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Appendix G

Baseline Risk Assessment Details

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Contents

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Terms

ARAR	applicable or relevant and appropriate requiremen
BERA	baseline ecological risk assessment
BRA	baseline risk assessment
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CSM	conceptual site model
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EcoSSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FS	feasibility study
GA	graded approach
HHE	human health and the environment
HHRA	human health risk assessment
HI	hazard index
MTCA	"Model Toxics Control Act" (WAC 173-340)
NCP	"National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300)
NEPA	*National Environmental Policy Act of 1969*
OU	operable unit
PEF	particulate emission factor
PRG	preliminary remediation goal
RAO	remedial action objective
RBSL	risk-based screening level
RCRA	*Resource Conservation and Recovery Act of 1976*
RfC	reference concentration

RfD	reference dose
RI	remedial investigation
ROD	record of decision
RSL	regional screening level
SF	slope factor
SLERA	screening level ecological risk assessment
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VF	volatization factor

G1 Baseline Risk Assessment

The purposes of a baseline risk assessment (BRA) are to assess potential risks associated with residual contamination at a site under baseline conditions (i.e., no further action), identify key radionuclide and chemical contributors to risk, identify key exposure pathways, and determine if there is a need to take an action to reduce risks. "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions" (Clay, 1991) provides clarification of the role of the BRA in developing Superfund remedial alternatives and supporting risk management decisions. This directive states that the BRA is part of the remedial investigation (RI). It further states:

> *...the baseline risk assessment should "characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to air, leaching through soil, remaining in the soil, and bioaccumulating in the food chain" (Section 300.430(d)(4)). The primary purpose of the baseline risk assessment is to provide risk managers with an understanding of the actual and potential risks to human health and the environment posed by the site and any uncertainties associated with the assessment. This information may be useful in determining whether a current or potential threat to human health or the environment exists that warrants remedial action.*

G1.1 Baseline Risk Assessment—General Approach

The following subsections provide brief descriptions of the methodologies that will be used for the human health risk assessments (HHRAs) and ecological risk assessments (ERAs) for the Inner Area. Subsequent sections describe BRA components that are common to the Inner Area operable units (OUs) as well as BRA components specific to the 200-WA-1/200-BC-1 waste sites.

G1.1.1 Human Health Risk Assessment Approach

The HHRA methodology under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) is a four-step process: hazard identification, exposure assessment, toxicity assessment, and risk characterization. In addition, the Washington State Department of Ecology (Ecology) will require application of the risk-based methodology described in WAC 173-340, "Model Toxics Control Act—Cleanup," also known as the MTCA. A brief description of each step is provided:

- In the *hazard identification*, environmental monitoring data are evaluated, contaminants of potential concern (COPCs) are selected for inclusion in the quantitative risk assessment, and the rationale for their selection is documented.

- In the *exposure assessment*, the human population, or groups of individuals potentially exposed to COPCs (i.e., potential human receptors), are characterized. From the many potential pathways of exposure, pathways applicable to potential receptors at the site are identified. The concentrations of COPCs in relevant media (e.g., soil) are converted to intakes, taking into account rates of contact (e.g., ingestion rates) and absorption rates of different COPCs. The magnitude, frequency, and duration of these exposures are then integrated to obtain estimates of daily intakes over a specified period of time (e.g., lifetime or less-than-lifetime).

- In the *toxicity assessment*, the relationship between extent of exposure and potential adverse health effects is estimated for each COPC. Chemical-specific toxicity values (such as cancer slope factors (SFs) for chemical carcinogens and radionuclides, inhalation unit risks for chemical carcinogens, and reference doses (RfDs) or reference concentrations (RfCs) for noncarcinogens, are presented along with a discussion of their scientific basis and derivation. The toxicity assessment will present toxicity values published by the U.S. Environmental Protection Agency (EPA) for the assessment of noncarcinogens and carcinogens for all constituents identified as COPCs in the HHRA for which such values are available. These values and the sources for each will be presented in the BRA. An uncertainty related to toxicity values is that for some COPCs, toxicity values are not readily available. This could result in an underreporting of cumulative risks or noncancer hazards.

- *Risk characterization* integrates the results of the toxicity assessment and the exposure assessment to derive quantitative estimates of human health risk, including the risks of cancer and potential for adverse health effects from noncarcinogens. The major uncertainties and limitations associated with the estimates of risk and their potential effects on the risk results are presented in this subsection. The risk characterization will present cumulative risks for potentially complete exposure pathways for each receptor assessed in the BRA. Cumulative risks will be compared to EPA's target risk range of 10^{-6} to 10^{-4} for carcinogens and the threshold hazard index (HI) of 1.

Human health risks also will be assessed with methods based on procedures described in the MTCA (WAC 173-340), which are derived from EPA's Risk Assessment Guidance for Superfund. Along with the exposure scenarios, which will be evaluated using the methodology based on CERCLA guidance, human health risks for non radionuclide COPCs in soil also will be assessed using Method B (WAC 173-340-740, "Model Toxics Control Act—Cleanup," "Unrestricted Land Use Soil Cleanup Standards") and Method C (WAC 173-340-745, "Model Toxics Control Act—Cleanup," "Soil Cleanup Standards for Industrial Properties"). Cancer risks evaluated using Method B will be compared to a target cancer risk of 10^{-6} for individual COPCs and a target cancer risk of 10^{-5} when multiple COPCs are present at a site. Noncancer effects both for individual and multiple COPCs will be evaluated by comparison with an HI of 1. Cancer risks evaluated using Method C will be compared to a target cancer risk of 10^{-5} and an HI of 1 for both individual and multiple COPCs (WAC 173-340-700(5)(b), "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards").

The HHRAs for the Inner Area will be based on CERCLA guidance, including the following:

- EPA/540/1-89/002, *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A): (Interim Final)*
- OSWER Directive 9285.6-03, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual <u>Supplemental Guidance</u> "Standard Default Exposure Factors" Interim Final*
- EPA/540/R/99/005, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment): Final*
- EPA 600/P-95/002Fa-c, *Exposure Factors Handbook,* Volumes I, II, and III
- EPA, 2011, "Regional Screening Levels for Chemical Contaminants at Superfund Sites"
- EPA, 2010, *Preliminary Remediation Goals for Radionuclides: User's Guide*
- OSWER 9285.6-07P, *Role of Background in the CERCLA Cleanup Program*
- OSWER Directive 9285.6-10, *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*
- EPA/600/R-07-038, *ProUCL Version 4.0 User Guide*

G1.1.1.1 Ecological Risk Assessment Approach

The ERAs will present an assessment of the potential adverse effects to ecological receptors. Evaluation of potential ecological risks will achieve the following objectives:

- Evaluate potential threats to the ecological receptors in the terrestrial environment from releases of hazardous substances (chemicals and radionuclides)
- Establish Hanford Site-specific preliminary remediation goals (PRGs), as appropriate
- Facilitate selection of remedial alternatives with respect to risks to ecological receptors

The ERAs for the Inner Area will be conducted using a tiered approach. The basic approach for the ERAs will be consistent with EPA guidance (EPA/540/R-97-006, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments: Interim Final*; EPA/630/R-95/002F, *Guidelines for Ecological Risk Assessment*; and EPA 540/F-01/014, *The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments*), which is an eight-step process with built in critical management and decision points to allow stakeholder input on the evaluation of interim findings and refinement of the technical approach. The approach will also be consistent with WAC 173-340-7490, "Model Toxics Control Act—Cleanup," "Terrestrial Ecological Evaluation Procedures," and DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.*

The approach will incorporate concepts discussed in the EPA 120/R-07/001, *Framework for Metals Risk Assessment*, and EPA 540/F-01/014. In addition, data from the numerous ecological studies (including biological surveys, environmental sampling programs, and risk assessments that have been conducted at the Hanford Site since the 1970s) will be discussed and incorporated, as appropriate.

