APPENDIX P
ECOLOGICAL RESOURCES AND RISK ANALYSIS

This appendix presents the ecological resources (see Section P.1) at the Hanford Site and lists the plants and animals evaluated in this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*. Potential impacts of both airborne releases during operations and groundwater discharges under the various alternatives are evaluated in this appendix. The purpose of the risk analysis is to compare alternatives quantitatively. The modeling and risk methods used to evaluate ecological impacts of the proposed alternatives on terrestrial resources are presented in Section P.2; on aquatic resources, in Section P.3.

Although impacts on ecological resources of air and groundwater releases are considered long-term impacts for the purposes of this environmental impact statement, some would occur in the near future after completion of waste management operations. Short-term impacts on ecological resources are evaluated in Chapter 4. Air emissions and their subsequent deposition on soils would be possible under all action alternatives, as well as the Tank Closure No Action Alternative. Immediately following operations, cumulative soil concentrations of radionuclides and chemicals would be at their maximum levels after accumulating during operations and then attenuating following completion of operations. Thus, the projected impacts represent conservative estimates of the impacts of exposure to contaminated soils in the more distant future. Potential adverse impacts on Columbia River aquatic and riparian resources would be more likely to occur in the more distant future after waste management operations have been terminated and chemical and radioactive constituents have migrated through the groundwater to the Columbia River.

P.1 ECOLOGICAL RESOURCES

The ecological resources at the Hanford Site (Hanford) and Idaho National Laboratory (INL) are described in detail in Chapter 3. The scientific names of plant and animal species cited in Chapter 3 and throughout this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* are listed in Table P–1. Species are grouped by common name and are listed in alphabetical order. Although 48 plant communities and land use areas exist on Hanford, they may be grouped into six basic types, with sagebrush-dominated shrublands being the most extensive (see Chapter 3, Figure 3–15). Pristine shrub-steppe habitat is considered a priority habitat by the Washington State Department of Ecology because of its relative scarcity in the state and because it is home to a number of sensitive species. A total of 727 vascular plant, 1,500 insect, 5 amphibian, 10 reptile, 258 bird, and 46 mammal species have been identified on Hanford. Section 3.2.7.4 and Table 3–8 of Chapter 3 provide information on threatened and endangered species occurring at Hanford.

INL lies in a cool desert ecosystem dominated by some of the best-condition shrub-steppe communities in the United States, as reflected by the establishment of the Sagebrush-Steppe Ecosystem Reserve in the north-central part of the site. Although sagebrush communities occupy about 80 percent of INL, a total of 11 plant communities have been identified (see Chapter 3, Figure 3–38). A total of 398 plant taxa and 1,240 insect, 1 amphibian, 11 reptile, 210 bird, and 47 mammal species have been identified on the INL site. Threatened and endangered species present at INL are discussed in Chapter 3, Section 3.3.7.4, and are listed in Table 3–36.

Table P–1. Scientific Names of Plant and Animal Species

Common Name	Scientific Name
Plants	
Alkali saltgrass	*Distichlis spicata*
Big sagebrush	*Artemisia tridentata*
Bitterbrush	*Purshia tridentata*
Black greasewood	*Sacrobatus vermiculatus*
Black locust	*Robinia pseudoacacia*
Bluebunch wheatgrass	*Agropyron spicatum*
Bulbous bluegrass	*Poa bulbosa*
Bullrush	*Scirpus* sp.
Cattail	*Typha* sp.
Cheatgrass	*Bromus tectorum*
Cottonwood	*Populus* sp.
Crested wheatgrass	*Agropyron desertorum (cristatum)*
Gray rabbitbrush	*Chrysothamnus nauseosus*
Green rabbitbrush	*Chrysothamnus viscidiflorus*
Indian ricegrass	*Achnatherum hymenoides*
Juniper	*Juniperus* sp.
Low sagebrush	*Artemisia arbuscula*
Lupine	*Lupinus* spp.
Mugwort	*Artemisia vulgaris*
Mulberry	*Morus* sp.
Needle-and-thread grass	*Stipa comata*
Peachleaf willow	*Salix amygdaloides*
Plantain	*Plantago* spp.
Pondweed	*Potamogeton* spp.
Poplar	*Populus* sp.
Reed canary grass	*Phalaris arundinacea*
Rigid sagebrush	*Artemisia rigida*
Rock buckwheat	*Eriogonum sphaerocephalum*
Rush	*Juncus* spp.
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola kali*
Sagebrush	*Artemisia* spp.
Salt rattlepod	*Swainsona salsula*
Sand dropseed	*Sporobolus cryptandrus*
Sandberg's bluegrass	*Poa sandbergii (secunda)*
Scrufpea	*Psoralidium tenuiflorum*
Sedge	*Carex* sp.
Siberian elm	*Ulmus pumila*
Snow buckwheat	*Eriogonum niveum*
Spike rush	*Eleocharis* spp.

Table P–1. Scientific Names of Plant and Animal Species *(continued)*

Common Name	Scientific Name
Plants *(continued)*	
Spiny hopsage	*Grayia spinosa*
Sycamore	*Platanus occidentalis*
Thickspike wheatgrass	*Agropyron dasystachyum*
Threetip sagebrush	*Artemisia tripartita*
Thymeleaf buckwheat	*Eriogonum thymoides*
Watercress	*Nasturtium* sp.
Water smartweed	*Polygonum amphibium*
Willow	*Salix* spp.
Winterfat	*Krascheninnikovia lanata*
Yarrow	*Achillea millefolium*
Fish	
American shad	*Alosa sapidissima*
Brook trout	*Salvelinus fontinalis*
Channel catfish	*Ictalurus punctatus*
Char	*Salvelinus* sp.
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
Common carp	*Cyprinus carpio*
Crappie	*Pomoxis* spp.
Kokanee salmon	*Oncorhynchus nerka*
Mountain whitefish	*Prosopium williamsoni*
Northern pikeminnow (squawfish)	*Ptychocheilus oregonensis*
Rainbow trout	*Oncorhynchus mykiss*
Redside shiner	*Richardsonius balteatus*
Shorthead sculpin	*Cottus confusus*
Smallmouth bass	*Micropterus dolomieu*
Sockeye salmon	*Oncorhynchus nerka*
Speckled dace	*Rhinichthys osculus*
Steelhead trout	*Oncorhynchus mykiss*
Walleye	*Stizostedion vitreum*
White sturgeon	*Acipenser transmontanus*
Yellow perch	*Perca flavescens*
Amphibians	
Bullfrog	*Rana catesbeiana*
Great Basin spadefoot toad	*Spea intermontana*
Pacific tree frog	*Pseudacris regilla*
Tiger salamander	*Ambystoma tigrinum*
Western toad	*Bufo boreas*
Woodhouse's toad	*Bufo woodhousii*

Table P–1. Scientific Names of Plant and Animal Species *(continued)*

Common Name	Scientific Name
Reptiles	
Great Basin gopher snake	*Pituophis melanoleucus*
Short-horned lizard	*Phrynosoma douglasii*
Side-blotched lizard	*Uta stansburiana*
Western rattlesnake	*Crotalus viridis*
Western yellow-bellied racer	*Coluber constrictor*
Birds	
American kestrel	*Falco sparverius*
American robin	*Turdus migratorius*
Bald eagle	*Haliaeetus leucocephalus*
Barn swallow	*Hirundo rustica*
Black-billed magpie	*Pica hudsonia*
Black-crowned night heron	*Nycticorax nycticorax*
Brewer's sparrow	*Spizella breweri*
Burrowing owl	*Athene cunicularia*
California gull	*Larus californicus*
Canada goose	*Branta canadensis*
Cliff swallow	*Petrochelidon pyrrhonota*
Common raven	*Corvus corax*
Dark-eyed junco	*Junco hyemalis*
European starling	*Sturnus vulgaris*
Ferruginous hawk	*Buteo regalis*
Forster's tern	*Sterna forsteri*
Golden eagle	*Aquila chrysaetos*
Great blue heron	*Ardea herodias*
Horned lark	*Eremophila alpestris*
Killdeer	*Charadrius vociferous*
Lark sparrow	*Chondestes grammacus*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Mourning dove	*Zenaida macroura*
Northern harrier	*Circus cyaneus*
Peregrine falcon	*Falco peregrinus*
Pigeon	*Columba livia*
Prairie falcon	*Falco mexicanus*
Red-tailed hawk	*Buteo jamaicensis*
Ring-billed gull	*Larus delawarensis*
Rock wren	*Salpinctes obsoletus*
Rough-winged swallow	*Stelgidopteryx serripennis*
Sage sparrow	*Amphispiza belli*
Sage thrasher	*Oreoscoptes montanus*

Table P–1. Scientific Names of Plant and Animal Species *(continued)*

Common Name	Scientific Name
Birds *(continued)*	
Say's phoebe	*Sayornis saya*
Short-eared owl	*Asio flammeus*
Song sparrow	*Melospiza melodia*
Spotted sandpiper	*Actitis macularia*
Swainson's hawk	*Buteo swainsoni*
Vesper sparrow	*Pooecetes gramineus*
Western meadowlark	*Sturnella neglecta*
Mammals	
Badger	*Taxidea taxus*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Great Basin pocket mouse	*Perognathus parvus*
Ground squirrel	*Citellus* sp.
Harvest mouse	*Reithrodontomys megalotis*
Least weasel	*Mustela nivalis*
Mink	*Mustela vison*
Mountain lion	*Puma concolor*
Mule deer	*Odocoileus hemionus*
Muskrat	*Ondatra zibethicus*
Northern pocket gopher	*Thomomys talpoides*
Porcupine	*Erethizon dorsatum*
Pronghorn	*Antilocapra americana*
Raccoon	*Procyon lotor*
Rocky Mountain elk	*Cervus elaphus*
Townsend's ground squirrel	*Spermophilus townsendii*

Key: sp.=species; spp.=species (plural).

P.2 IMPACTS ON TERRESTRIAL RESOURCES RESULTING FROM CONTAMINANT RELEASES

Terrestrial ecological resources at Hanford potentially would be adversely impacted by surface disturbances and contaminant releases during site and Waste Treatment Plant (WTP) construction and operations under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives. The different alternatives would result in different surface disturbances in the vicinity of the 200 Areas, the 400 Area, and Borrow Area C (see Chapter 4). The different actions also would result in different amounts and timing of air emissions and their dispersion to terrestrial habitats at Hanford. Potential long-term impacts on terrestrial ecological resources at on- and offsite locations of chemical and radionuclide releases to air during site and WTP operations are evaluated in Sections P.2.2.1 and P.2.2.2. Potential long-term impacts of air releases during operations and groundwater releases in the future on Columbia River aquatic and riparian ecological resources are evaluated in Section P.3.

