NA	0.0151	0.0003	0.0000	0.0000	0.0000	0.15	0.00
WAG 1	4,4-DDE	0.022	NA	0.1047	0.0023	0.0001	0.0000	0.0001	0.15	0.00
WAG 1	4,4-DDT	0.021	0.010	0.0080	0.0001	0.0000	0.0000	0.0000	0.15	0.00
WAG 1	Acetone	0.028	0.029	53.2970	1.5641	0.0482	0.0000	0.0482	1.9	0.03

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 1	Antimony	6.127	6.062	0.0400	0.2425	0.0075	0.0037	0.0112	0.01	1.12
WAG 1	Arsenic	9.012	9.769	0.0040	0.0391	0.0012	0.0060	0.0072	0.01	0.72
WAG 1	Benzene	0.008	0.003	2.3670	0.0074	0.0002	0.0000	0.0002	2.19	0.00
WAG 1	Benzo(a)pyrene	0.678	0.726	0.0115	0.0084	0.0003	0.0004	0.0007	0.08	0.01
WAG 1	Beryllium	0.949	1.013	0.0100	0.0101	0.0003	0.0006	0.0009	0.12	0.01
WAG 1	Bis(2-ethylhexyl) phthalate	0.458	0.441	0.0001	0.0000	0.0000	0.0003	0.0003	1.5	0.00
WAG 1	Boron	1204.965	1761.234	NA	NA	NA	1.0848	1.0848	5.2	0.21
WAG 1	Cadmium	1.770	1.962	0.6450	1.2654	0.0390	0.0012	0.0402	0.001	40.18
WAG 1	Carbon tetrachloride	0.008	0.006	0.9324	0.0056	0.0002	0.0000	0.0002	3	0.00
WAG 1	Chloroform	0.010	0.009	2.7040	0.0244	0.0008	0.0000	0.0008	2.8	0.00
WAG 1	Chromium	28.951	32.958	0.0410	1.3513	0.0416	0.0203	0.0619	0.61	0.10
WAG 1	Copper	19.625	22.256	0.4000	8.9025	0.2742	0.0137	0.2879	3.1	0.09
WAG 1	Cyanide	4.681	NA	NA	NA	NA	0.0029	0.0029	11.8	0.00
WAG 1	Di-n-butylphthalate	0.720	0.700	0.1656	0.1160	0.0036	0.0004	0.0040	46	0.00
WAG 1	Diethylphthalate	0.579	0.048	1.3899	0.0668	0.0021	0.0000	0.0021	381	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 1	Endrin	0.021	NA	0.0545	0.0011	0.0000	0.0000	0.0000	0.008	0.01
WAG 1	Heptachlor	0.011	NA	0.1267	0.0013	0.0000	0.0000	0.0000	0.03	0.00
WAG 1	Lead	40.874	46.324	0.0450	2.0846	0.0642	0.0285	0.0927	1.5	0.06
WAG 1	Mercury	1.306	1.850	0.1430	0.2645	0.0081	0.0011	0.0093	0.006	1.55
WAG 1	Methylene chloride	0.031	0.037	6.8640	0.2516	0.0077	0.0000	0.0078	1.09	0.01
WAG 1	PCB-1254	0.350	0.440	0.0127	0.0056	0.0002	0.0003	0.0004	0.004	0.11
WAG 1	PCB-1260	0.247	0.227	0.0029	0.0007	0.0000	0.0001	0.0002	0.004	0.04
WAG 1	Pentachlorophenol	2.957	0.280	NA	NA	NA	0.0002	0.0002	0.04	0.00
WAG 1	Selenium	14.565	16.841	0.0330	0.5558	0.0171	0.0104	0.0275	0.006	4.58
WAG 1	Tetrachloroethene	0.008	0.004	0.4196	0.0018	0.0001	0.0000	0.0001	0.1	0.00
WAG 1	Thallium	14.168	15.851	NA	NA	NA	0.0098	0.0098	0.001	9.76
WAG 1	Tin	50.730	54.202	NA	NA	NA	0.0334	0.0334	1.9	0.02
WAG 1	Toluene	0.007	0.004	1.0651	0.0038	0.0001	0.0000	0.0001	2.2	0.00
WAG 1	Trichloroethene	0.007	0.002	1.5878	0.0036	0.0001	0.0000	0.0001	0.06	0.00
WAG 1	Uranium	7.957	14.470	0.0063	0.0912	0.0028	0.0089	0.0117	0.25	0.05
WAG 1	Vinyl chloride	0.015	0.012	6.0089	0.0723	0.0022	0.0000	0.0022	0.03	0.07

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 1	Zinc	91.993	105.628	0.3701	39.0929	1.2039	0.0651	1.2690	30	0.04
WAG 1	Alpha-BHC	0.012	NA	0.4340	0.0051	0.0002	0.0000	0.0002	0.3	0.00
WAG 1	Alpha-chlordane	0.105	NA	0.0256	0.0027	0.0001	0.0001	0.0001	0.4	0.00
WAG 1	Gamma-chlordane	0.104	NA	0.0256	0.0027	0.0001	0.0001	0.0001	0.4	0.00
WAG 6	1,2-Dichlorethene	0.007	NA	3.0889	0.0209	0.0006	0.0000	0.0006	3.8	0.00
WAG 6	1,4-Dioxane	6.675	7.559	NA	NA	NA	0.0047	0.0047	0.1	0.05
WAG 6	Acetone	0.014	0.015	53.2970	0.7822	0.0241	0.0000	0.0241	1.9	0.01
WAG 6	Barium	132.813	143.471	0.1500	21.5206	0.6628	0.0884	0.7511	1	0.75
WAG 6	Beryllium	1.383	1.486	0.0100	0.0149	0.0005	0.0009	0.0014	0.12	0.01
WAG 6	Bis(2-ethylhexyl) phthalate	0.398	0.462	0.0001	0.0001	0.0000	0.0003	0.0003	1.5	0.00
WAG 6	Cadmium	2.501	2.846	0.6450	1.8354	0.0565	0.0018	0.0583	0.001	58.28
WAG 6	Chloroform	0.011	0.013	2.7040	0.0346	0.0011	0.0000	0.0011	2.8	0.00
WAG 6	Cyanide	23.817	NA	NA	NA	NA	0.0147	0.0147	11.8	0.00
WAG 6	Methylene chloride	0.028	0.038	6.8640	0.2595	0.0080	0.0000	0.0080	1.09	0.01
WAG 6	Nickel	38.284	41.626	0.0600	2.4975	0.0769	0.0256	0.1026	7.5	0.01

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 6	Tetrachloroethene	0.006	0.003	0.4196	0.0014	0.0000	0.0000	0.0000	0.1	0.00
WAG 6	Tin	55.025	89.243	NA	NA	NA	0.0550	0.0550	1.9	0.03
WAG 6	Toluene	0.004	0.002	1.0651	0.0026	0.0001	0.0000	0.0001	2.2	0.00
WAG 6	Trichloroethene	0.005	0.004	1.5878	0.0057	0.0002	0.0000	0.0002	0.06	0.00
WAG 6	Uranium	0.818	1.007	0.0063	0.0063	0.0002	0.0006	0.0008	0.25	0.00
UEFPC OU 2	Aluminum	29900.000	65257.008	0.0040	261.0280	8.0387	40.1937	48.2324	0.16	301.45
UEFPC OU 2	Barium	149.850	567.505	0.1500	85.1257	2.6216	0.3495	2.9711	1	2.97
UEFPC OU 2	Beryllium	1.250	2.197	0.0100	0.0220	0.0007	0.0014	0.0020	0.12	0.02
UEFPC OU 2	Chromium	39.700	76.951	0.0410	3.1550	0.0972	0.0474	0.1446	0.61	0.24
UEFPC OU 2	Copper	22.100	54.932	0.4000	21.9726	0.6767	0.0338	0.7105	3.1	0.23
UEFPC OU 2	Lead	36.600	250.005	0.0450	11.2502	0.3465	0.1540	0.5005	1.5	0.33
UEFPC OU 2	Lithium	22.700	31.539	NA	NA	NA	0.0194	0.0194	1.8	0.01

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
UEFPC OU 2	Manganese	484.000	2592.793	0.2500	648.1983	19.9622	1.5970	21.5592	16	1.35
UEFPC OU 2	Nickel	36.200	57.035	0.0600	3.4221	0.1054	0.0351	0.1405	7.5	0.02
UEFPC OU 2	Nitrate	0.585	1.122	NA	NA	NA	0.0007	0.0007	127	0.00
UEFPC OU 2	Strontium	21.100	117.700	NA	NA	NA	0.0725	0.0725	49	0.00
UEFPC OU 2	Uranium	1.565	6.206	0.0063	0.0391	0.0012	0.0038	0.0050	0.25	0.02
UEFPC OU 2	Zinc	86.200	286.977	0.3701	106.2103	3.2709	0.1768	3.4477	30	0.11
BC OU 2	1,1,1-trichlorethane	0.008	0.008	1.3899	0.0113	0.0003	0.0000	0.0004	87	0.00
BC OU 2	1,1-Dichlorethane	0.008	0.008	NA	NA	NA	0.0000	0.0000	5.6	0.00
BC OU 2	1,2-Dichlorethane	0.008	0.008	5.2602	0.0426	0.0013	0.0000	0.0013	4	0.00
BC OU 2	1,2-Dichlorethane	0.008	0.008	3.0889	0.0250	0.0008	0.0000	0.0008	3.8	0.00
BC OU 2	4,4-DDD	0.005	0.006	0.0151	0.0001	0.0000	0.0000	0.0000	0.15	0.00
BC OU 2	4,4-DDE	0.005	0.006	0.1047	0.0006	0.0000	0.0000	0.0000	0.15	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	4,4-DDT	0.005	0.006	0.0080	0.0000	0.0000	0.0000	0.0000	0.15	0.00
BC OU 2	Acetone	0.051	0.105	53.2970	5.6010	0.1725	0.0001	0.1726	1.9	0.09
BC OU 2	Aldrin	0.003	0.003	0.0250	0.0001	0.0000	0.0000	0.0000	0.04	0.00
BC OU 2	Aluminum	26143.846	35920.340	0.0040	143.6814	4.4249	22.1244	26.5493	0.16	165.93
BC OU 2	Antimony	0.309	0.357	0.0400	0.0143	0.0004	0.0002	0.0007	0.01	0.07
BC OU 2	Arsenic	33.369	35.093	0.0040	0.1404	0.0043	0.0216	0.0259	0.01	2.59
BC OU 2	Barium	101.400	153.978	0.1500	23.0967	0.7113	0.0948	0.8061	1	0.81
BC OU 2	Benzene	0.008	0.008	2.3670	0.0192	0.0006	0.0000	0.0006	2.19	0.00
BC OU 2	Benzo(a)pyrene	0.499	0.529	0.0115	0.0061	0.0002	0.0003	0.0005	0.08	0.01
BC OU 2	Beryllium	1.025	1.315	0.0100	0.0132	0.0004	0.0008	0.0012	0.12	0.01
BC OU 2	Bis(2-ethylhexyl) phthalate	0.499	0.529	0.0001	0.0001	0.0000	0.0003	0.0003	1.5	0.00
BC OU 2	Boron	65.500	79.406	NA	NA	NA	0.0489	0.0489	5.2	0.01
BC OU 2	Cadmium	1.247	0.857	0.6450	0.5529	0.0170	0.0005	0.0176	0.001	17.55
BC OU 2	Carbon tetrachloride	0.008	0.008	0.9324	0.0076	0.0002	0.0000	0.0002	3	0.00
BC OU 2	Chloroform	0.008	0.008	2.7040	0.0219	0.0007	0.0000	0.0007	2.8	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Chromium	37.331	44.232	0.0410	1.8135	0.0559	0.0272	0.0831	0.61	0.14
BC OU 2	Copper	39.223	57.365	0.4000	22.9461	0.7067	0.0353	0.7420	3.1	0.24
BC OU 2	Di-n-butylphthalate	0.499	0.529	0.1656	0.0876	0.0027	0.0003	0.0030	46	0.00
BC OU 2	Dieldrin	0.005	0.006	0.0317	0.0002	0.0000	0.0000	0.0000	0.004	0.00
BC OU 2	Diethylphthalate	0.499	0.529	1.3899	0.7353	0.0226	0.0003	0.0230	381	0.00
BC OU 2	Endosulfan I	0.003	0.003	NA	NA	NA	0.0000	0.0000	0.03	0.00
BC OU 2	Endosulfan II	0.005	0.006	NA	NA	NA	0.0000	0.0000	0.03	0.00
BC OU 2	Endrin	0.005	0.006	0.0555	0.0003	0.0000	0.0000	0.0000	0.008	0.00
BC OU 2	Heptachlor	0.003	0.003	0.1267	0.0004	0.0000	0.0000	0.0000	0.03	0.00
BC OU 2	Lead	81.015	126.822	0.0450	5.7070	0.1758	0.0781	0.2539	1.5	0.17
BC OU 2	Lindane	0.003	0.003	0.2741	0.0008	0.0000	0.0000	0.0000	1.5	0.00
BC OU 2	Lithium	39.250	47.194	NA	NA	NA	0.0291	0.0291	1.8	0.02
BC OU 2	Manganese	1021.523	1779.367	0.2500	444.8418	13.6996	1.0960	14.7955	16	0.92
BC OU 2	Mercury	49.019	76.055	0.1430	10.8759	0.3349	0.0468	0.3818	0.006	63.63
BC OU 2	Methoxychlor	0.026	0.028	NA	NA	NA	0.0000	0.0000	0.7	0.00
BC OU 2	Methylene chloride	0.016	0.018	6.8640	0.1231	0.0038	0.0000	0.0038	1.09	0.00

G-73

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Nickel	32.600	50.322	0.0600	3.0193	0.0930	0.0310	0.1240	7.5	0.02
BC OU 2	Niobium	9.850	NA	NA	NA	NA	0.0061	0.0061	0.013	0.47
BC OU 2	PCB-1016	0.052	0.056	NA	NA	NA	0.0000	0.0000	0.36	0.00
BC OU 2	PCB-1242	0.052	0.056	0.0029	0.0002	0.0000	0.0000	0.0000	0.018	0.00
BC OU 2	PCB-1248	0.052	0.056	0.0029	0.0002	0.0000	0.0000	0.0000	0	ERR
BC OU 2	PCB-1254	0.052	0.056	0.0127	0.0007	0.0000	0.0000	0.0001	0.004	0.01
BC OU 2	PCB-1260	0.042	0.048	0.0029	0.0001	0.0000	0.0000	0.0000	0.004	0.01
BC OU 2	Pentachlorophenol	1.211	1.296	NA	NA	NA	0.0008	0.0008	0.04	0.02
BC OU 2	Selenium	1.094	1.788	0.0330	0.0590	0.0018	0.0011	0.0029	0.006	0.49
BC OU 2	Strontium	109.925	133.870	NA	NA	NA	0.0825	0.0825	49	0.00
BC OU 2	Tetrachloroethene	0.007	0.008	0.4196	0.0033	0.0001	0.0000	0.0001	0.1	0.00
BC OU 2	Toluene	0.008	0.008	1.0651	0.0086	0.0003	0.0000	0.0003	2.2	0.00
BC OU 2	Toxaphene	0.261	0.284	NA	NA	NA	0.0002	0.0002	1.5	0.00
BC OU 2	Trichloroethene	0.008	0.008	1.5878	0.0129	0.0004	0.0000	0.0004	0.06	0.01
BC OU 2	Uranium	2.041	2.517	0.0063	0.0159	0.0005	0.0016	0.0020	0.25	0.01
BC OU 2	Vanadium	54.838	62.578	0.0060	0.3755	0.0116	0.0385	0.0501	0.04	1.25

G-74

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Vinyl chloride	0.015	0.016	6.0089	0.0974	0.0030	0.0000	0.0030	0.03	0.10
BC OU 2	Zinc	113.208	149.418	0.3701	55.2996	1.7030	0.0920	1.7951	30	0.06
BC OU 2	Zirconium	59.250	74.483	NA	NA	NA	0.0459	0.0459	0.14	0.33
BC OU 2	Alpha-BHC	0.003	0.003	0.4340	0.0012	0.0000	0.0000	0.0000	0.3	0.00
BC OU 2	Alpha-chlordane	0.003	0.003	0.0256	0.0001	0.0000	0.0000	0.0000	0.4	0.00
BC OU 2	Beta-BHC	0.003	0.003	0.4340	0.0012	0.0000	0.0000	0.0000	0.1	0.00
BC OU 2	Delta-BHC	0.003	0.003	0.4340	0.0012	0.0000	0.0000	0.0000	0.3	0.00
BC OU 2	Gamma-chlordane	0.003	0.003	0.0256	0.0001	0.0000	0.0000	0.0000	0.4	0.00
SCF	1,1,1-trichlorethane	0.436	0.955	1.3899	1.3273	0.0409	0.0006	0.0415	87	0.00
SCF	1,1-Dichlorethene	10.464	19.679	NA	NA	NA	0.0121	0.0121	5.6	0.00
SCF	1,2-Dichlorethene	60.893	157.216	5.2602	826.9877	25.4683	0.0968	25.5651	4	6.39
SCF	4,4-DDD	0.005	0.001	0.0151	0.0000	0.0000	0.0000	0.0000	0.15	0.00
SCF	4,4-DDE	0.003	0.002	0.1047	0.0002	0.0000	0.0000	0.0000	0.15	0.00
SCF	4,4-DDT	0.006	0.006	0.0080	0.0001	0.0000	0.0000	0.0000	0.15	0.00
SCF	Acetone	97.955	212.986	53.2970	11351.5129	349.586 4	0.1312	349.717 6	1.9	184.06

G-75

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
SCF	Aldrin	0.003	0.000	0.0250	0.0000	0.0000	0.0000	0.0000	0.04	0.00
SCF	Aluminum	16294.045	20546.940	0.0040	82.1878	2.5311	12.6555	15.1866	0.16	94.92
SCF	Antimony	3.125	1.215	0.0400	0.0486	0.0015	0.0007	0.0022	0.01	0.22
SCF	Arsenic	12.771	14.534	0.0040	0.0581	0.0018	0.0090	0.0107	0.01	1.07
SCF	Barium	111.605	139.739	0.1500	20.9608	0.6455	0.0861	0.7316	1	0.73
SCF	Benzene	0.916	2.040	2.3670	4.8287	0.1487	0.0013	0.1500	2.19	0.07
SCF	Benzo(a)pyrene	0.483	0.322	0.0115	0.0037	0.0001	0.0002	0.0003	0.08	0.00
SCF	Beryllium	1.480	1.611	0.0100	0.0161	0.0005	0.0010	0.0015	0.12	0.01
SCF	Bis(2-ethylhexyl) phthalate	0.439	0.176	0.0001	0.0000	0.0000	0.0001	0.0001	1.5	0.00
SCF	Cadmium	6.132	7.413	0.6450	4.7814	0.1472	0.0046	0.1518	0.001	151.82
SCF	Carbon tetrachloride	0.003	0.000	0.9324	0.0001	0.0000	0.0000	0.0000	3	0.00
SCF	Chloroform	0.886	1.987	2.7040	5.3734	0.1655	0.0012	0.1667	2.8	0.06
SCF	Chromium	56.892	61.157	0.0410	2.5074	0.0772	0.0377	0.1149	0.61	0.19
SCF	Copper	20.555	27.899	0.4000	11.1596	0.3437	0.0172	0.3609	3.1	0.12
SCF	Di-n-butylphthalate	0.470	0.118	0.1656	0.0196	0.0006	0.0001	0.0007	46	0.00

G-76

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
SCF	Dieldrin	0.004	0.001	0.0317	0.0000	0.0000	0.0000	0.0000	0.004	0.00
SCF	Endosulfan I	0.003	NA	NA	NA	NA	0.0000	0.0000	0.03	0.00
SCF	Endrin	0.005	0.001	0.0555	0.0001	0.0000	0.0000	0.0000	0.008	0.00
SCF	Heptachlor	0.003	NA	0.1267	0.0004	0.0000	0.0000	0.0000	0.03	0.00
SCF	Lead	41.506	52.212	0.0450	2.3495	0.0724	0.0322	0.1045	1.5	0.07
SCF	Manganese	1392.092	1849.264	0.2500	462.3159	14.2377	1.1390	15.3767	16	0.96
SCF	Mercury	0.682	0.854	0.1430	0.1222	0.0038	0.0005	0.0043	0.006	0.71
SCF	Methoxychlor	0.027	0.014	NA	NA	NA	0.0000	0.0000	0.7	0.00
SCF	Methylene chloride	136.175	281.149	6.8640	1929.8077	59.4312	0.1732	59.6044	1.09	54.68
SCF	Nickel	18.418	20.372	0.0600	1.2223	0.0376	0.0125	0.0502	7.5	0.01
SCF	PCB-1254	0.057	0.038	0.0127	0.0005	0.0000	0.0000	0.0000	0.004	0.01
SCF	PCB-1260	0.066	0.069	0.0029	0.0002	0.0000	0.0000	0.0000	0.004	0.01
SCF	Pentachlorophenol	0.266	0.005	NA	NA	NA	0.0000	0.0000	0.04	0.00
SCF	Selenium	2.796	2.965	0.0330	0.0978	0.0030	0.0018	0.0048	0.006	0.81
SCF	Tetrachloroethene	0.546	1.142	0.4196	0.4792	0.0148	0.0007	0.0155	0.1	0.15
SCF	Toluene	0.917	2.045	1.0651	2.1784	0.0671	0.0013	0.0683	2.2	0.03