The ERAs will include a comparison of radionuclide and chemical concentrations to the risk-based ecological risk-based concentrations that are available at the time the risk assessment is submitted (see Section G.1.1.2.6 for a description of the tiers of ecological risk-based concentrations that will be used in the ERAs). This screening of data against ecological risk-based concentrations is intended to differentiate between analytes that clearly present no risk and those for which existing data are not sufficient to conclude the absence of risk. This information will help both guide future actions that will be used in the feasibility study (FS) process and will help select PRGs from the available ecological risk-based concentrations. The following will be addressed as part of the ecological screening:

- Uncertainties associated with the available ecological risk-based concentrations in soil and exposure characterization data
- Potential impacts from making remedial decisions based on existing ecological risk-based concentrations and available exposure characterization data

Upon completion of the screening level ecological risk assessment (SLERA); Steps 1 and 2 of the EPA's eight-step process for ERA, the need for refining the values and exposure characterization data through collection of additional data is identified. The baseline ecological risk assessment (BERA) and characterization (Step 7) would further evaluate potential ecological risk from contaminants of potential ecological concern (COPECs) identified in the baseline problem formulation (Step 3) including the use of additional Hanford Site-specific data and the development of PRGs as needed (Steps 4 through 6). Risk management recommendations are discussed in Step 8 with input from risk managers.

G1.1.1.2 Protection of Groundwater Evaluation Approach

The assessment of the potential for contaminants to migrate to groundwater will be conducted using a graded approach (GA) that is currently under development and will be further detailed in the RI/FS reports and summarized in the BRAs for the Inner Area. At the current stage of development, the GA for assessment of groundwater protection comprises two tiers. The first tier uses "screening levels" as thresholds for determining if further evaluation of an analyte is warranted for the groundwater protection pathway. The second tier uses PRGs as comparison criteria. Section 3.7 provides the basis for the screening levels and the groundwater protection PRGs. The overall approach will include the following activities:

- Comparison of concentrations of analytes in the vadose zone to background levels and screening levels
- Site-specific evaluation for waste sites that do not meet generic criteria used for screening levels
- Comparison of concentrations of analytes in the vadose zone to groundwater protection PRGs
- Site-specific evaluation, including fate and transport modeling, for waste sites that do not meet generic criteria used for groundwater protection PRGs

Waste sites with analyte concentrations in vadose zone that exceed the groundwater protection PRGs will be carried forward to the FSs for remedial alternatives analysis. The GA and model inputs/outputs will be provided in the RI/FS reports and summarized in the BRAs for the Inner Area.

G1.1.2 Baseline Risk Assessment Components Common to Inner Area Operable Units

The components of the BRAs that are common to each of the Inner Area OUs included in the BRAs are described in the following sections.

G1.1.2.1 Land and Groundwater Use

Current and anticipated future uses for land and groundwater in the Inner Area OUs are discussed in the following sections. Land and groundwater use information is applied as appropriate in conjunction with the identification of potential exposure routes and receptors.

Current and Reasonably Anticipated Future Land Use. As the lead agency for CERCLA cleanup of the Hanford Site and, in accordance with 52 FR 2923, "Executive Order 12580: Superfund Implementation," DOE has exercised its responsibility to determine reasonably anticipated future land use as input to the CERCLA process. Two documents provide the basis for DOE's determination of reasonably anticipated future land use for CERCLA decision making: DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (with corresponding supplemental analysis [DOE/EIS-0222-SA-01, *Supplement Analysis: Hanford Comprehensive Land-Use Plan Environmental Impact Statement*], and the corresponding record of decision (ROD), 64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)."

Key elements of 64 FR 61615 relating to the Central Plateau include the following:

- "The Central Plateau (200 Areas) geographic area will be designated Industrial-Exclusive. An Industrial-Exclusive land-use designation will allow for continued Waste Management operations within the Central Plateau geographic area consistent with past NEPA, CERCLA, and RCRA commitments that have established numerous waste management treatment, storage, and disposal facilities such as, low-level waste burial grounds, hazardous wastes burial grounds, transuranic treatment and storage facilities, liquid wastes treatment, storage and disposal facilities, transuranic separation facilities, isotopic separation facilities, vitrification facilities, etc. This designation will also allow expansion of existing facilities or development of new compatible facilities. Designating the Central Plateau as Industrial-Exclusive will be consistent with the Hanford Future Site Working Group's 1992 recommendations, current DOE management practice, other governments' recommendations, and many public stakeholder values throughout the region."

- "The Industrial-Exclusive land use designation indicates an area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes and related activities."
- Within the Central Plateau Industrial-Exclusive area, DOE has further defined an "Inner Area," of less than a 10 square miles area, which it intends to use solely for waste management and containment of residual contamination.

In accordance with CERCLA requirements, cleanup levels will be established commensurate with the potential future use to ensure protection of potential future users and ecological receptors. Cleanup levels for waste sites within the Inner Area will be established recognizing permanent federal ownership and control, consistent with the reasonably anticipated future industrial land use.

Current and Reasonably Anticipated Future Groundwater Use. Groundwater beneath the Central Plateau is currently contaminated, and administrative controls prevent withdrawal of groundwater for human consumption. Under current site use conditions, no complete human or ecological exposure pathways to groundwater are assumed to exist. Two groundwater wells located in the 200 East Area (Wells 299-E28-11 and 299-E-28-15) are available for industrial purposes to serve as a source of emergency backup cooling water for cesium capsules stored in the Waste Encapsulation Storage Facility near B Plant (DOR/RL-2004-56, *2004 Site Wide Institutional Controls Annual Assessment Report for Hanford CERCLA Response Actions*). Regardless of land use designations, groundwater beneath the Central Plateau is not anticipated to become a future source of drinking water until cleanup criteria are met and groundwater is restored to its highest beneficial use.

G1.1.2.2 Inner Area Human Receptors

Human receptors in the Inner Area are organized to represent the following:

- A resident living in the Inner Area under hypothetical unrestricted land use which is the premise used in the BRA for baseline conditions
- An industrial worker, the construction worker and the trespasser under the reasonably anticipated future land use of industrial
- Tribal member receptors under a hypothetical unrestricted land use are assessed to inform decision makers and stakeholders

The following subsections describe the human receptor populations and exposure scenarios that will be evaluated in the HHRA portion of the BRAs for the Inner Area. These scenarios and their uses in the RI/FS are summarized in Table G-1. The potentially complete exposure pathways associated with these scenarios are summarized in Table G-2. The exposure factors that will be used to estimate potential exposures for these scenarios will be drawn from appropriate guidance, including the EPA guidance documents identified in Section G.1.1.1. These exposure factors will be discussed with the regulatory agencies prior to initiating the HHRA.

Table G-1. Summary of Human Exposure Scenarios

Exposure Scenario	Role in the RI/FS
Residential Scenario	Used to help assess baseline risk. Developed using standard default assumptions in EPA guidance. MTCA Method B standards also will be used to evaluate risks associated with this scenario.
Industrial Worker	Used to calculate PRGs (scenario used in Alternative Evaluation); PRGs for non-radionuclides will be MTCA Method C standards. Includes maintenance and surveillance activities which reflect a reasonably anticipated future land use for the Central Plateau Inner Area.
Trespasser	Used to calculate PRGs for use in alternatives evaluation. Used to inform stakeholders during Proposed Plan development.
Construction Worker	Used to calculate PRGs for use in alternatives evaluation. Used to inform stakeholders during Proposed Plan development. Assumptions also address potential risks to a well driller.
CTUIR Tribal Scenario	Used to inform decision makers during alternatives evaluation; used to inform stakeholders during Proposed Plan development.
Yakama Nation Tribal Scenario	Used to inform decision makers during alternatives evaluation; used to inform stakeholders during Proposed Plan development.