The potential for adverse effects on terrestrial ecological resources of radionuclide- and chemical-modeled air releases under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives was evaluated primarily using a quantitative ecological risk assessment approach (63 FR 26846; EPA 1992, 1997). Concentrations of radionuclides and chemicals resulting from deposition of airborne contaminants during construction and operations associated with the alternatives were predicted, as described in Appendix G. These predicted release concentrations were used to evaluate the impacts on terrestrial ecological resources at Hanford both during construction and operations and immediately following operations. The general approach to the assessment of the potential for adverse effects or impacts on ecological resources is discussed in Section P.2.1.

Terrestrial ecological resources would be potentially impacted by contaminant releases to air and soil "on site," i.e., within the Hanford boundaries, and "off site," i.e., outside the Hanford boundaries. Potential impacts on terrestrial ecological resources of exposure to contaminants in soil and air were evaluated using the maximum average annual air concentration and cumulative soil concentrations resulting from air deposition. The onsite maximum-exposure location would be in the vicinity of the tank farms and the 200 Areas because the WTP and ground-level facilities are located adjacent to the 200 Areas, the air dispersion model is a Gaussian plume, and air concentrations decrease in magnitude moving away from the source. For consistency with other *TC & WM EIS* assessments of long-term impacts (see Chapter 5), the line of analysis for the onsite maximum-exposure location is the Core Zone Boundary in the predominant downwind direction. The offsite maximum-exposure location would be at the Columbia River because the river forms the Hanford boundary in the predominant downwind direction.

Air emissions and their subsequent deposition on soils would be possible under all action alternatives, as well as under the Tank Closure No Action Alternative (Tank Closure Alternative 1). Radionuclides and chemicals emitted to the air during construction and operations would be potentially transported away from the source to on- and offsite locations (e.g., the Columbia River floodplain), where they could impact terrestrial resources, and the Columbia River, where they could impact aquatic and riparian resources. The evaluation of impacts at these locations was made at a single point in time, that is, what would be the completion of operations. The duration of operations would vary by alternative (see Chapter 2). Immediately following operations, cumulative soil concentrations are expected to be at their maximum level after accumulating during operations and before attenuating following completion of operations. Therefore, ignoring losses from soil and radioactive decay is a conservative approach. The evaluation of potential adverse impacts on aquatic and riparian ecological resources at the Columbia River is described in Section P.3. The evaluation of potential long-term impacts on terrestrial ecological resources of contaminants released to air under the various alternatives is discussed in the following subsections.

P.2.1 Methods

The potential for adverse effects on ecological resources of potential radionuclide and chemical releases under the different alternatives was evaluated using quantitative modeling (ANL 1999; DOE 1995, 1998; DOE Standard 1153-2002; Eslinger et al. 2002). The general approach was to estimate the exposure of ecological receptors to radionuclides and chemicals that would result from operations and actions under each alternative and then compare the estimated doses to benchmark doses, i.e., doses associated with a known level of adverse effect. Dose estimates were made for selected receptor organisms judged to be representative of groups of species known to occur and be exposed at Hanford, including federally and state-listed protected species; to be sensitive to chemicals and radionuclides potentially released; and to be among the highest exposed in their groups (ANL 1999). The benchmark doses used in this approach are associated with no or minimal adverse effect, so they are expected to be protective of all ecological resources, including special status species that may occur at Hanford (see Chapter 3, Section 3.2.7.4). Special status species are species protected by Federal and state laws, e.g., the Endangered Species Act of

1973, as amended (16 U.S.C. 1531 et seq.). Exposure estimates and Hazard Quotients allow the impacts under the different alternatives to be compared, as required by the National Environmental Policy Act. Comparing alternatives is the primary purpose of the ecological risk analysis in this *TC & WM EIS*.

A secondary purpose of the ecological risk analysis in this *TC & WM EIS* is to identify alternatives that would be unlikely to result in unacceptable risk to ecological receptors. Assessing the risk to highly exposed receptors and using conservative exposure assumptions and benchmarks allow those alternatives that are unlikely to result in adverse impacts on ecological resources to be identified with a high degree of confidence. In other words, if a conservatively estimated dose does not exceed the benchmark dose, then it is highly likely there would be no adverse impact of the exposure. On the other hand, this approach cannot be used to unequivocally conclude that any alternative would result in an unacceptable probability of an adverse impact on ecological resources. A conservatively estimated dose exceeding a benchmark dose does not imply that the receptor would be adversely impacted by the exposure because the actual dose may be less than the benchmark dose. In such a case, a more precise evaluation would be required to resolve the uncertainty. This "screening" approach is consistent with U.S. Environmental Protection Agency (EPA) (EPA 1997, 1999) and U.S. Department of Energy (DOE) guidelines (ANL 1999; DOE Standard 1153-2002; Eslinger et al. 2002) and is appropriate for prospective risk assessments for actions that have not yet occurred (Suter 1993).

Exposure was calculated using models that are consistent with EPA and DOE guidelines and with the ECEM [Ecological Contaminant Exposure Model], which was described in the *User Instructions for the Systems Assessment Capability, Rev. 0, Computer Codes*, Volume 2: *Impact Modules* (Eslinger et al. 2002) and used in the *Screening Assessment and Requirements for a Comprehensive Assessment, Columbia River Comprehensive Impact Assessment (CRCIA)* (DOE 1998) and the *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE and Ecology 1996). The model exposure equations are consistent with those used in the DOE technical standard, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE Standard 1153-2002). These are equilibrium steady state models, as opposed to dynamic time-varying models (Eslinger et al. 2002). The ECEM software was not used to make exposure calculations; however, the exposure calculations in this *TC & WM EIS* are functionally equivalent. Wherever possible, the representative receptors were selected from the ECEM model receptors, and the same receptor exposure parameters were used in this assessment. The selected receptors are presented in Table P–2.

The combined total dose from internal and external exposures to all radionuclides was calculated using equations based on those in *Methods for Estimating Doses to Organisms from Radioactive Materials Released into the Aquatic Environment* (Baker and Soldat 1992) and using the dose conversion factors (DCFs), activation energies, and other radiological parameters used in the ECEM. Chemical doses were calculated using published rates of ingestion of different media and estimated concentrations in the ingested media. Body burdens of chemicals and radionuclides were estimated using concentrations in ambient or ingested media and bioaccumulation factors (BAFs) for the receptor and the radionuclide or chemical in the media. As with the ECEM model (Eslinger et al. 2002), BAFs for animal receptors are constants at steady state, reflecting the net result of ingestion, inhalation, absorption, excretion, and elimination. For this assessment, inhalation of radionuclides and chemicals was estimated where possible, even though the dose from inhalation by biota would be small compared with ingestion and direct external radiation (DOE Standard 1153-2002). Dermal exposure was calculated only for external doses from radionuclides because dermal uptake of chemicals was judged to be small compared with direct exposure to chemicals in soil by incidental ingestion and indirect exposure of contaminated biota by ingestion. The exposure of animals to chemicals in soil by dermal contact would likely be small due to fur, feather, and epidermis barriers (EPA 2000).

Table P–2. Receptors and Exposure Pathways Evaluated for Long-Term Impacts of Air and Groundwater Releases

Receptor	Ingestion					Inhalation of Suspended Soil	Internal Exposure	Soil Exposure		Air Exposure	Near Water	Immersion		Sediment Surface Contact
	Plants	Soil/ Sediment Biota[a]	Vertebrate Prey[b]	Solid Substrate[c]	Surface Water[d]			Above Ground	Below Ground			Water	Sediment	
Terrestrial Environment														
Plants	–	–	–	–	–	–	A	A	A[e]	–	–	–	–	–
Soil-dwelling invertebrates	–	–	–	–	–	–	A	A	A[e]	–	–	–	–	–
Side-blotched lizard	–	A	–	A	–	A	A	A	A	A	–	–	–	–
Mule deer	A	–	–	A	–	A	A	A	–	A	–	–	–	–
Mourning dove	A	–	–	A	–	A	A	A	–	A	–	–	–	–
Great Basin pocket mouse	A	A	–	A	–	A	A	A	A	A	–	–	–	–
Western meadowlark	A	A	–	A	–	A	A	A	A	A	–	–	–	–
Coyote	–	–	A	A	–	A	A	A	A	A	–	–	–	–
Burrowing owl	–	–	A	A	–	A	A	A	A	A	–	–	–	–
Riparian Environment														
Woodhouse's toad	–	A	–	A	–	A	A	A	A	A	–	–	–	–
Muskrat	–	–	–	–	GW	–	GW	GW	GW	–	–	–	–	–
Aquatic Environment														
Benthic invertebrates	–	–	–	–	–	–	A, GW	–	–	–	–	A, GW	A[e], GW	–
Aquatic biota	–	–	–	–	–	–	A, GW	–	–	–	–	A[e], GW	–	A, GW
Salmonids	–	–	–	–	–	–	A, GW	–	–	–	–	A[e], GW	–	A, GW
Raccoon	–	A, GW	–	A, GW	A, GW	–	A, GW	A	A	–	A, GW	–	–	–
Spotted sandpiper	–	A, GW	–	A, GW	A, GW	–	A, GW	A	–	–	A, GW	–	–	–
Least weasel	–	–	A, GW	A, GW	A, GW	–	A, GW	A	A	–	A, GW	A, GW	–	–
Bald eagle	–	–	A, GW	A, GW	A, GW	–	A, GW	–	–	–	A, GW	–	–	–

[a] Soil-dwelling invertebrates for terrestrial and riparian; benthic invertebrates for aquatic.
[b] Small mammals for terrestrial; fish for aquatic.
[c] Surface soil for terrestrial; sediment for aquatic.
[d] For future impacts of groundwater release, the source of water ingested was assumed to be groundwater discharging at seeps along the Columbia River; otherwise, it was assumed to be nearshore surface water.
[e] For chemicals.

Note: Includes all direct and indirect exposure pathways.

Key: – =pathway not evaluated; A=pathway evaluated for air releases; GW=pathway evaluated for groundwater releases.

The exposure model equations are presented in the following sections for each of the impact assessments. The modeled pathways were assumed to be the largest exposure pathways for the receptors because of the habitat associated with each alternative and the source of contamination that was present. Partial doses were calculated where there was insufficient information to calculate the total dose. For example, an uptake or excretion parameter required to estimate the dose from inhalation might not have been available for a receptor, so inhalation could not be calculated for that receptor for any contaminant. The resulting underestimates of dose and risk were balanced by the overestimates from the conservative exposure assumptions. Calculated doses were adequate for comparing alternatives because they were consistent across the alternatives for a given receptor.