G-77

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
SCF	Trichloroethene	0.782	1.493	1.5878	2.3705	0.0730	0.0009	0.0739	0.06	1.23
SCF	Uranium	3.128	3.313	0.0063	0.0209	0.0006	0.0020	0.0027	0.25	0.01
SCF	Zinc	114.172	146.031	0.3701	54.0460	1.6644	0.0899	1.7544	30	0.06
SCF	Alpha-chlordane	0.003	0.001	0.0256	0.0000	0.0000	0.0000	0.0000	0.4	0.00
SCF	Delta-BHC	0.003	0.000	0.4340	0.0002	0.0000	0.0000	0.0000	0.3	0.00
SCF	Gamma-chlordane	0.003	0.001	0.0256	0.0000	0.0000	0.0000	0.0000	0.4	0.00
K-1420 OU	1,2-Dichlorethane	0.005	0.007	5.2602	0.0388	0.0012	0.0000	0.0012	4	0.00
K-1420 OU	Acetone	0.019	0.025	53.2970	1.3250	0.0408	0.0000	0.0408	1.9	0.02
K-1420 OU	Aldrin	0.011	NA	0.0250	0.0003	0.0000	0.0000	0.0000	0.04	0.00
K-1420 OU	Aluminum	19950.000	49308.945	0.0040	197.2358	6.0742	30.3708	36.4450	0.16	227.78
K-1420 OU	Barium	31.850	83.938	0.1500	12.5908	0.3878	0.0517	0.4395	1	0.44
K-1420 OU	Benzo(a)pyrene	0.378	0.386	0.0115	0.0045	0.0001	0.0002	0.0004	0.08	0.00

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Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1420 OU	Beryllium	0.375	1.290	0.0100	0.0129	0.0004	0.0008	0.0012	0.12	0.01
K-1420 OU	Bis(2-ethylhexyl) phthalate	0.215	0.289	0.0001	0.0000	0.0000	0.0002	0.0002	1.5	0.00
K-1420 OU	Boron	2.700	NA	NA	NA	NA	0.0017	0.0017	5.2	0.00
K-1420 OU	Chromium	15.200	25.472	0.0410	1.0443	0.0322	0.0157	0.0479	0.61	0.08
K-1420 OU	Copper	26.200	47.035	0.4000	18.8142	0.5794	0.0290	0.6084	3.1	0.20
K-1420 OU	Fluoride	40.015	0.030	0.0600	0.0018	0.0001	0.0000	0.0001	8.29	0.00
K-1420 OU	Lead	66.250	90.518	0.0450	4.0733	0.1254	0.0558	0.1812	1.5	0.12
K-1420 OU	Lithium	52.200	228.354	NA	NA	NA	0.1406	0.1406	1.8	0.08
K-1420 OU	Manganese	470.000	1960.045	0.2500	490.0113	15.0906	1.2072	16.2979	16	1.02
K-1420 OU	Mercury	0.203	0.430	0.1430	0.0615	0.0019	0.0003	0.0022	0.006	0.36
K-1420 OU	Methylene chloride	0.007	0.009	6.8640	0.0642	0.0020	0.0000	0.0020	1.09	0.00

G-79

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1420 OU	Nitrate	20.008	0.027	NA	NA	NA	0.0000	0.0000	127	0.00
K-1420 OU	PCB-1254	0.663	1.693	0.0127	0.0215	0.0007	0.0010	0.0017	0.004	0.43
K-1420 OU	Pentachlorophenol	2.106	NA	NA	NA	NA	0.0013	0.0013	0.04	0.03
K-1420 OU	Strontium	38.250	255.759	NA	NA	NA	0.1575	0.1575	49	0.00
K-1420 OU	Tetrachloroethene	0.006	NA	0.4106	0.0025	0.0001	0.0000	0.0001	0.1	0.00
K-1420 OU	Thallium	0.720	NA	NA	NA	NA	0.0004	0.0004	0.001	0.44
K-1420 OU	Trichloroethene	0.041	NA	1.5878	0.0651	0.0020	0.0000	0.0020	0.06	0.03
K-1420 OU	Uranium	139.109	282.563	0.0063	1.7801	0.0548	0.1740	0.2289	0.25	0.92
K-1420 OU	Vanadium	48.900	141.081	0.0060	0.8465	0.0261	0.0869	0.1130	0.04	2.82
K-1420 OU	Zinc	84.350	154.117	0.3701	57.0387	1.7566	0.0949	1.8515	30	0.06
K-1420 OU	Beta-BHC	0.014	NA	0.4340	0.0059	0.0002	0.0000	0.0002	0.1	0.00

G-80

Table G.10 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Contaminant exposure (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1414	Acetone	0.031	NA	53.2970	1.6522	0.0509	0.0000	0.0509	1.9	0.03
K-1414	Benzo(a)pyrene	0.287	NA	0.0115	0.0033	0.0001	0.0002	0.0003	0.08	0.00
K-1414	Bis(2-ethylhexyl) phthalate	0.224	NA	0.0001	0.0000	0.0000	0.0001	0.0001	1.5	0.00
K-1414	Di-n-butylphthalate	0.740	2.382	0.1656	0.3943	0.0121	0.0015	0.0136	46	0.00
K-1414	Methylene chloride	0.038	0.158	6.8640	1.0842	0.0334	0.0001	0.0335	1.09	0.03
K-1414	Tetrachloroethene	0.004	NA	0.4196	0.0017	0.0001	0.0000	0.0001	0.1	0.00

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NA= Not Available

PLE UCB not available - contaminant detected in only 1 sample.

Soil to plant uptake factor not available, therefore, estimated vegetation concentrations and exposure from food ingestion could not be calculated.

* Soil to plant uptake factors for antimony, arsenic, cadmium, chromium, mercury, selenium, zinc, and uranium were calculated using data collected from

Lower East Fork Poplar Creek. Other soil to plant uptake factors from Baes et al. 1984.

Table G.10 (continued)

Total contaminant exposure for the white-tailed deer in WAG 5

Location	Analyte	95% UCL		Soil-Plant Uptake Factor *	Plant Concentration mg/kg	Exposure mg/kg/d				NOAEL Toxicity Benchmark mg/kg/d	NOAEL HQ
		Water mg/L	Soil mg/kg			Water	Soil	Food	total exposure		
WAG 5	Lead	0	94	0.045	4.2300	0.0000	0.0579	0.1303	0.1882	1.5	0.13
WAG 5	Manganese	4.09	1100	0.25	275.0000	0.2678	0.6775	8.4690	9.4144	16	0.59
WAG 5	Mercury	0	1.3	0.143	0.1859	0.0000	0.0008	0.0057	0.0065	0.006	1.09
WAG 5	Nickel	0.57	34	0.06	2.0400	0.0373	0.0209	0.0628	0.1211	7.5	0.02
WAG 5	Selenium	0.24	0	0.033	0.0000	0.0157	0.0000	0.0000	0.0157	0.006	2.62
WAG 5	Vanadium	0.09	34	0.006	0.2040	0.0059	0.0209	0.0063	0.0331	0.04	0.83
WAG 5	Zinc	0.03	1000	0.3701	370.1000	0.0020	0.6159	11.3978	12.0157	30	0.40
WAG 5	Aroclor 1254	0	0.24	0.0127	0.0030	0.0000	0.0001	0.0001	0.0002	0.004	0.06
WAG 5	Aroclor 1260	0	0.18	0.0029	0.0005	0.0000	0.0001	0.0000	0.0001	0.004	0.03
WAG 5	Bis(2-Ethylhexyl) phthalate	0	1.3	0.0001	0.0001	0.0000	0.0008	0.0000	0.0008	1.5	0.00
WAG 5	Di-n-butyl Phthalate	0	1.5	0.1656	0.2484	0.0000	0.0009	0.0076	0.0086	46	0.00
WAG 5	Trichloroethene	0.13	0	0.4196	0.0000	0.0085	0.0000	0.0000	0.0085	0.1	0.09

* Soil to plant uptake factors for antimony, arsenic, cadmium, chromium, mercury, selenium, zinc, and uranium were calculated using data collected from Lower East Fork Poplar Creek. Other soil to plant uptake factors from Baes et al. 1984.

Table G.11. Total contaminant exposure and NOAEL HQs for wild turkey on the ORR

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BCVOU1	4,4-DDE	0.108	NA	0.1047	0.0113	0.0003	0.0003	0.0006	0.0024	0.27
BCVOU1	4,4-DDT	0.108	NA	0.0080	0.0009	0.0000	0.0003	0.0003	0.0024	0.14
BCVOU1	Acetone	0.036	0.043	53.2970	2.3048	0.0691	0.0001	0.0693	NA	NA
BCVOU1	Antimony	1.031	1.737	0.0400	0.0695	0.0021	0.0049	0.0069	NA	NA
BCVOU1	Arsenic	9.269	13.352	0.0040	0.0534	0.0016	0.0373	0.0389	2.87	0.01
BCVOU1	Barium	264.315	403.009	0.1500	60.4513	1.8135	1.1256	2.9392	5.8	0.51
BCVOU1	Benzo(a)pyrene	10.811	19.901	0.0115	0.2297	0.0069	0.0556	0.0625	NA	NA
BCVOU1	Beryllium	1.051	1.428	0.0100	0.0143	0.0004	0.0040	0.0044	NA	NA
BCVOU1	Bis(2-ethylhexyl) phthalate	3.333	0.587	0.0001	0.0001	0.0000	0.0016	0.0016	0.33	0.00
BCVOU1	Cadmium	5.380	10.736	0.6450	6.9250	0.2077	0.0300	0.2377	0.9	0.26

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BCVOU1	Chloroform	0.012	NA	2.7040	0.0315	0.0009	0.0000	0.0010	NA	NA
BCVOU1	Chromium	48.977	68.364	0.0410	2.8029	0.0841	0.1909	0.2750	NA	NA
BCVOU1	Copper	972.062	1779.997	0.4000	711.9989	21.3600	4.9717	26.3317	21	1.25
BCVOU1	Di-n-butylphthalate	2.999	0.316	0.1656	0.0524	0.0016	0.0009	0.0025	0.03	0.08
BCVOU1	Lead	287.462	543.246	0.0450	24.4461	0.7334	1.5173	2.2507	0.34	6.62
BCVOU1	Mercury	18.982	31.842	0.1430	4.5534	0.1366	0.0889	0.2255	0.004	56.39
BCVOU1	Methylene chloride	0.017	0.023	6.8640	0.1601	0.0048	0.0001	0.0049	NA	NA
BCVOU1	Molybdenum	8.855	18.202	NA	NA	NA	0.0508	0.0508	2.2	0.02
BCVOU1	Nickel	85.108	137.529	0.0600	8.2517	0.2476	0.3841	0.6317	40	0.02
BCVOU1	PCB-1254	1.790	2.665	0.0127	0.0338	0.0010	0.0074	0.0085	0.1	0.08
BCVOU1	PCB-1260	3.651	6.741	0.0029	0.0195	0.0006	0.0188	0.0194	0.1	0.19

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BCVOU1	Selenium	1.750	2.268	0.0330	0.0748	0.0022	0.0063	0.0086	0.3	0.03
BCVOU1	Tetrachloroethene	0.012	NA	0.4196	0.0049	0.0001	0.0000	0.0002	NA	NA
BCVOU1	Tin	20.523	34.428	NA	NA	NA	0.0962	0.0962	2	0.05
BCVOU1	Toluene	0.314	0.399	1.0651	0.4252	0.0128	0.0011	0.0139	NA	NA
BCVOU1	Zinc	668.908	1133.306	0.3701	419.4366	12.5831	3.1654	15.7485	10.1	1.56
LEFPC	4,4-DDD	0.017	0.001	0.0151	0.0000	0.0000	0.0000	0.0000	0.0024	0.00
LEFPC	4,4-DDE	0.015	0.002	0.1047	0.0002	0.0000	0.0000	0.0000	0.0024	0.01
LEFPC	4,4-DDT	0.017	0.001	0.0080	0.0000	0.0000	0.0000	0.0000	0.0024	0.00
LEFPC	Acetone	0.254	0.577	53.2970	30.7414	0.9222	0.0016	0.9239	NA	NA
LEFPC	Aldrin	0.008	0.000	0.0250	0.0000	0.0000	0.0000	0.0000	NA	NA
LEFPC	Antimony	1.284	0.787	0.0400	0.0315	0.0009	0.0022	0.0031	NA	NA
LEFPC	Barium	121.357	130.047	0.1500	19.5071	0.5852	0.3632	0.9484	5.8	0.16
LEFPC	Benzo(a)pyrene	0.492	0.484	0.0115	0.0056	0.0002	0.0014	0.0015	NA	NA

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
LEFPC	Bis(2-ethylhexyl) phthalate	0.334	0.201	0.0001	0.0000	0.0000	0.0006	0.0006	0.33	0.00
LEFPC	Cadmium	4.089	4.645	0.6450	2.9957	0.0899	0.0130	0.1028	0.9	0.11
LEFPC	Chromium	64.608	65.531	0.0410	2.6868	0.0806	0.1830	0.2636	NA	NA
LEFPC	Copper	78.033	89.671	0.4000	35.8685	1.0761	0.2505	1.3265	21	0.06
LEFPC	Cyanide	3.024	5.824	NA	NA	NA	0.0163	0.0163	NA	NA
LEFPC	Di-n-butylphthalate	0.421	0.184	0.1656	0.0305	0.0009	0.0005	0.0014	0.03	0.05
LEFPC	Dieldrin	0.017	0.002	0.0317	0.0000	0.0000	0.0000	0.0000	0.034	0.00
LEFPC	Diethylphthalate	0.461	0.173	1.3899	0.2409	0.0072	0.0005	0.0077	NA	NA
LEFPC	Endosulfan I	0.008	0.001	NA	NA	NA	0.0000	0.0000	4	0.00
LEFPC	Endosulfan II	0.017	0.001	NA	NA	NA	0.0000	0.0000	4	0.00
LEFPC	Endrin	0.017	0.001	0.0555	0.0000	0.0000	0.0000	0.0000	0.18	0.00
LEFPC	Heptachlor	0.008	0.000	0.1267	0.0000	0.0000	0.0000	0.0000	NA	NA
LEFPC	Lead	53.799	61.485	0.0450	2.7668	0.0830	0.1717	0.2547	0.34	0.75
LEFPC	Lindane	0.008	0.001	0.2741	0.0002	0.0000	0.0000	0.0000	1.1	0.00
LEFPC	Mercury	38.488	41.609	0.1430	5.9501	0.1785	0.1162	0.2947	0.004	73.68
LEFPC	Methoxychlor	0.083	0.006	NA	NA	0.0000	0.0000	0.0000	NA	NA

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
LEFPC	Methylene chloride	0.037	0.053	6.8640	0.3634	0.0109	0.0001	0.0111	NA	NA
LEFPC	Nickel	34.367	37.906	0.0600	2.2744	0.0682	0.1059	0.1741	40	0.00
LEFPC	PCB-1016	0.090	0.050	NA	NA	NA	0.0001	0.0001	NA	NA
LEFPC	PCB-1242	0.090	0.050	0.0029	0.0001	0.0000	0.0001	0.0001	0.13	0.00
LEFPC	PCB-1248	0.090	0.050	0.0029	0.0001	0.0000	0.0001	0.0001	NA	NA
LEFPC	PCB-1254	0.258	0.224	0.0127	0.0028	0.0001	0.0006	0.0007	0.1	0.01
LEFPC	PCB-1260	0.431	0.465	0.0029	0.0013	0.0000	0.0013	0.0013	0.1	0.01
LEFPC	Pentachlorophenol	1.692	0.377	NA	NA	NA	0.0011	0.0011	NA	NA
LEFPC	Selenium	13.566	8.704	0.0330	0.2872	0.0086	0.0243	0.0329	0.3	0.11
LEFPC	Thallium	0.809	NA	NA	NA	NA	0.0023	0.0023	NA	NA
LEFPC	Uranium	9.708	11.895	0.0063	0.0749	0.0022	0.0332	0.0355	10	0.00
LEFPC	Zinc	179.913	166.199	0.3701	61.5103	1.8453	0.4642	2.3095	10.1	0.23
LEFPC	Alpha-chlordane	0.073	0.003	0.0257	0.0001	0.0000	0.0000	0.0000	0.48	0.00
LEFPC	Delta-BHC	0.008	0.000	0.4340	0.0001	0.0000	0.0000	0.0000	0.17	0.00
LEFPC	Gamma-chlordane	0.073	0.001	0.0257	0.0000	0.0000	0.0000	0.0000	0.48	0.00

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1407 OU	1,1,1-trichlorethane	0.015	NA	1.3899	0.0215	0.0006	0.0000	0.0007	NA	NA
K-1407 OU	1,2-Dichlorethane	0.017	0.028	3.0889	0.0856	0.0026	0.0001	0.0026	NA	NA
K-1407 OU	Acetone	0.028	0.019	53.2970	1.0007	0.0300	0.0001	0.0301	NA	NA
K-1407 OU	Aluminum	26562.96	28723.527	0.0040	114.8941	3.4468	80.2278	83.6746	33.2	2.52
K-1407 OU	Antimony	7.151	NA	0.0400	0.2860	0.0086	0.0200	0.0286	NA	NA
K-1407 OU	Arsenic	12.433	13.068	0.0040	0.0523	0.0016	0.0365	0.0381	2.87	0.01
K-1407 OU	Barium	110.494	125.275	0.1500	18.7913	0.5637	0.3499	0.9136	5.8	0.16
K-1407 OU	Beryllium	1.016	1.127	0.0100	0.0113	0.0003	0.0031	0.0035	NA	NA
K-1407 OU	Boron	6.419	8.400	NA	NA	NA	0.0235	0.0235	16.1	0.00
K-1407 OU	Cadmium	1.880	2.149	0.6450	1.3863	0.0416	0.0060	0.0476	0.9	0.05
K-1407 OU	Chloroform	0.016	0.012	2.7040	0.0322	0.0010	0.0000	0.0010	NA	NA

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1407 OU	Chromium	61.037	69.864	0.0410	2.8644	0.0859	0.1951	0.2811	NA	NA
K-1407 OU	Copper	40.854	48.640	0.4000	19.4559	0.5837	0.1359	0.7195	21	0.03
K-1407 OU	Di-n-butylphthalate	0.017	0.018	0.1656	0.0031	0.0001	0.0001	0.0001	0.03	0.00
K-1407 OU	Lead	30.675	32.996	0.0450	1.4848	0.0445	0.0922	0.1367	0.34	0.40
K-1407 OU	Mercury	4.725	6.396	0.1430	0.9147	0.0274	0.0179	0.0453	0.004	11.33
K-1407 OU	Methylene chloride	0.018	0.021	6.8640	0.1457	0.0044	0.0001	0.0044	NA	NA
K-1407 OU	Nickel	192.179	251.090	0.0600	15.0654	0.4520	0.7013	1.1533	40	0.03
K-1407 OU	Selenium	7.152	NA	0.0330	0.2360	0.0071	0.0200	0.0271	0.3	0.09
K-1407 OU	Strontium	18.142	20.670	NA	NA	NA	0.0577	0.0577	NA	NA
K-1407 OU	Tetrachloroethene	0.023	0.024	0.4196	0.0102	0.0003	0.0001	0.0004	NA	NA
K-1407 OU	Toluene	0.011	0.001	1.0651	0.0011	0.0000	0.0000	0.0000	NA	NA

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1407 OU	Trichloroethene	0.025	0.028	1.5878	0.0446	0.0013	0.0001	0.0014	NA	NA
K-1407 OU	Uranium	143.694	255.850	0.0063	1.6119	0.0484	0.7146	0.7630	10	0.08
K-1407 OU	Zinc	59.778	64.471	0.3701	23.8607	0.7158	0.1801	0.8959	10.1	0.09
WAG 1	1,1,1-trichlorethane	0.008	0.003	1.3899	0.0045	0.0001	0.0000	0.0001	NA	NA
WAG 1	1,1-Dichlorethane	0.008	0.006	NA	NA	NA	0.0000	0.0000	NA	NA
WAG 1	1,2-Dichlorethane	0.008	0.006	5.2602	0.0316	0.0009	0.0000	0.0010	11.2	0.00
WAG 1	1,2-Dichlorethane	0.008	0.002	3.0889	0.0070	0.0002	0.0000	0.0002	NA	NA
WAG 1	4,4-DDD	0.021	NA	0.0151	0.0003	0.0000	0.0001	0.0001	0.0024	0.03
WAG 1	4,4-DDE	0.022	NA	0.1047	0.0023	0.0001	0.0001	0.0001	0.0024	0.05
WAG 1	4,4-DDT	0.021	0.010	0.0080	0.0001	0.0000	0.0000	0.0000	0.0024	0.01
WAG 1	Acetone	0.028	0.029	53.2970	1.5641	0.0469	0.0001	0.0470	NA	NA
WAG 1	Antimony	6.127	6.062	0.0400	0.2425	0.0073	0.0169	0.0242	NA	NA
WAG 1	Arsenic	9.012	9.769	0.0040	0.0391	0.0012	0.0273	0.0285	2.87	0.01
WAG 1	Benzene	0.008	0.003	2.3670	0.0074	0.0002	0.0000	0.0002	NA	NA