Resident. A residential scenario represents the baseline risk to evaluate the no action alternative in the FSs, in which the future use is assumed to be unrestricted. Inclusion of a residential scenario in a BRA is consistent with EPA and DOE guidance provided in EH-231-014/1292, *Use of Institutional Controls in a CERCLA Baseline Risk Assessment*, and is intended to provide an estimate of the reasonable maximum exposure, or "true" baseline risk, associated with a waste site in the absence of any remedial action or control (institutional or otherwise).

Industrial Worker. Industrial workers represent the human population more likely to be exposed to contaminants in soil within the Central Plateau Inner Area under the current and reasonably anticipated future land use described above. In addition to being evaluated in the HHRA, the industrial worker scenario also will provide the basis for development of PRGs for use in the alternatives analysis. The industrial worker scenario could encompass a range of activities; the depth in soil that this individual comes into contact with contaminants will depend on what activities are performed.

Construction Worker. Authorized construction workers could potentially be exposed to contaminants during construction activities in shallow zone soils within the Inner Area of the Central Plateau. The construction worker exposure scenario assumes that exposure to shallow-zone soil occurs while performing short-term work activities such as trenching or excavation. A special construction activity included in this scenario is well drilling. Well drilling could result in exposure to contaminants in the soil from deeper depths. Separate assumptions for a well driller will not be developed. The construction worker scenario will be used to assess risks to a well driller, using exposure point concentrations from deeper soils as appropriate. The construction worker scenario will be used to inform decision makers during the alternatives analysis, and may be used as appropriate for the development of PRGs.

Table G-2. Potentially Complete Exposure Pathways for Human Exposure Scenarios

Complete Exposure Pathways For Each Medium															
	Direct Contact with Soil					Groundwater (Future Leaching from Soil)[a]			Plant (Garden Produce)[b]	Plant (Wild Plants)	Beef[b]	Milk[b]	Poultry and Eggs[b]	Wild Game	Fish
Exposure Scenario Description	Ingestion	Vapor Inhalation	Dust Inhalation	Dermal Contact	External Exposure	Ingestion	Sweat Lodge, Inhalation[c]	Sweat Lodge, Dermal[c]	Ingestion	Ingestion	Ingestion	Ingestion	Ingestion	Ingestion	Ingestion
Residential Scenario	x	x	x	x (non-rad)	x (rad)				x (rad)		x (rad)	x (rad)	x (rad)		
Unrestricted Use (Residential)—non-rad (MTCA)[d]	x														
Industrial Worker—non-rad (MTCA)[e]	x														
Industrial Worker—rad	x		x		X										
Trespasser	x	x	x	x (non-rad)	x (rad)										
Construction Worker	x	x	x	x (non-rad)	x (rad)										
CTUIR Tribal Scenario	x	x	x	x (non-rad)	x (rad)	x			x (rad)		x (rad)				
Yakama Nation Tribal Scenario	x	x	x	x (non-rad)	x (rad)	x			x (rad)		x (rad)	x (rad)			

Table G-2. Potentially Complete Exposure Pathways for Human Exposure Scenarios

Complete Exposure Pathways For Each Medium															
	Direct Contact with Soil					Groundwater (Future Leaching from Soil)[a]			Plant (Garden Produce)[b]	Plant (Wild Plants)	Beef[b]	Milk[b]	Poultry and Eggs[b]	Wild Game	Fish
Exposure Scenario Description	Ingestion	Vapor Inhalation	Dust Inhalation	Dermal Contact	External Exposure	Ingestion	Sweat Lodge, Inhalation[c]	Sweat Lodge, Dermal[c]	Ingestion	Ingestion	Ingestion	Ingestion	Ingestion	Ingestion	Ingestion

a. For these scenarios, pathways associated with groundwater are assumed to occur as a result of leaching of contaminants from soil to groundwater. Exposure to contaminants through groundwater is assumed to occur at some point in the future, depending on the travel time for contaminants in soil.

b. Exposure to contaminants from ingestion of garden produce, meat, and milk raised in waste sites could occur from uptake of contaminants from soil through the food chain, and from uptake of contaminants in irrigation water applied to soil; it is assumed that contaminants occur in irrigation water through leaching from soil. Exposure through irrigation water is assumed to occur at some point in the future, depending on the travel time for contaminants in soil.

c. Inhalation and dermal exposure pathways associated with use of groundwater in sweat lodges are discussed further in risk assessments conducted for the groundwater operable units (200-PO-1, DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit*; 200-UP-1, DOE/RL-2009-122, *Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit*). The need to evaluate these pathways quantitatively for contaminants that could migrate from soil to groundwater will be addressed further in the Inner Area baseline risk assessments.

d. The Unrestricted Use (residential) - non-rad (MTCA) describes the scenario used to assess risks associated with direct contact with soil in accordance with WAC 173-340-740(3)(b)(iii)(B) "Model Toxics Control Act—Cleanup," "Unrestricted Land Use Soil Cleanup Standards;" in addition, Method B provides for concentrations in soil protective of groundwater as described in WAC 173-340-740(3)(b)(iii)(A).

e. The Industrial Worker - non-rad (MTCA) describes the scenario used to assess risks associated with direct contact with soil in accordance with WAC 173-340-745(5)(b)(iii)(B), "Model Toxics Control Act—Cleanup," "Soil Cleanup Standards for Industrial Properties;" in addition, Method C provides for concentrations in soil protective of groundwater as described in WAC 173-340-745(5)(b)(iii)(A).

x = Pathway is potentially complete for both radionuclides and non-radioactive contaminants and included in quantitative evaluation of human health risks.

x = (non-rad). Pathway is potentially complete for non-radioactive contaminants and included in quantitative evaluation of human health risks.

x = (rad). Pathway is potentially complete for radionuclides and included in quantitative evaluation of human health risks.

A blank cell indicates this pathway is considered to be incomplete.

Trespasser. With this scenario, an individual is assumed to trespass into the Central Plateau Inner Area, and is potentially exposed to contaminated surface soil while engaging in unauthorized off-road activities such as dirt bike riding, mountain biking or hiking. The trespasser scenario will be used to inform decision makers during the alternatives analysis, and will be used as appropriate for the development of PRGs.

Tribal Use Scenarios. Several local and regional Tribes have ancestral ties to the Hanford Reach of the Columbia River and surrounding lands. DOE has requested that each Tribe provide an exposure scenario that reflects their traditional activities. At this time, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) (Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments*; Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*; and Ridolfi, 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*) have provided scenarios. The Tribal scenarios are based on the assumption that a resident lives on a waste site in the future and receives exposure by direct contact with the soil and through garden-raised vegetables, and consumption of meat and milk from livestock raised onsite.

Both the CTUIR and Yakama Nation exposure scenarios include an exposure scenario from consumption of wild game. However, exposure from consumption of wild game is not included in the evaluation of the incremental risk contribution from 200-WA-1/200-BC-1 to the Inner Area West BRA because the waste sites are considered too small to support foraging wild game. The CTUIR and Yakama Nation scenarios also include assumptions to estimate potential exposure from the consumption of fish and sweat lodge use. For purposes of the Inner Area BRAs, both exposure pathways are considered incomplete and are not evaluated.

G1.1.2.3 Potential Ecological Receptor Populations

The vegetation of the Central Plateau uplands is characterized by native shrub-steppe, interspersed with large areas of disturbed ground dominated by annual grasses and forbs (PNNL-13745, *Hanford Site Ecological Quality Profile*). Other disturbed areas of the Central Plateau are primarily nonvegetated gravel or asphalt, or sparsely covered with non-native species. Most Central Plateau waste sites are nonvegetated gravel or asphalt and are treated with herbicide to prevent the uptake of underground contamination by deep-rooting plants. However, some waste sites are sparsely vegetated with non-native annual species, and some have been stabilized and seeded with non-native wheatgrasses.