The benchmarks for combined internal and external exposure from all radionuclides are associated with no adverse impact (NCRP 1991; IAEA 1992) and were used in the DOE technical standard for evaluating radiation doses (DOE Standard 1153-2002). The chemical benchmarks for plants; soil-dwelling invertebrates; aquatic biota, including salmonids (e.g., salmon, trout, char); and sediment biota exposed to soil, water, and sediment, as appropriate, come from a variety of sources. The chemical benchmarks for wildlife are doses associated with no observed adverse effect levels measured in laboratory toxicity tests on test species (EPA 2009; Sample, Opresko, and Suter 1996). Data are available for mammals and birds for some of the chemical contaminants that could be released to air or groundwater and are evaluated in this *TC & WM EIS*; data for birds were used for amphibians and lizards without adjustment. Unlike radionuclides, impacts of exposure to chemicals were evaluated individually, and doses from different chemicals were not summed or otherwise mathematically combined.

The assumptions, receptors, exposure pathways and uptake mechanisms (routes), predicted soil concentrations, exposure model equations, and benchmarks used to model exposure for terrestrial ecological resources potentially impacted by contaminant releases are described in the relevant sections below. The quantitative evaluations of long-term adverse impacts on terrestrial resources of air releases, based on Hazard Quotients, Hazard Indices, and soil pH, are summarized and discussed in Section P.2.2. Impacts of sulfur and nitrogen oxide deposition on the soil's pH were evaluated based on buffering capacity and predicted concentrations.

P.2.1.1 Key Assumptions

The following key assumptions were made in the evaluation of potential impacts on terrestrial resources of exposure to radionuclides and chemicals released to air during operations:

- Ecological receptors would not be exposed to onsite soil after operations once any proposed soil cover is in place.
- Major exposure pathways were evaluated.
- Toxicity benchmarks were protective.
- No loss, biological or chemical degradation, or radioactive decay of constituents of potential concern (COPCs) would occur in soil.

P.2.1.2 Receptors and Exposure Pathways and Routes

The receptors that were selected to represent the terrestrial ecological resources are listed in Table P–2. They are a subset of those listed in Table P–1. Representative receptors were selected because they are expected to have higher exposures than those not selected from their group, due to their higher ingestion rates per unit body weight for prey, water, and soil. The selected representative receptors are expected to be as highly exposed and/or sensitive as any other species. The receptors include plants and soil-dwelling invertebrates, as well as the side-blotched lizard, Woodhouse's toad, mule deer, mourning dove, Great Basin pocket mouse, western meadowlark, coyote, and burrowing owl. Plants and soil-dwelling invertebrates live in close contact with soil and are important food items for other receptors. The mourning dove, Great Basin pocket mouse, western meadowlark, and burrowing owl are not among the 52 ECEM receptors because the ECEM focuses on Columbia River riparian habitats more than the surrounding shrub-steppe habitat where these four receptors occur. The Great Basin pocket mouse was selected as a receptor for terrestrial habitats in the *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE and Ecology 1996) and is expected to be an important prey item for coyotes and burrowing owls. The mourning dove, western meadowlark, and burrowing owl are representative of birds exposed in terrestrial habitats at Hanford. Terrestrial receptors in common with the ECEM are the side-blotched lizard, mule deer, and coyote. Woodhouse's toad was evaluated instead of the side-blotched lizard for the offsite maximum-exposure location (the Columbia River) because side-blotched lizards are unlikely to occur in the Columbia River floodplain.

The exposure pathways evaluated in the ecological risk analysis for this *TC & WM EIS* are shown in Table P–2 for all ecological receptors. The exposure medium, exposure route, and receptor are indicated for each pathway evaluated in the analysis of impacts on terrestrial resources of releases to air.

P.2.1.3 Predicted Soil and Air Concentrations

The cumulative surface-soil and maximum air concentrations under Tank Closure Alternatives 1 through 6C; FFTF Decommissioning Alternatives 1, 2, and 3 (Hanford and Idaho Options); and Waste Management Alternatives 1, 2, and 3 were calculated from the modeled air deposition rates resulting from site and WTP operations (see Appendix G). The onsite soil concentrations were calculated from the maximum-modeled air deposition rates. The modeled soil concentrations assumed persistence of existing soil contamination and accumulation of deposited contamination over the duration of the operations period. The surface-soil concentrations were calculated assuming that the amount of material deposited on the soil surface over the operations period would be mixed throughout the upper 1 centimeter (0.39 inches) of soil. The deposition flux per unit area (grams per square meter per year or curies per square meter per year) was multiplied by the duration of operations (years) and divided by the mass of soil per unit area (grams per square meter) to estimate the concentration (grams of contaminant per gram of soil or curies per gram), and these results were converted to milligrams per kilogram or picocuries per gram. The mass of soil per unit area was estimated as the depth of soil (0.01 meters [0.03 feet]) multiplied by the soil density (1.7×10^6 grams per cubic meter). The instantaneous air concentration (milligrams per cubic meter or picocuries per cubic meter) was estimated as the annual average deposition flux (milligrams per second or picocuries per second) divided by the unitized flux rate (cubic meters per second). The conservative estimates of surface-soil concentrations for radionuclides were used for both above- and belowground external exposures.

Air concentrations at the ground surface resulting from resuspension of soil were calculated for each location for which soil concentrations were predicted. Modeled air concentrations of radionuclides were used to calculate external exposure to terrestrial ecological resources.

Soil and air concentrations were used as the source term in the exposure model described below.

P.2.1.4 Exposure Model Calculations

The exposure model calculated external and internal doses from radioactive COPCs for all receptors and ingestion and inhalation doses from chemical COPCs for all wildlife receptors. To calculate internal doses for radioactive COPCs in receptors exposed by direct contact with soil (plants and soil-dwelling invertebrates) and to calculate the ingested doses for wildlife receptors exposed by ingestion of these biota to chemical COPCs, the concentrations in these biota were required.

For plants, the concentration was calculated as follows:

$$C_p = P_v + P_r$$

where:

$$P_v = (D / \rho) \times Bv \times Fv \times VG \times 0.2$$

and

$$P_r = C_{\text{soil}} \times SP \times 0.2$$

where:

C_p	=	concentration in plants, milligrams per kilogram or picocuries per gram
P_v	=	concentration in plants from vapor, milligrams per kilogram or picocuries per gram
P_r	=	concentration in plants from root uptake, milligrams per kilogram or picocuries per gram
D	=	concentration in air, milligrams per cubic meter or picocuries per cubic meter
ρ	=	air density, 1.2 kilograms per cubic meter for chemical COPCs and 1,200 grams per cubic meter for radioactive COPCs
Bv	=	air-to-plant uptake factor, unitless
Fv	=	vapor fraction, 0 or 1
VG	=	empirical correction factor for air-to-plant transfer (1 for chemical COPCs and radioactive COPCs with a log K_{ow} < 4 or no log K_{ow} [EPA 2005]), unitless
0.2	=	dry weight–to–wet weight conversion factor (moisture content of plants assumed to be 0.8), unitless
C_{soil}	=	concentration in soil, milligrams per kilogram or picocuries per gram dry soil
SP	=	soil-to-plant uptake factor, unitless

Soil-to-plant uptake factors were used for all radioactive COPCs except carbon-14 and hydrogen-3 (tritium). For carbon-14 and tritium, internal activities were based on equilibrium with stable isotopes in tissue and water, as discussed in Section P.2.1.4.3.

For soil-dwelling invertebrates, the concentration was calculated as follows:

$$C_a = C_{\text{soil}} \times BAF\text{-}S$$

where:

C_a	=	concentration in soil-dwelling invertebrates, milligrams per kilogram or picocuries per gram
C_{soil}	=	concentration in soil, milligrams per kilogram or picocuries per gram dry soil
$BAF\text{-}S$	=	soil-to-soil invertebrate bioaccumulation factor, unitless

Per the *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA 1999), *BAF-S* values for organic chemical COPCs were derived from water-to-tissue bioconcentration factors (BCFs) for daphnids (EPA 1999) because there are no published values based on soil measurements. This approach assumed that soil-dwelling invertebrates are exposed to soil pore water in equilibrium with soil. The *BAF-S* values for the organic chemical COPCs were calculated as the *Daphnia* BCF for the chemical COPC divided by the product of the equilibrium partitioning coefficient (K_{oc}) and the soil organic carbon content, which was assumed to be 0.01 (DOE 1998). The *BAF-S* value for inorganic chemical COPCs was the arithmetic mean of the recommended values for those inorganic substances with empirical data available: arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc (EPA 1999).

P.2.1.4.1 External Dose from Radionuclides

External radiation doses from air, soil, water, and sediment were calculated by methods presented in *Methodology for Estimating Radiation Dose Rates to Freshwater Biota Exposed to Radionuclides in the Environment* (Blaylock, Frank, and O'Neal 1993) and *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al. 1997), based on *Methods for Estimating Doses to Organisms from Radioactive Materials Released into the Aquatic Environment* (Baker and Soldat 1992). External irradiation by immersion in air containing radioactive COPCs and by standing, sitting, or lying on the soil surface (aboveground radiation) was modeled using external DCFs, which are presented in *External Exposure to Radionuclides in Air, Water, and Soil* (Eckerman and Ryman 1993), and the activity of the radioactive COPCs in the medium. Aboveground external radiation from soil was adjusted for the fraction of time the receptor was assumed to spend on the soil surface or for the fraction of the receptor's body located above ground. Those fractions (based on professional judgment) are as follows: plants, 0.5; soil-dwelling invertebrates, 0.5; side-blotched lizard, 0.5; mule deer, 1; mourning dove, 1; Great Basin pocket mouse, 0.3; western meadowlark, 1; coyote, 0.7; and burrowing owl, 0.5. The DCFs used for the Woodhouse's toad were extrapolated from values for similarly sized receptors presented in *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al. 1997). The Woodhouse's toad's fraction of time above ground and fraction of time below ground were 0.5 and 0.5, respectively.

A roughness factor (F_{ruf}) was used to correct for absorption of radiation by uneven soil contours, and an elevation correction factor (ECF) was used to adjust DCFs to account for most ecological receptors whose bodies are closer to the ground than the humans for which the DCFs were derived. The F_{ruf} for all receptors was set at 0.7, which was assumed to be a representative average correction for ground roughness (1.0 equates to a paved surface, whereas 0.5 equates to a deeply plowed field). The ECF was 2 for all receptors except the mule deer (ECF = 1), which are large enough to receive radiation at approximately the same height as humans (Sample et al. 1997).