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	Benzo(a)pyrene	0.678	0.726	0.0115	0.0084	0.0003	0.0020	0.0023	NA	NA
WAG 1	Beryllium	0.949	1.013	0.0100	0.0101	0.0003	0.0028	0.0031	NA	NA
WAG 1	Bis(2-ethylhexyl) phthalate	0.458	0.441	0.0001	0.0000	0.0000	0.0012	0.0012	0.33	0.00
WAG 1	Boron	1204.965	1761.234	NA	NA	NA	4.9193	4.9193	16.1	0.31
WAG 1	Cadmium	1.770	1.962	0.6450	1.2654	0.0380	0.0055	0.0434	0.9	0.05
WAG 1	Carbon tetrachloride	0.008	0.006	0.9324	0.0056	0.0002	0.0000	0.0002	NA	NA
WAG 1	Chloroform	0.010	0.009	2.7040	0.0244	0.0007	0.0000	0.0008	NA	NA
WAG 1	Chromium	28.951	32.958	0.0410	1.3513	0.0405	0.0921	0.1326	NA	NA
WAG 1	Copper	19.625	22.256	0.4000	8.9025	0.2671	0.0622	0.3292	21	0.02
WAG 1	Cyanide	4.681	NA	NA	NA	NA	0.0131	0.0131	NA	NA
WAG 1	Di-n-butylphthalate	0.720	0.700	0.1656	0.1160	0.0035	0.0020	0.0054	0.03	0.18
WAG 1	Diethylphthalate	0.579	0.048	1.3899	0.0668	0.0020	0.0001	0.0021	NA	NA
WAG 1	Endrin	0.021	NA	0.0545	0.0011	0.0000	0.0001	0.0001	0.18	0.00
WAG 1	Heptachlor	0.011	NA	0.1267	0.0013	0.0000	0.0000	0.0001	NA	NA
WAG 1	Lead	40.874	46.324	0.0450	2.0846	0.0625	0.1294	0.1919	0.34	0.56

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	Mercury	1.306	1.850	0.1430	0.2645	0.0079	0.0052	0.0131	0.004	3.28
WAG 1	Methylene chloride	0.031	0.037	6.8640	0.2516	0.0075	0.0001	0.0076	NA	NA
WAG 1	PCB-1254	0.350	0.440	0.0127	0.0056	0.0002	0.0012	0.0014	0.1	0.01
WAG 1	PCB-1260	0.247	0.227	0.0029	0.0007	0.0000	0.0006	0.0007	0.1	0.01
WAG 1	Pentachlorophenol	2.957	0.280	NA	NA	NA	0.0008	0.0008	NA	NA
WAG 1	Selenium	14.565	16.841	0.0330	0.5558	0.0167	0.0470	0.0637	0.3	0.21
WAG 1	Tetrachloroethene	0.008	0.004	0.4196	0.0018	0.0001	0.0000	0.0001	NA	NA
WAG 1	Thallium	14.168	15.851	NA	NA	NA	0.0443	0.0443	NA	NA
WAG 1	Tin	50.730	54.202	NA	NA	NA	0.1514	0.1514	2	0.08
WAG 1	Toluene	0.007	0.004	1.0651	0.0038	0.0001	0.0000	0.0001	NA	NA
WAG 1	Trichloroethene	0.007	0.002	1.5878	0.0036	0.0001	0.0000	0.0001	NA	NA
WAG 1	Uranium	7.957	14.470	0.0063	0.0912	0.0027	0.0404	0.0432	10	0.00
WAG 1	Vinyl chloride	0.015	0.012	6.0089	0.0723	0.0022	0.0000	0.0022	NA	NA
WAG 1	Zinc	91.993	105.628	0.3701	39.0929	1.1728	0.2950	1.4678	10.1	0.15
WAG 1	Alpha-BHC	0.012	NA	0.4340	0.0051	0.0002	0.0000	0.0002	0.17	0.00
WAG 1	Alpha-chlordane	0.105	NA	0.0256	0.0027	0.0001	0.0003	0.0004	0.48	0.00

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	Gamma-chlordane	0.104	NA	0.0256	0.0027	0.0001	0.0003	0.0004	0.48	0.00
WAG 6	1,2-Dichlorethene	0.007	NA	3.0889	0.0209	0.0006	0.0000	0.0006	NA	NA
WAG 6	1,4-Dioxane	6.675	7.559	NA	NA	NA	0.0211	0.0211	NA	NA
WAG 6	Acetone	0.014	0.015	53.2970	0.7822	0.0235	0.0000	0.0235	NA	NA
WAG 6	Barium	132.813	143.471	0.1500	21.5206	0.6456	0.4007	1.0463	5.8	0.18
WAG 6	Beryllium	1.383	1.486	0.0100	0.0149	0.0004	0.0042	0.0046	NA	NA
WAG 6	Bis(2-ethylhexyl) phthalate	0.398	0.462	0.0001	0.0001	0.0000	0.0013	0.0013	0.33	0.00
WAG 6	Cadmium	2.501	2.846	0.6450	1.8354	0.0551	0.0079	0.0630	0.9	0.07
WAG 6	Chloroform	0.011	0.013	2.7040	0.0346	0.0010	0.0000	0.0011	NA	NA
WAG 6	Cyanide	23.817	NA	NA	NA	NA	0.0665	0.0665	NA	NA
WAG 6	Methylene chloride	0.028	0.038	6.8640	0.2595	0.0078	0.0001	0.0079	NA	NA
WAG 6	Nickel	38.284	41.626	0.0600	2.4975	0.0749	0.1163	0.1912	40	0.00
WAG 6	Tetrachloroethene	0.006	0.003	0.4196	0.0014	0.0000	0.0000	0.0001	NA	NA
WAG 6	Tin	55.025	89.243	NA	NA	NA	0.2493	0.2493	2	0.12
WAG 6	Toluene	0.004	0.002	1.0651	0.0026	0.0001	0.0000	0.0001	NA	NA

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 6	Trichloroethene	0.005	0.004	1.5878	0.0057	0.0002	0.0000	0.0002	NA	NA
WAG 6	Uranium	0.818	1.007	0.0063	0.0063	0.0002	0.0028	0.0030	10	0.00
UEFPC OU 2	Aluminum	29900.00	65257.008	0.0040	261.0280	7.8308	182.2696	190.1004	33.2	5.73
UEFPC OU 2	Barium	149.850	567.505	0.1500	85.1257	2.5538	1.5851	4.1389	5.8	0.71
UEFPC OU 2	Beryllium	1.250	2.197	0.0100	0.0220	0.0007	0.0061	0.0068	NA	NA
UEFPC OU 2	Chromium	39.700	76.951	0.0410	3.1550	0.0946	0.2149	0.3096	NA	NA
UEFPC OU 2	Copper	22.100	54.932	0.4000	21.9726	0.6592	0.1534	0.8126	21	0.04
UEFPC OU 2	Lead	36.600	250.005	0.0450	11.2502	0.3375	0.6983	1.0358	0.34	3.05
UEFPC OU 2	Lithium	22.700	31.539	NA	NA	NA	0.0881	0.0881	NA	NA
UEFPC OU 2	Manganese	484.000	2592.793	0.2500	648.1983	19.4459	7.2419	26.6879	230	0.12
UEFPC OU 2	Nickel	36.200	57.035	0.0600	3.4221	0.1027	0.1593	0.2620	40	0.01

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Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
UEFPC OU 2	Nitrate	0.585	1.122	NA	NA	NA	0.0031	0.0031	NA	NA
UEFPC OU 2	Strontium	21.100	117.700	NA	NA	NA	0.3287	0.3287	NA	NA
UEFPC OU 2	Uranium	1.565	6.206	0.0063	0.0391	0.0012	0.0173	0.0185	10	0.00
UEFPC OU 2	Zinc	86.200	286.977	0.3701	106.2103	3.1863	0.8016	3.9879	10.1	0.39
BC OU 2	1,1,1-trichlorethane	0.008	0.008	1.3899	0.0113	0.0003	0.0000	0.0004	NA	NA
BC OU 2	1,1-Dichlorethene	0.008	0.008	NA	NA	NA	0.0000	0.0000	NA	NA
BC OU 2	1,2-Dichlorethane	0.008	0.008	5.2602	0.0426	0.0013	0.0000	0.0013	11.2	0.00
BC OU 2	1,2-Dichlorethene	0.008	0.008	3.0889	0.0250	0.0008	0.0000	0.0008	NA	NA
BC OU 2	4,4-DDD	0.005	0.006	0.0151	0.0001	0.0000	0.0000	0.0000	0.0024	0.01
BC OU 2	4,4-DDE	0.005	0.006	0.1047	0.0006	0.0000	0.0000	0.0000	0.0024	0.01
BC OU 2	4,4-DDT	0.005	0.006	0.0080	0.0000	0.0000	0.0000	0.0000	0.0024	0.01
BC OU 2	Acetone	0.051	0.105	53.2970	5.6010	0.1680	0.0003	0.1683	NA	NA
BC OU 2	Aldrin	0.003	0.003	0.0250	0.0001	0.0000	0.0000	0.0000	NA	NA

G-95

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Aluminum	26143.85	35920.340	0.0040	143.6814	4.3104	100.3292	104.6397	33.2	3.15
BC OU 2	Antimony	0.309	0.357	0.0400	0.0143	0.0004	0.0010	0.0014	NA	NA
BC OU 2	Arsenic	33.369	35.093	0.0040	0.1404	0.0042	0.0980	0.1022	2.87	0.04
BC OU 2	Barium	101.400	153.978	0.1500	23.0967	0.6929	0.4301	1.1230	5.8	0.19
BC OU 2	Benzene	0.008	0.008	2.3670	0.0192	0.0006	0.0000	0.0006	NA	NA
BC OU 2	Benzo(a)pyrene	0.499	0.529	0.0115	0.0061	0.0002	0.0015	0.0017	NA	NA
BC OU 2	Beryllium	1.025	1.315	0.0100	0.0132	0.0004	0.0037	0.0041	NA	NA
BC OU 2	Bis(2-ethylhexyl) phthalate	0.499	0.529	0.0001	0.0001	0.0000	0.0015	0.0015	0.33	0.00
BC OU 2	Boron	65.500	79.406	NA	NA	NA	0.2218	0.2218	16.1	0.01
BC OU 2	Cadmium	1.247	0.857	0.6450	0.5529	0.0166	0.0024	0.0190	0.9	0.02
BC OU 2	Carbon tetrachloride	0.008	0.008	0.9324	0.0076	0.0002	0.0000	0.0002	NA	NA
BC OU 2	Chloroform	0.008	0.008	2.7040	0.0219	0.0007	0.0000	0.0007	NA	NA
BC OU 2	Chromium	37.331	44.232	0.0410	1.8135	0.0544	0.1235	0.1780	NA	NA
BC OU 2	Copper	39.223	57.365	0.4000	22.9461	0.6884	0.1602	0.8486	21	0.04
BC OU 2	Di-n-butylphthalate	0.499	0.529	0.1656	0.0876	0.0026	0.0015	0.0041	0.03	0.14

G-96

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Dieldrin	0.005	0.006	0.0317	0.0002	0.0000	0.0000	0.0000	0.034	0.00
BC OU 2	Diethylphthalate	0.499	0.529	1.3899	0.7353	0.0221	0.0015	0.0235	NA	NA
BC OU 2	Endosulfan I	0.003	0.003	NA	NA	NA	0.0000	0.0000	4	0.00
BC OU 2	Endosulfan II	0.005	0.006	NA	NA	NA	0.0000	0.0000	4	0.00
BC OU 2	Endrin	0.005	0.006	0.0555	0.0003	0.0000	0.0000	0.0000	0.18	0.00
BC OU 2	Heptachlor	0.003	0.003	0.1267	0.0004	0.0000	0.0000	0.0000	NA	NA
BC OU 2	Lead	81.015	126.822	0.0450	5.7070	0.1712	0.3542	0.5254	0.34	1.55
BC OU 2	Lindane	0.003	0.003	0.2741	0.0008	0.0000	0.0000	0.0000	1.1	0.00
BC OU 2	Lithium	39.250	47.194	NA	NA	NA	0.1318	0.1318	NA	NA
BC OU 2	Manganese	1021.523	1779.367	0.2500	444.8418	13.3453	4.9700	18.3152	230	0.08
BC OU 2	Mercury	49.019	76.055	0.1430	10.8759	0.3263	0.2124	0.5387	0.004	134.68
BC OU 2	Methoxychlor	0.026	0.028	NA	NA	NA	0.0001	0.0001	NA	NA
BC OU 2	Methylene chloride	0.016	0.018	6.8640	0.1231	0.0037	0.0001	0.0037	NA	NA
BC OU 2	Nickel	32.600	50.322	0.0600	3.0193	0.0906	0.1406	0.2311	40	0.01
BC OU 2	Niobium	9.850	NA	NA	NA	NA	0.0275	0.0275	NA	NA
BC OU 2	PCB-1016	0.052	0.056	NA	NA	NA	0.0002	0.0002	NA	NA

G-97

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	PCB-1242	0.052	0.056	0.0029	0.0002	0.0000	0.0002	0.0002	0.13	0.00
BC OU 2	PCB-1248	0.052	0.056	0.0029	0.0002	0.0000	0.0002	0.0002	NA	NA
BC OU 2	PCB-1254	0.052	0.056	0.0127	0.0007	0.0000	0.0002	0.0002	0.1	0.00
BC OU 2	PCB-1260	0.042	0.048	0.0029	0.0001	0.0000	0.0001	0.0001	0.1	0.00
BC OU 2	Pentachlorophenol	1.211	1.296	NA	NA	NA	0.0036	0.0036	NA	NA
BC OU 2	Selenium	1.094	1.788	0.0330	0.0590	0.0018	0.0050	0.0068	0.3	0.02
BC OU 2	Strontium	109.925	133.870	NA	NA	NA	0.3739	0.3739	NA	NA
BC OU 2	Tetrachloroethene	0.007	0.008	0.4196	0.0033	0.0001	0.0000	0.0001	NA	NA
BC OU 2	Toluene	0.008	0.008	1.0651	0.0086	0.0003	0.0000	0.0003	NA	NA
BC OU 2	Toxaphene	0.261	0.284	NA	NA	NA	0.0008	0.0008	NA	NA
BC OU 2	Trichloroethene	0.008	0.008	1.5878	0.0129	0.0004	0.0000	0.0004	NA	NA
BC OU 2	Uranium	2.041	2.517	0.0063	0.0159	0.0005	0.0070	0.0075	10	0.00
BC OU 2	Vanadium	54.838	62.578	0.0060	0.3755	0.0113	0.1748	0.1860	6.7	0.03
BC OU 2	Vinyl chloride	0.015	0.016	6.0089	0.0974	0.0029	0.0000	0.0030	NA	NA
BC OU 2	Zinc	113.208	149.418	0.3701	55.2996	1.6590	0.4173	2.0763	10.1	0.21
BC OU 2	Zirconium	59.250	74.483	NA	NA	NA	0.2080	0.2080	NA	NA
BC OU 2	Alpha-BHC	0.003	0.003	0.4340	0.0012	0.0000	0.0000	0.0000	0.17	0.00

G-98

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Alpha-chlordane	0.003	0.003	0.0256	0.0001	0.0000	0.0000	0.0000	0.48	0.00
BC OU 2	Beta-BHC	0.003	0.003	0.4340	0.0012	0.0000	0.0000	0.0000	NA	NA
BC OU 2	Delta-BHC	0.003	0.003	0.4340	0.0012	0.0000	0.0000	0.0000	0.17	0.00
BC OU 2	Gamma-chlordane	0.003	0.003	0.0256	0.0001	0.0000	0.0000	0.0000	0.48	0.00
SCF	1,1,1-trichlorethane	0.436	0.955	1.3899	1.3273	0.0398	0.0027	0.0425	NA	NA
SCF	1,1-Dichlorethene	10.464	19.679	NA	NA	NA	0.0550	0.0550	NA	NA
SCF	1,2-Dichlorethene	60.893	157.216	5.2602	826.9877	24.8096	0.4391	25.2488	11.2	2.25
SCF	4,4-DDD	0.005	0.001	0.0151	0.0000	0.0000	0.0000	0.0000	0.0024	0.00
SCF	4,4-DDE	0.003	0.002	0.1047	0.0002	0.0000	0.0000	0.0000	0.0024	0.00
SCF	4,4-DDT	0.006	0.006	0.0080	0.0001	0.0000	0.0000	0.0000	0.0024	0.01
SCF	Acetone	97.955	212.986	53.2970	11351.5129	340.5454	0.5949	341.1403	NA	NA
SCF	Aldrin	0.003	0.000	0.0250	0.0000	0.0000	0.0000	0.0000	NA	NA
SCF	Aluminum	16294.05	20546.940	0.0040	82.1878	2.4656	57.3897	59.8554	33.2	1.80
SCF	Antimony	3.125	1.215	0.0400	0.0486	0.0015	0.0034	0.0049	NA	NA
SCF	Arsenic	12.771	14.534	0.0040	0.0581	0.0017	0.0406	0.0423	2.87	0.01

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
SCF	Barium	111.605	139.739	0.1500	20.9608	0.6288	0.3903	1.0191	5.8	0.18
SCF	Benzene	0.916	2.040	2.3670	4.8287	0.1449	0.0057	0.1506	NA	NA
SCF	Benzo(a)pyrene	0.483	0.322	0.0115	0.0037	0.0001	0.0009	0.0010	NA	NA
SCF	Beryllium	1.480	1.611	0.0100	0.0161	0.0005	0.0045	0.0050	NA	NA
SCF	Bis(2-ethylhexyl) phthalate	0.439	0.176	0.0001	0.0000	0.0000	0.0005	0.0005	0.33	0.00
SCF	Cadmium	6.132	7.413	0.6450	4.7814	0.1434	0.0207	0.1641	0.9	0.18
SCF	Carbon tetrachloride	0.003	0.000	0.9324	0.0001	0.0000	0.0000	0.0000	NA	NA
SCF	Chloroform	0.886	1.987	2.7040	5.3734	0.1612	0.0056	0.1668	NA	NA
SCF	Chromium	56.892	61.157	0.0410	2.5074	0.0752	0.1708	0.2460	NA	NA
SCF	Copper	20.555	27.899	0.4000	11.1596	0.3348	0.0779	0.4127	21	0.02
SCF	Di-n-butylphthalate	0.470	0.118	0.1656	0.0196	0.0006	0.0003	0.0009	0.03	0.03
SCF	Dieldrin	0.004	0.001	0.0317	0.0000	0.0000	0.0000	0.0000	0.034	0.00
SCF	Endosulfan I	0.003	NA	NA	NA	NA	0.0000	0.0000	4	0.00
SCF	Endrin	0.005	0.001	0.0555	0.0001	0.0000	0.0000	0.0000	0.18	0.00
SCF	Heptachlor	0.003	NA	0.1267	0.0004	0.0000	0.0000	0.0000	NA	NA

G-100

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
SCF	Lead	41.506	52.212	0.0450	2.3495	0.0705	0.1458	0.2163	0.34	0.64
SCF	Manganese	1392.092	1849.264	0.2500	462.3159	13.8695	5.1652	19.0347	230	0.08
SCF	Mercury	0.682	0.854	0.1430	0.1222	0.0037	0.0024	0.0061	0.004	1.51
SCF	Methoxychlor	0.027	0.014	NA	NA	NA	0.0000	0.0000	NA	NA
SCF	Methylene chloride	136.175	281.149	6.8640	1929.8077	57.8942	0.7853	58.6795	NA	NA
SCF	Nickel	18.418	20.372	0.0600	1.2223	0.0367	0.0569	0.0936	40	0.00
SCF	PCB-1254	0.057	0.038	0.0127	0.0005	0.0000	0.0001	0.0001	0.1	0.00
SCF	PCB-1260	0.066	0.069	0.0029	0.0002	0.0000	0.0002	0.0002	0.1	0.00
SCF	Pentachlorophenol	0.266	0.005	NA	NA	NA	0.0000	0.0000	NA	NA
SCF	Selenium	2.796	2.965	0.0330	0.0978	0.0029	0.0083	0.0112	0.3	0.04
SCF	Tetrachloroethene	0.546	1.142	0.4196	0.4792	0.0144	0.0032	0.0176	NA	NA
SCF	Toluene	0.917	2.045	1.0651	2.1784	0.0654	0.0057	0.0711	NA	NA
SCF	Trichloroethene	0.782	1.493	1.5878	2.3705	0.0711	0.0042	0.0753	NA	NA
SCF	Uranium	3.128	3.313	0.0063	0.0209	0.0006	0.0093	0.0099	10	0.00
SCF	Zinc	114.172	146.031	0.3701	54.0460	1.6214	0.4079	2.0293	10.1	0.20
SCF	Alpha-chlordane	0.003	0.001	0.0256	0.0000	0.0000	0.0000	0.0000	0.48	0.00