The disturbed ground habitat of the Central Plateau provides little to no vegetative cover and low diversity of plant species. Overall animal diversity is usually low; however, transplanted trees associated with ponds and ditches, and structures and fences associated with buildings, attract bird species that are less common in other habitat types (e.g., Say's phoebe [*Sayornis saya*], western kingbird [*Tyranus verticalis*], and hawks) (DOE/RL-2002-69, *Feasibility Study for the 200-CW-1 and 200-CW-3 Operable Units and the 200 North Area Waste Sites*). Mammals associated with these buildings and facilities include cottontails, house mice (*Mus musculus*), Norway rats (*Rattus norvegicus*), and various bat species (DOE/RL-2001-54, *Central Plateau Ecological Evaluation*).

Figure G-1 presents the food web model for the Central Plateau in the habitat described above and based upon previous investigations as documented in previous reports for the Central Plateau (DOE/RL-2007-50, *Central Plateau Ecological Risk Assessment Data Package Report*).The figure portrays the feeding guilds found in the Central Plateau and the specific receptors that will be used to represent potential exposure to all members of those feeding guilds. Many of these receptors are the same as those that have been described previously for the Central Plateau (DOE/RL-2007-50). The representative receptor species selected for the following trophic guilds are:

- Herbivorous birds—California quail (*Callipepla californica*)
- Herbivorous mammals—Great Basin pocket mouse (*Perognathus parvus*)
- Insectivorous birds—killdeer (*Charadrius vociferus*)
- Insectivorous mammals—northern grasshopper mouse (*Onychomys leucogaster*)
- Omnivorous birds—western meadowlark (*Sturnella neglecta*)
- Omnivorous mammals—deer mouse (*Peromyscus maniculatus*)
- Carnivorous birds (raptors)—red tailed hawk (*Buteo jamaicensis*)
- Carnivorous mammals—badger (*Taxidea taxus*)

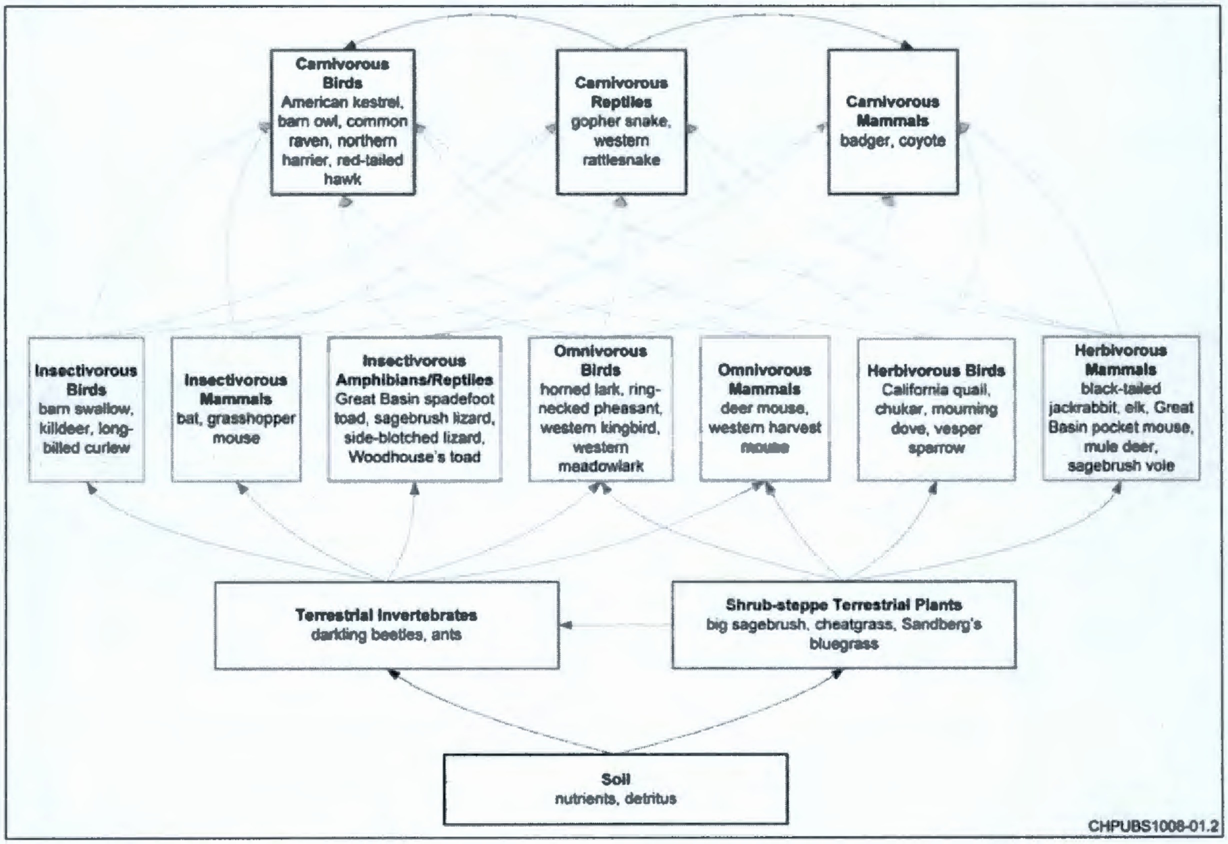
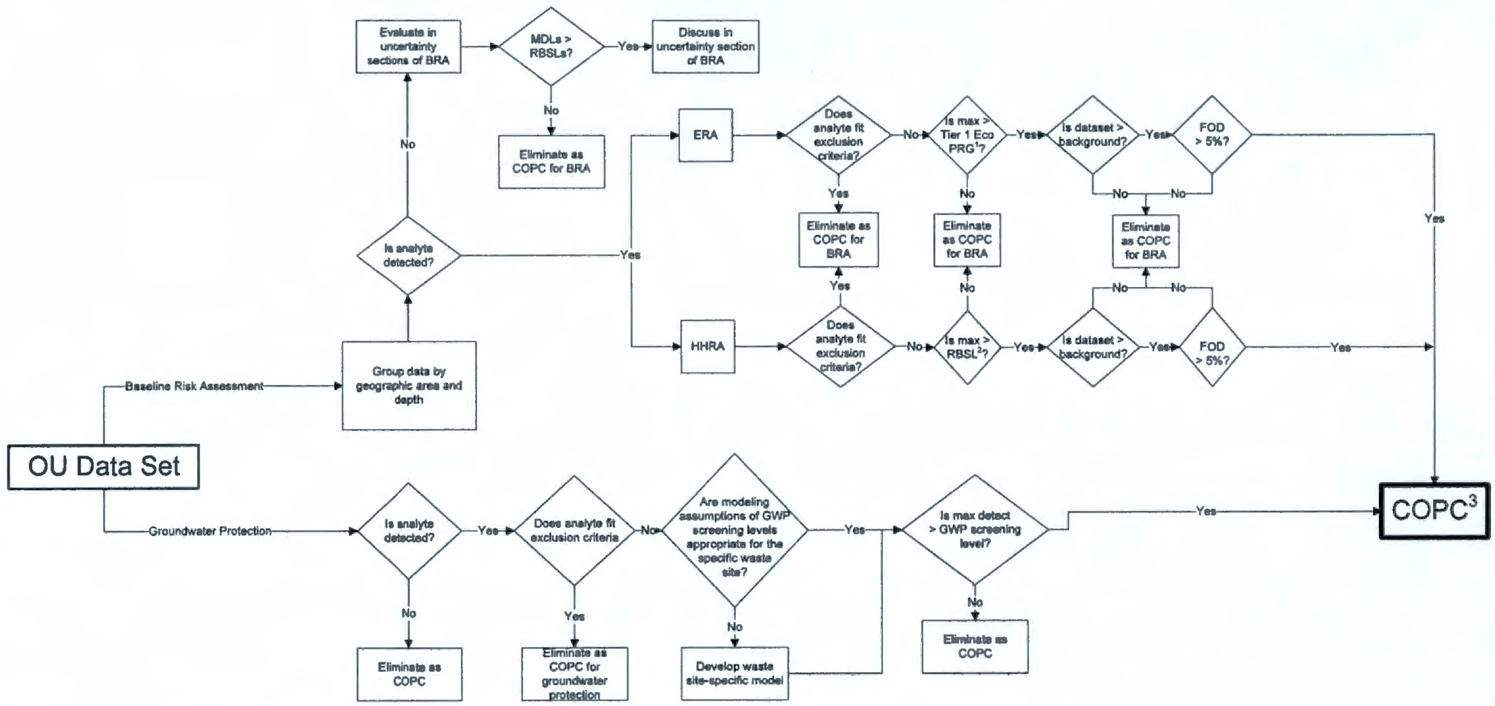