Belowground external radiation from soil was modeled by using the decay energies and tissue absorption fractions. Equations to calculate belowground external exposure are presented in *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al. 1997). Belowground exposure was adjusted for the fraction of time the receptor was assumed to be exposed under ground or the fraction of the body located above ground. Those fractions (based on professional judgment) are as follows: plants, 0.5; soil-dwelling invertebrates, 0.5; the side-blotched lizard, 0.5; the Woodhouse's toad, 0.5; the mule deer, 0; the mourning dove, 0; the Great Basin pocket mouse, 0.7; the western meadowlark, 0; the coyote, 0.3; and the burrowing owl, 0.5. Belowground and aboveground external exposure equations for soil were combined to form the equation for the external exposure to soil ($RD_{Ext\text{-}soil}$) given below.

Therefore, the external dose from radionuclides in soil and air (RD_{Ext}) was calculated as follows:

$$RD_{Ext} = RD_{Ext\text{-}soil} + RD_{Ext\text{-}air}$$

where:

$RD_{Ext\text{-}soil}$ = external radiation dose from soil, rad per day
$RD_{Ext\text{-}air}$ = external radiation dose from air, rad per day

For all receptors, the external dose from soil was calculated as follows (Eckerman and Ryman 1993):

$$RD_{\text{Ext-soil}} = C_{\text{soil}} \times DF_{\text{soil}}$$

where:

$RD_{\text{Ext-soil}}$ = external radiation dose from soil, rad per day
C_{soil} = activity of radionuclide in untilled soil, picocuries per gram
DF_{soil} = factor for converting activity in soil to external dose from untilled soil

The total external dose from all radioactive COPCs in soil was the sum of the external doses from each radioactive COPC.

The external dose factor for soil (DF_{soil}) was calculated as follows (Sample et al. 1997):

$$DF_{\text{soil}} = F_{\text{above}} \times F_{\text{ruf}} \times DCF \times CFb \times ECF + 1.05 \times F_{\text{below}} \times E_{\gamma}n_{\gamma} \times \Phi_{\gamma} \times CFa$$

where:

F_{above} = fraction of time spent above ground, unitless
F_{ruf} = dose rate reduction factor accounting for ground roughness, unitless
DCF = dose conversion factor for external radiation from soil contaminated to a depth of 1 centimeter (0.39 inches) (Eckerman and Ryman 1993), sieverts per second per becquerel per cubic meter
CFb = 5.12×10^{11}, factor for converting sieverts per second per becquerel per cubic meter to rad per day per picocurie per gram
ECF = elevation correction factor to adjust dose coefficient for effective height of receptor above ground (Sample et al. 1997), unitless
1.05 = conversion factor to account for immersion in soil rather than water
F_{below} = fraction of time spent below ground, unitless
$E_{\gamma}n_{\gamma}$ = photon energy emitted during transition from a higher to a lower energy state, 1 million electron volts (MeV) × proportion of disintegrations producing gamma radiation
Φ_{γ} = absorbed fraction of energy from gamma energy E_{γ}
CFa = unit conversion factor, 5.11×10^{-5} rad per day per picocurie per gram per MeV per disintegration

Only gamma radiation was relevant to the external dose.

The external dose to all receptors from air was calculated as follows (Eckerman and Ryman 1993):

$$RD_{\text{Ext-air}} = D \times DF_{\text{air}}$$

where:

$RD_{\text{Ext-air}}$ = external radiation dose from air, rad per day
D = activity of radionuclide in air, picocuries per cubic meter
DF_{air} = factor for converting activity in air to external dose from air

The external dose conversion factor for air (DF_{air}) was calculated as follows:

$$DF_{air} = 3.2 \times 10^5 \times DCF$$

where:

3.2×10^5	=	factor for converting sieverts per second per becquerel per cubic meter to rad per day per picocurie per cubic meter (Eckerman and Ryman 1993)
DCF	=	dose conversion factor for external radiation from immersion in air (Eckerman and Ryman 1993), sieverts per second per becquerel per cubic meter

P.2.1.4.2 Internal Dose from Radionuclides

Internal exposure to radionuclides was calculated from the activity in the receptor's tissues. The internal activities of radionuclides were calculated using uptake factors and activities in soil and food. Internal radiation doses were calculated by multiplying the activity in tissues by the sum of alpha, beta, and gamma decay energies, where alpha and beta energies were assumed to be completely absorbed. Because gamma rays, like x-rays, may pass through the tissues without depositing their energy, gamma energies were adjusted to account for greater absorption by larger organisms (e.g., the mule deer) at a given energy level and for greater absorption by all receptors at lower energy levels.

The internal doses (rad per day) to plants, soil-dwelling invertebrates, and wildlife receptors were calculated as follows (Sample et al. 1997):

$$RD_{Int} = C_n \times DF_{Int}$$

where:

$$DF_{Int} = CFa \times (QF \times E_\alpha n_\alpha \times \Phi_\alpha + E_\beta n_\beta \times \Phi_\beta + E_\gamma n_\gamma \times \Phi_\gamma)$$

and where:

RD_{Int}	=	internal radiation dose, rad per day
C_n	=	activity of radionuclide in receptor tissue, picocuries per gram
DF_{Int}	=	factor for converting radioactive COPC activity in tissue to internal dose
CFa	=	unit conversion factor, 5.11×10^{-5} rad per day per picocurie per gram per MeV per disintegration
QF	=	5, quality factor for biological effect of alpha radiation (Kocher and Trabalka 2000), unitless
$E_\alpha n_\alpha$	=	average energy emitted as alpha radiation, MeV per disintegration × proportion of disintegrations producing an alpha particle
Φ_α	=	absorbed fraction of energy from alpha energy E_α
$E_\beta n_\beta$	=	average energy emitted as beta radiation, MeV per disintegration × proportion of disintegrations producing a beta particle
Φ_β	=	absorbed fraction of energy from beta energy E_β
$E_\gamma n_\gamma$	=	photon energy emitted during transition from a higher to a lower energy state, MeV × proportion of disintegrations producing gamma radiation
Φ_γ	=	absorbed fraction of energy from gamma energy E_γ

In addition to estimating internal exposures, activities of radioactive COPCs and concentrations of chemical COPCs in some receptor tissues were also used to estimate the ingestion dose to predators eating those receptors.

P.2.1.4.3 Tissue Concentrations and Activities

The activity of a radioactive COPC and the concentration of a chemical COPC in receptor tissue results from ingestion and inhalation of radioactive and chemical COPCs in soil and food. Accumulation from ingested matter was modeled according to EPA guidelines (EPA 1999). The *CRCIA* (DOE 1998) contains a model for receptor- and chemical-specific accumulation from inhalation of particulates in air as a result of absorption and excretion (see *CRCIA*, Appendix I-D). For radionuclides, inhalation was normalized to ingestion of soil (DOE Standard 1153-2002). Because of a lack of available receptor- and chemical-specific data, absorption was assumed to be a receptor-specific parameter equal for all chemical and radioactive COPCs, and excretion was assumed to be a chemical-specific parameter common to all receptors.

The activities of radioactive COPCs and concentrations of chemical COPCs in receptor tissue, except for carbon-14 and tritium, were calculated as follows:

$$C_n = C_{n\text{-ing}} + C_{n\text{-inh}}$$

C_n = activity of radioactive COPCs and concentration of chemical COPCs in receptor tissue, picocuries per gram or milligrams per kilogram
$C_{n\text{-ing}}$ = activity of radioactive COPCs and concentration of chemical COPCs in receptor tissue resulting from ingestion, picocuries per gram or milligrams per kilogram
$C_{n\text{-inh}}$ = activity of radioactive COPCs and concentration of chemical COPCs in receptor tissue resulting from inhalation, picocuries per gram or milligrams per kilogram

where for radioactive COPCs:

$$C_{n\text{-inh}} = D_s \times IR_{\text{air}} \times PT/IT \times Ba_{\text{receptor}} \times BW_{\text{receptor}} \times 0.001$$

where:

$C_{n\text{-inh}}$ = activity of radioactive COPCs in receptor tissue resulting from inhalation, picocuries per gram
D_s = concentration in air from resuspended, untilled soil particles, milligrams per cubic meter air or picocuries per cubic meter air
IR_{air} = daily inhalation rate of soil, cubic meters air per kilogram body weight per day
PT/IT = unitless factor to adjust inhalation relative to ingestion for radionuclides (DOE Standard 1153-2002)
Ba_{receptor} = biotransfer rate of chemical in receptor, days per kilogram
BW_{receptor} = body weight of receptor, kilograms
0.001 = factor for converting kilograms to grams for radioactive COPCs, kilograms per gram

and D_s was calculated as follows:

$$D_s = C_{\text{soil}} \times L_d$$

where:

C_{soil} = concentration in untilled soil, milligrams per kilogram or picocuries per gram
L_d = dust loading constant, 150 micrograms per cubic meter, converted to kilograms per cubic meter or grams per cubic meter (Zach 1985).

and where for chemical COPCs:

$$C_{n\text{-inh}} = D_s \times IR_{\mathrm{air}} \times \alpha / K$$

where:

$C_{n\text{-inh}}$	=	concentration of chemical COPCs in receptor tissue resulting from inhalation, milligrams per kilogram
IR_{air}	=	daily inhalation rate of air, cubic meters air per kilogram body weight per day
α	=	fractional absorption coefficient, unitless
K	=	excretion constant, day^{-1}

IR_{air} was the receptor's inhalation rate of air (cubic meters air per kilogram body weight per day). It was receptor-specific and was derived from EPA guidelines (EPA 1993) using the fraction of dioxygen in dry atmosphere and the average annual Hanford temperature, as was done in the *CRCIA* (DOE 1998). IR_{air} values were obtained from regression equations based on body weight, except for the value for the Woodhouse's toad, which was based on the metabolic rate of an adult bullfrog (EPA 1993).