G-101

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
SCF	Delta-BHC	0.003	0.000	0.4340	0.0002	0.0000	0.0000	0.0000	0.17	0.00
SCF	Gamma-chlordane	0.003	0.001	0.0256	0.0000	0.0000	0.0000	0.0000	0.48	0.00
K-1420 OU	1,2-Dichlorethane	0.005	0.007	5.2602	0.0388	0.0012	0.0000	0.0012	11.2	0.00
K-1420 OU	Acetone	0.019	0.025	53.2970	1.3250	0.0397	0.0001	0.0398	NA	NA
K-1420 OU	Aldrin	0.011	NA	0.0250	0.0003	0.0000	0.0000	0.0000	NA	NA
K-1420 OU	Aluminum	19950.00	49308.945	0.0040	197.2358	5.9171	137.7250	143.6421	33.2	4.33
K-1420 OU	Barium	31.850	83.938	0.1500	12.5908	0.3777	0.2344	0.6122	5.8	0.11
K-1420 OU	Benzo(a)pyrene	0.378	0.386	0.0115	0.0045	0.0001	0.0011	0.0012	NA	NA
K-1420 OU	Beryllium	0.375	1.290	0.0100	0.0129	0.0004	0.0036	0.0040	NA	NA
K-1420 OU	Bis(2-ethylhexyl) phthalate	0.215	0.289	0.0001	0.0000	0.0000	0.0008	0.0008	0.33	0.00
K-1420 OU	Boron	2.700	NA	NA	NA	NA	0.0075	0.0075	16.1	0.00

G-102

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1420 OU	Chromium	15.200	25.472	0.0410	1.0443	0.0313	0.0711	0.1025	NA	NA
K-1420 OU	Copper	26.200	47.035	0.4000	18.8142	0.5644	0.1314	0.6958	21	0.03
K-1420 OU	Fluoride	40.015	0.030	0.0600	0.0018	0.0001	0.0001	0.0001	2.5	0.00
K-1420 OU	Lead	66.250	90.518	0.0450	4.0733	0.1222	0.2528	0.3750	0.34	1.10
K-1420 OU	Lithium	52.200	228.354	NA	NA	NA	0.6378	0.6378	NA	NA
K-1420 OU	Manganese	470.000	1960.045	0.2500	490.0113	14.7003	5.4746	20.1749	230	0.09
K-1420 OU	Mercury	0.203	0.430	0.1430	0.0615	0.0018	0.0012	0.0030	0.004	0.76
K-1420 OU	Methylene chloride	0.007	0.009	6.8640	0.0642	0.0019	0.0000	0.0020	NA	NA
K-1420 OU	Nitrate	20.008	0.027	NA	NA	NA	0.0001	0.0001	NA	NA
K-1420 OU	PCB-1254	0.663	1.693	0.0127	0.0215	0.0006	0.0047	0.0054	0.1	0.05
K-1420 OU	Pentachlorophenol	2.106	NA	NA	NA	NA	0.0059	0.0059	NA	NA

G-103

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1420 OU	Strontium	38.250	255.759	NA	NA	NA	0.7144	0.7144	NA	NA
K-1420 OU	Tetrachloroethene	0.006	NA	0.4106	0.0025	0.0001	0.0000	0.0001	NA	NA
K-1420 OU	Thallium	0.720	NA	NA	NA	NA	0.0020	0.0020	NA	NA
K-1420 OU	Trichloroethene	0.041	NA	1.5878	0.0651	0.0020	0.0001	0.0021	NA	NA
K-1420 OU	Uranium	139.109	282.563	0.0063	1.7801	0.0534	0.7892	0.8426	10	0.08
K-1420 OU	Vanadium	48.900	141.081	0.0060	0.8465	0.0254	0.3941	0.4194	6.7	0.06
K-1420 OU	Zinc	84.350	154.117	0.3701	57.0387	1.7112	0.4305	2.1416	10.1	0.21
K-1420 OU	Beta-BHC	0.014	NA	0.4340	0.0059	0.0002	0.0000	0.0002	NA	NA
K-1414	Acetone	0.031	NA	53.2970	1.6522	0.0496	0.0001	0.0497	NA	NA
K-1414	Benzo(a)pyrene	0.287	NA	0.0115	0.0033	0.0001	0.0008	0.0009	NA	NA
K-1414	Bis(2-ethylhexyl) phthalate	0.224	NA	0.0001	0.0000	0.0000	0.0006	0.0006	0.33	0.00

G-104

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1414	Di-n-butylphthalate	0.740	2.382	0.1656	0.3943	0.0118	0.0067	0.0185	0.03	0.62
K-1414	Methylene chloride	0.038	0.158	6.8640	1.0842	0.0325	0.0004	0.0330	NA	NA
K-1414	Tetrachloroethene	0.004	NA	0.4196	0.0017	0.0001	0.0000	0.0001	NA	NA
CR OU2*	Aluminum	NA	21900.0000	0.004	87.6	2.63	61.2	63.8	33.2	1.92
CR OU2	Arsenic	NA	131.0000	0.004	1.77	0.0531	0.366	0.419	2.87	0.15
CR OU2	Barium	NA	450.0000	0.150	67.5	2.03	1.26	3.28	5.80	0.57
CR OU2	Chromium	NA	25.1000	0.041	5.30	0.159	0.0701	0.229	0.60	0.38
CR OU2	Copper	NA	69.1000	0.400	27.6	0.829	0.193	1.02	21.0	0.05
CR OU2	Lead	NA	18.8000	0.045	1.07	0.0321	0.525	0.0846	0.340	0.25
CR OU2	Manganese	NA	152.0000	0.250	38.0	1.14	0.425	1.56	230	0.01
CR OU2	Mercury	NA	0.7050	0.143	0.060	0.0018	0.00197	0.00377	0.004	0.94
CR OU2	Nickel	NA	36.0000	0.060	2.16	0.0648	0.101	0.165	40.0	0.00
CR OU2	Selenium	NA	14.8000	0.033	23.6	0.708	0.0413	0.750	0.300	2.50
CR OU2	Vanadium	NA	84.9000	0.006	0.509	0.0153	0.237	0.252	6.70	0.04

G-105

Table G.11 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-plant uptake factor*	Plant concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
CR OU2	Zinc	NA	53.9000	0.370	19.9	0.598	0.151	0.749	10.1	0.07
CR OU2	bis(2-Ethylhexyl) phthalate	NA	0.2700	0.0001	2.70e-05	8.10e-07	7.54e-04	7.55e-04	0.330	0.00
CR OU2	alpha-BHC	NA	0.0003	0.434	1.30e-04	3.91e-06	8.38e-07	4.74e-06	0.170	0.00

NA= Not Available

PLE UCB not available - contaminant detected in only 1 sample.

Soil to plant uptake factor not available, therefore, estimated vegetation concentrations and exposure from food ingestion could not be calculated.

* Soil to plant uptake factors for antimony, arsenic, cadmium, chromium, mercury, selenium, zinc, and uranium were calculated using data collected from Lower East Fork Poplar Creek. Other soil to plant uptake factors from Baes et al. 1984.

* Chestnut Ridge OU2 data available in the Baseline Ecological Risk Assessment for the Chestnut Ridge Operable Unit 2 Remedial Investigation/Feasibility Study. Measured contaminant concentrations in vegetation reported for arsenic, chromium, lead, mercury, and selenium.

Table G.11 (continued)

Total contaminant exposure for the wild turkey in WAG 5

Location	Analyte	95% UCL		Soil-Plant Uptake Factor *	Plant Concentration mg/kg	Exposure (mg/kg/d)				NOAEL Toxicity Benchmark mg/kg/d	NOAEL HQ
		Water mg/L	Soil mg/kg			Water	Soil	Food	Total exposure		
WAG 5	Lead	0	94	0.045	4.2300	0.0000	0.2626	0.1269	0.3895	0.34	1.15
WAG 5	Manganese	4.09	1100	0.25	275.0000	0.1340	3.0724	8.2500	11.4564	230	0.05
WAG 5	Mercury	0	1.3	0.143	0.1859	0.0000	0.0036	0.0056	0.0092	0.004	2.30
WAG 5	Nickel	0.57	34	0.06	2.0400	0.0187	0.0950	0.0612	0.1748	40	0.00
WAG 5	Selenium	0.24	0	0.033	0.0000	0.0079	0.0000	0.0000	0.0079	0.3	0.03
WAG 5	Vanadium	0.09	34	0.006	0.2040	0.0029	0.0950	0.0061	0.1040	6.7	0.02
WAG 5	Zinc	0.03	1000	0.3701	370.1000	0.0010	2.7931	11.1030	13.8971	10.1	1.38
WAG 5	Aroclor 1254	0	0.24	0.0127	0.0030	0.0000	0.0007	0.0001	0.0008	0.1	0.01
WAG 5	Aroclor 1260	0	0.18	0.0029	0.0005	0.0000	0.0005	0.0000	0.0005	0.1	0.01
WAG 5	Bis(2-Ethylhexyl) Phthalate	0	1.3	0.0001	0.0001	0.0000	0.0036	0.0000	0.0036	0.33	0.01
WAG 5	Di-n-butyl Phthalate	0	1.5	0.1656	0.2484	0.0000	0.0042	0.0075	0.0116	0.03	0.39
WAG 5	Trichloroethene	0.13	0	0.4196	0.0000	0.0043	0.0000	0.0000	0.0043	NA	ERR

* Soil to plant uptake factors for antimony, arsenic, cadmium, chromium, mercury, selenium, zinc, and uranium were calculated using data collected from Lower East Fork Poplar Creek. Other soil to plant uptake factors from Baes et al. 1984.

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Table G.12. Total contaminant exposure and NOAEL HQs for the short-tailed shrew on the ORR

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BCVOU1	4,4-DDE	0.108	NA	NA	NA	NA	0.008	0.008	2.26	0.00
BCVOU1	4,4-DDT	0.108	NA	NA	NA	NA	0.008	0.008	2.26	0.00
BCVOU1	Acetone	0.036	0.043	NA	NA	NA	0.003	0.003	28.3	0.00
BCVOU1	Antimony	1.03	1.74	NA	NA	NA	0.135	0.135	0.157	0.86
BCVOU1	Arsenic	9.27	13.35	0.632	8.44	5.06	1.04	6.11	0.158	38.65
BCVOU1	Barium	264.32	403.01	0.078	31.31	18.79	31.43	50.22	15.5	3.24
BCVOU1	Benzo(a)pyrene	10.81	19.90	NA	NA	NA	1.552	1.552	1.26	1.23
BCVOU1	Beryllium	1.05	1.43	1.305	1.864	1.119	0.111	1.230	1.87	0.66
BCVOU1	Bis(2-ethylhexyl) phthalate	3.33	0.59	NA	NA	NA	0.046	0.046	23	0.00
BCVOU1	Cadmium	5.38	10.74	4.812	51.66	31.00	0.84	31.83	0.023	1384.10

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BCVOU1	Chloroform	0.012	NA	NA	NA	NA	0.001	0.001	42.4	0.00
BCVOU1	Chromium	48.98	68.36	0.289	19.77	11.86	5.33	17.19	9.27	1.85
BCVOU1	Copper	972.06	1780.00	NA	NA	NA	138.84	138.84	46.8	2.97
BCVOU1	Di-n-butylphthalate	3.00	0.32	NA	NA	NA	0.025	0.025	691	0.00
BCVOU1	Lead	287.46	543.25	NA	NA	NA	42.373	42.373	22.6	1.87
BCVOU1	Mercury	18.98	31.84	5.767	183.63	110.18	2.48	112.66	0.09	1251.80
BCVOU1	Methylene chloride	0.017	0.023	NA	NA	NA	0.002	0.002	16.54	0.00
BCVOU1	Molybdenum	8.86	18.20	NA	NA	NA	1.420	1.420	0.33	4.30
BCVOU1	Nickel	85.11	137.53	NA	NA	NA	10.727	10.727	113.1	0.09
BCVOU1	PCB-1254	1.79	2.66	7.107	18.94	11.36	0.21	11.57	0.066	175.29
BCVOU1	PCB-1260	3.65	6.74	7.107	47.90	28.74	0.53	29.27	0.066	443.45

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BCVOU1	Selenium	1.75	2.27	NA	NA	NA	0.177	0.177	0.096	1.84
BCVOU1	Tetrachloroethene	0.012	NA	NA	NA	NA	0.001	0.001	1.8	0.00
BCVOU1	Tin	20.52	34.43	NA	NA	NA	2.685	2.685	29.4	0.09
BCVOU1	Toluene	0.314	0.399	NA	NA	NA	0.031	0.031	32.7	0.00
BCVOU1	Zinc	668.91	1133.31	5.590	6334.84	3800.90	88.40	3889.30	452	8.60
LEFPC	4,4-DDD	0.017	0.001	NA	NA	NA	0.000	0.000	2.26	0.00
LEFPC	4,4-DDE	0.015	0.002	NA	NA	NA	0.000	0.000	2.26	0.00
LEFPC	4,4-DDT	0.017	0.001	NA	NA	NA	0.000	0.000	2.26	0.00
LEFPC	Acetone	0.254	0.577	NA	NA	NA	0.045	0.045	28.3	0.00
LEFPC	Aldrin	0.008	0.000	NA	NA	NA	0.000	0.000	0.57	0.00

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
LEFPC	Antimony	1.284	0.787	NA	NA	NA	0.061	0.061	0.157	0.39
LEFPC	Barium	121.36	130.05	0.078	10.10	6.06	10.14	16.21	15.5	1.05
LEFPC	Benzo(a)pyrene	0.492	0.484	NA	NA	NA	0.038	0.038	1.26	0.03
LEFPC	Bis(2-ethylhexyl) phthalate	0.334	0.201	NA	NA	NA	0.016	0.016	23	0.00
LEFPC	Cadmium	4.09	4.64	4.812	22.35	13.41	0.36	13.77	0.023	598.76
LEFPC	Chromium	64.61	65.53	0.289	18.95	11.37	5.11	16.48	9.27	1.78
LEFPC	Copper	78.03	89.67	NA	NA	NA	6.994	6.994	46.8	0.15
LEFPC	Cyanide	3.02	5.82	NA	NA	NA	0.454	0.454	179	0.00
LEFPC	Di-n-butylphthalate	0.421	0.184	NA	NA	NA	0.014	0.014	691	0.00
LEFPC	Dieldrin	0.017	0.002	NA	NA	NA	0.000	0.000	0.057	0.00
LEFPC	Diethylphthalate	0.461	0.173	NA	NA	NA	0.014	0.014	5761	0.00

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
LEFPC	Endosulfan I	0.008	0.001	NA	NA	NA	0.000	0.000	0.42	0.00
LEFPC	Endosulfan II	0.017	0.001	NA	NA	NA	0.000	0.000	0.42	0.00
LEFPC	Endrin	0.017	0.001	NA	NA	NA	0.000	0.000	0.116	0.00
LEFPC	Heptachlor	0.008	0.000	NA	NA	NA	0.000	0.000	0.4	0.00
LEFPC	Lead	53.80	61.49	NA	NA	NA	4.796	4.796	22.6	0.21
LEFPC	Lindane	0.008	0.001	NA	NA	NA	0.000	0.000	22.6	0.00
LEFPC	Mercury	38.49	41.61	5.77	239.95	143.97	3.25	147.22	0.09	1635.75
LEFPC	Methoxychlor	0.083	0.006	NA	NA	NA	0.000	0.000	11.3	0.00
LEFPC	Methylene chloride	0.037	0.053	NA	NA	NA	0.004	0.004	16.54	0.00
LEFPC	Nickel	34.37	37.91	NA	NA	NA	2.957	2.957	113.1	0.03
LEFPC	PCB-1016	0.090	0.050	NA	NA	NA	0.004	0.004	5.48	0.00

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
LEFPC	PCB-1242	0.090	0.050	NA	NA	NA	0.004	0.004	0.276	0.01
LEFPC	PCB-1248	0.090	0.050	NA	NA	NA	0.004	0.004	0.07	0.06
LEFPC	PCB-1254	0.258	0.224	7.107	1.591	0.955	0.017	0.972	0.066	14.73
LEFPC	PCB-1260	0.431	0.465	7.107	3.308	1.985	0.036	2.021	0.066	30.62
LEFPC	Pentachlorophenol	1.692	0.377	NA	NA	NA	0.029	0.029	0.68	0.04
LEFPC	Selenium	13.566	8.704	7.42	64.55	38.73	0.679	39.409	0.096	410.51
LEFPC	Thallium	0.81	NA	NA	NA	NA	0.063	0.063	0.021	3.01
LEFPC	Uranium	9.71	11.89	NA	NA	NA	0.928	0.928	3.77	0.25
LEFPC	Zinc	179.91	166.20	5.59	929.00	557.40	12.96	570.37	452	1.26
LEFPC	Alpha-chlordane	0.073	0.003	NA	NA	NA	0.000	0.000	5.8	0.00
LEFPC	Delta-BHC	0.008	0.000	NA	NA	NA	0.000	0.000	4.5	0.00

G-113

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
LEFPC	Gamma-chlordane	0.073	0.001	NA	NA	NA	0.000	0.000	5.8	0.00
K-1407 OU	1,1,1-trichlorethane	0.015	NA	NA	NA	NA	0.001	0.001	1323	0.00
K-1407 OU	1,2-Dichlorethane	0.017	0.028	NA	NA	NA	0.002	0.002	56.8	0.00
K-1407 OU	Acetone	0.028	0.019	NA	NA	NA	0.001	0.001	28.3	0.00
K-1407 OU	Aluminum	26562.96	28723.53	0.032	910.54	546.32	2240.44	2786.76	2.43	1146.81
K-1407 OU	Antimony	7.15	NA	NA	NA	NA	0.558	0.558	0.157	3.55
K-1407 OU	Arsenic	12.43	13.07	0.632	8.26	4.96	1.02	5.98	0.158	37.82
K-1407 OU	Barium	110.49	125.28	0.078	9.73	5.84	9.77	15.61	15.5	1.01
K-1407 OU	Beryllium	1.016	1.127	1.305	1.471	0.882	0.088	0.970	1.87	0.52
K-1407 OU	Boron	6.419	8.400	NA	NA	NA	0.655	0.655	79.2	0.01

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1407 OU	Cadmium	1.880	2.149	4.812	10.34	6.21	0.17	6.37	0.023	277.07
K-1407 OU	Chloroform	0.016	0.012	NA	NA	NA	0.00	0.00	42.4	0.00
K-1407 OU	Chromium	61.04	69.86	0.289	20.20	12.12	5.45	17.57	9.27	1.90
K-1407 OU	Copper	40.85	48.64	NA	NA	NA	3.794	3.794	46.8	0.08
K-1407 OU	Di-n-butylphthalate	0.017	0.018	NA	NA	NA	0.001	0.001	691	0.00
K-1407 OU	Lead	30.68	33.00	NA	NA	NA	2.57	2.57	22.6	0.11
K-1407 OU	Mercury	4.73	6.40	5.767	36.89	22.13	0.50	22.63	0.09	251.46
K-1407 OU	Methylene chloride	0.018	0.021	NA	NA	NA	0.002	0.002	16.54	0.00
K-1407 OU	Nickel	192.18	251.09	NA	NA	NA	19.59	19.59	113.1	0.17
K-1407 OU	Selenium	7.15	NA	7.416	53.04	31.82	0.558	32.379	0.096	337.29
K-1407 OU	Strontium	18.14	20.67	NA	NA	NA	1.612	1.612	744	0.00

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1407 OU	Tetrachloroethene	0.023	0.024	NA	NA	NA	0.002	0.002	1.8	0.00
K-1407 OU	Toluene	0.011	0.001	NA	NA	NA	0.000	0.000	32.7	0.00
K-1407 OU	Trichloroethene	0.025	0.028	NA	NA	NA	0.002	0.002	0.88	0.00
K-1407 OU	Uranium	143.69	255.85	NA	NA	NA	19.956	19.956	3.77	5.29
K-1407 OU	Zinc	59.78	64.47	5.59	360.37	216.22	5.03	221.25	452	0.49
WAG 1	1,1,1-trichlorethane	0.008	0.003	NA	NA	NA	0.000	0.000	1323	0.00
WAG 1	1,1-Dichlorethane	0.008	0.006	NA	NA	NA	0.000	0.000	84.8	0.00
WAG 1	1,2-Dichlorethane	0.008	0.006	NA	NA	NA	0.000	0.000	66	0.00
WAG 1	1,2-Dichlorethane	0.008	0.002	NA	NA	NA	0.000	0.000	56.8	0.00
WAG 1	4,4-DDD	0.021	NA	NA	NA	NA	0.002	0.002	2.26	0.00