Figure G-1. Inner Area Terrestrial Food Web

G1.1.2.4 Identification of Contaminants of Potential Concern

This section presents a summary of the process that will be used in the Inner Area RI/FS and BRA reports to identify COPCs. This term, COPC, is typically used to describe those contaminants present or potentially present at a site at concentrations that may potentially pose risk to human health or the environment. For the Inner Area, the term COPC is used to describe a list of contaminants that will be used for various evaluations in the RI/FS and BRA reports. The COPCs are identified by a comparison of the analytical data against appropriate screening levels, as well as other steps that are used to identify analytes that are potentially related to Hanford practices/processes. Figure G-2 presents a highly generalized process for identification of COPCs for both the HHRAs and ERAs.



Acronyms:

BRA	= baseline risk assessment
COPC	= contaminant of potential concern
CSM	= conceptual site model
ERA	= ecological risk assessment
FOD	= frequency of detection
GWP	= groundwater protection
HHRA	= human health risk assessment
MDL	= method detection level
OU	= Operable Unit
RBSL	= risk-based screening level
RCRA	= Resource Conservation and Recovery Act
RI	= remedial investigation
TSD	= treatment storage and disposal

Notes:

1) Tier 1 Eco PRGs are Washington Department of Ecology and EPA screening values.
2) RBSLs are EPA residential Screening Levels.
3) Additional COPCs may be added based upon review of process knowledge, CSMs, or RCRA TSD lists.

Figure G-2. Contaminant of Potential Concern Identification

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The general steps for identifying COPCs are as follows:

- Available analytical data, process or historical information will be reviewed to identify the range of contaminants potentially present in the Inner Area OU being evaluated.
- The preliminary list of contaminants will be compared with lists of contaminants maintained by regulatory agencies to determine if they should be carried further into the process of identifying COPCs. These lists include the list of contaminants for which EPA has developed Regional Screening Levels (RSLs) (EPA, 2011) or radionuclide PRGs (EPA, 2010), or for which Ecology has developed cleanup levels under MTCA, in its Cleanup Levels and Risk Calculations (CLARC) database (Ecology, 2010). A contaminant that does not fall on one of these lists has no toxicity values available for it, and is not carried quantitatively into the risk assessment. Contaminants found on these agency lists will be further evaluated in the COPC identification process. Analytical data that are available will be reviewed to determine if this contaminant has been detected; contaminants that have never been detected will be retained for development of PRGs; these will be discussed as uncertainties in the risk assessment, and will be retained for future use in the remedial response process as appropriate, but will not be carried through the risk assessment and RI/FS processes.
- Contaminants that have been detected will be further screened to identify COPCs. Contaminants that meet the following exclusion criteria may not be carried into the risk assessment:
  - Essential nutrients (e.g., calcium, magnesium, potassium, and sodium) that are not elevated above background or are not associated with the waste at a waste site
  - Radionuclides that are associated with background conditions and not associated with waste site activities (e.g., potassium-40, radium- 224, radium-226, radium-228, thorium-228, thorium-230, and thorium-232)
  - Radionuclides with half-lives less than 3 years and, upon decay, they produce no significant daughter products
- Maximum detected concentrations of analytes that are not excluded using the criteria described above will be compared with risk-based screening levels (RBSLs). Description of RBSLs for human health risks, ecological risks, and groundwater protection are described in the following subsection. Contaminants with maximum concentrations less than all RBSLs may not be carried into the risk assessment.
- The maximum detected concentrations for each detected analyte are compared against background vadose zone concentrations consistent with EPA (EPA/600/R-07/038) and Ecology guidance documents (WAC 173-340-709, "Model Toxics Control Act—Cleanup," "Methods for Defining Background Concentrations"). Further discussion of available background data and background comparison methods is presented in the following subsection. Contaminants with maximum concentrations less than background concentrations may not be carried into the risk assessment.
- For contaminants that are not detected in a medium, the maximum detection limit will be compared with the RBSLs; if the maximum detection limit is less than RBSLs, that contaminant may not be carried into the risk assessment.

Contaminants that are carried into the risk assessment will be evaluated further, as discussed in the following subsection.

Evaluation of Background Concentrations in Soil. Background concentration data in soil are available for a variety of analytes (both radionuclide and nonradionuclide) and are contained in the following reports:

- DOE/RL 92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*
- DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides*
- DOE/RL-95-55, *Hanford Site Background: Evaluation of Existing Soil Radionuclide Data*

For most analytes, background values were selected from a Hanford Site-specific background data set. Where Hanford Site-specific background data are not available for a constituent, Washington State average values (either Yakima basin or state-wide) are used. WAC 173-340-709 indicates that chemical soil background shall be defined as, "for lognormally distributed data, … the true upper 90th percentile or four times the true 50th percentile, whichever is lower." Consistent with the regulation for assigning background values for chemical analytes, the 90th percentile value is also used for radionuclides for the background comparison step in the COPC identification process.

Contaminants that are retained as COPCs based on the process outlined above may be further evaluated using a background statistical test. A background statistical test may be appropriate if the waste site data set contains at least eight samples, or a background threshold value as described in EPA/600/R-07/038, *ProUCL Version 4.00.05 User Guide (Draft)*, if the waste site data set contains less than eight samples. The hypothesis test will be evaluated in accordance with EPA guidance (OSWER Directive 9285.6-07P; EPA 540-R-01-003, *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*). If the results of the statistical test indicate that an analyte represents background conditions, this analyte may be eliminated as a COPC. For the background threshold test, maximum detected concentrations at a waste site are compared to a background threshold value (90th percentile background value). If the maximum detected concentration is less than the background threshold value, the analyte may be eliminated as a COPC.

G1.1.2.5 Evaluation of Human Health Risks

The HHRA will be based on COPCs identified as described above. RBSLs that will be used in that COPC identification process for the HHRA will include radionuclide PRGs for a residential scenario provided by EPA RSLs (EPA, 2011) for chemical contaminants (EPA, 2010), and Method B Standards, also for chemical contaminants.[1]

Potential exposures through the potentially complete exposure pathways will be estimated using the following methods, which will be consistent with EPA guidelines (Risk Assessment Guidance for Superfund), and other regulatory guidance as appropriate:

- Direct contact exposures, including soil ingestion and dermal (skin) contact with soil, will be estimated using exposure factors that describe the amounts of soil an individual may come into contact with.
- External exposure to radionuclides in soil will be estimated based on the frequency and duration of time spent over the contaminated area. For residential scenarios which include a portion of time indoors, a gamma shielding factor will be used to account for the reduction in external exposure while indoors.
- Estimating inhalation exposures from contaminants in soil first require calculation of the corresponding concentration in air using either a particulate emission factor (PEF) for nonvolatile

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[1] Noncarcinogens will be compared to the RSLs or Method B standards divided by 10, representing a hazard quotient of 0.1.

contaminants or volatilization factor (VF) for volatile contaminants. Modeling is performed to calculate PEFs and VFs. The concentration in air is then combined with exposure factors (inhalation rate, exposure time, and frequency and duration of exposure) to calculate inhalation exposures.

- Those scenarios involving ingestion of produce or ingestion of meat and milk first involve estimating concentrations in biota (i.e., fruits, vegetables, meat, or milk) from concentrations in soil using bioaccumulation factors. The concentrations in biota are then combined with exposure factors, specifically ingestion rates for produce, meat, and milk, to calculate exposures through food ingestion pathways.

