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17. OU 10-04 ECOLOGICAL RISK ASSESSMENT

17.1 Introduction

The U.S. Environmental Protection Agency (EPA) listed the INEEL as a Superfund site on the National Priorities List November 21, 1989. In December of the previous year, the EPA had directed that "thorough and consistent" ecological risk assessments should be performed at all Superfund sites (EPA, 1988a). This directive was based on the language in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which mandated remediation of hazardous waste sites to protect human health, as well as the environment. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), which implements CERCLA, requires that baseline risk assessments characterize the current and potential threats to human health and the environment [40 CFR Part 300.430(d)(4)]. The NCP specifies that environmental risk evaluations be performed to "assess threats to the environment, especially sensitive habitats and critical habitats of species protected under the Endangered Species Act" [40 CFR Part 300.430(e)(2)(i)(G)].

Based on CERCLA and to facilitate the remedial investigation (RI)/feasibility study (FS) (RI/FS) process, INEEL hazardous waste sites were systematically divided into 10 waste area groups (WAGs) through the Federal Facility Agreement and Consent Order (FFA/CO) between EPA Region 10, the State of Idaho, and Department of Energy-Idaho Operations Office (DOE-ID) in December 1991. WAGs 1 through 9 generally correspond to INEEL operational facilities. As discussed in Section 1, WAG 10 encompasses concerns associated with the Snake River Plain Aquifer and those surface and subsurface areas not included in the bounds of the facility-specific WAGs (DOE-ID, 1991).

This OU 10-04 baseline ecological risk assessment (ERA) is the third phase of the INEEL ERA approach, as discussed in Section 4 (Figure 4-5). The phased approach at the INEEL uses the results of the WAG ERAs and other identified supporting information as inputs to the OU 10-04 ERA. This section summarizes and analyzes the multiyear effort. For additional detail, see the following documents, which report the major efforts performed in support of the OU 10-04 ERA:

- *Guidance Manual for Conducting Screening Level Ecological Risk Assessments at the INEL* (VanHorn et al. 1995). This document presents a consistent approach for performing the individual WAG ERAs, and presents a path forward for developing an OU 10-04 approach.

- *Approach and Data Gap Identification of OU 10-04 INEL-Wide Ecological Risk Assessment Technical Memorandum* (INEL 1996). This document lists data gaps and recommends how to fill the gaps.

- *Work Plan for Waste Area Groups 6 and 10 Operable Unit 10-04 Comprehensive Remedial Investigation/Feasibility Study* (DOE-ID 1999). Appendix C2 of the OU 10-04 Work Plan (DOE-ID 1999) continues the Technical Memorandum (INEL 1996). Appendix D of the OU 10-04 Work Plan (DOE-ID 1999) summarizes the phased approach to the OU 10-04 ERA at the INEEL. It also documents the receptors and parameters used in the WAG ERA risk assessments.

- Appendices H1 through H12 of this document present several significant compilations (white papers and other contributions) supporting the OU 10-04 ERA.

17.1.1 OU 10-04 ERA Organization

The OU 10-04 ERA has been a multiyear effort that has included sampling and other supporting information in the form of compilations and analyses of existing data. The problem formulation (Section 17.2) summarizes this information. Details of each of the assessments are presented in the appendices. This OU 10-04 ERA follows the three major steps of the ERA process: (1) problem formulation (Section 17.2), (2) analysis (Section 17.3), and (3) risk characterization (Section 17.4) (EPA 1992). The document summarizes significant effort, which is described in the appendices, H1 through H12.

17.1.1.1 Problem Formulation. The activities performed in the problem formulation are highly interrelated and interactive. The problem formulation integrates available information supporting the ERA, develops the assessment endpoints and conceptual site model, and lays the foundation for the analysis phase (EPA 1998). As such, the problem formulation is a process for generating and evaluating hypotheses as to if and why ecological effects have occurred, based on human activities (EPA 1998).

Included in the "Problem Formulation" section are summaries of significant past and on-going efforts in support of the OU 10-04 ERA. These include the WAG ERA summaries, OU 10-04 ERA sampling and surveys, evaluation of extent of the assessment area, and other supporting information. Detail is presented in the appendices.

17.1.1.2 Analysis. The "Analysis" section presents an exposure analysis and an effects analysis. The exposure analysis includes a spatial analysis (see Section 17.1.3) in support of the OU 10-04. Other supporting information is summarized or analyzed in this section, or in the appendices, as discussed below. Exposure analysis develops the exposure point concentrations, which are the media concentrations to which receptors are exposed. The exposure analysis also estimates the daily intakes for each of the receptors evaluated. The effects analysis reports the toxicity information and benchmark values used in the risk characterization.

17.1.1.3 Risk Characterization. The "Risk Characterization" section discusses the results of the spatial analysis as it relates to the assessment endpoint identified in the problem formulation. A lines-of-evidence approach (see Section 17.4.2) was used to summarize the supporting information and to organize the risk characterization.

17.1.1.4 Appendices The appendices report significant effort in support of the OU 10-04 ERA, as discussed below:

> Appendix H1: WAG ERA results summarized by site for each WAG assessed. Attachment H1-1 presents the WAG ERA summary tables with the COPCs with HQs greater than 10 highlighted.
>
> Appendix H2: WAG ERA results summarized by COPC for each COPC with an HQ greater than 1. Each COPC was evaluated as discussed in this appendix for retention in the OU 10-04 ERA. Attachments H2-1 and H2-2 include a summary of average and maximum HQs within the WAGs. Attachment H2-3 includes a summary of COPCs by functional group and selected receptors for each WAG.
>
> Appendix H3: Summary of characterization data and risk assessment results from soil and biota sampling performed in 1997, the archived 1997 soils analyzed in 1999, 1999 onion sampling results, and BORAX sampling data collected in 2000. The appendix also discusses and evaluates site-specific bioaccumulation factors (BAFs) compared to literature BAFs.

Appendix H4: Summary of sampling performed by the RESL to evaluate doses previously incurred by receptors at selected INEEL facilities. These RESL data were collected during the 1970s and 1980s and were not specifically designed for use in an ERA.

Appendix H5: Air modeling performed to support the OU 10-04 ERA efforts at the TRA Warm Waste Ponds (WWPs). To eliminate unnecessary sampling, air modeling was used to evaluate the potential spread of contamination from the WAG areas. For reasons discussed in this appendix, the TRA WWPs were selected as a worst-case scenario for windblown spread of contamination.

Appendix H6: Selection of management goals, endpoints, measures, and receptors. The appendix presents the use of functional groups to select individual species for assessment endpoints in the site-wide OU 10-04 ERA.

Appendix H7: Results of a biological survey of state and federal threatened or endangered (T/E) species and other species of concern that may inhabit or frequent contaminated sites within INEEL facilities. Attachment H7-1 is the draft report produced to support this effort.

Appendix H8: GIS data compilation, mapping, and analyses. This appendix presents the characterization and interpretation of the spatial relationship of ecological receptors to sources and areas of contamination, including the extent of contamination and concentration; location and extent of habitat for species of interest; and species distribution (i.e., which areas of the INEEL are used and/or inhabited). Attachment H8-1 contains the ORACLE and ARCVIEW databases to support the OU 10-04 GIS mapping and analyses. Attachment H8-2 contains the literature review to support OU 10-04 GIS mapping and analyses. Attachment H8-3 contains the data set descriptions and limitations. And Attachment H8-4 contains the interpretive maps.

Appendix H9: Analysis of receptor exposure. The number of COPCs was used to identify WAGs for which potential receptor exposures are more likely and to allow prioritization of COPCs evaluation. The higher the number of COPCs that may have been dispersed, the greater the chance of exposure, especially for species with low mobility. Risk shown by the WAG ERAs was used as an indicator as to which receptors should be further evaluated in a site-wide assessment and for long-term monitoring.

Appendices H10 and 11: The breeding bird survey and analysis. Appendix H10 presents analysis of the breeding bird survey presented in Appendix H11. The analysis evaluated trends for avian species selected as receptors for the OU 10-04 ERA.

Appendix H12: *Long-term Vegetation Dynamics in Sagebrush Steppe at the INEEL* (Anderson and Inouye 1999). This study was evaluated to support the problem formulation and the risk characterization in Section 17.4.

17.1.2 OU 10-04 ERA Goals

The OU 10-04 ERA begun in 1995 is finalized in this document. The primary purpose of the OU 10-04 ERA was to assess risk to ecological receptors at the INEEL from contamination potentially released to the environment. This contamination is largely a result of activities performed in support of DOE and other missions, as discussed in previous RI/FS documents and this comprehensive RI/FS. The goals of the OU 10-04 ERA are as follows:

- To evaluate and assess the sampling data collected to date including:
  - Sampling performed in 1997 and 2000 to support the OU 10-04 ERA
  - Sampling performed for the WAG-specific ERAs. Specifically, to more clearly identify sites and receptors of concern and refine the COPC list on a site-wide basis.
- To define new assessment areas surrounding the WAGs, and to quantitatively compare the percentage of the assessment areas to species/habitat associations on the INEEL.
- To evaluate supporting information and studies previously performed on the INEEL, which qualitatively support the risk characterization.

The results of the OU 10-04 ecological assessment will summarize the risk to ecological receptors site wide. Ultimately, the risk results will be used to focus on long-term monitoring and stewardship issues.

17.1.3 Spatial and Temporal Scale Assumptions

Spatial and temporal scales need to be adequately defined to allow accurate determination of the extent of receptor exposure. The following sections present the assumptions concerning both spatial and temporal scales for the OU 10-04 ERA.