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	4,4-DDE	0.022	NA	NA	NA	NA	0.002	0.002	2.26	0.00
WAG 1	4,4-DDT	0.021	0.010	NA	NA	NA	0.001	0.001	2.26	0.00
WAG 1	Acetone	0.028	0.029	NA	NA	NA	0.002	0.002	28.3	0.00
WAG 1	Antimony	6.13	6.06	NA	NA	NA	0.473	0.473	0.157	3.01
WAG 1	Arsenic	9.01	9.77	0.632	6.176	3.706	0.762	4.468	0.158	28.28
WAG 1	Benzene	0.008	0.003	NA	NA	NA	0.000	0.000	33.13	0.00
WAG 1	Benzo(a)pyrene	0.678	0.726	NA	NA	NA	0.057	0.057	1.26	0.04
WAG 1	Beryllium	0.949	1.013	1.31	1.32	0.793	0.079	0.872	1.87	0.47
WAG 1	Bis(2-ethylhexyl) phthalate	0.458	0.441	NA	NA	NA	0.034	0.034	23	0.00
WAG 1	Boron	1204.97	1761.23	NA	NA	NA	137.38	137.38	79.2	1.73
WAG 1	Cadmium	1.770	1.962	4.81	9.44	5.664	0.153	5.817	0.023	252.91

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	Carbon tetrachloride	0.008	0.006	NA	NA	NA	0.000	0.000	45.2	0.00
WAG 1	Chloroform	0.010	0.009	NA	NA	NA	0.001	0.001	42.4	0.00
WAG 1	Chromium	28.95	32.96	0.289	9.531	5.719	2.571	8.290	9.27	0.89
WAG 1	Copper	19.62	22.26	NA	NA	NA	1.736	1.736	46.8	0.04
WAG 1	Cyanide	4.681	NA	NA	NA	NA	0.365	0.365	179	0.00
WAG 1	Di-n-butylphthalate	0.720	0.700	NA	NA	NA	0.055	0.055	691	0.00
WAG 1	Diethylphthalate	0.579	0.048	NA	NA	NA	0.004	0.004	5761	0.00
WAG 1	Endrin	0.021	NA	NA	NA	NA	0.002	0.002	0.116	0.01
WAG 1	Heptachlor	0.011	NA	NA	NA	NA	0.001	0.001	0.4	0.00
WAG 1	Lead	40.87	46.32	NA	NA	NA	3.613	3.613	22.6	0.16
WAG 1	Mercury	1.306	1.850	5.767	10.667	6.400	0.144	6.544	0.09	72.71

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	Methylene chloride	0.031	0.037	NA	NA	NA	0.003	0.003	16.54	0.00
WAG 1	PCB-1254	0.350	0.440	7.107	3.129	1.878	0.034	1.912	0.066	28.97
WAG 1	PCB-1260	0.247	0.227	7.107	1.613	0.968	0.018	0.986	0.066	14.94
WAG 1	Pentachlorophenol	2.957	0.280	NA	NA	NA	0.022	0.022	0.68	0.03
WAG 1	Selenium	14.57	16.84	7.416	124.89	74.93	1.314	76.248	0.096	794.2
WAG 1	Tetrachloroethene	0.008	0.004	NA	NA	NA	0.000	0.000	1.8	0.00
WAG 1	Thallium	14.17	15.85	NA	NA	NA	1.236	1.236	0.021	58.87
WAG 1	Tin	50.73	54.20	NA	NA	NA	4.228	4.228	29.4	0.14
WAG 1	Toluene	0.007	0.004	NA	NA	NA	0.000	0.000	32.7	0.00
WAG 1	Trichloroethene	0.007	0.002	NA	NA	NA	0.000	0.000	0.88	0.00
WAG 1	Uranium	7.96	14.47	NA	NA	NA	1.129	1.129	3.77	0.30

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 1	Vinyl chloride	0.015	0.012	NA	NA	NA	0.001	0.001	0.48	0.00
WAG 1	Zinc	91.99	105.63	5.59	590.43	354.26	8.24	362.50	452	0.80
WAG 1	Alpha-BHC	0.012	NA	NA	NA	NA	0.001	0.001	4.5	0.00
WAG 1	Alpha-chlordane	0.105	NA	NA	NA	NA	0.008	0.008	5.8	0.00
WAG 1	Gamma-chlordane	0.104	NA	NA	NA	NA	0.008	0.008	5.8	0.00
WAG 6	1,2-Dichlorethene	0.007	NA	NA	NA	NA	0.001	0.001	56.8	0.00
WAG 6	1,4-Dioxane	6.675	7.559	NA	NA	NA	0.590	0.590	1.4	0.42
WAG 6	Acetone	0.014	0.015	NA	NA	NA	0.001	0.001	28.3	0.00
WAG 6	Barium	132.81	143.47	0.078	11.148	6.689	11.191	17.879	15.5	1.15
WAG 6	Beryllium	1.383	1.486	1.305	1.939	1.164	0.116	1.280	1.87	0.68

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Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
WAG 6	Bis(2-ethylhexyl) phthalate	0.398	0.462	NA	NA	NA	0.036	0.036	23	0.00
WAG 6	Cadmium	2.501	2.846	4.812	13.69	8.22	0.222	8.437	0.023	366.84
WAG 6	Chloroform	0.011	0.013	NA	NA	NA	0.001	0.001	42.4	0.00
WAG 6	Cyanide	23.82	NA	NA	NA	NA	1.858	1.858	179	0.01
WAG 6	Methylene chloride	0.028	0.038	NA	NA	NA	0.003	0.003	16.54	0.00
WAG 6	Nickel	38.28	41.63	NA	NA	NA	3.247	3.247	113.1	0.03
WAG 6	Tetrachloroethene	0.006	0.003	NA	NA	NA	0.000	0.000	1.8	0.00
WAG 6	Tin	55.03	89.24	NA	NA	NA	6.961	6.961	29.4	0.24
WAG 6	Toluene	0.004	0.002	NA	NA	NA	0.000	0.000	32.7	0.00
WAG 6	Trichloroethene	0.005	0.004	NA	NA	NA	0.000	0.000	0.88	0.00
WAG 6	Uranium	0.818	1.007	NA	NA	NA	0.079	0.079	3.77	0.02

G-121

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
UEFPC OU 2	Aluminum	29900.00	65257.01	0.032	2068.65	1241.19	5090.05	6331.23	2.43	2605.45
UEFPC OU 2	Barium	149.85	567.50	0.078	44.10	26.46	44.27	70.72	15.5	4.56
UEFPC OU 2	Beryllium	1.25	2.20	1.305	2.868	1.721	0.171	1.892	1.87	1.01
UEFPC OU 2	Chromium	39.70	76.95	0.289	22.25	13.35	6.002	19.35	9.27	2.09
UEFPC OU 2	Copper	22.10	54.93	NA	NA	NA	4.285	4.285	46.8	0.09
UEFPC OU 2	Lead	36.60	250.00	NA	NA	NA	19.500	19.500	22.6	0.86
UEFPC OU 2	Lithium	22.70	31.54	NA	NA	NA	2.460	2.460	26.6	0.09
UEFPC OU 2	Manganese	484.00	2592.79	NA	NA	NA	202.24	202.24	249	0.81
UEFPC OU 2	Nickel	36.20	57.04	NA	NA	NA	4.449	4.449	113.1	0.04
UEFPC OU 2	Nitrate	0.585	1.122	NA	NA	NA	0.087	0.087	1929	0.00

G-122

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
UEFPC OU 2	Strontium	21.10	117.70	NA	NA	NA	9.181	9.181	744	0.01
UEFPC OU 2	Uranium	1.57	6.21	NA	NA	NA	0.484	0.484	3.77	0.13
UEFPC OU 2	Zinc	86.20	286.98	5.590	1604.12	962.47	22.38	984.85	452	2.18
BC OU 2	1,1,1-trichlorethane	0.008	0.008	NA	NA	NA	0.001	0.001	1323	0.00
BC OU 2	1,1-Dichlorethene	0.008	0.008	NA	NA	NA	0.001	0.001	84.8	0.00
BC OU 2	1,2-Dichlorethene	0.008	0.008	NA	NA	NA	0.001	0.001	66	0.00
BC OU 2	1,2-Dichlorethene	0.008	0.008	NA	NA	NA	0.001	0.001	56.8	0.00
BC OU 2	4,4-DDD	0.005	0.006	NA	NA	NA	0.000	0.000	2.26	0.00
BC OU 2	4,4-DDE	0.005	0.006	NA	NA	NA	0.000	0.000	2.26	0.00
BC OU 2	4,4-DDT	0.005	0.006	NA	NA	NA	0.000	0.000	2.26	0.00

G-123

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Acetone	0.051	0.105	NA	NA	NA	0.008	0.008	28.3	0.00
BC OU 2	Aldrin	0.003	0.003	NA	NA	NA	0.000	0.000	0.57	0.00
BC OU 2	Aluminum	26143.85	35920.34	0.032	1138.67	683.20	2801.79	3484.99	2.43	1434.15
BC OU 2	Antimony	0.309	0.357	NA	NA	NA	0.028	0.028	0.157	0.18
BC OU 2	Arsenic	33.37	35.09	0.632	22.19	13.31	2.737	16.05	0.158	101.57
BC OU 2	Barium	101.40	153.98	0.078	11.96	7.18	12.01	19.19	15.5	1.24
BC OU 2	Benzene	0.008	0.008	NA	NA	NA	0.001	0.001	33.13	0.00
BC OU 2	Benzo(a)pyrene	0.499	0.529	NA	NA	NA	0.041	0.041	1.26	0.03
BC OU 2	Beryllium	1.025	1.315	1.305	1.717	1.030	0.103	1.133	1.87	0.61
BC OU 2	Bis(2-ethylhexyl) phthalate	0.499	0.529	NA	NA	NA	0.041	0.041	23	0.00
BC OU 2	Boron	65.50	79.41	NA	NA	NA	6.194	6.194	79.2	0.08

G-124

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Cadmium	1.247	0.857	4.812	4.124	2.475	0.067	2.542	0.023	110.50
BC OU 2	Carbon tetrachloride	0.008	0.008	NA	NA	NA	0.001	0.001	45.2	0.00
BC OU 2	Chloroform	0.008	0.008	NA	NA	NA	0.001	0.001	42.4	0.00
BC OU 2	Chromium	37.33	44.23	0.289	12.79	7.675	3.450	11.125	9.27	1.20
BC OU 2	Copper	39.22	57.37	NA	NA	NA	4.474	4.474	46.8	0.10
BC OU 2	Di-n-butylphthalate	0.499	0.529	NA	NA	NA	0.041	0.041	691	0.00
BC OU 2	Dieldrin	0.005	0.006	NA	NA	NA	0.000	0.000	0.057	0.01
BC OU 2	Diethylphthalate	0.499	0.529	NA	NA	NA	0.041	0.041	5761	0.00
BC OU 2	Endosulfan I	0.003	0.003	NA	NA	NA	0.000	0.000	0.42	0.00
BC OU 2	Endosulfan II	0.005	0.006	NA	NA	NA	0.000	0.000	0.42	0.00
BC OU 2	Endrin	0.005	0.006	NA	NA	NA	0.000	0.000	0.116	0.00

G-125

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Heptachlor	0.003	0.003	NA	NA	NA	0.000	0.000	0.4	0.00
BC OU 2	Lead	81.02	126.82	NA	NA	NA	9.892	9.892	22.6	0.44
BC OU 2	Lindane	0.003	0.003	NA	NA	NA	0.000	0.000	22.6	0.00
BC OU 2	Lithium	39.25	47.19	NA	NA	NA	3.681	3.681	26.6	0.14
BC OU 2	Manganese	1021.52	1779.37	NA	NA	NA	138.79	138.79	249	0.56
BC OU 2	Mercury	49.019	76.055	5.767	438.60	263.16	5.93	269.09	0.09	2989.94
BC OU 2	Methoxychlor	0.026	0.028	NA	NA	NA	0.002	0.002	11.3	0.00
BC OU 2	Methylene chloride	0.016	0.018	NA	NA	NA	0.001	0.001	16.54	0.00
BC OU 2	Nickel	32.600	50.322	NA	NA	NA	3.925	3.925	113.1	0.03
BC OU 2	Niobium	9.850	NA	NA	NA	NA	0.768	0.768	0.195	3.94
BC OU 2	PCB-1016	0.052	0.056	NA	NA	NA	0.004	0.004	5.48	0.00

G-126

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	PCB-1242	0.052	0.056	NA	NA	NA	0.004	0.004	0.276	0.02
BC OU 2	PCB-1248	0.052	0.056	NA	NA	NA	0.004	0.004	0.07	0.06
BC OU 2	PCB-1254	0.052	0.056	7.107	0.401	0.241	0.004	0.245	0.066	3.71
BC OU 2	PCB-1260	0.042	0.048	7.107	0.338	0.203	0.004	0.206	0.066	3.13
BC OU 2	Pentachlorophenol	1.211	1.296	NA	NA	NA	0.101	0.101	0.68	0.15
BC OU 2	Selenium	1.094	1.788	7.416	13.26	7.956	0.139	8.096	0.096	84.33
BC OU 2	Strontium	109.93	133.87	NA	NA	NA	10.44	10.44	744	0.01
BC OU 2	Tetrachloroethene	0.007	0.008	NA	NA	NA	0.001	0.001	1.8	0.00
BC OU 2	Toluene	0.008	0.008	NA	NA	NA	0.001	0.001	32.7	0.00
BC OU 2	Toxaphene	0.261	0.284	NA	NA	NA	0.022	0.022	22.6	0.00
BC OU 2	Trichloroethene	0.008	0.008	NA	NA	NA	0.001	0.001	0.88	0.00

G-127

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
BC OU 2	Uranium	2.041	2.517	NA	NA	NA	0.196	0.196	3.77	0.05
BC OU 2	Vanadium	54.838	62.578	NA	NA	NA	4.881	4.881	0.54	9.04
BC OU 2	Vinyl chloride	0.015	0.016	NA	NA	NA	0.001	0.001	0.48	0.00
BC OU 2	Zinc	113.21	149.42	5.590	835.20	501.12	11.65	512.78	452	1.13
BC OU 2	Zirconium	59.25	74.48	NA	NA	NA	5.810	5.810	2.19	2.65
BC OU 2	Alpha-BHC	0.003	0.003	NA	NA	NA	0.000	0.000	4.5	0.00
BC OU 2	Alpha-chlordane	0.003	0.003	NA	NA	NA	0.000	0.000	5.8	0.00
BC OU 2	Beta-BHC	0.003	0.003	NA	NA	NA	0.000	0.000	1.1	0.00
BC OU 2	Delta-BHC	0.003	0.003	NA	NA	NA	0.000	0.000	4.5	0.00
BC OU 2	Gamma-chlordane	0.003	0.003	NA	NA	NA	0.000	0.000	5.8	0.00

G-128

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
SCF	1,1,1-trichlorethane	0.436	0.955	NA	NA	NA	0.074	0.074	1323	0.00
SCF	1,1-Dichlorethene	10.46	19.68	NA	NA	NA	1.535	1.535	84.8	0.02
SCF	1,2-Dichlorethane	60.89	157.22	NA	NA	NA	12.26	12.26	66	0.19
SCF	4,4-DDD	0.005	0.001	NA	NA	NA	0.000	0.000	56.8	0.00
SCF	4,4-DDE	0.003	0.002	NA	NA	NA	0.000	0.000	2.26	0.00
SCF	4,4-DDT	0.006	0.006	NA	NA	NA	0.001	0.001	2.26	0.00
SCF	Acetone	97.955	212.986	NA	NA	NA	16.613	16.613	2.26	7.35
SCF	Aldrin	0.003	0.000	NA	NA	NA	0.000	0.000	28.3	0.00
SCF	Aluminum	16294.05	20546.94	0.032	651.34	390.80	1602.66	1993.46	0.57	3497.31
SCF	Antimony	3.125	1.215	NA	NA	NA	0.095	0.095	2.43	0.04
SCF	Arsenic	12.77	14.53	0.632	9.189	5.513	1.134	6.647	0.158	42.07
SCF	Barium	111.60	139.74	0.078	10.86	6.51	10.90	17.41	15.5	1.12
SCF	Benzene	0.916	2.040	NA	NA	NA	0.159	0.159	33.13	0.00
SCF	Benzo(a)pyrene	0.483	0.322	NA	NA	NA	0.025	0.025	1.26	0.02
SCF	Beryllium	1.480	1.611	1.305	2.103	1.262	0.126	1.388	1.87	0.74
SCF	Bis(2-ethylhexyl) phthalate	0.439	0.176	NA	NA	NA	0.014	0.014	23	0.00

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
SCF	Cadmium	6.132	7.413	4.812	35.67	21.40	0.58	21.98	0.023	955.66
SCF	Carbon tetrachloride	0.003	0.000	NA	NA	NA	0.000	0.000	45.2	0.00
SCF	Chloroform	0.886	1.987	NA	NA	NA	0.155	0.155	42.4	0.00
SCF	Chromium	56.89	61.16	0.289	17.69	10.61	4.77	15.38	9.27	1.66
SCF	Copper	20.55	27.90	NA	NA	NA	2.176	2.176	46.8	0.05
SCF	Di-n-butylphthalate	0.470	0.118	NA	NA	NA	0.009	0.009	691	0.00
SCF	Dieldrin	0.004	0.001	NA	NA	NA	0.000	0.000	0.057	0.00
SCF	Endosulfan I	0.003	NA	NA	NA	NA	0.000	0.000	0.42	0.00
SCF	Endrin	0.005	0.001	NA	NA	NA	0.000	0.000	0.116	0.00
SCF	Heptachlor	0.003	NA	NA	NA	NA	0.000	0.000	0.4	0.00
SCF	Lead	41.51	52.21	NA	NA	NA	4.073	4.073	22.6	0.18
SCF	Manganese	1392.09	1849.26	NA	NA	NA	144.24	144.24	249	0.58
SCF	Mercury	0.682	0.854	5.767	4.926	2.956	0.067	3.022	0.09	33.58
SCF	Methoxychlor	0.027	0.014	NA	NA	NA	0.001	0.001	11.3	0.00
SCF	Methylene chloride	136.18	281.15	NA	NA	NA	21.930	21.930	16.54	1.33

G-130

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
SCF	Nickel	18.42	20.37	NA	NA	NA	1.589	1.589	113.1	0.01
SCF	PCB-1254	0.057	0.038	7.107	0.267	0.160	0.003	0.163	0.066	2.47
SCF	PCB-1260	0.066	0.069	7.107	0.493	0.296	0.005	0.301	0.066	4.57
SCF	Pentachlorophenol	0.266	0.005	NA	NA	NA	0.000	0.000	0.68	0.00
SCF	Selenium	2.796	2.965	7.416	21.98	13.19	0.231	13.42	0.096	139.81
SCF	Tetrachloroethene	0.546	1.142	NA	NA	NA	0.089	0.089	1.8	0.05
SCF	Toluene	0.917	2.045	NA	NA	NA	0.160	0.160	32.7	0.00
SCF	Trichloroethene	0.782	1.493	NA	NA	NA	0.116	0.116	0.88	0.13
SCF	Uranium	3.128	3.313	NA	NA	NA	0.258	0.258	3.77	0.07
SCF	Zinc	114.17	146.03	5.590	816.27	489.76	11.39	501.15	452	1.11
SCF	Alpha-chlordane	0.003	0.001	NA	NA	NA	0.000	0.000	5.8	0.00
SCF	Delta-BHC	0.003	0.000	NA	NA	NA	0.000	0.000	4.5	0.00
SCF	Gamma-chlordane	0.003	0.001	NA	NA	NA	0.000	0.000	5.8	0.00
K-1420 OU	1,2-Dichlorethane	0.005	0.007	NA	NA	NA	0.001	0.001	66	0.00
K-1420 OU	Acetone	0.019	0.025	NA	NA	NA	0.002	0.002	28.3	0.00

G-131

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1420 OU	Aldrin	0.011	NA	NA	NA	NA	0.001	0.001	0.57	0.00
K-1420 OU	Aluminum	19950.00	49308.94	0.032	1563.09	937.86	3846.10	4783.95	2.43	1968.71
K-1420 OU	Barium	31.85	83.94	0.078	6.522	3.913	6.547	10.46	15.5	0.67
K-1420 OU	Benzo(a)pyrene	0.378	0.386	NA	NA	NA	0.030	0.030	1.26	0.02
K-1420 OU	Beryllium	0.375	1.290	1.305	1.684	1.011	0.101	1.111	1.87	0.59
K-1420 OU	Bis(2-ethylhexyl) phthalate	0.215	0.289	NA	NA	NA	0.023	0.023	23	0.00
K-1420 OU	Chromium	15.20	25.47	0.289	7.366	4.420	1.987	6.407	9.27	0.69
K-1420 OU	Copper	26.20	47.04	NA	NA	NA	3.669	3.669	46.8	0.08
K-1420 OU	Fluoride	40.02	0.030	NA	NA	NA	0.002	0.002	125.43	0.00
K-1420 OU	Lead	66.25	90.52	NA	NA	NA	7.060	7.060	22.6	0.31
K-1420 OU	Lithium	52.20	228.35	NA	NA	NA	17.81	17.81	26.6	0.67

G-132

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1420 OU	Mercury	0.203	0.430	5.767	2.481	1.488	0.034	1.522	0.09	16.91
K-1420 OU	Methylene chloride	0.007	0.009	NA	NA	NA	0.001	0.001	16.54	0.00
K-1420 OU	Nitrate	20.01	0.027	NA	NA	NA	0.002	0.002	1929	0.00
K-1420 OU	PCB-1254	0.663	1.693	7.107	12.03	7.221	0.132	7.353	0.066	111.40
K-1420 OU	Pentachlorophenol	2.106	NA	NA	NA	NA	0.164	0.164	0.68	0.24
K-1420 OU	Strontium	38.250	255.759	NA	NA	NA	19.949	19.949	744	0.03
K-1420 OU	Tetrachloroethene	0.006	NA	NA	NA	NA	0.000	0.000	1.8	0.00
K-1420 OU	Trichloroethene	0.041	NA	NA	NA	NA	0.003	0.003	0.88	0.00
K-1420 OU	Uranium	139.11	282.56	NA	NA	NA	22.04	22.04	3.77	5.85
K-1420 OU	Vanadium	48.90	141.08	NA	NA	NA	11.00	11.00	0.54	20.38
K-1420 OU	Zinc	84.35	154.12	5.590	861.47	516.88	12.02	528.90	452	1.17

G-133

Table G.12 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg/d)	NOAEL HQ
		Mean	PLE 95% UCL			Food	Soil	Total		
K-1420 OU	Beta-BHC	0.014	NA	NA	NA	NA	0.001	0.001	1.1	0.00
K-1414	Acetone	0.031	NA	NA	NA	NA	0.002	0.002	28.3	0.00
K-1414	Benzo(a)pyrene	0.287	NA	NA	NA	NA	0.022	0.022	1.26	0.02
K-1414	Bis(2-ethylhexyl) phthalate	0.224	NA	NA	NA	NA	0.017	0.017	23	0.00
K-1414	Di-n-butylphthalate	0.740	2.382	NA	NA	NA	0.186	0.186	691	0.00
K-1414	Methylene chloride	0.038	0.158	NA	NA	NA	0.012	0.012	16.54	0.00
K-1414	Tetrachloroethene	0.004	NA	NA	NA	NA	0.000	0.000	1.8	0.00

NA= Not Available

PLE UCB not available - contaminant detected in only 1 sample.