These estimated exposures will then be combined with toxicity values developed by EPA. Estimated exposures to carcinogenic COPCs will be multiplied by cancer SFs to calculate lifetime cancer risks. Estimated exposures to noncarcinogenic COPCs will be divided by RfDs or RfCs to calculate noncancer hazard quotients and HIs. Toxicity values will be selected based on the recommended hierarchy described in *Human Health Toxicity Values in Superfund Risk Assessments* (Cook, 2003). Cancer SFs for radionuclides will be obtained from EPA 540-R-97-036, *Health Effects Assessment Summary Tables: FY 1997 Update*).

G1.1.2.6 Evaluation of Ecological Risk

The ERA will be based on COPCs identified as described above. RBSLs that will be used in that COPC identification process for the ERA will include Generic Screening Levels provided in CHPRC-00784, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site.*

Ecological risks would be evaluated for sites for which sampling and analytical data are currently available. Sites where the information available includes radiological survey data, historical information, or inventory information, but may be lacking sampling and analytical data, will be evaluated qualitatively; for example, the potential for ecological exposure will be evaluated taking into consideration the potential for complete exposure pathways or the proximity of ecological receptors.

A tiered framework has been devised to develop ecological PRGs that will be applied to upland environments across the Hanford Site (CHPRC-00784). This tiered framework describes a general process for progression to increasingly more biologically realistic and site-specific ecological values for use as PRGs in ERAs and RI/FSs. Higher tiers reflect increasing complexity and greater investment of time and resources. Higher tiers also reflect more refined characterization of ecological risks, which may be important in cleanup decision making. Central to the concept of a systematic, informed progression is an iterative process (i.e., cycles) of decision making involving evaluation of existing information, deliberation, data collection, and communication. All of these steps should be focused on the following decisions:

- Whether or not the ecological risk-based concentrations at the current tier are sufficient to be used as an ecological PRG and support cleanup decision making (a process for exiting the tiered approach is available at each tier)
- If the information available at the current tier is determined to be insufficient for use in developing an ecological PRG, whether or not progression to a higher tier of refinement would sufficiently reduce uncertainties to warrant the additional effort

These tiers are described as follows:

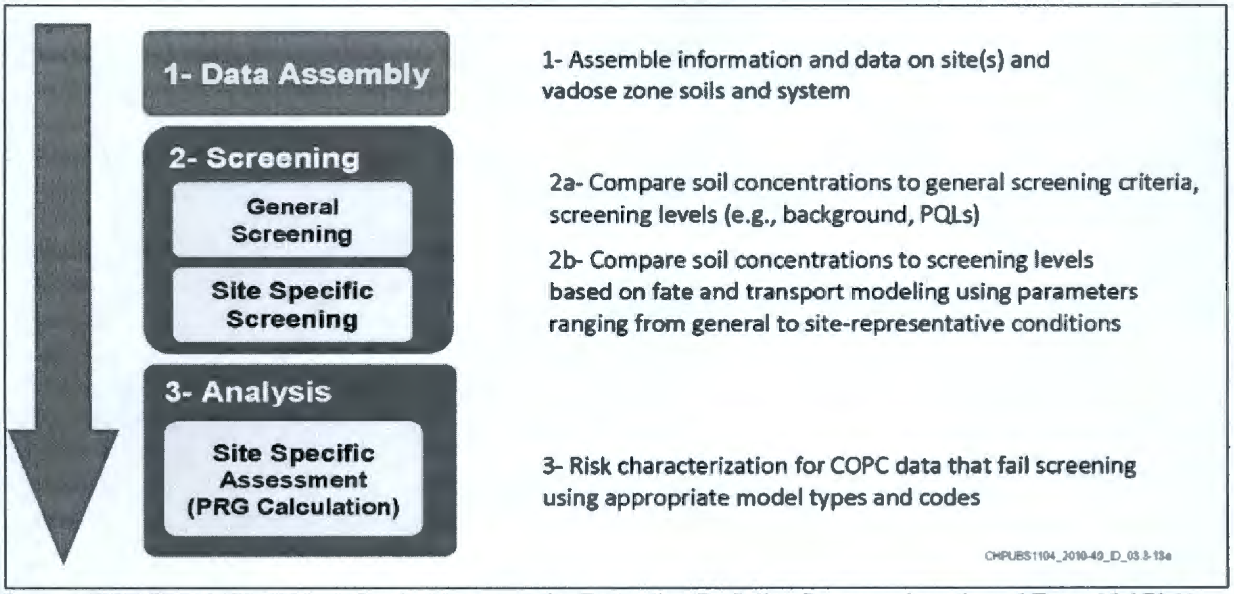
- **Generic Screening Levels**—Generic Screening Levels for plants, soil invertebrates, birds, and mammals are obtained from existing published and accepted sources: EPA (ecological soil screening levels [EcoSSLs]), Ecology (Ecological Indicator Soil Concentrations), Oak Ridge National Laboratory (screening level benchmarks), and DOE (Biota Concentration Guides). Generic Screening Levels are not specific to the Hanford Site; rather, they represent conservative, literature-based screening values. Because of their inherent conservatism, Generic Screening Levels are intended to differentiate between contaminants that clearly present no risk and those for which additional evaluation may be warranted.

- **Tier 1 Values**—Tier 1 ecological risk-based concentration values are developed to reflect Hanford-specific conditions using information obtained from the literature. The Tier 1 values are calculated for bird and mammal species found at the Hanford Site. Exposure factors, such as food and soil ingestion rates, were derived for Hanford-specific wildlife from a review of the literature. Concentrations in food items were calculated with bioaccumulation models drawn primarily from EPA EcoSSL guidance.
- **Tier 2 Values**—Tier 2 values are calculated for the same bird and mammal species found at the Hanford Site and used to develop Tier 1 values. They incorporate additional Hanford Site-specific information; in particular, bioaccumulation models based food chains present at the Hanford Site (e.g., arthropods in soil). In addition, these bioaccumulation models incorporate soil and tissue data collected from the site.
- **Tier 3 Values**—Tier 3 values represent waste site-specific or location-specific PRGs, based on data (e.g., bioaccumulation sampling, bioassays, and exposure factors) collected for specific locations at the Hanford Site. Development of Tier 3 values would involve development of separate SAPs and field sampling plans to support data collection. Tier 3 values would be the most refined and would be developed on an as needed basis to address specific receptor contaminant issues for which existing data are inadequate to reduce uncertainty about ecological risks. There are no plans for development of Tier 3 values for use as ecological PRGs or additional data collection for the 200-WA-1/200-BC-1 waste sites for use in developing Tier 3 values.

G1.1.2.7 Evaluation of Groundwater Protection

For each waste site that has available analytical data, an evaluation of groundwater protection will be conducted on a waste site-basis by comparing all detected analytes from all depths within the vadose zone (following reduction based on comparison with exclusion criteria as described above) to background soil concentrations and screening levels.

Graded Approach for the Determination and Use of Soil Levels Protective of Groundwater. The GA for determination and use of soil levels protective of groundwater is based on the framework in DOE-STD-1153-2002 for the general use of the GA for risk-based applications. Figure G-3 summarizes the GA adapted for groundwater protection applications for the Hanford Site (DOE-STD-1153-2002). The Hanford Site GA for the determination and use of soil levels protective of groundwater involves the following three main steps as shown in Figure G-3.



Source: DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.*

Figure G-3. Adaptation of the DOE Graded Approach for Risk Assessment Applications to Groundwater Protection at the Hanford Site

The following is a summary of the three steps in this GA.

Step 1—Data Assembly. The data assembly step involves the compilation and assembly of information and data on the system of interest that are needed for screening and, if necessary, site-specific analysis or assessments. These data and information include soil concentration measurements to be compared to screening or protection levels, as well as all available information that contribute to the conceptual site model (CSM).