17.1.3.1 Spatial Scale. Overall, the INEEL site encompasses a land area of approximately 227,840 ha (569,600 acres), with approximately 2% (4,560 ha [11,400 acres]) used by 659 buildings and 2,000 support structures (WAGs 1 through 9) (DOE-ID1994). WAGs 1 through 9 are spatially distributed across the site, separated by distances as small as 3 km (2 mi) and as great as 48 km (38 mi). There are currently 437 sites of contamination at the INEEL, with approximately 160 radionuclides and 100 organics and metals identified as contaminants. Contaminated sites vary in size from a few square meters to several hundred hectares, with widely differing habitat.

The OU 10-04 ERA encompasses only the area within INEEL boundaries (DOE-ID 1999). No regional issues (regional being the large geographic area that has natural boundaries important to ecological concepts) beyond the INEEL boundary are addressed, because no evidence of off-Site contamination has been found. The fact of no off-Site contamination has been verified by results of the INEEL off-Site Environmental Surveillance Program. This program routinely samples air, soils, water, environmental dosimeters, and various foodstuffs throughout the upper Snake River Plain for contaminants originating from the INEEL.

The interpretation of supporting off-site data is important to support the evaluation of risk to INEEL ecological resources. This is particularly important in evaluating the breeding bird surveys. The regional evaluation of INEEL resources is critical because the INEEL maintains several declining ecosystems, and this, in combination with long-term stewardship issues, may affect risk management decisions and direct long-term monitoring.

17.1.3.1.1 Terrestrial Resources—The OU 10-04 ERA evaluated several terrestrial ecological resources within the boundaries of the INEEL. Spatial areas of contamination representing potential exposure to ecological receptors across the INEEL (WAG-specific assessment areas) were defined primarily by human health risk assessment results and analytical sampling data from soils, sediments, sludges, and air monitoring. Ecological risk was interpreted at a population level using spatial distribution of species/habitat associations within the WAG-specific assessment areas compared to the overall INEEL area.

17.1.3.1.2 Surface Water—Major INEEL watercourses include the Big Lost River and Birch Creek drainages. There are no known seeps or discharge points on the facility to these drainages. Contaminant characterization for the Big Lost River and Birch Creek has not been performed and was not quantitatively assessed in the OU 10-04 ERA. It is considered unlikely that these areas have been contaminated by facility operations. The OU 10-04 Work Plan (DOE-ID 1999) anticipated that the ESRF would verify sampling performed in these areas by 1999 or 2000. This has not yet occurred and remains an uncertainty in the OU 10-04 ERA.

Evaluation of INEEL aquatic receptors was limited to those associated with WAG facility sewage disposal and industrial waste ponds. The home range for aquatic receptors was assumed to be restricted to the area of individual ponds. Although aquatic receptors were only qualitatively addressed in the OU 10-04 ERA, there are some WAG ERA results for aquatic receptors, which are summarized in Appendix H1.

17.1.3.1.3 Groundwater—No pathway from groundwater to ecological receptors exists on the INEEL. Therefore, groundwater was not quantitatively evaluated in the OU 10-04 ERA. The OU 10-08 RI/FS will contain an extensive analysis of the groundwater issues at the INEEL. The OU 10-08 RI/FS will evaluate all site groundwater sampling data and account for contributions from all activities at the site.

17.1.3.2 Temporal Scale. The temporal scale includes the time period during which exposure occurs, and the time pattern of exposure (i.e., intermittent, chronic). Current conditions were evaluated in the OU 10-04 ERA. No past or future scenarios were included in the assessment. Duration of receptor exposures are currently reflected by the toxicity reference values, site use factors, and exposure duration exposure model input values documented in the OU 10-04 Work Plan (DOE-ID 1999).

17.2 Problem Formulation

The activities performed in the problem formulation were highly interactive and interrelated. The problem formulation integrates available information supporting the ERA, develops the assessment endpoints and conceptual site model, and offers an analysis plan (EPA 1998). The problem formulation was a process for generating and evaluating hypotheses to determine if and why ecological effects have occurred based on site-related activities (EPA 1998).

For OU 10-04, much information was compiled, evaluated, and analyzed. The results of this effort are presented in Appendices H-1 through H-12, which are referred to and discussed. Figure 17-1 is a flow diagram of the OU 10-04 ERA problem formulation phase. The problem formulation analysis section summarizes the final efforts performed to support the risk assessment for the OU 10-04 ERA.

17.2.1 Evaluation of the WAG ERA Results for the OU10-04 ERA

Evaluation of the results of the WAG ERAs was conducted in several steps. The sites with contaminants having elevated HQs were compiled, and both the COPCs and receptors potentially affected were evaluated. These efforts aimed at reducing the overall list of COPCs, sites, and receptors for the site-wide assessment. The sites, COPCs, and receptors that resulted from these evaluations constitute the final list for long-term monitoring and/or remediation. See Appendices H1 and H2 for more detail about these efforts.

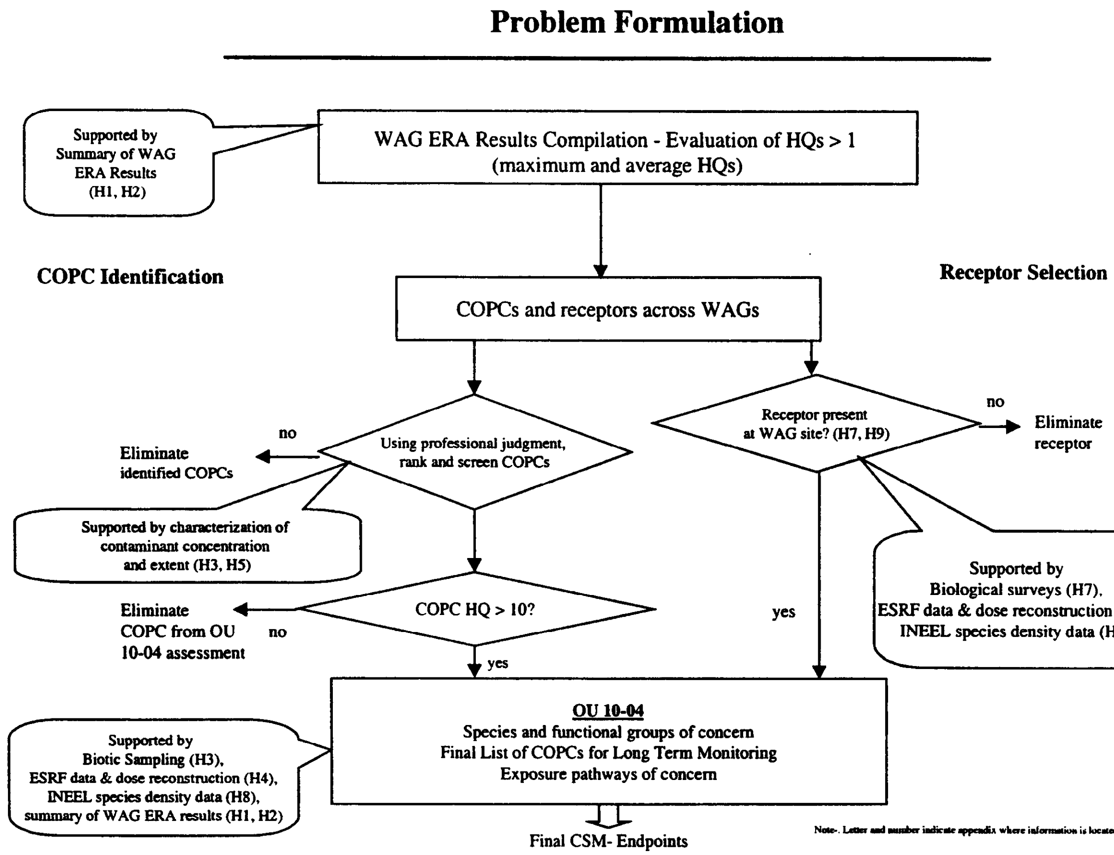

Figure 17-1. Problem formulation flow diagram.

Appendix H1 summarizes the individual WAG ERA sites and contaminants of concern. Tables H1-1 to H1-7 in this appendix present the WAG ERA results including the HQ ranges. From this initial WAG ERA summary, a combination of professional judgment and HQ levels (looking primarily at HQs greater than 10) was used to narrow the focus of the OU 10-04 ERA to the most common contaminants. Appendix H2 details the contaminant list reduction and associated rationale. The inclusive contaminant list and the rationale for inclusion or removal of a COPC are presented in Table H2-1 of this appendix and summarized below. As presented in Table H2-1, the primary rationale for elimination of those contaminants was HQs above 1.0 for nonradionuclides and 0.1 for radionuclides at only one WAG. These contaminants were removed from the OU 10-04 ERA COPC list, providing the COPC was not highly toxic or persistent or possibly bioaccumulative in the terrestrial environment. Additionally, due to the common presence and concern surrounding radionuclide contamination, a list of these were also retained. The intent of the evaluation was primarily to identify the contaminants, locations, and ultimately the receptors, that most likely warrant long-term monitoring or further study. Tables 17-1 through 17-7 show the final list of WAG ERA sites and associated COPCs that were carried forward for evaluation in the OU 10-04 ERA. Note, however, that inconsistencies occurred in the WAG ERAs. At times, the ERAs used different EBSLs, background data, exposure parameters, and TRVs. The WAG ERA results were used as they existed in the final version for each WAG ERA, with the exception of WAG 2. WAG 2 data was reanalyzed with more thoroughly reviewed toxicity data and these results were used in this analysis (see Table H1-2).

The contaminants not carried forward are as follows:

Inorganics

- Aluminum— This analyte can be eliminated as a COPC, since INEEL soils are typically alkaline (pH>7.0). The EPA (2000) states that aluminum should not be considered a COPC unless the soils have pHs below 5.5.