• Soil to earthworm uptake factor not available, therefore, estimated earthworm concentrations and exposure from food ingestion could not be calculated.

Table G.13. Total contaminant exposure and NOAEL HQs for the American woodcock on the ORR

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BCVOU1	4,4-DDE	0.108	NA	NA	NA	NA	0.009	0.009	0.0072	1.18
BCVOU1	4,4-DDT	0.108	NA	NA	NA	NA	0.009	0.009	0.0072	1.18
BCVOU1	Acetone	0.036	0.043	NA	NA	NA	0.003	0.003	NA	NA
BCVOU1	Antimony	1.031	1.737	NA	NA	NA	0.137	0.137	NA	NA
BCVOU1	Arsenic	9.269	13.352	0.632	8.441	6.395	1.052	7.447	8.76	0.85
BCVOU1	Barium	264.315	403.009	0.078	31.314	23.723	31.752	55.475	17.7	3.13
BCVOU1	Benzo(a)pyrene	10.811	19.901	NA	NA	NA	1.568	1.568	NA	NA
BCVOU1	Beryllium	1.051	1.428	1.305	1.864	1.412	0.113	1.525	NA	NA
BCVOU1	Bis(2-ethylhexyl) phthalate	3.333	0.587	NA	NA	NA	0.046	0.046	1.01	0.05
BCVOU1	Cadmium	5.380	10.736	4.812	51.661	39.137	0.846	39.983	2.6	15.38

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BCVOU1	Chloroform	0.012	NA	NA	NA	NA	0.001	0.001	NA	NA
BCVOU1	Chromium (III)	48.977	68.364	0.289	19.771	14.978	5.386	20.364	1.8	11.3
BCVOU1	Copper	972.062	1779.997	NA	NA	NA	140.242	140.242	65	2.16
BCVOU1	Di-n-butylphthalate	2.999	0.316	NA	NA	NA	0.025	0.025	0.1	0.25
BCVOU1	Lead	287.462	543.246	NA	NA	NA	42.801	42.801	1.03	41.55
BCVOU1	Mercury	18.982	31.842	5.767	183.631	139.115	2.509	141.623	0.011	12874.8 5
BCVOU1	Methylene chloride	0.017	0.023	NA	NA	NA	0.002	0.002	NA	NA
BCVOU1	Molybdenum	8.855	18.202	NA	NA	NA	1.434	1.434	6.8	0.21
BCVOU1	Nickel	85.108	137.529	NA	NA	NA	10.836	10.836	121.8	0.09
BCVOU1	PCB-1254	1.790	2.665	7.107	18.936	14.345	0.210	14.555	0.31	46.95
BCVOU1	PCB-1260	3.651	6.741	7.107	47.903	36.290	0.531	36.822	0.31	118.78
BCVOU1	Selenium	1.750	2.268	NA	NA	NA	0.179	0.179	0.9	0.20

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BCVOU1	Tetrachloroethene	0.012	NA	NA	NA	NA	0.001	0.001	NA	NA
BCVOU1	Tin	20.523	34.428	NA	NA	NA	2.713	2.713	6.2	0.44
BCVOU1	Toluene	0.314	0.399	NA	NA	NA	0.031	0.031	NA	NA
BCVOU1	Zinc	668.908	1133.306	5.590	6334.841	4799.1 22	89.291	4888.413	30.8	158.71
LEFPC	4,4-DDD	0.017	0.001	NA	NA	NA	0.000	0.000	0.0072	0.01
LEFPC	4,4-DDE	0.015	0.002	NA	NA	NA	0.000	0.000	0.0072	0.02
LEFPC	4,4-DDT	0.017	0.001	NA	NA	NA	0.000	0.000	0.0072	0.02
LEFPC	Acetone	0.254	0.577	NA	NA	NA	0.045	0.045	NA	NA
LEFPC	Aldrin	0.008	0.000	NA	NA	NA	0.000	0.000	NA	NA
LEFPC	Antimony	1.284	0.787	NA	NA	NA	0.062	0.062	NA	NA
LEFPC	Barium	121.357	130.047	0.078	10.105	7.655	10.246	17.901	17.7	1.01

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
LEFPC	Benzo(a)pyrene	0.492	0.484	NA	NA	NA	0.038	0.038	NA	NA
LEFPC	Bis(2-ethylhexyl) phthalate	0.334	0.201	NA	NA	NA	0.016	0.016	1.01	0.02
LEFPC	Cadmium	4.089	4.645	4.812	22.349	16.931	0.366	17.297	2.6	6.65
LEFPC	Chromium (III)	64.608	65.531	0.289	18.951	14.357	5.163	19.520	1.8	10.84
LEFPC	Copper	78.033	89.671	NA	NA	NA	7.065	7.065	65	0.11
LEFPC	Cyanide	3.024	5.824	NA	NA	NA	0.459	0.459	NA	NA
LEFPC	Di-n-butylphthalate	0.421	0.184	NA	NA	NA	0.015	0.015	0.1	0.15
LEFPC	Dieldrin	0.017	0.002	NA	NA	NA	0.000	0.000	0.102	0.00
LEFPC	Diethylphthalate	0.461	0.173	NA	NA	NA	0.014	0.014	NA	NA
LEFPC	Endosulfan I	0.008	0.001	NA	NA	NA	0.000	0.000	13	0.00
LEFPC	Endosulfan II	0.017	0.001	NA	NA	NA	0.000	0.000	13	0.00

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
LEFPC	Endrin	0.017	0.001	NA	NA	NA	0.000	0.000	0.54	0.00
LEFPC	Heptachlor	0.008	0.000	NA	NA	NA	0.000	0.000	NA	NA
LEFPC	Lead	53.799	61.485	NA	NA	NA	4.844	4.844	1.03	4.70
LEFPC	Lindane	0.008	0.001	NA	NA	NA	0.000	0.000	3.4	0.00
LEFPC	Mercury	38.488	41.609	5.767	239.954	181.78 3	3.278	185.061	0.011	16823.7 6
LEFPC	Methoxychlor	0.083	0.006	NA	NA	NA	0.000	0.000	NA	NA
LEFPC	Methylene chloride	0.037	0.053	NA	NA	NA	0.004	0.004	NA	NA
LEFPC	Nickel	34.367	37.906	NA	NA	NA	2.987	2.987	121.8	0.02
LEFPC	PCB-1016	0.090	0.050	NA	NA	NA	0.004	0.004	NA	NA
LEFPC	PCB-1242	0.090	0.050	NA	NA	NA	0.004	0.004	0.4	0.01
LEFPC	PCB-1248	0.090	0.050	NA	NA	NA	0.004	0.004	NA	NA

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
LEFPC	PCB-1254	0.258	0.224	7.107	1.591	1.205	0.018	1.223	0.31	3.95
LEFPC	PCB-1260	0.431	0.465	7.107	3.308	2.506	0.037	2.543	0.31	8.20
LEFPC	Pentachlorophenol	1.692	0.377	NA	NA	NA	0.030	0.030	NA	NA
LEFPC	Selenium	13.566	8.704	7.416	64.550	48.901	0.686	49.587	0.9	55.10
LEFPC	Thallium	0.809	NA	NA	NA	NA	0.064	0.064	NA	NA
LEFPC	Uranium	9.708	11.895	NA	NA	NA	0.937	0.937	29	0.03
LEFPC	Zinc	179.913	166.199	5.590	929.003	703.79 1	13.094	716.885	30.8	23.28
LEFPC	Alpha-chlordane	0.073	0.003	NA	NA	NA	0.000	0.000	1.47	0.00
LEFPC	Delta-BHC	0.008	0.000	NA	NA	NA	0.000	0.000	0.51	0.00
LEFPC	Gamma-chlordane	0.073	0.001	NA	NA	NA	0.000	0.000	1.47	0.00
K-1407 OU	1,1,1-trichlorethane	0.015	NA	NA	NA	NA	0.001	0.001	NA	NA

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1407 OU	1,2-Dichlorethene	0.017	0.028	NA	NA	NA	0.002	0.002	NA	NA
K-1407 OU	Acetone	0.028	0.019	NA	NA	NA	0.001	0.001	NA	NA
K-1407 OU	Aluminum	26562.963	28723.527	0.032	910.536	689.800	2263.066	2952.866	101.2	29.18
K-1407 OU	Antimony	7.151	NA	NA	NA	NA	0.563	0.563	NA	NA
K-1407 OU	Arsenic	12.433	13.068	0.632	8.262	6.259	1.030	7.288	8.76	0.83
K-1407 OU	Barium	110.494	125.275	0.078	9.734	7.374	9.870	17.244	17.7	0.97
K-1407 OU	Beryllium	1.016	1.127	1.305	1.471	1.114	0.089	1.203	NA	NA
K-1407 OU	Boron	6.419	8.400	NA	NA	NA	0.662	0.662	49.1	0.01
K-1407 OU	Cadmium	1.880	2.149	4.812	10.342	7.835	0.169	8.004	2.6	3.08
K-1407 OU	Chloroform	0.016	0.012	NA	NA	NA	0.001	0.001	NA	NA
K-1407 OU	Chromium (III)	61.037	69.864	0.289	20.205	15.307	5.504	20.811	1.8	11.56

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1407 OU	Copper	40.854	48.640	NA	NA	NA	3.832	3.832	65	0.06
K-1407 OU	Di-n-butylphthalate	0.017	0.018	NA	NA	NA	0.001	0.001	0.1	0.01
K-1407 OU	Lead	30.675	32.996	NA	NA	NA	2.600	2.600	1.03	2.52
K-1407 OU	Mercury	4.725	6.396	5.767	36.888	27.945	0.504	28.449	0.011	2586.30
K-1407 OU	Methylene chloride	0.018	0.021	NA	NA	NA	0.002	0.002	NA	NA
K-1407 OU	Nickel	192.179	251.090	NA	NA	NA	19.783	19.783	121.8	0.16
K-1407 OU	Selenium	7.152	NA	7.416	53.036	40.179	0.563	40.742	0.9	45.27
K-1407 OU	Strontium	18.142	20.670	NA	NA	NA	1.629	1.629	NA	NA
K-1407 OU	Tetrachloroethene	0.023	0.024	NA	NA	NA	0.002	0.002	NA	NA
K-1407 OU	Toluene	0.011	0.001	NA	NA	NA	0.000	0.000	NA	NA
K-1407 OU	Trichloroethene	0.025	0.028	NA	NA	NA	0.002	0.002	NA	NA

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1407 OU	Uranium	143.694	255.850	NA	NA	NA	20.158	20.158	29	0.70
K-1407 OU	Zinc	59.778	64.471	5.590	360.374	273.01 1	5.080	278.090	30.8	9.03
WAG 1	1,1,1-trichlorethane	0.008	0.003	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	1,1-Dichlorethane	0.008	0.006	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	1,2-Dichlorethane	0.008	0.006	NA	NA	NA	0.000	0.000	34.3	0.00
WAG 1	1,2-Dichlorethane	0.008	0.002	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	4,4-DDD	0.021	NA	NA	NA	NA	0.002	0.002	0.0072	0.23
WAG 1	4,4-DDE	0.022	NA	NA	NA	NA	0.002	0.002	0.0072	0.24
WAG 1	4,4-DDT	0.021	0.010	NA	NA	NA	0.001	0.001	0.0072	0.11
WAG 1	Acetone	0.028	0.029	NA	NA	NA	0.002	0.002	NA	NA
WAG 1	Antimony	6.127	6.062	NA	NA	NA	0.478	0.478	NA	NA

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 1	Arsenic	9.012	9.769	0.632	6.176	4.679	0.770	5.449	8.76	0.62
WAG 1	Benzene	0.008	0.003	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	Benzo(a)pyrene	0.678	0.726	NA	NA	NA	0.057	0.057	NA	NA
WAG 1	Beryllium	0.949	1.013	1.305	1.322	1.001	0.080	1.081	NA	NA
WAG 1	Bis(2-ethylhexyl) phthalate	0.458	0.441	NA	NA	NA	0.035	0.035	1.01	0.03
WAG 1	Boron	1204.965	1761.234	NA	NA	NA	138.764	138.764	49.1	2.83
WAG 1	Cadmium	1.770	1.962	4.812	9.440	7.151	0.155	7.306	2.6	2.81
WAG 1	Carbon tetrachloride	0.008	0.006	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	Chloroform	0.010	0.009	NA	NA	NA	0.001	0.001	NA	NA
WAG 1	Chromium (III)	28.951	32.958	0.289	9.531	7.221	2.597	9.817	1.8	5.45
WAG 1	Copper	19.625	22.256	NA	NA	NA	1.754	1.754	65	0.03

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)		Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil		
WAG 1	Cyanide	4.681	NA	NA	NA	NA	0.369	NA	NA
WAG 1	Di-n-butylphthalate	0.720	0.700	NA	NA	NA	0.055	0.1	0.55
WAG 1	Diethylphthalate	0.579	0.048	NA	NA	NA	0.004	NA	NA
WAG 1	Endrin	0.021	NA	NA	NA	NA	0.002	0.54	0.00
WAG 1	Heptachlor	0.011	NA	NA	NA	NA	0.001	NA	NA
WAG 1	Lead	40.874	46.324	NA	NA	NA	3.650	1.03	3.54
WAG 1	Mercury	1.306	1.850	5.767	10.667	8.081	0.146	0.011	747.87
WAG 1	Methylene chloride	0.031	0.037	NA	NA	NA	0.003	NA	NA
WAG 1	PCB-1254	0.350	0.440	7.107	3.129	2.371	0.035	0.31	7.76
WAG 1	PCB-1260	0.247	0.227	7.107	1.613	1.222	0.018	0.31	4.00
WAG 1	Pentachlorophenol	2.957	0.280	NA	NA	NA	0.022	NA	NA

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 1	Selenium	14.565	16.841	7.416	124.890	94.614	1.327	95.940	0.9	106.60
WAG 1	Tetrachloroethene	0.008	0.004	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	Thallium	14.168	15.851	NA	NA	NA	1.249	1.249	NA	NA
WAG 1	Tin	50.730	54.202	NA	NA	NA	4.270	4.270	6.2	0.69
WAG 1	Toluene	0.007	0.004	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	Trichloroethene	0.007	0.002	NA	NA	NA	0.000	0.000	NA	NA
WAG 1	Uranium	7.957	14.470	NA	NA	NA	1.140	1.140	29	0.04
WAG 1	Vinyl chloride	0.015	0.012	NA	NA	NA	0.001	0.001	NA	NA
WAG 1	Zinc	91.993	105.628	5.590	590.428	447.29 4	8.322	455.616	30.8	14.79
WAG 1	Alpha-BHC	0.012	NA	NA	NA	NA	0.001	0.001	0.51	0.00
WAG 1	Alpha-chlordane	0.105	NA	NA	NA	NA	0.008	0.008	1.47	0.01

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 1	Gamma-chlordane	0.104	NA	NA	NA	NA	0.008	0.008	1.47	0.01
WAG 6	1,2-Dichlorethene	0.007	NA	NA	NA	NA	0.001	0.001	NA	NA
WAG 6	1,4-Dioxane	6.675	7.559	NA	NA	NA	0.596	0.596	NA	NA
WAG 6	Acetone	0.014	0.015	NA	NA	NA	0.001	0.001	NA	NA
WAG 6	Barium	132.813	143.471	0.078	11.148	8.445	11.304	19.749	17.7	1.12
WAG 6	Beryllium	1.383	1.486	1.305	1.939	1.469	0.117	1.586	NA	NA
WAG 6	Bis(2-ethylhexyl) phthalate	0.398	0.462	NA	NA	NA	0.036	0.036	1.01	0.04
WAG 6	Cadmium	2.501	2.846	4.812	13.692	10.373	0.224	10.597	2.6	4.08
WAG 6	Chloroform	0.011	0.013	NA	NA	NA	0.001	0.001	NA	NA
WAG 6	Cyanide	23.817	NA	NA	NA	NA	1.877	1.877	NA	NA
WAG 6	Methylene chloride	0.028	0.038	NA	NA	NA	0.003	0.003	NA	NA

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
WAG 6	Nickel	38.284	41.626	NA	NA	NA	3.280	3.280	121.8	0.03
WAG 6	Tetrachloroethene	0.006	0.003	NA	NA	NA	0.000	0.000	NA	NA
WAG 6	Tin	55.025	89.243	NA	NA	NA	7.031	7.031	6.2	1.13
WAG 6	Toluene	0.004	0.002	NA	NA	NA	0.000	0.000	NA	NA
WAG 6	Trichloroethene	0.005	0.004	NA	NA	NA	0.000	0.000	NA	NA
WAG 6	Uranium	0.818	1.007	NA	NA	NA	0.079	0.079	29	0.00
UEFPC OU 2	Aluminum	29900.000	65257.008	0.032	2068.647	1567.1 57	5141.461	6708.618	101.2	66.29
UEFPC OU 2	Barium	149.850	567.505	0.078	44.095	33.405	44.712	78.118	17.7	4.41
UEFPC OU 2	Beryllium	1.250	2.197	1.305	2.868	2.172	0.173	2.346	NA	NA
UEFPC OU 2	Chromium (III)	39.700	76.951	0.289	22.254	16.859	6.063	22.922	1.8	12.73
UEFPC OU 2	Copper	22.100	54.932	NA	NA	NA	4.328	4.328	65	0.07

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
UEFPC OU 2	Lead	36.600	250.005	NA	NA	NA	19.697	19.697	1.03	19.12
UEFPC OU 2	Lithium	22.700	31.539	NA	NA	NA	2.485	2.485	NA	NA
UEFPC OU 2	Manganese	484.000	2592.793	NA	NA	NA	204.281	204.281	700	0.29
UEFPC OU 2	Nickel	36.200	57.035	NA	NA	NA	4.494	4.494	121.8	0.04
UEFPC OU 2	Nitrate	0.585	1.122	NA	NA	NA	0.088	0.088	NA	NA
UEFPC OU 2	Strontium	21.100	117.700	NA	NA	NA	9.273	9.273	NA	NA
UEFPC OU 2	Uranium	1.565	6.206	NA	NA	NA	0.489	0.489	29	0.02
UEFPC OU 2	Zinc	86.200	286.977	5.590	1604.117	1215.2 40	22.610	1237.850	30.8	40.19
BC OU 2	1,1,1-trichlorethane	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	1,1-Dichlorethane	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	1,2-Dichlorethane	0.008	0.008	NA	NA	NA	0.001	0.001	34.3	0.00