For both radioactive and chemical COPCs, the concentrations of contaminants from ingestion were calculated as follows:

$$C_{n\text{-ing}} = C_{\mathrm{soil}} \times BAF\text{-}Ts + C_w \times BAF\text{-}Tw + C_a \times BAF\text{-}Ta + C_p \times BAF\text{-}Tp$$

where:

$C_{n\text{-ing}}$	=	concentration of contaminant in receptor tissue from ingestion, picocuries per gram or milligrams per kilogram
C_{soil}	=	concentration of contaminant in untilled soil, picocuries per gram or milligrams per kilogram
C_w	=	concentration of contaminant in surface water, picocuries per milliliter or milligrams per liter
C_a	=	concentration of contaminant in animals, picocuries per gram or milligrams per kilogram
C_p	=	concentration of contaminants in plants, picocuries per gram or milligrams per kilogram

where C_a, the concentration of chemicals or radionuclides in animal food, was calculated as C_n for the prey item as a receptor and *BAF-Ts*, *BAF-Tw*, *BAF-Ta*, and *BAF-Tp* were the receptor's uptake factors for the different ingested media: soil or sediment (kilogram per kilogram), water (liter per kilogram or milliliter per gram), animals (kilogram per kilogram), and plants (kilogram per kilogram), respectively, as follows:

$$\begin{aligned} BAF-Ts &= I_s \times Ba_{\mathrm{receptor}} \\ BAF-Tw &= I_w \times Ba_{\mathrm{receptor}} \\ BAF-Ta &= I_a \times Ba_{\mathrm{receptor}} \\ BAF-Tp &= I_p \times Ba_{\mathrm{receptor}} \end{aligned}$$

and

$$Ba_{\mathrm{receptor}} = Ba_{\mathrm{cow}} \times BW_{\mathrm{cow}} / BW_{\mathrm{receptor}}$$

where:

Ba_{receptor}	=	biotransfer rate of chemical in receptor, days per kilogram
Ba_{cow}	=	biotransfer rate of chemical in cow, days per kilogram
BW_{cow}	=	body weight of cow, kilograms = 200 kilograms (440 pounds)
BW_{receptor}	=	body weight of receptor, kilograms
I_s	=	daily ingestion rate of soil or sediment, kilograms dry matter per day
I_w	=	daily ingestion rate of water, liters per day
I_a	=	daily ingestion rate of animal matter, kilograms wet weight animal per day
I_p	=	daily ingestion rate of plant matter, kilograms wet weight plant per day

BAFs for wildlife receptors corrected the biotransfer factors for a 200-kilogram (440-pound) cow (Baes et al. 1984) for differences in body weight between cow and receptor. This approach was conservative and assumed that net uptake and assimilation efficiency would be more similar across organisms than the biotransfer factor, which is a function of body weight, uptake efficiency (absorption, elimination), and excretion.

I_s, I_w, I_a, and I_p were the receptor's ingestion rates for soil or sediment, water, animal food, and plant food, respectively. The ingestion rates for solid matter were calculated as follows:

$$I_s = IR_f \times SF \times BW$$

$$I_p = IR_f \times PF \times BW$$

$$I_a = IR_f \times AF \times BW$$

where:

IR_f	=	daily specific ingestion rate of food, kilograms wet weight per kilograms body weight per day
SF	=	dry soil or sediment ingested as a fraction of daily food (wet weight) ingested, unitless
BW	=	body weight, kilograms
PF	=	fraction of diet that is plant, unitless
AF	=	fraction of diet that is animal, unitless

The ingestion rate for water (I_w) was calculated as follows:

$$I_w = IR_w \times BW$$

where:

IR_w	=	daily specific ingestion rate of water, liters per kilogram body weight per day
BW	=	body weight, kilograms

These were the general equations; not all receptors ingested plant, animal, soil, sediment, and water. Only receptors exposed to soil were assumed to inhale untilled soil particles resuspended in air. Per the simplifying assumptions, exposure models for on- and offsite terrestrial receptors at Hanford did not include ingestion of water and sediment. Models for riparian receptors at the Columbia River (see Sections P.3.1.2 and P.3.2.1.2) included ingestion of water and sediment, but not soil. When a receptor did not ingest a medium, the concentration and ingestion rate for that medium were taken to be zero and the calculated BAF and fraction of total dose were zero; thus, that medium did not contribute to the receptor's tissue concentration.

Exposure calculations for most radioactive COPCs were based on the assumption that radionuclides would be present as particulates in soil or vapors in air. However, special consideration was given to carbon-14 and tritium, as these radioactive COPCs are processed by vegetation with natural carbon and hydrogen, respectively. Thus, the vegetation pathways for carbon-14 and tritium would depend on the exchange of carbon and hydrogen between plants and the environment. For this assessment, guidance from U.S. Nuclear Regulatory Commission Regulatory Guide 1.109 (NRC 1977) was used to account for the bioaccumulation of carbon-14 and tritium in plants. This was done through the use of correction factors, along with the assumption that all carbon-14 would be released in oxide form (carbon monoxide or carbon dioxide) and tritium would be released as water vapor. These correction factors were applied to the air concentration (e.g., picocuries per cubic meter) estimated at the point of exposure by the air model.

The concentration of carbon-14 in vegetation was calculated under the assumption that its ratio to the natural carbon in vegetation would equal the ratio of carbon-14 to the natural carbon in the atmosphere surrounding the vegetation, as follows (NRC 1977):

$$C_{p(\mathrm{C\text{-}14})} = D_{\mathrm{C\text{-}14}} \times p \times 0.11 / 0.16$$

where:

$C_{p(\mathrm{C\text{-}14})}$	=	concentration of carbon-14 in vegetation, picocuries radioactive COPC per gram wet plant tissue
$D_{\mathrm{C\text{-}14}}$	=	concentration of carbon-14 in the surrounding air, picocuries per cubic meter air
p	=	ratio of the total annual release time to the total annual time during which photosynthesis occurs; a conservative ratio of 1.0 was used
0.11	=	fraction of the total plant mass that is natural carbon, grams carbon per gram wet plant tissue
0.16	=	concentration of natural carbon in the atmosphere, grams carbon per cubic meter air

The concentration of tritium in vegetation was calculated based on the equilibrium between moisture in the air and water in plants, as follows (NRC 1977):

$$C_{p(\mathrm{H\text{-}3})} = D_{\mathrm{H\text{-}3}} \times 0.80 \times (0.5 / \mathrm{humidity})$$

where:

$C_{p(\mathrm{H\text{-}3})}$	=	concentration of tritium in vegetation, picocuries radioactive COPC per gram wet plant tissue
$D_{\mathrm{H\text{-}3}}$	=	concentration of tritium in the surrounding air, picocuries per cubic meter air
0.80	=	site-specific assumed fraction of the total plant mass that is water, grams plant water per gram wet plant tissue
0.5	=	ratio of tritium concentration in plant water to tritium concentration in atmospheric water, curies per gram plant water per curies per gram water in air
humidity	=	humidity of the atmosphere, grams water per cubic meter air

A site-specific value of 68 percent or 0.68 grams per cubic meter (USFS, NPS, and USFWS 2000) was used for humidity.

The concentration of carbon-14 and tritium in vegetation was used as the total plant concentration for these radioactive COPCs throughout the risk assessment instead of estimating concentrations for specific parts of the plants (i.e., above and below ground). The concentrations of carbon-14 and tritium in the tissues of all terrestrial animal receptors were assumed to be equal to the concentrations in plants.

P.2.1.4.4 Exposure Doses from Chemicals

Exposure was estimated only for wildlife exposed to chemical COPCs via ingestion and inhalation. The average daily dose (ADD) for chemical COPCs was compared with benchmark doses to characterize risk. For plants and soil-dwelling invertebrates exposed to chemicals by multiple pathways (direct contact, ingestion) resulting from living in soil, exposure was not calculated. The assessment of impacts on plants and soil-dwelling invertebrates was made by comparing estimated soil concentrations to soil benchmark concentrations for these receptors (see Section P.2.1.5).

The doses to terrestrial wildlife receptors from chemical COPCs in soil were calculated as the sum of doses from inhaling air containing suspended soil and ingesting soil, food (plant and animal fractions), and water as follows:

$$ADD_{\mathrm{total}} = ADD_{\mathrm{plant}} + ADD_{\mathrm{animal}} + ADD_{\mathrm{soil}} + ADD_{\mathrm{water}} + ADD_{\mathrm{air}}$$

where:

ADD_{total} = total ingestion-equivalent dose of chemical from plant food, animal food, soil, and air, milligrams per kilogram body weight per day
ADD_{plant} = dose of chemical from ingestion of plants, milligrams per kilogram body weight per day
ADD_{animal} = dose of chemical from ingestion of animals, milligrams per kilogram body weight per day
ADD_{soil} = dose of chemical from ingestion of soil, milligrams per kilogram body weight per day
ADD_{water} = dose of chemical from ingestion of water, milligrams per kilogram body weight per day
ADD_{air} = ingestion-equivalent dose of chemical from inhalation of soil in air, milligrams per kilogram body weight per day

The dose of chemical from ingestion of plants (ADD_{plant}) was calculated as follows:

$$ADD_{\mathrm{plant}} = C_p \times IR_p = C_p \times IR_f \times PF$$

where:

C_p = concentration in plants, milligrams per kilogram wet weight
IR_p = daily ingestion rate of plant matter, kilograms fresh plant per kilograms body weight per day
IR_f = daily food ingestion rate, kilograms wet weight per kilograms body weight per day
PF = plant fraction of diet (ADD_{animal})

The dose of chemical from ingestion of animals (ADD_{animal}) was calculated as follows:

$$ADD_{\mathrm{animal}} = C_a \times IR_a = C_a \times IR_f \times AF$$

where:

C_a = concentration in animal prey, milligrams per kilogram wet weight
IR_a = daily ingestion rate of animal matter, kilograms wet weight animal per kilogram body weight per day
IR_f = daily food ingestion rate, kilograms wet weight per kilogram body weight per day
AF = animal fraction of diet

Soil-dwelling invertebrates were the animal prey of the side-blotched lizard, Woodhouse's toad, Great Basin pocket mouse, and western meadowlark. The Great Basin pocket mouse was the animal prey of the coyote and the burrowing owl. Note that, for predators of the Great Basin pocket mouse, C_a was calculated as C_n, with the Great Basin pocket mouse treated as a receptor.