- Beryllium—This metal was a COPC only at WAG 9 for the two WAG 9 sites where risks were estimated; HQs were less than 5.

- Boron—HQs were <= 100 for plants (all other receptors had HQs <=2). Boron was a COPC only at one site (CPP-66 (Fly Ash Pit)).

- Chlorine— Present at only one WAG (also see discussion in Appendix K).

- Chloride—Removed as COPCs, in accordance with the discussion in Appendix K.

- Fluoride—Generally, low HQs were observed in the WAG ERAs. Environmental concentrations of fluoride vary widely, based on soil types. Toxicity reference values are generally lacking or highly uncertain. See discussion in Appendix K.

- Nitrate—Present at low HQs (less than 5) at both WAG 4 and WAG 10. However, nitrate is an inorganic form of nitrogen readily taken up by plants and is a common fertilizer.

- Nitrite—Present at low HQs (less than 2) at WAG 10. Nitrite occurs as an intermediate form and does not usually accumulate in soils because it is readily transformed to nitrate or denitrified.

- Phosphate(PO_4) —Only at one site at WAGs 3 and 9. No data available for the WAG 3 site. Phosphate is a common fertilizer and phosphorous is an essential element for plant growth.

- Sodium—Does not greatly exceed dietary requirements at WAGs at which it was detected; was removed as a COPC.

- Sulfate—Only found at two sites at one WAG (one site with HQs <= 5). Often used in ammonia sulfate as a fertilizer. Toxicity values are generally lacking or highly uncertain.

- Sulfide—Present at only one site at one WAG in low concentrations.

- Tin—At WAG 1, at TSF-07 (Disposal Pond), HQs were less than 300. The only other sites (WAG 2) where tin was a COPC were TRA-02 and TRA-06; the HQs were less than 1.

Table 17-1. Reduced WAG 1 sites and contaminants evaluated in the OU 10-04 ERA.

Site	Description/Size (m^2)	COPC	Max. Conc. (mg/kg)[1]	Bkgd. Conc. (mg/kg)[1]	WAG ERA EBSL (mg/kg)[1]	WAG ERA HQ[a]	RA decision for this site in the WAG 1 ROD?
LOFT-02	LOFT Disposal Pond (TAN-750) (10,000 m^2)	Manganese	1.08E+03	490		<1 to 20	No
TSF-03	TSF Burn Pits (155 m^2)	Lead	1.13E+03	2.30E+01	NA	<1 to 200	Yes
TSF-07	TSF Disposal Pond	Arsenic	4.92E+01	7.40E+00		<1 to 50	Yes
	(9,800 m^2)	Antimony	2.74E+01	7.40E+00		<1 to 30	
		Barium	9.74E+03	4.40E+02	NA	<1 to 90,000	
		Cadmium	1.49E+01	3.70E+00	NA	<1 to 6,000	
		Cobalt	1.99E+01	1.80E+01		<1 to 40	
		Chromium (III)	1.50E+02	5.00E+01	NA	<1 to 200	
		Copper	1.09E+03	3.20E+01	NA	<1 to 500	
		Cyanide	2.93E+00	NA	1.43E-01	<1 to 20	
		Lead	3.38E+02	2.30E+01	NA	<1 to 600	
		Mercury	4.04E+03	7.40E-02	NA	70 to 300,000	
		Nickel	7.82E+01	5.50E+01	NA	<1 to 30	
		Selenium	4.22E+01	3.40E-02	NA	<1 to 500	
		Silver[3]	1.66E+02	NA	2.99E+00	<1 to 100	
		Thallium	4.82E+01	6.80E-01	NA	<1 to 300	
		Vanadium	9.45E+01	7.00E+01	NA	<1 to 300	
		Zinc	2.40E+03	2.20E+02	NA	<1 to 300	

Table 17-1. (continued).

Site	Description/Size (m²)	COPC	Max. Conc. (mg/kg)[1]	Bkgd. Conc. (mg/kg)[1]	WAG ERA EBSL (mg/kg)[1]	WAG ERA HQ[a]	RA decision for this site in the WAG 1 ROD?
TSF-08	TSF HTRE III Mercury Spill Area (90 m^2)	Mercury	5.90E+01	7.40E-02	NA	<1 to 300	No, however, this site was forwarded for further evaluation under WAG 10, OU 10-08.
WRRTF-01	WRRTF Burn Pits (2,520 m^2)	Chromium (III)[c]	2.64E+02	5.00E+01	NA	<1 to 300	Yes
		Chromium (VI)[c]	2.64E+02	5.00E+01	NA	<1 to 300	
		Lead	2.35E+03	2.30E+01	NA	<1 to 4,000	
		2-methylnaphthalene	1.03E+01	NA	3.25E-02	<1 to 300	
WRRTF-03	WRRTF Evaporation Pond (5,574 m^2)	Cadmium	1.17E+01	3.70E+00	NA	<1 to 4,000	No
		Chromium (III)[c]	7.89E+01	5.00E+01	NA	<1 to 80	
		Chromium (VI)[c]	7.89E+01	5.00E+01	NA	<1 to 80	
WRRTF-13	WRRTF Fuel Oil Leak	2-methylnaphthalene	2.90E+02	NA	3.25E-02	<1 to 800	Yes
	(125 m^2)	TPH	1.98E+04	NA	5.16E+01	<1 to 200	

Note - TSF-08 is currently being evaluated for phytoremediation under OU 10-08.

ROD = Record of decision; RA = remedial action

[1] pCi/g for radionuclides. [2] mg/kg for metals & organic compounds

This represents the maximum HQs calculated across functional groups and T/E species.

At TSF-07, the average silver concentration also exceeded AWQC (AWQC = 0.12 ug/L, average silver concentration = 20.5 ug/L).

Soil chemical analysis was for total chromium only. In the absence of specific analyses, chromium (III) & chromium (VI) concentrations were conservatively both assumed to be present.

NA = not applicable, or not available (e.g., no background concentration or verified EBSL for this COPC).

Table 17-2. Reduced list of WAG 2 sites and contaminants evaluated in the OU 10-04 ERA.

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	Updated HQs	RA Decision for this site in the WAG 2 ROD?
TRA-04/05	TRA Warm Waste Retention Basin (TRA-712)	Chromium (III)	2.14E+01	3.30E+01		<=20	No
	Waste Disposal Well, Sampling Pit (TRA-674) & Sump (TRA-703) (12,700 m^2)	Lead	3.97E+01	1.70E+01	3.34E-03	<=100	
TRA-06	TRA Chemical Waste Pond (TRA-701)	Barium	1.86E+03	3.00E+02	NA	<=20,000	Yes
		Cadmium	2.05E+00	2.20E+00	6.13E-01	<=800	
		Chromium (III)	2.41E+01	3.30E+01	NA	<=20	
		Lead	2.25E+01	1.70E+01	3.34E-03	<=40	
		Mercury	1.33E+02	5.00E-02	3.00E-01	<=9,000	
		Selenium	1.69E+01	2.20E-01	1.72E-01	<=200	
		Thallium	8.43E+00	4.30E-01	1.01E-01	<=60	
TRA-08	TRA Cold Waste Disposal Pond (TRA-702)(14,700 m^2)	Arsenic	3.94E+01	5.80E+00	7.60E-01	<=40	Yes
		Barium	4.58E+02	3.00E+02	NA	<=4,000	
		Cadmium	1.10E+01	2.20E+00	NA	<=4,000	
		Chromium (III)	4.49E+01	3.30E+01	NA	<=40	
		Copper	5.80E+01	2.20E+01	NA	<=20	

Table 17-2. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	Updated HQs	RA Decision for this site in the WAG 2 ROD?
		Lead	3.52E+01	1.70E+01	3.34E-03	<=90	
		Mercury	6.00E-01	5.00E-02	3.00E-01	<=40	
		Selenium	3.85E+01	2.20E-01	1.72E-01	<=400	
		Silver	2.35E+01	NA	2.00E+00	<=20	
		Xylene	2.00E-02	NA	2.78E-01	<=20	
TRA-13	TRA Final Sewage Leach Ponds (2) (TRA-732) (3,020 m^2)	Lead	7.23E+01	1.70E+01	3.34E-03	<=100	Yes
		Mercury	6.15E+00	5.00E-02	3.00E-01	<=400	
		Selenium	3.07E+00	2.20E-01	1.72E-01	<=30	
		Silver	2.29E+01	NA	2.00E+00	<=20	
		Zinc	4.98E+02	1.50E+02		<=50	
TRA-36	TRA ETR Cooling Tower Basin (TRA-751)	Cadmium	2.65E+00	2.20E+00		<=900	No
	(1,060 m^2)	Selenium	3.63E+00	2.20E-01	1.72E-01	<=30	
TRA-38	TRA ATR Cooling Tower	Thallium	2.29E+01	4.30E-01	1.01E-01	<=100	No
	(TRA-771) (956 m^2)	Selenium	2.40E+01	2.20E-01	1.72E-01	<=200	
TRA-39	TRA MTR Cooling Tower N of TRA-607 (734 m^2)	Chromium (III)	3.74E+02	3.30E+01	NA	Plants were 400, other wise only AV221, 222, 222A (avian insectivores) slightly exceeded HQs of 1 (all less than 3)	No, however, this site was eliminated as an ecological risk within this ROD.

Table 17-2. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	Updated HQs	RA Decision for this site in the WAG 2 ROD?
TRA-653 (Cr)	TRA-653 Chromium contaminated soil	Chromium (III)	1.08E+02	3.30E+01	NA	HQs were <= 110 (plants only) and maximum concentration was below an older WAG EBSL	No, however, this site was eliminated as an ecological risk within this ROD.