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity benchmark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	1,2-Dichlorethene	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	4,4-DDD	0.005	0.006	NA	NA	NA	0.000	0.000	0.0072	0.06
BC OU 2	4,4-DDE	0.005	0.006	NA	NA	NA	0.000	0.000	0.0072	0.06
BC OU 2	4,4-DDT	0.005	0.006	NA	NA	NA	0.000	0.000	0.0072	0.06
BC OU 2	Acetone	0.051	0.105	NA	NA	NA	0.008	0.008	NA	NA
BC OU 2	Aldrin	0.003	0.003	NA	NA	NA	0.000	0.000	NA	NA
BC OU 2	Aluminum	26143.846	35920.340	0.032	1138.675	862.63 2	2830.087	3692.720	101.2	36.49
BC OU 2	Antimony	0.309	0.357	NA	NA	NA	0.028	0.028	NA	NA
BC OU 2	Arsenic	33.369	35.093	0.632	22.186	16.807	2.765	19.572	8.76	2.23
BC OU 2	Barium	101.400	153.978	0.078	11.964	9.064	12.132	21.195	17.7	1.20
BC OU 2	Benzene	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Benzo(a)pyrene	0.499	0.529	NA	NA	NA	0.042	0.042	NA	NA
BC OU 2	Beryllium	1.025	1.315	1.305	1.717	1.301	0.104	1.404	NA	NA
BC OU 2	Bis(2-ethylhexyl) phthalate	0.499	.529	NA	NA	NA	0.042	0.042	1.01	0.04
BC OU 2	Boron	65.500	79.406	NA	NA	NA	6.256	6.256	49.1	0.13
BC OU 2	Cadmium	1.247	0.857	4.812	4.124	3.125	0.068	3.192	2.6	1.23
BC OU 2	Carbon tetrachloride	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Chloroform	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Chromium (III)	37.331	44.232	0.289	12.792	9.691	3.485	13.176	1.8	7.32
BC OU 2	Copper	39.223	57.365	NA	NA	NA	4.520	4.520	65	0.07
BC OU 2	Di-n-butylphthalate	0.499	0.529	NA	NA	NA	0.042	0.042	0.1	0.42
BC OU 2	Dieldrin	0.005	0.006	NA	NA	NA	0.000	0.000	0.102	0.00

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Diethylphthalate	0.499	0.529	NA	NA	NA	0.042	0.042	NA	NA
BC OU 2	Endosulfan I	0.003	0.003	NA	NA	NA	0.000	0.000	13	0.00
BC OU 2	Endosulfan II	0.005	0.006	NA	NA	NA	0.000	0.000	13	0.00
BC OU 2	Endrin	0.005	0.006	NA	NA	NA	0.000	0.000	0.54	0.00
BC OU 2	Heptachlor	0.003	0.003	NA	NA	NA	0.000	0.000	NA	NA
BC OU 2	Lead	81.015	126.822	NA	NA	NA	9.992	9.992	1.03	9.70
BC OU 2	Lindane	0.003	0.003	NA	NA	NA	0.000	0.000	3.4	0.00
BC OU 2	Lithium	39.250	47.194	NA	NA	NA	3.718	3.718	NA	NA
BC OU 2	Manganese	1021.523	1779.367	NA	NA	NA	140.193	140.193	700	0.20
BC OU 2	Mercury	49.019	76.055	5.767	438.604	332.27 6	5.992	338.268	0.011	30751.6 2
BC OU 2	Methoxychlor	0.026	0.028	NA	NA	NA	0.002	0.002	NA	NA

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Methylene chloride	0.016	0.018	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Nickel	32.600	50.322	NA	NA	NA	3.965	3.965	121.8	0.03
BC OU 2	Niobium	9.850	NA	NA	NA	NA	0.000	0.000	NA	NA
BC OU 2	PCB-1016	0.052	0.056	NA	NA	NA	0.004	0.004	NA	NA
BC OU 2	PCB-1242	0.052	0.056	NA	NA	NA	0.004	0.004	0.4	0.01
BC OU 2	PCB-1248	0.052	0.056	NA	NA	NA	0.004	0.004	NA	NA
BC OU 2	PCB-1254	0.052	0.056	7.107	0.401	0.304	0.004	0.308	0.31	0.99
BC OU 2	PCB-1260	0.042	0.048	7.107	0.338	0.256	0.004	0.260	0.31	0.84
BC OU 2	Pentachlorophenol	1.211	1.296	NA	NA	NA	0.102	0.102	NA	NA
BC OU 2	Selenium	1.094	1.788	7.416	13.260	10.046	0.141	10.186	0.9	11.32
BC OU 2	Strontium	109.925	133.870	NA	NA	NA	10.547	10.547	NA	NA

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Tetrachloroethene	0.007	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Toluene	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Toxaphene	0.261	0.284	NA	NA	NA	0.022	0.022	NA	NA
BC OU 2	Trichloroethene	0.008	0.008	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Uranium	2.041	2.517	NA	NA	NA	0.198	0.198	29	0.01
BC OU 2	Vanadium	54.838	62.578	NA	NA	NA	4.930	4.930	20.5	0.24
BC OU 2	Vinyl chloride	0.015	0.016	NA	NA	NA	0.001	0.001	NA	NA
BC OU 2	Zinc	113.208	149.418	5.590	835.202	632.72 9	11.772	644.501	30.8	20.93
BC OU 2	Zirconium	59.250	74.483	NA	NA	NA	5.868	5.868	NA	NA
BC OU 2	Alpha-BHC	0.003	0.003	NA	NA	NA	0.000	0.000	0.51	0.00
BC OU 2	Alpha-chlordane	0.003	0.003	NA	NA	NA	0.000	0.000	1.47	0.00

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
BC OU 2	Beta-BHC	0.003	0.003	NA	NA	NA	0.000	0.000	NA	NA
BC OU 2	Delta-BHC	0.003	0.003	NA	NA	NA	0.000	0.000	0.51	0.00
BC OU 2	Gamma-chlordane	0.003	0.003	NA	NA	NA	0.000	0.000	1.47	0.00
SCF	1,1,1-trichlorethane	0.436	0.955	NA	NA	NA	0.075	0.075	NA	NA
SCF	1,1-Dichlorethene	10.464	19.679	NA	NA	NA	1.550	1.550	NA	NA
SCF	1,2-Dichlorethane	60.893	157.216	NA	NA	NA	12.387	12.387	34.3	0.36
SCF	4,4-DDD	0.005	0.001	NA	NA	NA	0.000	0.000	0.0072	0.02
SCF	4,4-DDE	0.003	0.002	NA	NA	NA	0.000	0.000	0.0072	0.02
SCF	4,4-DDT	0.006	0.006	NA	NA	NA	0.001	0.001	0.0072	0.07
SCF	Acetone	97.955	212.986	NA	NA	NA	16.781	16.781	NA	NA
SCF	Aldrin	0.003	0.000	NA	NA	NA	0.000	0.000	NA	NA
SCF	Aluminum	16294.045	20546.940	0.032	651.338	493.43 8	1618.85	2112.288	101.2	20.87
SCF	Antimony	3.125	1.215	NA	NA	NA	0.096	0.096	101.2	0.00
SCF	Arsenic	12.771	14.534	0.632	9.189	6.961	1.145	8.106	8.76	0.93

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Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
SCF	Barium	111.605	139.739	0.078	10.858	8.226	11.010	19.235	17.7	1.09
SCF	Benzene	0.916	2.040	NA	NA	NA	0.161	0.161	NA	NA
SCF	Benzo(a)pyrene	0.483	0.322	NA	NA	NA	0.025	0.025	NA	NA
SCF	Beryllium	1.480	1.611	1.305	2.103	1.593	0.127	1.720	NA	NA
SCF	Bis(2-ethylhexyl) phthalate	0.439	0.176	NA	NA	NA	0.014	0.014	1.01	0.01
SCF	Cadmium	6.132	7.413	4.812	35.670	27.023	0.584	27.607	2.6	10.62
SCF	Carbon tetrachloride	0.003	0.000	NA	NA	NA	0.000	0.000	NA	NA
SCF	Chloroform	0.886	1.987	NA	NA	NA	0.157	0.157	NA	NA
SCF	Chromium	56.892	61.157	0.289	17.687	13.399	4.818	18.217	NA	NA
SCF	Copper	20.555	27.899	NA	NA	NA	2.198	2.198	65	0.03
SCF	Di-n-butylphthalate	0.470	0.118	NA	NA	NA	0.009	0.009	0.1	0.09
SCF	Dieldrin	0.004	0.001	NA	NA	NA	0.000	0.000	0.102	0.00
SCF	Endosulfan I	0.003	NA	NA	NA	NA	0.000	0.000	13	0.00
SCF	Endrin	0.005	0.001	NA	NA	NA	0.000	0.000	0.54	0.00
SCF	Heptachlor	0.003	NA	NA	NA	NA	0.000	0.000	NA	NA
SCF	Lead	41.506	52.212	NA	NA	NA	4.114	4.114	1.03	3.99
SCF	Manganese	1392.092	1849.264	NA	NA	NA	145.700	145.700	700	0.21

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
SCF	Mercury	0.682	0.854	5.767	4.926	3.732	0.067	3.799	0.011	345.39
SCF	Methoxychlor	0.027	0.014	NA	NA	NA	0.001	0.001	NA	NA
SCF	Methylene chloride	136.175	281.149	NA	NA	NA	22.151	22.151	NA	NA
SCF	Nickel	18.418	20.372	NA	NA	NA	1.605	1.605	121.8	0.01
SCF	PCB-1254	0.057	0.038	7.107	0.267	0.202	0.003	0.205	0.31	0.66
SCF	PCB-1260	0.066	0.069	7.107	0.493	0.374	0.005	0.379	0.31	1.22
SCF	Pentachlorophenol	0.266	0.005	NA	NA	NA	0.000	0.000	NA	NA
SCF	Selenium	2.796	2.965	7.416	21.984	16.655	0.234	16.888	0.9	18.76
SCF	Tetrachloroethene	0.546	1.142	NA	NA	NA	0.090	0.090	NA	NA
SCF	Toluene	0.917	2.045	NA	NA	NA	0.161	0.161	NA	NA
SCF	Trichloroethene	0.782	1.493	NA	NA	NA	0.118	0.118	NA	NA
SCF	Uranium	3.128	3.313	NA	NA	NA	0.261	0.261	29	0.01
SCF	Zinc	114.172	146.031	5.590	816.269	618.38 5	11.505	629.891	30.8	20.45
SCF	Alpha-chlordane	0.003	0.001	NA	NA	NA	0.000	0.000	1.47	0.00
SCF	Delta-BHC	0.003	0.000	NA	NA	NA	0.000	0.000	0.51	0.00
SCF	Gamma-chlordane	0.003	0.001	NA	NA	NA	0.000	0.000	1.47	0.00

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench- mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1420 OU	1,2-Dichlorethane	0.005	0.007	NA	NA	NA	0.001	0.001	34.3	0.00
K-1420 OU	Acetone	0.019	0.025	NA	NA	NA	0.002	0.002	NA	NA
K-1420 OU	Aldrin	0.011	NA	NA	NA	NA	0.001	0.001	NA	NA
K-1420 OU	Aluminum	19950.000	49308.945	0.032	1563.094	1184.1 62	3884.947	5069.109	101.2	50.09
K-1420 OU	Barium	31.850	83.938	0.078	6.522	4.941	6.613	11.554	17.7	0.65
K-1420 OU	Benzo(a)pyrene	0.378	0.386	NA	NA	NA	0.030	0.030	NA	NA
K-1420 OU	Beryllium	0.375	1.290	1.305	1.684	1.276	0.102	1.378	NA	NA
K-1420 OU	Bis(2-ethylhexyl) phthalate	0.215	0.289	NA	NA	NA	0.023	0.023	1.01	0.02
K-1420 OU	Chromium	15.200	25.472	0.289	7.366	5.581	2.007	7.587	NA	NA
K-1420 OU	Copper	26.200	47.035	NA	NA	NA	3.706	3.706	65	0.06
K-1420 OU	Fluoride	40.015	0.030	NA	NA	NA	0.002	0.002	7.6	0.00

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1420 OU	Lead	66.250	90.518	NA	NA	NA	7.132	7.132	1.03	6.92
K-1420 OU	Lithium	52.200	228.354	NA	NA	NA	17.992	17.992	NA	NA
K-1420 OU	Mercury	0.203	0.430	5.767	2.481	1.879	0.034	1.913	0.011	173.91
K-1420 OU	Methylene chloride	0.007	0.009	NA	NA	NA	0.001	0.001	NA	NA
K-1420 OU	Nitrate	20.008	0.027	NA	NA	NA	0.002	0.002	NA	NA
K-1420 OU	PCB-1254	0.663	1.693	7.107	12.034	9.117	0.133	9.250	0.31	29.84
K-1420 OU	Pentachlorophenol	2.106	NA	NA	NA	NA	0.166	0.166	NA	NA
K-1420 OU	Strontium	38.250	255.759	NA	NA	NA	20.151	20.151	NA	NA
K-1420 OU	Tetrachloroethene	0.006	NA	NA	NA	NA	0.000	0.000	NA	NA
K-1420 OU	Trichloroethene	0.041	NA	NA	NA	NA	0.003	0.003	NA	NA
K-1420 OU	Uranium	139.109	282.563	NA	NA	NA	22.263	22.263	29	0.77

Table G.13 (continued)

Location	Analyte	Soil concentration (mg/kg)		Soil-earthworm uptake factor	Estimated worm concentration (mg/kg)	Exposure estimate (mg/kg/d)			Toxicity bench-mark (mg/kg)	NOAEL HQ
		Mean	PLE UCB			Food	Soil	Total		
K-1420 OU	Vanadium	48.900	141.081	NA	NA	NA	11.115	11.115	20.5	0.54
K-1420 OU	Zinc	84.350	154.117	5.590	861.468	652.62 7	12.143	664.769	30.8	21.58
K-1420 OU	Beta-BHC	0.014	NA	NA	NA	NA	0.001	0.001	NA	NA
K-1414	Acetone	0.031	NA	NA	NA	NA	0.002	0.002	NA	NA
K-1414	Benzo(a)pyrene	0.287	NA	NA	NA	NA	0.023	0.023	NA	NA
K-1414	Bis(2-ethylhexyl) phthalate	0.224	NA	NA	NA	NA	0.018	0.018	1.01	0.02
K-1414	Di-n-butylphthalate	0.740	2.382	NA	NA	NA	0.188	0.188	0.1	1.88
K-1414	Methylene chloride	0.038	0.158	NA	NA	NA	0.012	0.012	NA	NA
K-1414	Tetrachloroethene	0.004	NA	NA	NA	NA	0.000	0.000	NA	NA

NA= Not Available

PLE UCB not available - contaminant detected in only 1 sample.

* Soil to earthworm uptake factor not available, therefore, estimated earthworm concentrations and exposure from food ingestion could not be calculated.

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Table G.14 . Estimated NOAELs and LOAELs for mammals

Experimental information							Short-tailed shrew	Eastern cottontail		White-tailed deer		
Contaminant	Form	Test species	NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)
Acetone	NA	rat	100 90 days	500 90 days	liver & kidney damage	EPA 1986c	2.26	141	6.7	33	1.9	9
Aluminum	AlCl ₃	mouse	1.93 ¹ 3 gen.	19.3 3 gen.	reproduction	Ondreicka et al. 1966	2.43	24.3	0.57	5.7	0.16	1.6
Antimony	Antimony Potassium Tartrate	mouse	.125 ¹ >1yr	1.25 >1yr	lifespan, longevity	Schroeder et al. 1968b	0.157	1.57	0.037	0.37	0.01	0.1
Arsenic	As+3	mouse	0.126 ¹ 3 gen.	1.26 3 gen.	reproduction	Schroeder and Mitchner 1971	0.158	1.58	0.037	0.370	0.01	0.1
Barium	BaCl	rat	100 16 mon.		growth, hypertension	Perry et al. 1983	15.5		3.6		1	
				19.8 ¹ 10 days	mortality	Borzelleca et al. 1988		56		13.2		3.7
Benzo(a)pyrene	NA	mouse	1 ¹ critical lifestage ³	10 critical lifestage ³	reproduction	Mackenzie and Angevine 1981	1.26	12.6				
Boron	Boric acid	rat	28 3 gen.	93.6 3 gen.	reproduction	Weir and Fisher 1972	79.2	265	18.6	62		
Cadmium	CdCl ₂	rat	.008 4 gen.	.01 4 gen.	reproduction	Wills et al. 1981	0.023	0.028	0.005	0.007	0.001	0.002
Chromium	Cr ⁺³	rat			reproduction, longevity	Ivankovic & Preussmann 1975	9.27	37.2				
Chloroform									59	189		
Copper	copper sulfate	mink	11.71 357 days	15.14 357 days	reproduction	Aulerich et al. 1982	46.8	60.5	11	14.3	3.1	4

Table G.14 (continued)

Contaminant	Form	Test species	Experimental information				Short-tailed shrew		Eastern cottontail		White-tailed deer	
			NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)
1,2-Dichloroethane	NA	mouse	50 2 gen.	-	reproduction	Lane et al. 1982			16	-	4	-
Lead	acetate	rat	8 3 gen.	80 3 gen.	reproduction	Azar et al. 1973	22.6	226	5.3	53		
Manganese	oxide	rat	88 gestation	284 gestation	reproduction	Laskey et al. 1992			59	189	16	53
Mercury	methyl	rat	0.032 3 gen.	0.16 3 gen.	reproduction	Verschuuren et al. 1976	0.09	0.45	0.021	0.11	0.006	0.03
Methylene Chloride	NA	rat	5.85 2 yrs.	50 2 yrs.	liver histology	NCA 1982	16.54	141	3.9	33	1.09	9
Molybdenum	molybdate	mouse	0.26 3 gen.	2.6 3 gen.	reproduction	Schroeder and Mitchner 1971	0.33	3.3	0.08	0.8		
Niobium	sodium niobate	mouse	0.155 > 1 yr.	1.55 > 1 yr.	lifespan longevity	Schroeder et al. 1968	0.195	1.95	0.046	0.46		
PCBs	Aroclor 1254	Oldfield mouse	.068 ¹ 12 mo.	0.68 12 mo.	reproduction	McCoy et al. 1995	0.066	0.66	0.016	0.16	0.004	0.04
Selenium	selenate	mouse	0.076 ¹ 3 gen.	0.76 3 gen.	reproduction	Schroeder and Mitchner 1971	0.096	0.96	0.023	0.22	0.006	0.06
Thallium	sulfate	rat	0.0074 ¹ 60 days	0.074 60 days	reproduction	Formigli et al. 1986	0.021	0.212	0.005	0.05	0.001	0.014
Trichloroethene	NA	mouse	0.7 ¹ 6 wks.	7 6 wks.	hepatotoxicity	Buben and O'Flaherty 1985					0.06	0.6
Uranium	acetate	mouse	3.07 critical lifestage ⁴	6.13	reproduction	Paternain et al. 1989	3.77	7.5	0.89	1.8		

Table G.14 (continued)

Contaminant	Form	Test species	Experimental information				Short-tailed shrew		Eastern cottontail		White-tailed deer	
			NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration	Endpoint	Citation	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)
Vanadium	sodium metavanadate	rat	0.21 ¹ critical lifestage ⁴	2.1	reproduction	Domingo et al. 1986	0.54	5.4	0.13	1.3	0.04	0.4
Zinc	oxide	rat	160 critical lifestage ³	320	reproduction	Schlicker and Cox 1968	452	905				
Zirconium	sulfate	mouse	1.74 > 1 yr.	-	lifespan, longevity	Schroeder et al. 1968b	2.19	-	0.52	-		

¹ Estimated NOAEL: LOAEL to NOAEL factor applied.

² Subchronic to chronic uncertainty factor of 0.1 applied.

³ Critical lifestage: days 7 to 16 of gestation.

⁴ Critical lifestage: 60 days prior to gestation, through gestation, delivery and lactation.

⁵ Critical lifestage: days 1 to 16 of gestation.