The dose of chemical from ingestion of soil (ADD_{soil}) was calculated as follows:

$$ADD_{\text{soil}} = C_{\text{soil}} \times IR_s = C_{\text{soil}} \times IR_f \times SF$$

where:

C_{soil}	=	concentration in soil, milligrams per kilogram dry soil
IR_s	=	ingestion rate of soil by the receptor, kilograms dry soil per kilogram body weight per day
IR_f	=	daily food ingestion rate, kilograms wet weight per kilogram body weight per day
SF	=	dry soil ingested as a fraction of daily food (wet weight) ingested, unitless

The dose of chemical from ingestion of water (ADD_{water}) was calculated as follows:

$$ADD_{\text{water}} = C_w \times IR_w$$

where:

C_w	=	concentration in water, milligrams per liter water
IR_w	=	daily specific ingestion rate of water, liters per kilogram body weight per day

The dose of chemical from inhalation of soil in air (ADD_{air}) was calculated as follows:

$$ADD_{\text{air}} = D_s \times IR_{\text{air}} \times \alpha / K / (Ba_{\text{receptor}} \times BW_{\text{receptor}})$$

where:

D_s	=	concentration in air from resuspended untilled soil particles, milligrams per cubic meter of air
IR_{air}	=	daily inhalation rate of air, cubic meters per kilogram body weight per day
α	=	fractional absorption coefficient, unitless
K	=	excretion constant, day^{-1}
Ba_{receptor}	=	biotransfer rate of chemical in receptor, days per kilogram
BW_{receptor}	=	receptor body weight, kilograms

The factor, $\alpha / K / (Ba_{\text{receptor}} \times BW_{\text{receptor}})$, relates the efficiency of uptake into blood from the lung to the efficiency of uptake into blood from the gastrointestinal tract and was used to convert inhaled dose to ingested dose for the purposes of estimating the risk from exposure of inhaled substance in terms of ingestion-based toxicity reference values (TRVs). This factor was derived by taking the ratio of the equations for bioaccumulation in tissue of a substance inhaled (DOE 1998:I-D.10) and that of the substance ingested (EPA 1999:Equation 5-3), written in terms of dose. This approach assumes that, once a molecule of the substance is in the bloodstream, its fate is independent of the pathway by which it came to be there. In other words, a unit tissue concentration could result from either inhalation or ingestion of soil:

$$C_{n\text{-ing}} = C_{n\text{-inh}}$$

and

$$C_{soil} \times BAF\text{-}Ts = C_{soil} \times L_d \times IR_{air} \times \alpha / K$$
$$C_{soil} \times Ba_{receptor} \times I_s = D_s \times IR_{air} \times \alpha / K$$
$$C_{soil} \times IR_s \times Ba_{receptor} \times BW_{receptor} = D_s \times IR_{air} \times \alpha / K$$
$$\text{Dose}_{ingested} \times (Ba_{receptor} \times BW_{receptor}) = \text{Dose}_{inhaled} \times \alpha / \text{K}$$
$$\text{Dose}_{ingested} = \text{Dose}_{inhaled} \times \alpha / K / (Ba_{receptor} \times BW_{receptor})$$

where:

$$I_s = IR_s \times BW_{receptor}$$

and where:

C_{soil}	=	concentration of contaminant in untilled soil, picocuries per gram or milligrams per kilogram
$BAF\text{-}Ts$	=	$I_s \times Ba_{receptor}$
L_d	=	dust loading constant, 150 micrograms per cubic meter, converted to kilograms per cubic meter or grams per cubic meter (Zach 1985)
IR_{air}	=	daily inhalation rate of air, cubic meters air per kilogram body weight per day
α	=	fractional absorption coefficient, unitless
K	=	excretion constant, day^{-1}
$Ba_{receptor}$	=	biotransfer rate of chemical in receptor, days per kilogram
I_s	=	daily ingestion rate of soil or sediment, kilograms dry matter per day
D_s	=	concentration in air from resuspended untilled soil particles, milligrams per cubic meter air
IR_s	=	ingestion rate of soil by the receptor, kilograms dry soil per kilogram body weight per day
$BW_{receptor}$	=	body weight of receptor, kilograms
$\text{Dose}_{ingested}$	=	dose of chemical from ingestion resulting in unit of chemical in tissue, milligrams per kilogram body weight per day
$\text{Dose}_{inhaled}$	=	dose of chemical from inhalation resulting in unit of chemical in tissue, milligrams per kilogram body weight per day

Area use factors and temporal use factors were assumed to equal 1 for conservatism; thus, these factors did not appear in the exposure equations.

P.2.1.5 Toxicological Benchmarks

The benchmark for combined internal and external exposure from all radionuclides was 0.1 rad per day for the side-blotched lizard, Woodhouse's toad, mule deer, mourning dove, Great Basin pocket mouse, meadowlark, coyote, and burrowing owl, and 1 rad per day for plants and soil-dwelling invertebrates (IAEA 1992). Chemical benchmarks (TRVs) for plants and soil-dwelling invertebrates exposed to soil were soil concentrations (milligrams per kilogram), and TRVs for terrestrial receptors potentially impacted by chemicals in surface soil were doses (milligrams per kilogram body weight per day). All TRVs used were chemical-specific literature values from a variety of published sources (e.g., Efroymson, Will, and Suter 1997; Efroymson et al. 1997; EPA 2009; Sample, Opresko, and Suter 1996).

P.2.1.6 Risk Indices

As discussed earlier in the introduction to Section P.2.1, the long-term impacts on ecological resources of potential radionuclide and chemical releases were evaluated by comparing estimates of exposure for a given ecological receptor exposed to a given chemical or radioactive COPC under each alternative to the threshold exposures associated with a known level of the adverse effect of the COPC on that type of receptor. The estimate of chemical exposure for plants and soil-dwelling invertebrates was the predicted soil concentration under each alternative (see Appendix G). The methods for estimating exposure doses for terrestrial receptors from predicted air and soil concentrations were defined in Section P.2.1.4. The exposure concentrations or doses associated with a known level of adverse effect were the TRVs (see Section P.2.1.5). These two values were compared by calculating a risk index, the dimensionless ratio of the exposure estimate (concentration or dose) to the corresponding TRV (concentration or dose). These calculated risk indices, i.e., the Hazard Quotients for individual chemical COPCs and the Hazard Indices for all radioactive COPCs combined, were used to compare the *TC & WM EIS* alternatives (see Chapter 5) and to identify exposures posing little or no risk (Hazard Quotient or Hazard Index less than or equal to unity [1]).

The risk indices were calculated as follows:

For plants and soil-dwelling invertebrates exposed to chemical COPCs in soil:

$$HQ = C_{\mathrm{soil}} / TRV$$

where:

HQ = Hazard Quotient
C_{soil} = concentration in untilled soil, milligrams per kilogram or picocuries per gram
TRV = toxicity reference value, milligrams per kilogram

For wildlife receptors exposed to chemical COPCs in soil and air:

$$HQ = ADD_{\mathrm{total}} / TRV$$

where:

HQ = Hazard Quotient
ADD_{total} = total ingestion-equivalent dose of chemical from plant food, animal food, soil, and air, milligrams per kilogram body weight per day
TRV = toxicity reference value, milligrams per kilogram body weight per day

For all receptors, the Hazard Index is the sum of external and internal doses from all radioactive COPCs divided by the TRV, as follows:

$$HI = (RD_{\mathrm{Ext}} + RD_{\mathrm{Int}}) / TRV$$

where:

HI = Hazard Index
RD_{Ext} = external radiation dose from exposure to all radioactive COPCs in air, soil, sediment, and/or water, rad per day
RD_{Int} = internal radiation dose from all radioactive COPCs, rad per day
TRV = toxicity reference value, rad per day

Except where an exposure parameter or TRV was not available for a given receptor or COPC, the dose (ADD_{total}) and Hazard Quotient for all chemical COPCs, as well as the dose (RD_{Ext} + RD_{Int}) summed over all radioactive COPCs and the Hazard Index, were calculated for all terrestrial receptors potentially exposed at the two locations under all *TC & WM EIS* alternatives using predicted air and soil concentrations resulting from air releases during operations. Tables with predicted air and soil concentrations, input parameters, and calculations of dose and risk indices are provided in *Calculating Risk Indices for Long-Term Impacts to Ecological Receptors – Releases to Air* (SAIC 2011a). Results are summarized in Section P.2.2 using maximum Hazard Quotients and Hazard Indices.

P.2.2 Results and Discussion

Radiological and chemical hazards estimated for terrestrial ecological receptors due to exposure to contaminant release to the air and subsequent deposition are discussed below. Hazards due to releases into the air and subsequent deposition in the Columbia River and releases into the groundwater for aquatic receptors and terrestrial wildlife feeding in the Columbia River are discussed in Section P.3.

P.2.2.1 Onsite Terrestrial Resources

The results of the assessment for radioactive and chemical contaminant releases to air and subsequent deposition estimated for terrestrial receptors at the onsite maximum-exposure location under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives, as well as the alternative combinations, are summarized in Tables P–3, P–4, and P–5.

The maximum combined radiological Hazard Index from emissions under all alternatives was calculated to be 0.026 for the Great Basin pocket mouse under Tank Closure Alternative 6A, Option Case. Table P–3 presents the maximum Hazard Indices associated with air emissions of radioactive COPCs that are calculated to reach the onsite receptors under each of the alternatives. There would be no releases of radioactive COPCs under FFTF Decommissioning Alternative 1 and Waste Management Alternative 1. Exposures to radioactive COPCs from air emissions under all alternatives would be below the 1-rad-per-day benchmark for plants and soil-dwelling invertebrates, as well as the 0.1-rad-per-day benchmark for terrestrial wildlife receptors (i.e., side-blotched lizard, mule deer, mourning dove, Great Basin pocket mouse, western meadowlark, coyote, and burrowing owl). Estimated hazards for the representative species indicated that no adverse effects are expected for onsite terrestrial receptors from exposure to radioactive COPCs from air emissions. Because the direct impacts of air exposure are expected to be small, any associated, potential indirect impacts on the ecosystem are expected to be correspondingly minor.