NA = not applicable, or not available (e.g., no background concentration or verified EBSL for this COPC)

Note – concentrations are in mg/kg for metals & organic compounds.

Table 17-3. Reduced list of WAG 3 sites and contaminants evaluated in the OU 10-04 ERA.

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	Updated HQs[a]	RA decision for this site in the WAG 3 ROD?
CPP-13	Pressurization of the Solid Storage Cyclone NE of CPP-633	Sr-90[I]	4.18E+03	4.90E-01	3.34E+03	<=50	Yes
CPP-14	Sewage Treatment Plant South of CPP-664 (3,920 m^2)	Mercury	3.80E-01	5.00E-02	3.00E-01	<=30	Yes
CPP-19	CPP-603 to CPP-604 Line Leak	Cs-137[I]	4.08E+05	8.20E-01	5.58E+03	<=200	Yes
		Eu-152[I]	8.76E+04	NA	2.18E+03	<=100	
		Eu-154[I]	5.35E+04	NA	3.31E+03	<=40	
		Sr-90[I]	1.25E+05	4.90E-01	3.34E+03	<=300	
CPP-34	Soil Storage Area, NE corner of CPP	Mercury	2.90E-01	5.00E-02		<=20	Yes
		Sr-90[I]	6.00E+03	4.90E-01	3.34E+03	<=60	
CPP-37A	CPP Gravel Pit #1	Mercury	9.60E-01	5.00E-02	3.00E-01	<=60	Yes
CPP-39	CPP HF Storage Tank (YBD-105) and Dry Well (488 m^2)	Barium	1.10E+03	3.00E+02	NA	<=4000	No
CPP-40	Lime Pit at the Base of the CPP-601 Berm and Drain (30.1 m^2)	Chromium (III)	7.20E+01	3.30E+01		<=40	No
CPP-42	Drainage Ditch West of CPP-608	Barium	1.10E+03	3.00E+02	NA	<=1000	No
CPP-44	Grease Pit South of CPP-608	Cadmium	8.40E+00	2.20E+00	NA	<=700	Yes
		Chromium (III)	1.54E+03	3.30E+01	1.00E+00	<=800	
CPP-54	Drum Storage Area West of CPP-660	Mercury	2.90E+01	5.00E-02	3.00E-01	<=100	No

Table 17-3. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	Updated HQs[a]	RA decision for this site in the WAG 3 ROD?
CPP-55	Mercury Contaminated Area Near CPP-T-15	Chromium (III)	6.50E+01	3.30E+01	1.00E+00	<=30	Yes
		Chromium (VI)	6.50E+01	NA	1.62E-01	<=30	
		Lead	3.20E+01	1.70E+01		<=30	
		Mercury	5.20E+00	5.00E-02	3.00E-01	<=200	
CPP-66	CPP CFSGP Fly Ash Pit	Selenium	1.60E+00	2.20E-01		<=20	
	(29,100 m^2)						
CPP-88	Radiologically–Contaminated Soils Map	Mercury	5.52E-01	5.00E-02		<=50	No
	(55.7 m^2)	Nickel	5.51E+01	3.50E+01		<=20	
CPP-90	CPP-709 Ruthenium Detection (501 m^2)	Mercury	1.00E+00	5.00E-02		<=30	No
CPP-93	Simulated Calcine Trench (297 m^2)	Mercury	1.40E+02	5.00E-02	3.00E-01	<=2000	
NA	Old Storage Pool	Eu-152[1]	9.44E+03	NA	2.18E+03	<=60	Yes
	(1,240 m^2)	Eu-154[1]	9.44E+03	NA	3.31E+03	<=20	
NA	Tank Farm	Am-241[1]	9.10E+02	1.10E-02	1.78E+01	<=50	No, however, this site was forwarded for further investigation under the OU 3-14 RI/FS.
	(16,000 m^2)	Cs-137[1]	2.02E+06	8.20E-01	5.58E+03	<=4000	
		Sr-90[1]	3.62E+05	4.90E-01	3.34E+03	<=4000	
		U-235[1]	5.50E+02	NA	2.27E+01	<=20	
		Cs-137[2]	2.02E+06	8.20E-01	4.95E+03	<=200	

Table 17-3. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	Updated HQs[a]	RA decision for this site in the WAG 3 ROD?
NA	Tank Farm South (2,080 m^2)	Mercury	6.10E-01	5.00E-02	3.00E-01	<=40	No, however, this site was forwarded for further investigation under the OU 3-14 RI/FS.
NA	WCF	Mercury	1.24E+00	5.00E-02	3.00E-01	<=80	Yes
		Am-241[I]	3.46E+02	1.10E-02	1.78E+01	<=20	
		Sr-90[I]	6.36E+04	4.90E-01	3.34E+03	<=600	

pCi/g for radionuclides

mg/kg for metals & organic compounds

a. Updated TRVs were incorporated into the excel spreadsheet for WAG 2. These updated results are used in all subsequent analysis for OU 10-04 ERA.

IExternal radionuclide COPC.

2Internal radionuclide COPC.

NA = not applicable, or not available (e.g., no background concentration or verified EBSL for this COPC)

Table 17-4. Reduced list of WAG 4 sites and contaminants evaluated in the OU 10-04 ERA.

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 4 ROD?
CFA-01	Landfill I	Chromium (III)	5.30E+01	3.30E+01	3.25E+01	<=1 to 50	No
	(43,000 m^2)	Copper	7.34E+01	2.20E+01	2.11E+00	<1 to 30	
		Lead	9.70E+01	1.70E+01	7.17E-02	1 to 200	
		Zinc	2.30E+02	1.50E+02	6.37E+00	<=1 to 30	
CFA-02	Landfill II	Acetone	5.80E+00	NA	5.53E-01	<=1 to 20	No
	(707,000 m^2)	Arsenic	1.72E+01	5.80E+00	8.76E-01	<=1 to 20	
		Lead	2.55E+02	1.70E+01	7.17E-02	1 to 700	
CFA-04	Pond near CFA-674	Barium	1.12E+03	3.00E+02	9.74E-02	<=1 to 1000	Yes
	(6,880 m^2)	Cadmium	6.80E+00	2.20E+00	2.36E-03	<=1 to 3,000	
		Cobalt	1.28E+01	1.10E+01	4.54E-02	<=1 to 200	
		Copper	3.65E+02	2.20E+01	2.11E+00	<=1 to 60	
		Lead	4.93E+01	1.70E+01	7.17E-02	<=1 to 90	
		Mercury	4.39E+02	5.00E-02	6.13E-03	<1 to 30,000	
		Nickel	3.55E+02	3.50E+01	2.69E+00	<1 to 100	
		Silver	1.21E+02	NA	2.99E+00	<=1 to 20	
		Vanadium	5.56E+01	4.00E+01	2.55E-01	<=1 to 90	
CFA-05	Motor Pool Pond (ditch)	Arsenic	1.98E+01	5.80E+00	8.76E-01	<=1 to 20	
	(7,430 m^2)	Cadmium	3.80E+01	2.20E+00	2.36E-03	<=1 to 10,000	
		Chromium (III)	9.13E+01	3.30E+01	3.25E+01	<=1 to 90	
		Cobalt	1.50E+01	1.10E+01	4.54E-02	<=2 to 20	
		Copper	3.42E+02	2.20E+01	2.11E+00	<=1 to 100	
		Lead	6.31E+02	1.70E+01	7.17E-02	<=1 to 1,000	

Table 17-4. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 4 ROD?
		Manganese	7.67E+02	4.90E+02	1.41E+01	<=1 to 70	
		Mercury	5.80E-01	5.00E-02	6.13E-03	<=1 to 80	
		Vanadium	4.72E+01	4.50E+01	2.55E-02	<=1 to 20	
		Zinc	8.58E+02	6.37E+00	1.50E+02	<=1 to 20	
	Motor Pool Pond (pond)	Cadmium	6.80E+00	2.20E+00	2.36E-03	<=1 to 1,000	
		Chromium (III)	3.49E+01	3.30E+01	3.25E+01	<1 to 30	
		Copper	5.86E+01	2.20E+01	2.11E+00	<1 to 30	
		Lead	1.06E+02	1.70E+01	7.17E-02	<=1 to 70	
		Manganese	5.74E+02	4.90E+02	1.41E+01	<=1 to 30	
		Zinc	2.41E+02	6.37E+00	1.50E+02	<=1 to 20	
CFA-06	Lead Shop (outside areas)	Lead	1.53E+02	1.70E+01	7.17E-02	<=1 to 200	No
CFA-08	Sewage Plant (CFA-691), Septic Tank (CFA-716), and Drainfield	Lead	2.23E+01	1.70E+01	7.17E-02	<1 to 40	Yes
	(18,400 m^2)	Mercury	5.10E-01	5.00E-02	6.13E-03	<=1 to 30	
		Selenium	1.40E+00	2.20E-01	8.11E-02	<1 to 20	
CFA-10	Transformer Yard Oil Spills	Cadmium	7.30E+00	2.20E+00	2.36E-03	<=1 to 2,000	Yes
	(808 m^2)	Cobalt	1.57E+01	1.10E+01	4.54E-02	<=1 to 20	
		Copper	2.59E+02	2.20E+01	2.11E+00	<1 to 70	
		Lead	3.30E+03	1.70E+01	7.17E-02	<1 to 3,000	
		Manganese	5.09E+02	4.90E+02	1.41E+01	<=1 to 20	
		Nickel	1.11E+02	3.50E+01	2.69E+00	<=1 to 20	
		Zinc	1.15E+03	1.50E+02	6.37E+00	<=1 to 70	

Table 17-4. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 4 ROD?
CFA-13	Dry Well (South of CFA-640) (25 m^2)	Cadmium	7.37E+00	2.20E+00	2.36E-03	<=1 to 60	No
		Chromium (III)	1.79E+02	3.30E+01	3.25E+01	<1 to 200	
		Copper	1.90E+03	2.20E+01	2.11E+00	<=1 to 20	
		Lead	7.25E+02	1.70E+01	7.17E-02	<1 to20	
CFA-41	Excess Drum Storage (south of CFA-674) (6,970 m^2)	TPH	<1,000	NA	5.16E+01	<1 to 20	No
CFA-43	Lead Storage Area (15,300 m^2)	Lead	1.80E+02	1.70E+01	7.17E-02	1 to 900	No
CFA-51	Dry Well at north end of CFA-640 (0.1 m^2)	Cadmium	1.40E+01	2.20E+00	2.36E-03	<1 to 90	No

NA = not applicable, or not available (e.g., no background concentration or verified EBSL for this COPC)

Table 17-5. Reduced list of WAG 5 sites and contaminants evaluated in the OU 10-04 ERA.