Step 2—Screening. The second step in the GA involves a process of step-wise General Screening, followed by a tiered process of Site Specific Screening, as needed, to identify COPCs and/or sites that warrant no further assessment. The General Screening step involves the use of criteria, methods, and models ranging from existing information (e.g., background) to generic (conservative) soil screening levels based on analytical methods and/or simplified numerical models. Site-Specific Screening involves the development of a CSM to support the calculation of screening levels using simplified to detailed site-specific information and easily obtained site-specific parameters. The specificity in the screening levels can range from area-wide to waste site-specific, with conservatism in the levels reduced as the screening model and parameters become more representative of site conditions.

Step 3—Site Specific Analysis: Risk Characterization. The third step in the GA process, which includes the determination of PRGs, involves a single characterization of the risk as a final product of the risk assessment (EPA 100-B-00-002, *Risk Characterization Handbook*). This characterization is intended to be the most comprehensive and representative evaluation practically achievable for the system of interest. The level of rigor in the determination of PRGs and/or evaluation of risk associated with risk characterization is greater than that for screening. Risk characterization involves more comprehensive requirements to meet the associated technical and scientific expectations (EPA 100-B-00-002).

Implementation of the steps in the GA for groundwater protection is described in DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection.*

A future document will provide details for the modeling assumptions, implementation, and results for every step of the GA.

G1.1.3 Baseline Risk Assessment Inputs

In addition to defining the elements of the BRA described above there will be specific inputs to the BRA for each of the OUs in the Inner Area. OU specific input information includes: preliminary CSMs, and information on the nature and extent of known contamination. The following sections identify the inputs that are specific for the 200-WA-1/200-BC-1 waste sites. Input specific information for the other OUs will be defined in their respective work plans.

G1.1.4 Specific Baseline Risk Assessment Inputs for 200-WA-1/200-BC-1 Waste Sites

Specific inputs to be used for the BRAs for the 200-WA-1/200-BC-1 waste sites within the Inner Area are discussed in the following sections.

G1.1.4.1 Preliminary Conceptual Exposure Model

The preliminary conceptual exposure model for the 200-WA-1/200-BC-1 waste sites that will support the Inner Area BRAs is based on information pertaining to contaminant sources, release mechanisms, transport media, exposure routes, and receptors. Assumptions concerning potential receptors are based on current and reasonably anticipated future land use.

Contaminant Sources. As described in Section 3.1 from the main text of this work plan, the sources of contamination for the 200-WA-1/200-BC-1 waste sites are primarily the liquid and solid wastes associated with the process areas in the Inner Area West. Waste streams associated with the five geographical areas in Inner Area West are described in Section 2.2 from the main text of this work plan.

Exposure Pathways for Human Receptors. An exposure pathway describes a mechanism by which a population or individual may be exposed to chemicals present at a site. A completed exposure pathway requires the following four components:

- Source and mechanism of chemical release to the environment
- Environmental transport medium for the released chemical
- Point of potential human contact with the contaminated medium
- Human exposure route at the point of exposure

All four components must exist for an exposure pathway to be complete and for exposure to occur. Incomplete exposure pathways do not result in actual human exposure and are not included in the exposure assessment and resulting risk characterization. The human receptors presented in Table G-1 were identified for evaluation in the BRA in a manner consistent with EPA guidance for conducting HHRAs under CERCLA. Table G-2 provides more details related to the potentially complete exposure pathways for 200-WA-1/200-BC-1.

Exposure Pathways for Ecological Receptors. With consideration of the ecological setting, land use, and COPEC release mechanisms for the 200-WA-1/200-BC-1 waste sites within the Inner Area, incidental soil ingestion and ingestion of contaminated food items are the predominant exposure pathways for terrestrial receptors for the Inner Area. All other exposure pathways were considered incomplete or insignificant. Figure G-4 displays the ecological exposure pathways considered most plausible for the Inner Area. These pathways include:

- Potential current and future direct contact of vegetation with constituents in surface soil as defined by the standard point of compliance in MTCA (WAC 173-340)

- Potential current or future direct contact with, or ingestion of, surface soil by terrestrial invertebrates (e.g., beetles and ants)
- Uptake by plants and soil biota
- Direct contact with, or ingestion of, surface soil by terrestrial avian and mammalian wildlife that may use the Inner Area
- Dietary exposure to COPECs bioaccumulated in food items (e.g., plants or prey) and subsequently consumed by terrestrial avian and mammalian wildlife that may forage within the Inner Area
- Exposure to emissions from radionuclides bioaccumulated and retained within the tissues of plants, terrestrial invertebrates, and terrestrial wildlife resident in the Inner Area
- External exposure of plants, terrestrial invertebrates, and terrestrial wildlife resident in the Inner Area to radiation from radionuclides in soil

The media of concern with respect to the evaluation of ecological receptors is soil. The SLERA for the 200-WA-1/200-BC-1 waste sites will identify the depth in soil to which potentially complete exposure pathways could be present to terrestrial plants and animals. The SLERA will also identify the depth of the biologically active zone for these waste sites. In general, the biologically active zone within the Central Plateau is 3.05 m (10 ft) or shallower (CHPRC-00651, *Evaluation of Biointrusion at the Hanford Site for Protection of Ecological Receptors*). This information will be used in the FS to identify a point of compliance for protection of ecological receptors in accordance with WAC 173-340-7490(4)(a). This code allows for a conditional point of compliance that is set at the depth of the biologically active soil zone. A conditional point of compliance with institutional controls may be used at a site to prevent excavation of deeper soil. The point of compliance is one of the criteria for determining when a site requires no further evaluation under the terrestrial ecological evaluation procedure. Under WAC 173-340-7491(1)(a), "Model Toxics Control Act—Cleanup," "Exclusions from a Terrestrial Ecological Evaluation," no further action is required if all soil contaminated with hazardous substances is, or will be, located below the point of compliance established under WAC 173-340-7490(4).

G1.1.4.2 Data Inputs to 200-WA-1/200-BC-1 BRA

For the BRA for the 200-WA-1/200-BC-1 waste sites, the waste sites will be grouped by geographical area, and each geographical area will be considered an exposure area for the risk assessment calculations. An exposure area is the portion of a site where receptors may come into contact with potentially affected media through their daily activities. Because the wastes sites within a geographical area are located in the same vicinity and waste streams are similar within the geographical plant areas, the assumption was made that these are reasonable exposure areas for the future industrial land use of the 200-WA-1/200-BC-1 OU. The five geographical areas are as follows:

- T Plant and vicinity
- Plutonium Finishing Plant and vicinity
- U Plant and vicinity
- S Plant (Reduction-Oxidation Plant) and vicinity
- 200-BC Cribs and Trenches