Table G.15. Estimated NOAELs and LOAELs for the Avian endpoints

Contaminant	Form	Test species	Experimental information		Endpoint	Citation	American woodcock		Wild turkey	
			NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration			Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)
Aluminum	Al ₂ (SO ₄) ₃	ringed dove	109.7 4 mon.		reproduction	Carriere et al. 1986	101.2		33.2	
	chloride	white leghorn chicks		44.5 2 wks.	mortality	Storer and Nelson 1968		33		10.8
Barium	hydroxide	1-day chicks	20.8 4 wks.	41.7 4 wks	mortality	Johnson et al. 1960	17.7	35.4		
Boron	boric acid	mallard ducks	28.8 critical lifestage ²	100	reproduction	Smith and Anders 1989	49.1	171		
Cadmium	chloride	mallard ducks	1.45 90 days	20 90 days	reproduction	White and Finley 1978	2.6	36		
Copper	oxide	1 day chicks	46.97 10 wks	61.72 10 wks	growth, mortality	Mehring et al. 1960	65	85.6	21	28.1
4,4-DDT	NA	brown pelican	0.0028 ¹ 5 yrs	0.028 5 yrs	reproduction	Anderson et al. 1975	0.0072	0.072		
1,2-Dichloroethane	NA	chicken	17.2 2 yrs.	34.4 2 yrs.	reproduction	Alumot et al. 1976			11.2	22
Di-n-butyl phthalate	NA	ringed dove	0.11 ¹ 4 wks	1.1 4 wks	reproduction	Peakall 1974	0.1	1		
Lead	acetate	japanese quail	1.13 ¹ 12 wks.	11.3 12 wks.	reproduction	Edens et al. 1976	1.03	10	.34	3
Mercury	methyl Hg Dicyandiamide	mallard duck	0.0064 3 gen.	0.064 3 gen.	reproduction	Heinz 1979	0.011	0.109	0.004	0.036
PCB-1254	NA	ring-necked pheasant	0.18 ¹ 17 wks	1.8 17 wks	reproduction	Dahlgren et al. 1972	0.31	3.07		

Table G.15 (continued)

Contaminant	Form	Test species	Experimental information		Endpoint	Citation	American woodcock		Wild turkey	
			NOAEL (mg/kg/d) and duration	LOAEL (mg/kg/d) and duration			Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)	Estimated NOAEL (mg/kg/d)	Estimated LOAEL (mg/kg/d)
Selenium	selanomethionine	mallard duck	0.4 100 days	0.8 100 days	reproduction	Heinz et al. 1989	0.9	1.7		
Tin	bis(Tributyltin) oxide	japanese quail	6.8 6 wks	16.9 6 wks	reproduction	Schlatterer et al. 1993	6.2	15.4		
Zinc	sulfate	white leghorn hens	1.935 44 wks.	1.766 44 wks.	reproduction	Stahl et al. 1990	30.8	278	10.1	91

¹ Estimated NOAEL: LOAEL to NOAEL factor applied.

² Critical lifestage: 3 wks prior to, during, and 3 wks post reproduction.

Table G.16. HQs for contaminants of potential concern for white-tailed deer on the ORR

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
BCVOU1	Barium	2.1099	1	2.11	3.7	0.57
BCVOU1	Cadmium	0.2199	0.001	219.88	0.002	109.94
BCVOU1	Copper	23.0234	3.1	7.43	4	5.76
BCVOU1	Mercury	0.1598	0.006	26.64	0.03	5.33
BCVOU1	PCB-1260 *	0.0048	0.004	1.19	0.04	0.12
LEFPC	Cadmium	0.0951	0.001	95.12	0.002	47.56
LEFPC	Mercury	0.2089	0.006	34.81	0.03	6.96
LEFPC	Selenium	0.0142	0.006	2.37	0.06	0.24
K-1407 OU	Aluminum	21.2300	0.16	132.69	1.6	13.27
K-1407 OU	Antimony	0.0132	0.01	1.32	0.1	0.13
K-1407 OU	Cadmium	0.0440	0.001	44.02	0.002	22.01
K-1407 OU	Mercury	0.0321	0.006	5.35	0.03	1.07

Table G.16 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
K-1407 OU	Selenium	0.0117	0.006	1.95	0.06	0.19
WAG 1	Antimony	0.0112	0.01	1.12	0.1	0.11
WAG 1	Cadmium	0.0402	0.001	40.18	0.002	20.09
WAG 1	Mercury	0.0093	0.006	1.55	0.03	0.31
WAG 1	Selenium	0.0275	0.006	4.58	0.06	0.46
WAG 1	Thallium	0.0098	0.001	9.76	0.014	0.70
WAG 6	Cadmium	0.0583	0.001	58.28	0.002	29.14
UEFPC OU 2	Aluminum	48.2324	0.16	301.45	1.6	30.15
UEFPC OU 2	Barium	2.9711	1	2.97	3.7	0.80
UEFPC OU 2	Manganese	21.5592	16	1.35	53	0.41
BC OU 2	Aluminum	26.5493	0.16	165.93	1.6	16.59
BC OU 2	Arsenic	0.0259	0.01	2.59	0.1	0.26
BC OU 2	Cadmium	0.0176	0.001	17.55	0.002	8.78
BC OU 2	Mercury	0.3818	0.006	63.63	0.03	12.73

Table G.16 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
BC OU 2	Vanadium	0.0501	0.04	1.25	0.4	0.13
SCF	1,2-Dichlorethane	25.5651	4	6.39	NA	NA
SCF	Acetone	349.7176	1.9	184.06	9	38.86
SCF	Aluminum	15.1866	0.16	94.92	1.6	9.49
SCF	Arsenic	0.0107	0.01	1.07	0.1	0.11
SCF	Cadmium	0.1518	0.001	151.82	0.002	75.91
SCF	Methylene chloride	59.6044	1.09	54.68	9	6.62
SCF	Trichloroethene	0.0739	0.06	1.23	0.6	0.12
K-1420 OU	Aluminum	36.4450	0.16	227.78	1.6	22.78
K-1420 OU	Vanadium	0.1130	0.04	2.82	0.4	0.28
CR OU2 ^a	Arsenic	0.12841	0.01	12.841	0.1	1.28
CR OU2	Cadmium	0.03567	0.001	35.67	0.002	17.84
CR OU2	Selenium	0.69332	0.006	115.55333	0.06	11.56
CR OU2	Thallium	0.03029	0.001	30.29	0.014	2.16
CR OU2	Vanadium	0.05056	0.04	1.264	0.4	0.13

Table G.16 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
WAG 5	Mercury	0.0065	0.006	1.09	0.03	0.22
WAG 5	Selenium	0.0157	0.006	2.62	0.06	0.26

* The NOAEL and LOAEL Toxicity Benchmark for PCB-1254 is used.

* CR OU2 Source: Ecological Risk Assessment for the Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond/Upper McCoy Branch) at the Oak Ridge Y-12 Pant, Oak Ridge .
DOE/OR/02-1238 DO

Table G.17. HQs for contaminants of concern for wild turkey on the ORR

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
BCVOU1	Copper	26.3317	21	1.25	28.1	0.94
BCVOU1	Lead	2.2507	0.34	6.62	3	0.75
BCVOU1	Mercury	0.2255	0.004	56.39	0.036	6.27
BCVOU1	Zinc	15.7485	10.1	1.56	91	0.17
LEFPC	Mercury	0.2947	0.004	73.68	0.036	8.19
K-1407 OU	Aluminum	83.6746	33.2	2.52	10.8	7.75
K-1407 OU	Mercury	0.0453	0.004	11.33	0.036	1.26
WAG 1	Mercury	0.0131	0.004	3.28	0.036	0.36

Table G.17 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
UEFPC OU 2	Aluminum	190.1004	33.2	5.73	10.8	17.60
UEFPC OU 2	Lead	1.0358	0.34	3.05	3	0.35
BC OU 2	Aluminum	104.6397	33.2	3.15	10.8	9.69
BC OU 2	Lead	0.5254	0.34	1.55	3	0.18
BC OU 2	Mercury	0.5387	0.004	134.68	0.036	14.96
SCF	1,2-Dichlorethane	25.2488	11.2	2.25	22	1.15
SCF	Aluminum	59.8554	33.2	1.80	10.8	5.54
SCF	Mercury	0.0061	0.004	1.51	0.036	0.17
K-1420 OU	Aluminum	143.6421	33.2	4.33	10.8	13.30
K-1420 OU	Lead	0.3750	0.34	1.10	3	0.13

Table G.17 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
WAG 5	Lead	0.3895	0.34	1.15	3	0.13
WAG 5	Mercury	0.0092	0.004	2.30	0.036	0.26
WAG 5	Zinc	13.8971	10.1	1.38	91	0.15

Table G.18. HQs for contaminants of potential concern for the short-tailed shrews on the ORR

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
BCVOU1	Arsenic	6.11	0.158	38.6	1.58	3.9
BCVOU1	Barium	50.22	15.5	3.2	56	0.9
BCVOU1	Benzo(a)pyrene	1.55	1.26	1.2	12.6	0.1
BCVOU1	Cadmium	31.83	0.023	1384.1	0.028	1136.9
BCVOU1	Chromium	17.19	9.27	1.9	37.2	0.5
BCVOU1	Copper	138.84	46.8	3.0	60.5	2.3
BCVOU1	Lead	42.37	22.6	1.9	226	0.2
BCVOU1	Mercury	112.66	0.09	1251.8	0.45	250.4
BCVOU1	Molybdenum	1.42	0.33	4.3	3.3	0.4
BCVOU1	PCB-1254	11.57	0.066	175.3	0.66	17.5
BCVOU1	PCB-1260	29.27	0.066	443.5	0.66	44.3
BCVOU1	Selenium	0.177	0.096	1.8	0.96	0.2
BCVOU1	Zinc	3889.30	452	8.6	905	4.3
LEFPC	Barium	16.21	15.5	1.0	56	0.3
LEFPC	Cadmium	13.77	0.023	598.8	0.028	491.8
LEFPC	Chromium	16.48	9.27	1.8	37.2	0.4
LEFPC	Mercury	147.22	0.09	1635.8	0.45	327.2

Table G.18 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
LEFPC	PCB-1254	0.972	0.066	14.7	0.66	1.5
LEFPC	PCB-1260	2.02	0.066	30.6	0.66	3.1
LEFPC	Selenium	39.41	0.096	410.5	0.96	41.1
LEFPC	Thallium	0.063	0.021	3.0	0.212	0.3
LEFPC	Zinc	570.37	452	1.3	905	0.6
K-1407 OU	Aluminum	2786.76	2.43	1146.8	24.3	114.7
K-1407 OU	Antimony	0.558	0.157	3.6	1.57	0.4
K-1407 OU	Arsenic	5.98	0.158	37.8	1.58	3.8
K-1407 OU	Barium	15.61	15.5	1.0	56	0.3
K-1407 OU	Cadmium	6.37	0.023	277.1	0.028	0.3
K-1407 OU	Chromium	17.57	9.27	1.9	37.2	0.5
K-1407 OU	Mercury	22.63	0.09	251.5	0.45	50.3
K-1407 OU	Selenium	32.38	0.096	337.3	0.96	33.7
K-1407 OU	Uranium	19.96	3.77	5.3	7.5	2.7
WAG 1	Antimony	0.473	0.157	3.0	1.57	0.3
WAG 1	Arsenic	4.47	0.158	28.3	1.58	2.8
WAG 1	Boron	137.38	79.2	1.7	265	0.5

Table G.18 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
WAG 1	Cadmium	5.82	0.023	252.9	0.028	207.7
WAG 1	Mercury	6.54	0.09	72.7	0.45	14.5
WAG 1	PCB-1254	1.91	0.066	29.0	0.66	2.9
WAG 1	PCB-1260	0.986	0.066	14.9	0.66	1.5
WAG 1	Selenium	76.25	0.096	794.2	0.96	79.4
WAG 1	Thallium	1.24	0.021	58.9	0.212	5.8
WAG 6	Barium	17.88	15.5	1.2	56	0.3
WAG 6	Cadmium	8.44	0.023	366.8	0.028	301.3
UEFPC OU 2	Aluminum	6331.23	2.43	2605.4	24.3	260.5
UEFPC OU 2	Barium	70.72	15.5	4.6	56	1.3
UEFPC OU 2	Beryllium	1.892	1.87	1.01	NA	NA
UEFPC OU 2	Chromium	19.35	9.27	2.1	37.2	0.5
UEFPC OU 2	Zinc	984.85	452	2.2	905	1.1
BC OU 2	Aluminum	3484.99	2.43	1434.2	24.3	143.4
BC OU 2	Arsenic	16.05	0.158	101.6	1.58	10.2
BC OU 2	Barium	19.19	15.5	1.2	56	0.3

Table G.18 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
BC OU 2	Cadmium	2.54	0.023	110.5	0.028	90.8
BC OU 2	Chromium	11.13	9.27	1.2	37.2	0.3
BC OU 2	Mercury	269.09	0.09	2989.9	0.45	598.0
BC OU 2	Niobium	0.7683	0.195	3.9	1.95	0.4
BC OU 2	PCB-1254	0.245	0.066	3.7	0.66	0.4
BC OU 2	PCB-1260	0.206	0.066	3.1	0.66	0.3
BC OU 2	Selenium	8.10	0.096	84.3	0.96	8.4
BC OU 2	Vanadium	4.88	0.54	9.0	5.4	0.9
BC OU 2	Zirconium	5.81	2.19	2.7	NA	NA
SCF	Acetone	16.61	2.26	7.4	141	0.1
SCF	Aluminum	1993.46	0.57	3497.3	24.3	82.0
SCF	Arsenic	6.65	0.158	42.1	1.58	4.2
SCF	Barium	17.41	15.5	1.1	56	0.3
SCF	Cadmium	21.98	0.023	955.7	0.028	785.0
SCF	Chromium	15.38	9.27	1.7	37.2	0.4
SCF	Mercury	3.02	0.09	33.6	0.45	6.7
SCF	Methylene chloride	21.93	16.54	1.3	141	0.2

Table G.18 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
SCF	PCB-1254	0.163	0.066	2.5	0.66	0.2
SCF	PCB-1260	0.301	0.066	4.6	0.66	0.5
SCF	Selenium	13.42	0.096	139.8	0.96	14.0
SCF	Zinc	501.15	452	1.1	905	0.6
K-1420 OU	Aluminum	4783.95	2.43	1968.7	24.3	196.9
K-1420 OU	Mercury	1.52	0.09	16.9	0.45	3.4
K-1420 OU	PCB-1254	7.35	0.066	111.4	0.66	11.1
K-1420 OU	Uranium	22.04	3.77	5.8	7.5	2.9
K-1420 OU	Vanadium	11.00	0.54	20.4	5.4	2.0
K-1420 OU	Zinc	528.90	452	1.2	905	0.6
WAG 5	Mercury	0.8211	0.09	9.12	0.45	1.82
WAG 5	Selenium	0.5280	0.096	5.50	0.94	0.55
WAG 5	Vanadium	2.8500	0.538	5.30	5.4	0.53
WAG 5	Zinc	614.677	452.43	1.36	905	0.68
WAG 5	Total PCBs	0.3193	0.066	4.84	0.66	0.48

WAG 5 Source: Baseline Ecological Risk Assessment Report for Waste Area Grouping 5 at Oak Ridge National Laboratory.

Table G.19. HQs for contaminants of potential concern for the woodcock on the ORR

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
BCVOU1	4,4-DDE	0.0085	0.0072	1.18	0.072	0.12
BCVOU1	4,4-DDT	0.0085	0.0072	1.18	0.072	0.12
BCVOU1	Barium	55.47	17.7	3.13	35.4	1.57
BCVOU1	Cadmium	39.98	2.6	15.38	36	1.11
BCVOU1	Copper	140.24	65	2.16	85.6	1.64
BCVOU1	Lead	42.80	1.03	41.55	10	4.28
BCVOU1	Mercury	141.62	0.011	12874.85	0.109	1299.30
BCVOU1	PCB-1254	14.56	0.31	46.95	3.07	4.74
BCVOU1	PCB-1260	36.82	0.31	118.78	3.07	11.99
BCVOU1	Zinc	4888.41	30.8	158.71	278	17.58

Table G.19 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
LEFPC	Barium	17.90	17.7	1.01	35.4	0.51
LEFPC	Cadmium	17.30	2.6	6.65	36	0.48
LEFPC	Lead	4.84	1.03	4.70	10	0.48
LEFPC	Mercury	185.06	0.011	16823.76	0.109	1697.81
LEFPC	PCB-1254	1.22	0.31	3.95	3.07	0.40
LEFPC	PCB-1260	2.54	0.31	8.20	3.07	0.83
LEFPC	Selenium	49.59	0.9	55.10	1.7	29.17
LEFPC	Zinc	716.88	30.8	23.28	278	2.58
K-1407 OU	Aluminum	2952.87	101.2	29.18	33	89.48

Table G.19 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
K-1407 OU	Cadmium	8.00	2.6	3.08	36	0.22
K-1407 OU	Lead	2.60	1.03	2.52	10	0.26
K-1407 OU	Mercury	28.45	0.011	2586.30	0.109	261.00
K-1407 OU	Selenium	40.74	0.9	45.27	1.7	23.97
K-1407 OU	Zinc	278.09	30.8	9.03	278	1.00
WAG 1	Boron	138.76	49.1	2.83	171	0.81
WAG 1	Cadmium	7.31	2.6	2.81	36	0.20
WAG 1	Lead	3.65	1.03	3.54	10	0.36
WAG 1	Mercury	8.23	0.011	747.87	0.109	75.47
WAG 1	PCB-1254	2.41	0.31	7.76	3.07	0.78

Table G.19 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
WAG 1	PCB-1260	1.24	0.31	4.00	3.07	0.40
WAG 1	Selenium	95.94	0.9	106.60	1.7	56.44
WAG 1	Zinc	455.62	30.8	14.79	278	1.64
WAG 6	Barium	19.75	17.7	1.12	35.4	0.56
WAG 6	Cadmium	10.60	2.6	4.08	36	0.29
WAG 6	Tin	7.03	6.2	1.13	15.4	0.46
UEFPC OU 2	Aluminum	6708.62	101.2	66.29	33	203.29
UEFPC OU 2	Barium	78.12	17.7	4.41	35.4	2.21
UEFPC OU 2	Lead	19.70	1.03	19.12	10	1.97

Table G.19 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
UEFPC OU 2	Zinc	1237.85	30.8	40.19	278	4.45
BC OU 2	Aluminum	3692.72	101.2	36.49	33	111.90
BC OU 2	Arsenic	19.57	8.76	2.23	21.9	0.89
BC OU 2	Barium	21.20	17.7	1.20	35.4	0.60
BC OU 2	Cadmium	3.19	2.6	1.23	36	0.09
BC OU 2	Lead	9.99	1.03	9.70	10	1.00
BC OU 2	Mercury	338.27	0.011	30751.62	0.109	3103.37
BC OU 2	Selenium	10.19	0.9	11.32	1.7	5.99
BC OU 2	Zinc	644.50	30.8	20.93	278	2.32

Table G.19 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
SCF	Barium	19.24	17.7	1.09	35.4	0.54
SCF	Cadmium	27.61	2.6	10.62	36	0.77
SCF	Lead	4.11	1.03	3.99	10	0.41
SCF	Mercury	3.80	0.011	345.39	0.109	34.86
SCF	PCB-1260	0.3791	0.31	1.22	3.07	0.12
SCF	Selenium	16.89	0.9	18.76	1.7	9.93
SCF	Zinc	629.89	30.8	20.45	278	2.27
K-1420 OU	Aluminum	5069.11	101.2	50.09	33	153.61
K-1420 OU	Lead	7.13	1.03	6.92	10	0.71
K-1420 OU	Mercury	1.91	0.011	173.91	0.109	17.55

Table G.19 (continued)

Location	Analyte	Total exposure (mg/kg/d)	NOAEL toxicity benchmark (mg/kg/d)	NOAEL HQ	LOAEL toxicity benchmark (mg/kg/d)	LOAEL HQ
K-1420 OU	PCB-1254	9.25	0.31	29.84	3.07	3.01
K-1420 OU	Zinc	664.77	30.8	21.58	278	2.39
K-1414	Di-n-butylphthalate	0.1876	0.1	1.88	1	0.19
WAG 5	Lead	8.8462	3.35	2.64	10	0.88
WAG 5	Mercury	1.0111	0.011	91.92	0.109	9.28
WAG 5	Zinc	756.3303	30.8	24.56	278	2.72
WAG 5	Di-N-butylphthalate	0.1182	0.1	1.18	1	0.12

WAG 5 Source: Baseline Ecological Risk Assessment Report for Waste Area Grouping 5 at Oak Ridge National Laboratory.

Scale 1:90,000

GUIDE TO CODES

BC - Bear Creek
 CR - Chestnut Ridge
 K - K-25 Plant
 OU - Operable unit
 UEPC - Upper East Fork Poplar Creek
 WAG - Waste Area Grouping

Fig.G.1. Locations of OUs evaluated as part of the ORR-wide assessment of risk to vermivores and herbivores.

Fig. G.2. Sum of NOAEL-based toxic units for evaluation of risks to white-tailed deer on the ORR. Order of contaminants in legend corresponds to order of contaminants in bars.

Sum of Toxic Units

Fig. G.3. Sum of NOAEL-based toxic units for evaluation of risks to wild turkey on the ORR. Order of contaminants in legend corresponds to order of contaminants in bars.

Sum of Toxic Units

Fig. G.4. Sum of NOAEL-based toxic units for evaluation of risks to American woodcock on the ORR. Order of contaminants in legend corresponds to order of contaminants in bars.

Fig. G.5. Sum of NOAEL-based toxic units for evaluation of risks to short-tailed shrew on the ORR. Order of contaminants in legend corresponds to order of contaminants in bars.

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