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 5 ROD?
ARA-01	Chemical evaporation pond	Arsenic	2.58E+01	5.80E+00	NA	<= 20	Yes
	(2,990 m^2)	Cadmium	3.80E+00	2.20E+00	NA	<= 1000	
		Lead	4.39E+01	1.70E+01	NA	<= 1 to <= 50	
		Selenium	2.77E+01	2.20E-01	NA	<= 300	
		Thallium	5.92E+01	4.30E-01	NA	<= 1 to <= 400	
		Vanadium	6.80E+01	4.50E+01	NA	<= 200	
		Zinc	2.33E+02	1.50E+02	NA	<= 20	
ARA-25	Soil beneath the ARA-626 hot cells	Arsenic	4.06E+01	5.80E+00	NA	<= 1 to <= 20	Yes
	(178 m^2)	Cobalt	1.04E+02	1.10E+01	NA	<= 1 to <= 90	
		Copper	2.27E+02	2.20E+01	NA	<= 1 to <= 40	
		Lead	1.43E+03	1.70E+01	NA	<= 1 to <= 900	
		Vanadium	1.04E+02	4.50E+01	NA	<= 1 to <= 100	
		Zinc	8.55E+02	1.50E+02	NA	<= 1 to <= 20	
ARA-12	Radiological waste leach pond	Cadmium	6.06E+00	2.20E+00	NA	<= 1 to <= 2,000	Yes
	(5,748 m^2)	Copper	6.23E+02	2.20E+01	NA	<= 300	
		Lead	1.58E+02	1.70E+01	NA	<= 300	
		Manganese	5.70E+02	4.90E+02	NA	<= 40	
		Mercury	1.40E+00	5.00E-02	NA	<= 90	
		Selenium	2.70E+00	2.20E-01	NA	<= 30	
		Zinc	3.76E+02	1.50E+02	NA	<= 50	
PBF-16	SPERT-II leach pond	Lead	3.21E+01	1.70E+01	NA	<= 60	Yes

Table 17-5. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 5 ROD?
	(3,570 m^2)	Mercury	7.10E-01	5.00E-02	NA	<= 50	
PBF-22	Leach pond	Copper	4.84E+01	2.20E+01	NA	<= 20	No
	(5,008 m^2)	Lead	6.84E+01	1.70E+01	NA	<= 1 to <= 40	
		Mercury	2.70E-01	5.00E-02	NA	<= 20	
		Selenium	1.70E+00	2.20E-01	NA	<= 20	
PBF-26	SPERT-IV Lake	Copper	2.34E+02	2.20E+01	NA	<= 100	No
		Lead	4.30E+01	1.70E+01	NA	<= 100	
		Mercury	3.40E-01	5.00E-02	NA	<= 20	
		Nickel	4.50E+01	3.50E+01	NA	<= 20	
		Silver	3.70E+01	NA	2.00E+00	<= 20	
		Zinc	2.59E+02	1.50E+02	NA	<= 40	

a. Each entry in the column represents the range of hazard quotients calculated across functional groups

b. Background concentrations are the 95%/95% UTLs for composite samples from Rood, Harris, and White (1996). NA = not applicable, a background value is not identified for the contaminant.

NA = not applicable, or not available (e.g., no background concentration or verified EBSL for this COPC)

Table 17-6. Reduced list of WAG 6 and 10 sites and contaminants evaluated in the OU 10-04 ERA.

Site Description	COPC	Exposure Point Concentration (EPC) mg/kg	Hazard Quotient
BORAX-01	Cadmium	4.14E+00	≤ 1 to ≤ 800
BORAX-09	Manganese	3.99E+02	≤ 1 to ≤ 14
Burn Ring	Zinc	2.71 E+03	≤ 1 to ≤ 80
CFA-633	RDX	6.30E+00	≤ 1 to ≤ 70
Experimental Field Station, Area #1	1,3-Dinitrobenzene	1.40 E+01	≤ 1 to ≤ 80
	2,4,6-Trinitrotoluene	1.10 E+03	≤ 1 to ≤ 300
Fire Station 2 Zone and Range Fire Burn Area #1	2,4,6-Trinitrotoluene	6.20 E+01	≤ 1 to ≤ 20
Area #2	RDX	3.70 E+00	≤ 1 to ≤ 40
Area #4	2,4,6-Trinitrotoluene	1.30 E+02	≤ 1 to ≤ 40
Land Mine and Fuze Burn Area, Area #3[a]	2,4,6-Trinitrotoluene	6.90 E+04	≤ 1 to ≤ 10,000
National Oceanic and Atmospheric Administration (NOAA) Grid, Area #2a	2,4,6-Trinitrotoluene	8.64 E+02	≤ 1 to ≤ 200
Area #3	2,4,6-Trinitrotoluene	4.01 E+02	≤ 1 to ≤ 100
	RDX	1.78 E+00	≤ 1 to ≤ 20
Area #5	2,4,6-Trinitrotoluene	1.90 E+03	≤ 1 to ≤ 500
Area #6	1,3-Dinitrobenzene	2.70 E+01	≤ 1 to ≤ 200
	2,4,6-Trinitrotoluene	4.80 E+02	≤ 1 to ≤ 100
Naval Ordnance Disposal Area (NODA) Area #2	Barium		≤ 1 to ≤ 70
	Cadmium		≤ 1 to ≤ 500
	Cobalt		≤ 1 to ≤ 50

Table 17-6. (continued).

Site Description	COPC	Exposure Point Concentration (EPC) mg/kg	Hazard Quotient
	Copper	5.68 E+02	≤ 1 to ≤ 30
	RDX	3.28 E+02	≤ 1 to ≤ 4,000
Area #3	Barium	2.98E+02	≤ 1 to ≤ 90
	Cobalt	1.14E+01	≤ 1 to ≤ 70
	Manganese	4.53+02	≤ 1 to ≤ 20
Area #4	Manganese	5.55E+02	≤ 1 to ≤ 20
	TPH-diesel	1.20 E+03	≤ 1 to ≤ 80
Security Training Facility Gun Range Berm (STF-02), remainder area	Lead	2.44E+04	≤ 1 to ≤ 2,000
Security Training Facility Gun Range (STF-02), kickout area	Manganese	4.74E+02	≤ 1 to ≤ 20

Note - For more detail on these sites, see Appendix F.

a. 1,3-dinitrobenzene and 2,4-dinitrobenzene were not assessed as contaminants at the Land Mine and Fuze Burn Area because of uncertainties associated with the lab analysis. The exposure point concentrations used in the ERA were based on sample results that the lab flagged as a nondetect. There were significant issues with lab methods and the sample matrix that resulted in extremely high detection limits. These uncertainties limit the ability to determine risk to ecological receptors. However, the Land Mine and Fuze Burn Area are currently being evaluated for remediation from 2,4,6-TNT contamination, and presumably 1,3-dinitrobenzene and 2,4-dinitrotoluene would also be treated or removed as part of that remediation action. Post-remedial sampling for the Land Mine and Fuze Burn Area would also include analyzing for 1,3-dinitrobenzene and 2,4-dinitrotoluene to determine if any residual contamination is left behind. These COPCs are also being retained for the OU 10-04 ERA.

Table 17-7. Reduced list of WAG 9 sites and contaminants evaluated in the OU 10-04 ERA.