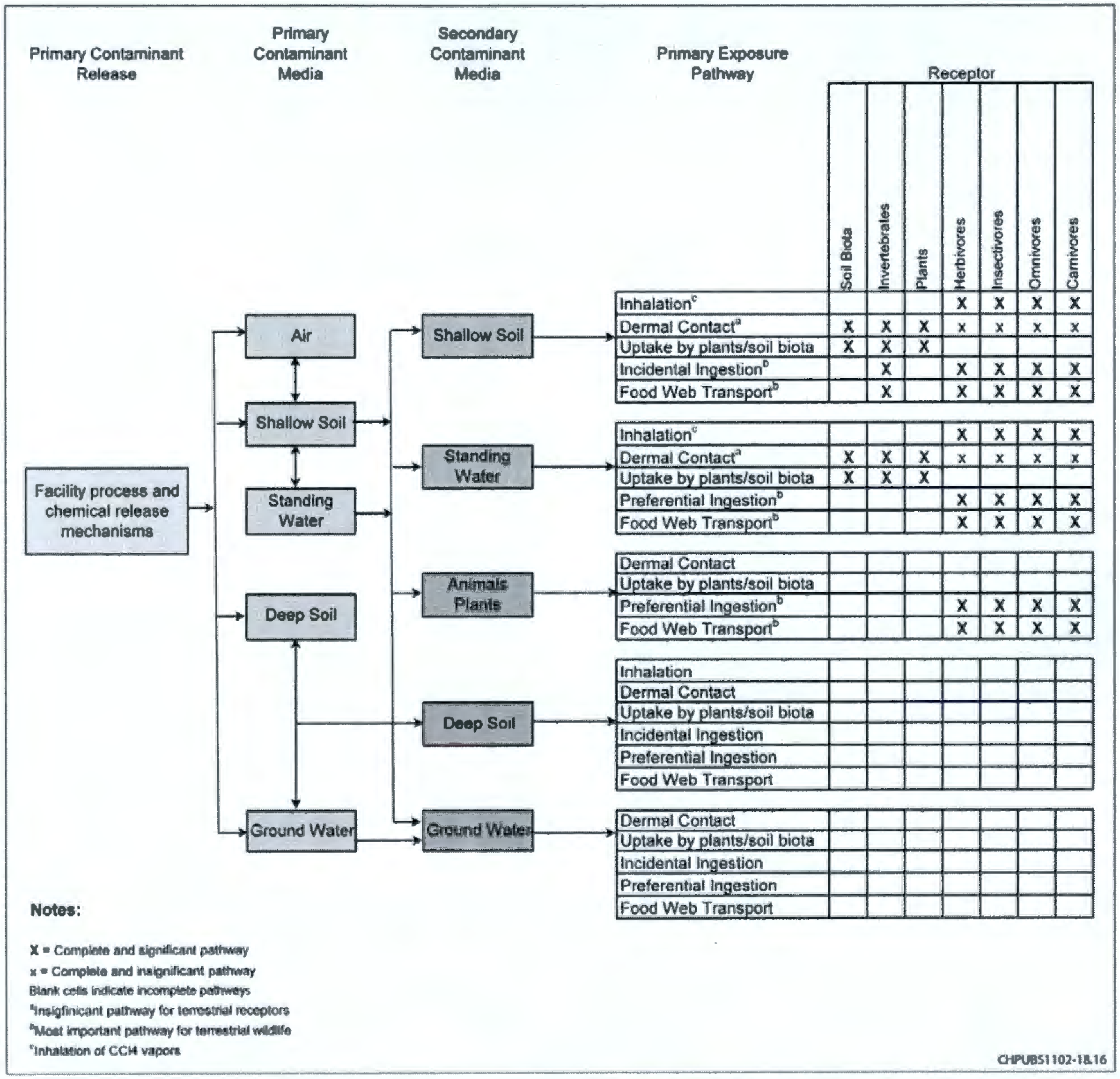


Figure G-4. Conceptual Ecological Exposure Model for Upland Habitats in the Central Plateau

COPCs will be identified for each geographical area using analytical data that are available from 38 waste sites. The waste sites that have available analytical data are listed in Table B-6 (Appendix B). For waste sites that do not have analytical data, the BRA will provide an estimate of potential risks based on analogous waste sites with analytical data that are located within the same geographical area.

G1.2 Preliminary Remediation Goals

The PRGs are radionuclide-specific or chemical-specific concentration goals for specific media and anticipated future use of land. The PRGs serve as a target to use during the initial development, analysis, and selection of cleanup alternatives. These goals should be protective of human health and the environment (HHE) and comply with applicable or relevant and appropriate requirements (ARARs) for all exposure pathways being addressed.

Initial risk-based PRGs will be developed for use in the ERA portions of the BRA and the FS. These PRGs may be later modified during development of the FS and based on results of the BRA. The BRA clarifies exposure pathways and may identify situations where cumulative risk of multiple contaminants or multiple exposure pathways indicate the need for more or less stringent cleanup levels than those initially developed as PRGs. In addition to being modified (based on the BRA), cleanup levels may also be modified based on the given waste management strategy selected at the time of remedy selection, that is, based on the balancing of the nine criteria used for remedy selection (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," henceforth referred to as the NCP). The FS will develop and evaluate a range of alternatives, including No Action. In order for all alternatives to be considered viable, they must demonstrate they are protective of HHE and be compliant with ARARs.

G1.2.1 Human Health PRGs

PRGs for protection of human health will be developed using the exposure scenarios that reflect the reasonably anticipated future land use in the Central Plateau Inner Area. These will be the Industrial Worker, Trespasser, and Construction Worker scenarios. These PRGs for radionuclides and carcinogenic non-radioactive contaminants will be based on EPA target cancer risk range of 1×10^{-6} to 1×10^{-4}. PRGs for noncarcinogenic contaminants will be based on a noncancer HI of 1. In addition to these scenarios, Method C standards will be identified for use as PRGs. As discussed previously, Method C standards are based on a target cancer risk level of 1×10^{-5} for carcinogenic contaminants and a noncancer HI of 1 for noncarcinogenic contaminants.

G1.2.2 Ecological PRGs

A tiered framework has been devised to develop ecological PRGs that will be applied to upland environments across the Hanford Site (CHPRC-00784). This tiered framework describes a general process for progression to increasingly more biologically realistic and site specific ecological values for use as PRGs in RI/FSs. Selection of the specific values for ecological PRGs will be take into consideration the results and the uncertainties in the ERA.

G1.3 Preliminary Remedial Action Objectives

Section 300.430(e)(2)(i) of the NCP (40 CFR 300) specifies that remedial action objectives (RAOs) be developed specifying contaminants and media of concern, potential exposure pathways, and remediation goals. For the purposes of assessing data adequacy, this section includes an initial identification of RAOs. The RAOs will be refined as needed, based on the BRA, and used during the detailed analysis of alternatives conducted in the FS. The RAOs will be finalized and documented in the ROD.

The RAOs are preliminary descriptions of what the remedial action is expected to accomplish. The following RAOs are also used to evaluate the various remedial alternatives and long-term protectiveness:

- **RAO-1**—Prevent or mitigate unacceptable risk to human health and ecological receptors associated with radiological exposure to waste or soil contaminated above risk-based criteria.
- **RAO-2**—Prevent or mitigate unacceptable risk to human and ecological receptors associated with chemical exposure to waste or soil contaminated above risk-based criteria.
- **RAO-3**—Control the sources of potential groundwater contamination to support the Central Plateau groundwater goal of restoring and protecting the beneficial uses of groundwater.

G1.4 Documenting Baseline Risks for 200 West and 200 East Areas of the Inner Area

The previous sections define methodology and inputs for conducting the BRAs for the Inner Area OUs. The results of the BRAs will be documented in two reports: the BRA for the 200 West Inner Area, and the BRA for the 200 East Inner Area. The two reports will document the risks associated with the waste sites in the 200 West and 200 East Areas of the Inner Area, provide documentation of the need for taking cleanup actions and provide a comparative basis to risks across the waste sites. The BRAs for the Inner Area will address both human health and ecological risk for each of the OUs within the respective areas. In addition, a summary discussion of potential threats to groundwater will be included in the Inner Area BRAs. The groundwater OUs will each have their own BRAs that are independent of the Inner Area BRAs.

Table G-3 identifies the OU inputs that will be included in the West Inner Area and East Inner Area BRAs. Pipeline systems and associated UPR waste sites within these OUs will be included in the BRAs. These two documents will be published as stand-alone reports that will support the development of the RI reports for the OUs in each geographic area.

Table G-3. Operable Units Addressed in the West and East Inner Area Baseline Risk Assessments

West Inner Area	East Inner Area
200 WA-1/200-BC-1 OU	200-EA-1 OU/200-IS-1 OU
200-CR-1 OU (Reduction-Oxidation Plant)	200-CB-1 OU and 200-CP-1 OU (B Plant and Plutonium Uranium Extraction Plant)
200-SW-2 OU (west landfills only)	200-SW-2 OU (east landfills only)
200-DV-1 OU (west area waste sites only)	200-DV-1 OU (east area waste sites only)

G2 References

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