Table P–3. Long-Term Impacts of Radioactive COPC Air Deposition on Terrestrial Resources at the Onsite Maximum-Exposure Location: Maximum Hazard Indices by Receptor and Alternative

Alternative	Maximum Hazard Index by Receptor								
	Plants	Soil Invertebrates	Side-Blotched Lizard	Mule Deer	Mourning Dove	Great Basin Pocket Mouse	Western Meadowlark	Coyote	Burrowing Owl
Tank Closure									
1	7.67×10^{-4}	8.51×10^{-3}	7.35×10^{-3}	6.48×10^{-3}	9.81×10^{-3}	7.33×10^{-3}	9.58×10^{-3}	9.24×10^{-3}	8.15×10^{-3}
2A	3.43×10^{-3}	1.17×10^{-2}	1.09×10^{-2}	7.35×10^{-3}	1.54×10^{-2}	1.67×10^{-2}	1.24×10^{-2}	1.12×10^{-2}	1.29×10^{-2}
2B	2.77×10^{-3}	3.18×10^{-3}	3.52×10^{-3}	9.47×10^{-4}	5.53×10^{-3}	9.10×10^{-3}	2.85×10^{-3}	2.02×10^{-3}	4.64×10^{-3}
3A	3.09×10^{-3}	3.60×10^{-3}	7.82×10^{-3}	5.10×10^{-3}	9.93×10^{-3}	1.37×10^{-2}	7.12×10^{-3}	6.24×10^{-3}	9.00×10^{-3}
3B	2.62×10^{-3}	3.00×10^{-3}	3.30×10^{-3}	8.23×10^{-4}	5.21×10^{-3}	8.64×10^{-3}	2.65×10^{-3}	1.85×10^{-3}	4.37×10^{-3}
3C	3.15×10^{-3}	3.85×10^{-3}	8.33×10^{-3}	5.22×10^{-3}	1.04×10^{-2}	1.46×10^{-2}	7.39×10^{-3}	6.72×10^{-3}	9.55×10^{-3}
4	2.91×10^{-3}	3.35×10^{-3}	4.22×10^{-3}	1.49×10^{-3}	6.33×10^{-3}	1.01×10^{-2}	3.51×10^{-3}	2.63×10^{-3}	5.40×10^{-3}
5	2.61×10^{-3}	3.07×10^{-3}	4.22×10^{-3}	1.64×10^{-3}	6.18×10^{-3}	9.78×10^{-3}	3.56×10^{-3}	2.72×10^{-3}	5.34×10^{-3}
6A, Base Case	4.80×10^{-3}	6.64×10^{-3}	8.76×10^{-3}	1.98×10^{-3}	1.33×10^{-2}	2.29×10^{-2}	7.01×10^{-3}	4.89×10^{-3}	1.17×10^{-2}
6A, Option Case	5.50×10^{-3}	7.92×10^{-3}	9.86×10^{-3}	2.29×10^{-3}	1.50×10^{-2}	**2.57×10^{-2}**	7.91×10^{-3}	5.54×10^{-3}	1.31×10^{-2}
6B, Base Case	4.93×10^{-3}	6.81×10^{-3}	9.06×10^{-3}	2.14×10^{-3}	1.38×10^{-2}	2.35×10^{-2}	7.28×10^{-3}	5.11×10^{-3}	1.20×10^{-2}
6B, Option Case	5.27×10^{-3}	7.52×10^{-3}	9.34×10^{-3}	2.31×10^{-3}	1.42×10^{-2}	2.41×10^{-2}	7.53×10^{-3}	5.31×10^{-3}	1.24×10^{-2}
6C	2.5×10^{-3}	3.13×10^{-3}	3.52×10^{-3}	9.39×10^{-4}	5.50×10^{-3}	9.08×10^{-3}	2.85×10^{-3}	2.02×10^{-3}	4.64×10^{-3}
FFTF Decommissioning									
1	0	0	0	0	0	0	0	0	0
2, Hanford Option	1.10×10^{-5}	1.38×10^{-5}	1.29×10^{-4}	1.09×10^{-4}	1.86×10^{-4}	1.36×10^{-4}	1.76×10^{-4}	2.00×10^{-4}	1.86×10^{-4}
2, Idaho Option	4.84×10^{-12}	6.64×10^{-11}	1.41×10^{-10}	2.65×10^{-11}	1.96×10^{-10}	3.63×10^{-10}	1.12×10^{-10}	7.86×10^{-11}	1.89×10^{-10}
3, Hanford Option	1.10×10^{-5}	1.38×10^{-5}	1.29×10^{-4}	1.09×10^{-4}	1.86×10^{-4}	1.36×10^{-4}	1.76×10^{-4}	2.00×10^{-4}	1.86×10^{-4}
3, Idaho Option	0	0	0	0	0	0	0	0	0
Waste Management									
1	0	0	0	0	0	0	0	0	0
2, DG1	9.49×10^{-11}	9.70×10^{-10}	2.23×10^{-12}	6.59×10^{-12}	2.72×10^{-11}	1.40×10^{-11}	2.70×10^{-12}	2.21×10^{-12}	2.01×10^{-12}
2, DG2	9.49×10^{-11}	9.70×10^{-10}	2.23×10^{-12}	6.59×10^{-12}	2.72×10^{-11}	1.40×10^{-11}	2.70×10^{-12}	2.21×10^{-12}	2.01×10^{-12}
2, DG3	9.49×10^{-11}	9.70×10^{-10}	2.23×10^{-12}	6.59×10^{-12}	2.72×10^{-11}	1.40×10^{-11}	2.70×10^{-12}	2.21×10^{-12}	2.01×10^{-12}
3, DG1	9.49×10^{-11}	9.70×10^{-10}	2.23×10^{-12}	6.59×10^{-12}	2.72×10^{-11}	1.40×10^{-11}	2.70×10^{-12}	2.21×10^{-12}	2.01×10^{-12}
3, DG2	9.49×10^{-11}	9.70×10^{-10}	2.23×10^{-12}	6.59×10^{-12}	2.72×10^{-11}	1.40×10^{-11}	2.70×10^{-12}	2.21×10^{-12}	2.01×10^{-12}
3, DG3	9.49×10^{-11}	9.70×10^{-10}	2.23×10^{-12}	6.59×10^{-12}	2.72×10^{-11}	1.40×10^{-11}	2.70×10^{-12}	2.21×10^{-12}	2.01×10^{-12}
Alternative Combination									
1	7.67×10^{-4}	8.51×10^{-3}	7.35×10^{-3}	6.48×10^{-3}	9.81×10^{-3}	7.33×10^{-3}	9.58×10^{-3}	9.24×10^{-3}	8.15×10^{-3}
2	2.78×10^{-3}	3.19×10^{-3}	3.65×10^{-3}	1.06×10^{-3}	5.71×10^{-3}	9.23×10^{-3}	3.03×10^{-3}	2.22×10^{-3}	4.82×10^{-3}
3	4.94×10^{-3}	6.83×10^{-3}	9.19×10^{-3}	2.25×10^{-3}	1.39×10^{-2}	2.37×10^{-2}	7.46×10^{-3}	5.31×10^{-3}	1.22×10^{-2}

Note: The maximum Hazard Index is indicated by **bold** text. Hazard Index is unitless.
Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility.

Table P–4. Long-Term Impacts of Chemical COPC Air Deposition on Terrestrial Resources at the Onsite Maximum-Exposure Location: Maximum Risk Index by Alternative

Alternative	Maximum Hazard Quotient	Chemical COPC	Receptor
Tank Closure			
1	1.16	Xylene	Great Basin pocket mouse
2A	1.52×10^{2}	Mercury	Side-blotched lizard
2B	1.66×10^{2}	Mercury	Side-blotched lizard
3A	3.92×10^{2}	Mercury	Side-blotched lizard
3B	1.23×10^{2}	Xylene	Great Basin pocket mouse
3C	3.92×10^{2}	Mercury	Side-blotched lizard
4	1.57×10^{2}	Mercury	Side-blotched lizard
5	1.49×10^{2}	Xylene	Great Basin pocket mouse
6A, Base Case	2.70×10^{2}	Xylene	Great Basin pocket mouse
6A, Option Case	2.74×10^{2}	Xylene	Great Basin pocket mouse
6B, Base Case	1.73×10^{2}	Mercury	Side-blotched lizard
6B, Option Case	1.71×10^{2}	Mercury	Side-blotched lizard
6C	1.71×10^{2}	Mercury	Side-blotched lizard
FFTF Decommissioning			
1	2.11×10^{3}	Xylene	Great Basin pocket mouse
2, Hanford Option	7.63	Xylene	Great Basin pocket mouse
2, Idaho Option	3.71	Xylene	Great Basin pocket mouse
3, Hanford Option	7.68	Xylene	Great Basin pocket mouse
3, Idaho Option	3.76	Xylene	Great Basin pocket mouse
Waste Management			
1	1.65	Xylene	Great Basin pocket mouse
2, DG1	8.70×10^{1}	Xylene	Great Basin pocket mouse
2, DG2	3.44×10^{2}	Xylene	Great Basin pocket mouse
2, DG3	4.67×10^{2}	Xylene	Great Basin pocket mouse
3, DG1	8.36×10^{1}	Xylene	Great Basin pocket mouse
3, DG2	3.41×10^{2}	Xylene	Great Basin pocket mouse
3, DG3	4.63×10^{2}	Xylene	Great Basin pocket mouse
Alternative Combination			
1	$\mathbf{2.12\times10^{3}}$	Xylene	Great Basin pocket mouse
2	1.92×10^{2}	Xylene	Great Basin pocket mouse
3	5.03×10^{2}	Xylene	Great Basin pocket mouse

Note: The maximum Hazard Quotient of all receptors is indicated by **bold** text. Risk indices are unitless.
Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility.

Table P–5. Long-Term Impacts of Chemical COPC Air Deposition on Terrestrial Resources at the Onsite Maximum-Exposure Location: Maximum Risk Index by Receptor

Receptor	Alternative	Maximum Hazard Quotient	Chemical COPC
Plants	Alternative Combination 1	4.68×10^{1}	Toluene
Soil-dwelling invertebrates	Tank Closure Alternatives 3A, 3C	2.33	Mercury
Side-blotched lizard	Tank Closure Alternatives 3A, 3C	3.92×10^{2}	Mercury
Great Basin pocket mouse	Alternative Combination 1	2.12×10^{3}	Xylene
Coyote	Alternative Combination 1	2.69×10^{2}	Xylene
Mule deer	Waste Management Alternative 2, DG3	9.97×10^{1}	Formaldehyde
Western meadowlark	Tank Closure Alternatives 3A, 3C	2.35×10^{2}	Mercury
Mourning dove	Tank Closure Alternatives 3A, 3C	1.94×10^{1}	Mercury
Burrowing owl	Tank Closure Alternatives 3A, 3C	1.64×10^{1}	Mercury

Note: Risk indices are unitless.

Key: COPC=constituent of potential concern; DG=Disposal Group.