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. In RI (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 9 ROD?
ANL-01	Industrial Waste Pond and Cooling Tower Blowdown Ditches (3)	Arsenic	2.50E+01	7.40E+00	5.80E+00	NA	<=20	Yes
	(12,140 m^2)	Barium	1.70E+03	4.40E+02	3.00E+02	NA	<=20,000	
		Cadmium	4.20E+00	—	2.20E+00	NA	<=2000	
		Chromium(III)	1.00E+04	5.00E+01	3.30E+01	NA	<=5000	
		Chromium(VI)	1.10E+03	5.00E+01	NB	1.67E-01	<=700	
		Copper	2.00E+02	3.20E+01	2.20E+02	NA	<=80	
		Cyanide	5.90E+00	NA	NB	2.15E-02	<=60	
		Lead	3.80E+01	2.30E+01	1.70E+01	NA	<=90	
		Manganese	7.70E+02	7.00E+02	4.90E+02	NA	<=50	
		Mercury	3.90E+00	7.40E-02	5.00E-02	NA	<=300	
		Nickel	9.20E+01	5.50E+01	3.50E+01	NA	<=30	
		Selenium	8.40E+00	3.40E-02	2.20E-01	NA	<=90	
		Silver	3.80E+01	NA	NA	1.39E+00	<=30	
		Vanadium	1.10E+02	7.00E+01	4.00E+01	NA	<=400	
		Zinc	5.00E+03	2.20E+02	1.50E+02	NA	<=700	
ANL-01A	Main Cooling Tower Blowdown Ditch (288 m^2)	Arsenic	3.50E+01	7.40E+00	5.80E+00	NA	<=20	Yes
		Barium	1.00E+03	4.40E+02	3.00E+02	NA	<=2000	Yes
		Chromium(III)	7.10E+02	5.00E+01	3.30E+01	NA	—	

Table 17-7. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. In RI (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 9 ROD?
		Chromium (VI)	7.90E+01	5.00E+01	NA	1.67E-01	<=40	
		Copper	2.09E+02	3.20E+01	2.20E+02	NA	>10 to <100	
		Lead	7.40E+01	2.30E+01	1.70E+01	NA	<=20	
		Manganese	1.20E+03	7.00E+02	4.90E+02	NA	<=20	
		Mercury	8.80E+00	7.40E-02	5.00E-02	NA	<=100	
		Vanadium	7.40E+01	7.00E+01	4.00E+01	NA	<=40	
		Zinc	8.50E+02	2.20E+02	1.50E+02	NA	<=20	
ANL-04	ANL Sewage Lagoons	Arsenic	1.00E+01	7.40E+00	5.80E+00	NA	<=30	Yes
	(7,200 m^2)	Barium	5.60E+02	4.40E+02	3.00E+02	NA	<=5000	
		Chromium III	6.90E+01	5.00E+01	3.30E+01	NA	<=30	
		Copper	3.50E+02	3.20E+01	2.20E+02	NA	<=100	
		Lead	1.20E+02	2.30E+01	1.70E+01	NA	<=200	
		Mercury	3.30E+00	7.40E-02	5.00E-02	NA	<200	
		Selenium	3.50E+00	3.40E-02	2.20E-01	NA	<=40	
		Silver	3.70E+01	NA	NA	1.39E+00	<=20	
		Vanadium	7.30E+01	7.00E+01	4.00E+01	NA	<=200	
		Zinc	2.40E+03	2.20E+02	1.50E+02	NA	<=300	
ANL-09	ANL Interceptor Canal	Arsenic	9.70E+00	7.40E+00	5.80E+00	NA	<=20	Yes
	(3,848 m^2)	Lead	3.50E+01	2.30E+01	1.70E+01	NA	<=90	
		Mercury	2.70E-01	7.40E-02	5.00E-02	NA	<=20	

Table 17-7. (continued).

Site	Description	COPC	Max. Conc. (mg/kg)	Bkgd. Conc. In RI (mg/kg)	Bkgd. Conc. (mg/kg)	WAG ERA EBSL (mg/kg)	HQ in the RI/FS	RA decision for this site in the WAG 9 ROD?
ANL-29	Industrial Waste Lift Station (9 m^2)	Silver	5.40E+03	NA	NB	1.39E+00	<=3000	No
ANL-35	Industrial Waste Lift Station	Arsenic	1.20E+01	7.40E+00	5.80E+00	NA	<=20	Yes
		Barium	6.50E+02	4.40E+02	3.00E+02	NA	<=4,000	
		Cadmium	4.80E+00	3.70E+00	2.20E+00	NA	<=1,000	
		Chromium (III)	5.10E+01	5.00E+01	3.30E+01	NA	<=30	
		Copper	1.30E+02	3.20E+01	2.20E+02	NA	<=40	
		Lead	4.70E+01	2.30E+01	1.70E+01	NA	<=50	
		Manganese	1.20E+03	7.00E+02	4.90E+02	NA	<=60	
		Mercury	3.10E-01	7.40E-02	5.00E-02	NA	<=20	
		Nickel	6.40E+01	5.50E+01	3.50E+01	NA	<=20	
		Silver	3.50E+02	NA	NB	1.39E+00	<=200	
		Vanadium	7.20E+01	7.00E+01	4.00E+01	NA	<=100	
		Zinc	2.30E+02	2.20E+02	1.50E+02	NA	<=20	

NA = not applicable, or not available (e.g., no background concentration or verified EBSL for this COPC)

Organics

- 1,1,1,-Trichloroethane, 2,4-Dimethylphenol, 4,4-DDT, 4-methyl-4-hydroxy-2-pentanone, acenaphthene, benzo(a)anthracene, butylbenzylphthalate, carbon tetrachloride, di-n-butylphthalate, di-n-octylphthalate, fluoranthene, phenanthrene, and pyrene had no HQs >= 1. 1, 4-dichlorobenzene, 4-chloroaniline, benzene, dibenzofuran, dichlorodifluoromethane, HpCDD, methylene chloride, OCDD, propionitrile, tetrachoroethylene, tetrahydrofuran, toluene, and vinyl acetate were identified at only one WAG.

- Acetone—Identified as a COPC at three of the WAGs. Acetone was eliminated based on the fact that it occurs naturally, microbes in soil remove part, some is lost from soil by evaporation and biodegradation. Also, acetone molecules do not bind tightly to soil. Rainwater and melted snow dissolve acetone and carry it deeper into the soil to groundwater.

- Benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, and indeno(1,2,3cd)pyrene all have low HQs (below 10) and low concentrations at multiple WAGs.

- Chrysene—At CPP-39 (WAG 3), the HQs from chrysene were less than 1. At CPP-67, chrysene was the only contaminant, and no HQs were calculated. The maximum chrysene concentration at that location was 0.6 mg/kg, which is only slightly elevated above the EBSL [0.227 mg/kg]). At the Landfill (CFA-01), there were chrysene HQs up to 200, but chrysene was only a concern at this one location.

- Di(2-ethylhexyl)phthalate—Very low HQ values. All HQs, <2 at both sites.

- Pentachlorophenol—This analyte was detected at only two locations: CFA-02 (Landfill II) and CFA-12 (two French drains at CFA690). Detections occurred at very low concentrations (0.074 mg/kg and 0.25 mg/kg, respectively). The compound probably biodegraded over time and is no longer present.

- Napthalene—Very low HQs at 3 WAGs; none exceeded 2.

COPCs carried forward from the WAG ERA summaries owing to their environmental persistence, toxicity, or potential for bioaccumulation are as follows:

- Hexavalent chromium—In general, chromium (VI) is favored by higher pH, aerobic conditions, and low amounts of organic matter and the presence of manganese and iron oxides (EPA 2000). If organic matter is present, the trivalent form, chromium (III), dominates. It is retained as a conservative measure.

- Aroclor 1248—HQs were below 1 at one site, PBF-22, WAG5.

- Aroclor 1254— HQs were below 1 at one site, ARA-25, WAG5. HQs were below 9 at PBF-26 (SPERT IV-Lake), WAG 5.

- Aroclor 1260— HQs were below 3 at one site, TSF-07-Disposal Pond, WAG1.

- PCBs— These exist at several sites in WAGs 2, 3, and 9 (all HQs were below 10).

- Arsenic—This COPC was retained owing to its toxicity and common occurrence as a potential contaminant at CERCLA sites.

- Antimony—This COPC was retained owing to its toxicity and common occurrence as a potential contaminant at CERCLA sites

- Explosives— From the discussion in Section 12, explosive contamination may be present over large areas of the INEEL from past activities on the Naval Proving Ground. This includes HMX, RDX, 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, 4-amino-2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene. Even though some of these COPCs did not produce HQs in excess of 1, they remain COPCs for ordnance sites where possible remediation activities would require confirmation sampling.

Several radionuclides are brought forward because their presence in the environment is documented. The report of RESL sampling surrounding the WAGs (Jessmore et al. 1994) states that radionuclides were released from past activities at the facilities. The remediation of some of the CERCLA sites also uses capping (e.g., BORAX (see Section 7)) and other means to control the contamination in situ. Therefore, several common radionuclides will remain as COPCs at the INEEL. Table 17-8 presents the final focused OU 10-04 ERA COPC list.

17.2.2 Summary of OU 10-04 ERA Sampling

Sampling to support the OU 10-04 ERA was conducted in 1997 and again in 2000. While not strictly in support of the OU 10-04 ERA, onion samples were collected in 1999 to address Native American concerns. The results of those sampling activities are presented in Appendix H3, Attachment 1, and summarized briefly in this section. Biological surveys were also conducted, and the results are summarized here.

17.2.2.1 1997 Soil, Biota, Sediment, Surface Water. Ecological investigations in 1997 included sampling for chemical analysis and biological surveys. The results of the biological surveys are presented in Appendix H7. Surface soil and biota collected in 1997 were analyzed for selected metals and radionuclides in 1997 to support the ERA. The samples were collected in the area of the INTEC (formerly the Chemical Processing Plant) plume and an offsite reference area [see Figures D1-4.1 and D1-4-2 of the OU 10-04 Work Plan, respectively (DOE/ID-10554, 1999)].

Biota collection in 1997 consisted of five samples each at the onsite and offsite locations, and included deer mice (*Peromyscus maniculatus*), Nuttall's cottontail (*Sylvilagus nuttallii*), crested wheatgrass (*Agropyron cristatum*), Wyoming big sagebrush (*Artemisia tridentata, spp. Wyomingensis*), beetles (*Eleodes* spp), and grasshoppers (family Acrididae). Where possible, the biotic samples were co-located with the soil samples. These data were also used to evaluate uptake as discussion in Appendix H3 and summarized in Section 17.3.

In addition, two sediment and surface water samples were collected from the Industrial Waste Pond at ANL-W and analyzed for radionuclides and metals. Summary statistics for the surface water and sediment samples are provided in Appendix H3.

Due to elevated detection limits for some analytes in soil, archived 1997 soil samples were also analyzed in 1999 for metals and radionuclides. Appendix H3 summarizes statistics for the archived soils.

Table 17-8. OU 10-04 COPCs summarized from the WAG ERAs (Appendix H2).

COPCs	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 9	WAGs 6 & 10
Inorganics							
Arsenic *	X	X		X	X	X	
Antimony *	X						
Barium	X	X	X	X		X	
Cadmium	X	X	X	X	X	X	
Chromium (III)	X	X	X	X		X	
Chromium (VI)			X			X	
Cobalt	X			X	X		
Copper	X	X		X	X	X	X
Cyanide*	X					X	
Lead	X	X	X	X	X	X	X
Manganese	X			X	X	X	
Mercury	X	X	X	X	X	X	
Nickel	X		X	X	X	X	
Selenium	X	X	X	X	X	X	
Silver	X	X		X	X	X	
Strontium			X				
Thallium	X	X			X		
Vanadium	X			X	X	X	
Zinc	X	X		X	X	X	X
Organics							
1,3-Dinitrobenzene							X

Table 17-8. (continued).

COPCs	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 9	WAGs 6 & 10
2,4-Dinitrotoluene							X
2,6-Dinitrotoluene							X
2-Amino-4,6-Dinitrotoluene[a]							X
4-Amino-2,6-Dinitrotoluene[a]							X
RDX							X
HMX[a]							X
1,3,5-Trinitrobenzene[a]							X
2,4,6-Trinitrotoluene							X
4-Methyl-4-hydroxy-2-pentanone			X				
2-Methylnaphthalene	X						
Polychlorinated biphenyls (PCBs), including Aroclors-1248, 1254, 1260[a]	See footnote a	X	X	See footnote a	X	X	
Total petroleum hydrocarbons (TPH)	X			X			X
Xylene[a]							
Radionuclides							
Am-241, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Pu-238, Pu-239, Pu-239/240, Sr-90, U-235, U-238, Tritium	NA	NA	NA	NA	NA	NA	NA

Note - Radionuclides were retained for the OU 10-04 and not screened for HQs >10.

PCBs, including Aroclors, were retained due to environmental persistence and potential for bioaccumulation.

*Retained due to toxicity and common occurrence as a contaminant at CERCLA sites.

a. No sites with HQ>10 for this contaminant; however, it may be a potential contaminant of concern for post-remediation confirmation sampling at ordnance sites.

Appendix H3 summaries the statistics for all 1997 samples. The appendix also presents the complete results of the soil and biota samples and details pertaining to the collection and analysis of those samples.

17.2.2.2 June 2000 Soil and Biota Sampling. According to the Field Sampling Plan, a limited sampling effort was conducted in June 2000 at the BORAX area (INEEL/EXT-99-01053). This effort included collecting both soil and biota samples. The purposes of the effort were to assess the performance of the cap at the BORAX-0I site pertaining to the potential for small mammal intrusion and to establish potential biotic uptake. There was concern that radionuclides might be transported from under the cap to the surface by small mammals burrowing under the cap. Appendix H3, Attachment 1, presents the results of the BORAX sampling and analysis.

17.2.2.3 1999 Onion Sampling. Wild onion samples were collected in 1999 for information in support of the Native American scenario and were not strictly associated with the OU 10-04 ERA. These samples were analyzed for nitroaromatics, metals, and radionuclides. Sample locations were onsite at INTEC and the Fire Station areas, and the offsite reference area (i.e., two of the same sample locations as those sampled in 1997). Appendix H3 summarizes the statistics for the onion samples.

17.2.2.4 1997 Biological Field Survey Results. Details concerning the biological information collected in the summer of 1997 to support the OU 10-04 ERA are summarized in Appendix H7. These results were used as additional lines of evidence in the risk characterization (Section 17.4) and are not further discussed here.

17.2.3 Ecosystem Characterization

Ecosystem characterization includes defining the assessment area(s), describing the types and abundance of different flora and fauna species and their trophic relationships, and describing any abiotic factors that may be important to the assessment (e.g., climate, topography, hydrology, and soil characteristics).

17.2.3.1 Refining the Assessment Areas. To evaluate ecological risks from the WAG activities and summarize the WAG ERAs, it was necessary to define the assessment area as the areas surrounding the WAGs that may be potentially contaminated (Figure 17-2). The Radiological Environmental Science Laboratory (RESL) sampling during the early 1970s through the 1980s indicates possible significant biotic transport in localized areas at the INEEL . These data are summarized in Appendix H4. Most of the sites under study have had remediation actions since that time, and, therefore, the RESL data were not used to delineate assessment areas.

Preliminary assessment areas surrounding the WAGs were determined in 1995 (VanHorn et al. 1995; DOE/ID 1999). These initial assessment areas were established on the basis of gamma spectroscopic flyover analyses and RESL soil sampling results, which provided radionuclide isopleths around several of the WAGs. As a conservative measure, the isopleths were extended by a margin of error to delineate the boundaries of the assessment areas. As discussed in Appendix H5, stack emissions associated with facilities at the INEEL (INTEC, WERF, and others) have potentially contributed to windblown contamination across the INEEL. Other windblown contamination nonpoint sources include various waste, drainage, leaching, or evaporative ponds [e.g., Test Area North (TAN) and the Loss of Fluid Test (LOFT) Facility at WAG 1, and the Test Reactor Area (TRA) at WAG 2], many of which have since been remediated. The Warm Waste Ponds (WWP) at TRA (WAG 2), the Chemical Processing Plant (CPP) percolation ponds (WAG 3), and other process-related ponds at the Power Burst Facility (PBF) (WAG 5) were also identified as windblown contamination sources. Other contamination from nonpoint sources include various waste piles and drainage, leaching, or evaporative ponds, which were

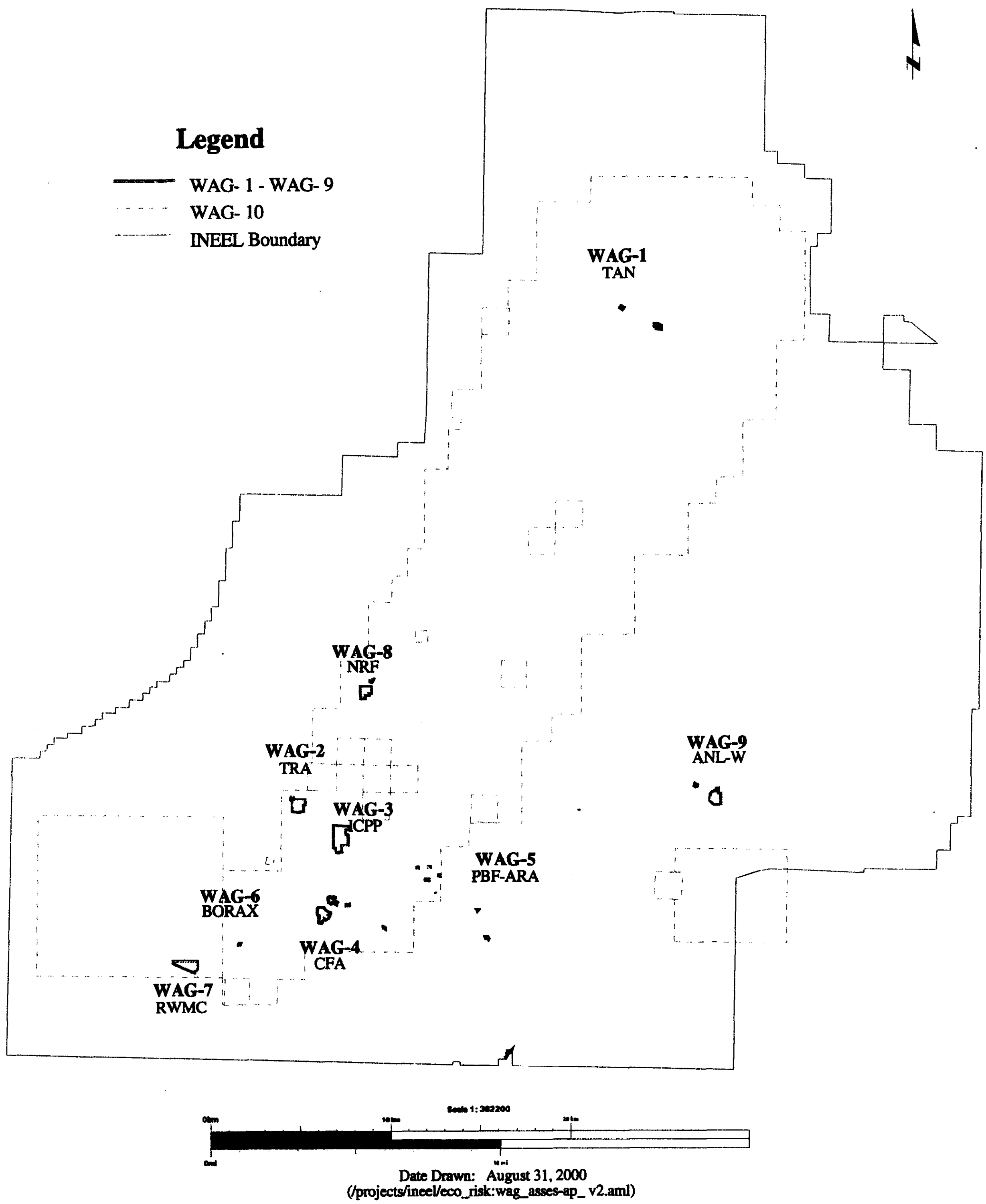

Figure 17-2. Delineation of contaminant spatial extent.

also identified as potential windblown contamination sources. Windblown contamination was considered to be the most likely contributor to increased contamination outside the WAGs. The final determination of the extent of off-WAG contamination was deferred to the OU 10-04 ERA. Both the OU 10-04 ecological sampling and an analysis of windblown dispersion supported this analysis.

17.2.3.1.1 OU 10-04 ERA Sampling—The first OU 10-04 ecological sampling was conducted during the summer of 1997 to evaluate the potential for biotic transport or plume dispersion off WAG 3. This limited sampling effort included five samples of soil and biota each, at onsite (CPP plume region in WAG 3) and offsite (i.e., reference) areas. In 1999, limited onion sampling was performed to evaluate the potential for uptake of ordnance contamination and to support the Native American scenario (see Appendix H3). In 2000, soil and biotic sampling was performed at the BORAX site in support of characterizing OU 10-04 and to evaluate the potential for biotic movement of contamination in the environment (see Appendix H3). The 1997 and 2000 sampling indicates that biotic transport is not a major contributor to transport of contamination (with the possible exception of WAG 7, for which an ERA has not yet been performed).

The OU 10-04 ERA sampling, presented in Appendix H3, indicates that levels of contaminants outside of the WAG boundaries are not significantly elevated for metals and radionuclides (given the limited sampling) compared to the off-site control and INEEL background data sets. Although sampling for organic compounds was not performed, and the number of samples is limited, the results support reduction of the assessment areas to the WAG boundaries.

Air dispersion modeling, which uses existing soil and meteorological data as well as historical information was used to further assess airborne concentrations and resulting ground-surface deposition (fallout) of windblown contamination. This modeling allowed extrapolation of soil concentrations outside the WAG boundaries from sites on the WAG, thus better delineating the assessment areas. As discussed in Appendix H5, the windblown contamination resulting from remediation activities at the Warm Waste Ponds was used to evaluate a worst-case scenario. As summarized in Appendix H5, the results of this evaluation concluded that the extent of windblown contamination is minimal and is limited to the region near and downwind of the Warm Waste Ponds.

The primary purpose of the air modeling was to verify that contamination had not significantly dispersed from the contaminant source. In particular, it was important to verify that radionuclide contamination had not dispersed off the INEEL, and to assess whether metals contamination was likely to be dispersed off the INEEL, since no previous inorganic sampling had been conducted in the areas outside the WAGs.

The Agencies agreed upon a worst-case scenario site and an air modeling approach in 1999 following submittal of a white paper. The Warm Waste Pond (WWP) was selected to represent a worst-case scenario, since historical concentrations of radionuclides and some metals were higher than any other potential windblown source. In addition, it was expected that remediation activities generated the greatest amounts of windblown contamination due to road building and operation of heavy equipment. The initial modeling effort was restricted to the immediate vicinity of the WWP rather than selecting an offsite receptor grid. This approach was also very conservative, since contamination was expected to be higher in the immediate vicinity of the ponds, based on wind patterns and historical data. Three radionuclides, Sr-90, Cs-137, Co-60, and chromium were selected for modeling. Following the initial air modeling, it was agreed that if the results indicated an inconsequential increase in contaminant deposition relative to the INEEL background and the EBSLs, no further modeling would be done.

The detailed results of the ISC3 retrospective air modeling applied to the 1993 remediation effort at the WWP are presented in Appendix H5 and are summarized briefly below.

All modeled concentrations were decay corrected to the year 2000. The highest concentration of Co-60 estimated by the model was 4.5 pCi/g, directly on top of the 1964 cell in 0 to 2 inches of surface soil. This value is orders of magnitude below the INEEL EBSL of 1,180 pCi/g; however, there is no INEEL background value for comparison (Rood et al. 1996). The estimated Co-60 concentrations in the area surrounding the WWP typically ranged from 0.001 to 0.1 pCi/g.

Modeled Cs-137 concentrations ranged from 0.01 to 24 pCi/g, with the maximum value occurring on top of the 1964 cell. The measured concentrations in the vicinity of the remediation area ranged from 0.01 to 0.1 pCi/g. The INEEL 95% UTL background value for Cs-137 is 0.82 pCi/g, whereas the EBSL is 4,950 pCi/g. Although the modeled maximum concentration represents an approximate 25-fold increase over background, the concentrations in the soil surrounding the ponds are below background and indicate that elevated levels of the contaminant do not occur off site. Thus, the model conservatively overpredicts dispersion of Cs-137.

The maximum estimated concentration of Sr-90 was 0.5 pCi/g, directly on top of the 1964 cell. The concentrations in the vicinity ranged from 0.0001 to 0.1 pCi/g. All Sr-90 values were at or below the INEEL 95%/95% UTL background value of 0.49 pCi/g, as well as the EBSL of 3,340 pCi/g.

Of the other inorganics, only chromium was observed to be evaluated for this modeling effort. Historical concentrations of this metal were highly elevated in the pond sediments owing to large discharges of reactor cooling water reportedly containing hexavalent chromium. The historical mean concentration of chromium at the WWP was estimated to be 340 mg/kg, with a maximum concentration in excess of 4,000 mg/kg. It was believed that chromium did not migrate significantly down toward ground water but was tightly bound to the sediments. The modeled maximum concentration of chromium was 1.1 mg/kg in the 1964 cell. Chromium concentrations ranged from 0.001 to 0.1 mg/kg in the surrounding surface soils. The INEEL 95%/95% UTL background value for chromium is 33 mg/kg, and the EBSL value is 1.0 mg/kg. The remaining contaminant concentrations are at the EBSL or well below background. Thus, chromium dispersal does not appear to occur by air transport mechanisms.

Refinement of the assessment areas was warranted for the OU 10-04 ERA, based on results from the WAG ERAs, ecological sampling, and air modeling. It appears that contamination is largely localized at the WAG where it occurs, and significant dispersal has not occurred. Based on these findings, the final assessment areas surrounding the WAGs were reduced to the area within the fences, as shown in Figure 17-2.

In addition to calculating quantitative risk estimates for soil and dietary ingestion at the OU 10-04 level, the need was identified to address potential exposure to ecological receptors by inhalation and ingestion of windblown contamination. Based on the air modeling results, calculating risk values based on inhalation and ingestion of windblown soil contamination was deemed unnecessary.

17.2.4 Supporting Site Investigation and Surveys

The INEEL is a large complex, established over 50 years ago. Concern about the impact of site-related activities on the environment has been reflected in long-term monitoring, research, and analysis of the environment. Although limited in some cases in applicability to the OU 10-04 ERA, these long-term information and research results are considered as potential support to the analysis phase of the ERA. In addition, sampling to support the OU 10-04 ERA was conducted in 1997 and again in 2000. Details of those sampling events are presented in Sections 17.3 and 17.4.

Other existing site investigations and surveys used to support the OU 10-04 ERA include the following.

17.2.4.1 *Breeding-Bird Surveys.* A continental monitoring program for all breeding birds was developed during the 1960s. This program was designed to monitor the abundance and distribution of birds in the both the United States and southern Canada (Belthoff and Ellsworth 1999). Known as the breeding-birds surveys, the surveys were designed to provide a continent-wide perspective of population changes. Observation/survey routes are randomly located in order to sample habitats representative of the entire region (Sauer et al., 1997).

The breeding-birds surveys use a roadside route survey of avifauna. Since 1985, breeding birds and modified mini-routes have been officially surveyed at the INEEL. These surveys have yielded information about the population dynamics and breeding status of a number of bird species of concern. A recent report [*Breeding Bird Surveys at the Idaho National Engineering and Environmental Laboratory* (Belthoff and Ellsworth 1999)] summarized results of the 1999 surveys at the INEEL and briefly compared them to findings from previous years. Appendix H11 is this document. The information is valuable both for comparing population changes in the avian species of concern at the INEEL and for evaluating the patterns of population change in western states (with limitations). Appendix H10 summarizes this analysis.

Bird population trends based on the data gathered from the breeding-birds surveys from 1985 to 1999 are summarized in Table 17-9. Bird populations from the State of Idaho and the nation as a whole from the past 20 years were analyzed in a similar timeframe as surveys conducted at the INEEL from 1985 to 1999. Breeding bird populations at the INEEL for the seven target species and sage grouse have remained constant, except for an increase in the number of mourning doves, and a decrease in sage grouse populations. This is encouraging when compared to the trends found throughout Idaho. Loggerhead shrikes, ferruginous hawks, mourning doves, blue-wing teal, sage grouse, and sage sparrows have all seen declines in their numbers in other parts of Idaho. Only the black-billed magpie and the burrowing owl have seen slight increases in Idaho during this timeframe. The national trends indicate that the loggerhead shrike and mourning dove and sage grouse have experienced population declines over the fifteen-year span, while the ferruginous hawk, burrowing owl, blue-wing teal, sage sparrow, and black-billed magpie have seen increases in their population. A more detailed explanation of the breeding-birds surveys can be found in Appendix H10. Information developed by the surveys contributed to the selection of avian ecological receptors for evaluation in the OU 10-04 ERA (Section 17.2.7).

Table 17-9. Comparison of INEEL breeding-bird populations to the State of Idaho and the United States.

Species Common Name	INEEL Populations	State of Idaho Populations	United States Nationwide Populations
Sage grouse	-	-	-
Loggerhead shrike	*	-	-
Ferruginous hawk	*	-	+
Burrowing owl	*	+	+
Mourning dove	+	-	-
Blue-wing teal	*	-	+
Sage sparrow	*	--	+
Black-billed magpie	*	+	+

* No change or little change in population
\+ Slight to moderate increase in population
\- Slight to moderate decrease in population
-- Significant decrease in population