Exposure to chemicals from air emissions under all alternatives exceeds the Hazard Quotient criterion of 1 for one or more receptors at the onsite maximum-exposure location. The highest Hazard Quotient for each alternative or alternative combination was either for side-blotched lizard exposed to mercury or Great Basin pocket mouse exposed to xylene (see Table P–4). Mercury had the highest Hazard Quotient for soil-dwelling invertebrates, lizards, and birds (Tank Closure Alternatives 3A and 3C), and Hazard Quotients for mercury exceeded 1 for plants, soil-dwelling invertebrates, and mammals under one or more Tank Closure alternative and alternative combination, except for Tank Closure Alternative 1 and Alternative Combination 1. Xylene had the highest Hazard Quotient for the Great Basin pocket mouse and coyote (Alternative Combination 1), and Hazard Quotients for xylene exceeded 1 for mammals under all Tank Closure, FFTF Decommissioning, and Waste Management alternatives and alternative combinations. Toluene had the highest Hazard Quotient for plants (Alternative Combination 1), and formaldehyde had the highest Hazard Quotient for the mule deer (Waste Management Alternative 2, Disposal Group 3). Hazard Quotients for toluene exceeded 1 for mammals under all alternatives except Tank Closure Alternative 1, Waste Management Alternative 1, and the Idaho Option for FFTF Decommissioning Alternatives 2 and 3. Hazard Quotients for formaldehyde exceeded 1 for the Great Basin pocket mouse and mule deer under all Tank Closure, FFTF Decommissioning, and Waste Management alternatives except Tank Closure Alternative 1, Waste Management Alternative 1, FFTF Decommissioning Alternative 2, Idaho Option, and Alternative 3. The maximum Hazard Quotient from emissions under all alternatives was calculated to be 2,120 for the Great Basin pocket mouse exposed to xylene under Alternative Combination 1, which comprises the No Action Alternatives for Tank Closure, FFTF Decommissioning, and Waste Management (see Table P–5). Three other chemical COPCs, benzene, toluene, and mercury, had Hazard Quotients between 1 and 20 for terrestrial receptors at the onsite maximum-exposure location.

The benzene, toluene, xylene, and formaldehyde Hazard Quotients above 1 would be unlikely to indicate significant risks to mammals for three reasons. First, benzene, toluene, xylene, and formaldehyde concentrations were overestimated because these substances are expected to dissipate (volatilization, biodegradation), not accumulate in soil, as was assumed for the risk calculations. High-end estimates of the half-lives of benzene, toluene, xylene, and formaldehyde in soil are 39 days, 22 days, 28 days, and 20 days, respectively (Howard et al. 1991). Second, the soil-dwelling invertebrate *BAF-S* might have been overestimated. The *BAF-S* was based on a *Daphnia* BCF using a log K_{ow} regression applied to soil-dwelling invertebrates exposed to soil pore water in equilibrium with soil at 1 percent organic carbon. *Daphnia* are aquatic organisms, and uptake via water by aquatic biota is expected to be greater than uptake via soil water by terrestrial biota. The Great Basin pocket mouse feeds on soil-dwelling invertebrates, so an overestimate of the *BAF-S* would result in greater chemical intake via ingestion of soil-dwelling invertebrates. Third, the use of lowest-observed adverse effect levels (LOAELs), which are greater than no-observed-adverse-effect levels, would result in further reduction of the Hazard Quotients. LOAELs are toxicological benchmarks associated with low levels of adverse effects on individuals, but which may not cause significant adverse impacts on populations. LOAELs are acceptable benchmarks for species that are not threatened or endangered. Thus, Hazard Quotients for the representative species likely overestimated the potential for adverse effects on onsite terrestrial resources.

The mercury Hazard Quotients above 1 do not necessarily indicate high risks to terrestrial ecological receptors at the onsite maximum-exposure location. The mercury TRV used to calculate the Hazard Quotients was the no-observed-adverse-effect level for methylmercury, which is highly toxic compared with the forms of mercury typically found in terrestrial environments. Mercury Hazard Quotients can be used to compare alternatives with confidence, but Hazard Quotients exceeding 1 should not be used as the basis to conclude that ecological resources at the onsite maximum-exposure location would be adversely impacted.

A potential adverse impact that could not be evaluated using the Hazard Quotients was the potential acidification of soil or water by deposition of the chemical COPCs nitrogen dioxide and sulfur dioxide. The deposition of nitrogen and sulfur dioxides in air emissions from site and WTP operations would be unlikely to acidify soil at Hanford. The Soil Survey for Benton County, Washington, describes the representative soil, the Quincy series, as ranging from mildly to moderately alkaline throughout (pH 7.8 to 8.4) and strongly effervescent in the lower part, indicating abundant calcium carbonate and acid-buffering capacity (Rasmussen 1971; NRCS 2008). The Quincy (Rupert) sand is derived from extensive alluvial and lacustrine flood deposits rather than from the basaltic rock in the area. The Burbank loamy sand, the second most widely distributed soil unit on the site, is very similar to the Quincy sand. The chemical properties table for Benton County does not indicate that the Quincy or Burbank soils are particularly saline. Soils in wetter regions of the western United States, especially soils derived from acidic parent materials, have little buffering capacity from calcium carbonate and other minerals because these minerals are leached out. In contrast, soils in arid regions such as Hanford tend to have a relatively high buffer capacity because soluble ions (particularly basic ions and associated minerals) tend to accumulate in the upper portion of the soil profile. With a pH (a measure of acidity/alkalinity) greater than 8 in the upper 20 centimeters (8 inches) according to the Natural Resources Conservation Service Soil Series Database and a reported soil pH of 7 for the 200 Area (Paragon Analytics 2003), soil acidification due to acid deposition from site and WTP emissions would not be a concern.

P.2.2.2 Offsite Terrestrial Resources

The results of the assessment of radioactive and chemical contaminant releases to air and subsequent deposition estimated for terrestrial receptors at the offsite maximum-exposure location under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives, as well as the alternative combinations, are summarized in Tables P–6, P–7, and P–8.

The maximum combined radiological Hazard Index from emissions under all alternatives was calculated to be 0.0000532 for the Great Basin pocket mouse under Tank Closure Alternative 6A, Option Case. Table P–6 presents the maximum Hazard Indices associated with air emissions calculated to reach the terrestrial receptors at the offsite maximum-exposure location (the Columbia River) under all alternatives. Exposure to radioactive COPCs from air emissions under all alternatives was below the l-rad-per-day benchmark for soil-dwelling invertebrates and plants and the 0.l-rad-per-day benchmark for terrestrial wildlife receptors (i.e., Woodhouse's toad, mule deer, mourning dove, Great Basin pocket mouse, western meadowlark, coyote, and burrowing owl). Estimated hazards for the representative species indicated that no adverse effects are expected for offsite terrestrial receptors from exposure to radioactive COPCs from air emissions. Because the direct impacts of air exposure are expected to be small, any associated, potential indirect impacts on the ecosystem would be correspondingly minor.

Table P–6. Long-Term Impacts of Radioactive COPC Air Deposition on Terrestrial Resources at the Offsite Maximum-Exposure Location: Maximum Hazard Indices by Receptor and Alternative

	Maximum Hazard Index by Receptor								
Alternative	**Plants**	**Soil Invertebrates**	**Woodhouse's Toad**	**Mule Deer**	**Mourning Dove**	**Great Basin Pocket Mouse**	**Western Meadowlark**	**Coyote**	**Burrowing Owl**
Tank Closure									
1	1.16×10^{-6}	9.80×10^{-6}	1.16×10^{-5}	1.03×10^{-5}	1.40×10^{-5}	1.12×10^{-5}	1.37×10^{-5}	1.34×10^{-5}	1.21×10^{-5}
2A	1.08×10^{-5}	2.11×10^{-5}	1.77×10^{-5}	1.42×10^{-5}	3.42×10^{-5}	4.42×10^{-5}	2.45×10^{-5}	2.11×10^{-5}	2.92×10^{-5}
2B	1.03×10^{-5}	1.17×10^{-5}	8.67×10^{-6}	6.53×10^{-6}	2.27×10^{-5}	3.53×10^{-5}	1.33×10^{-5}	1.03×10^{-5}	1.95×10^{-5}
3A	1.04×10^{-5}	1.19×10^{-5}	1.43×10^{-5}	1.21×10^{-5}	2.85×10^{-5}	4.13×10^{-5}	1.90×10^{-5}	1.60×10^{-5}	2.54×10^{-5}
3B	9.55×10^{-6}	1.08×10^{-5}	6.12×10^{-6}	4.05×10^{-6}	1.96×10^{-5}	3.17×10^{-5}	1.05×10^{-5}	7.67×10^{-6}	1.66×10^{-5}
3C	1.05×10^{-5}	1.22×10^{-5}	1.49×10^{-5}	1.23×10^{-5}	2.90×10^{-5}	4.23×10^{-5}	1.93×10^{-5}	1.65×10^{-5}	2.60×10^{-5}
4	1.02×10^{-5}	1.16×10^{-5}	8.91×10^{-6}	6.71×10^{-6}	2.32×10^{-5}	3.60×10^{-5}	1.36×10^{-5}	1.06×10^{-5}	2.00×10^{-5}
5	9.65×10^{-6}	1.11×10^{-5}	1.11×10^{-5}	8.94×10^{-6}	2.47×10^{-5}	3.71×10^{-5}	1.55×10^{-5}	1.27×10^{-5}	2.17×10^{-5}
6A, Base Case	1.20×10^{-5}	1.50×10^{-5}	8.14×10^{-6}	4.79×10^{-6}	2.83×10^{-5}	4.73×10^{-5}	1.49×10^{-5}	1.05×10^{-5}	2.43×10^{-5}
6A, Option Case	1.32×10^{-5}	1.71×10^{-5}	9.20×10^{-6}	5.42×10^{-6}	3.17×10^{-5}	**5.32×10^{-5}**	1.68×10^{-5}	1.19×10^{-5}	2.73×10^{-5}
6B, Base Case	1.24×10^{-5}	1.56×10^{-5}	1.13×10^{-5}	7.86×10^{-6}	3.19×10^{-5}	5.15×10^{-5}	1.82×10^{-5}	1.38×10^{-5}	2.79×10^{-5}
6B, Option Case	1.28×10^{-5}	1.64×10^{-5}	1.16×10^{-5}	8.14×10^{-6}	3.25×10^{-5}	5.22×10^{-5}	1.86×10^{-5}	1.41×10^{-5}	2.83×10^{-5}
6C	9.88×10^{-6}	1.15×10^{-5}	8.67×10^{-6}	6.50×10^{-6}	2.26×10^{-5}	3.53×10^{-5}	1.32×10^{-5}	1.03×10^{-5}	1.95×10^{-5}
FFTF Decommissioning									
1	0	0	0	0	0	0	0	0	0
2, Hanford Option	1.33×10^{-8}	1.64×10^{-8}	1.58×10^{-7}	1.31×10^{-7}	2.18×10^{-7}	1.62×10^{-7}	2.07×10^{-7}	2.35×10^{-7}	2.19×10^{-7}
2, Idaho Option	5.52×10^{-15}	7.57×10^{-14}	6.72×10^{-14}	3.02×10^{-14}	2.23×10^{-13}	4.14×10^{-13}	1.28×10^{-13}	8.97×10^{-14}	2.16×10^{-13}
3, Hanford Option	1.33×10^{-8}	1.64×10^{-8}	1.58×10^{-7}	1.31×10^{-7}	2.18×10^{-7}	1.62×10^{-7}	2.07×10^{-7}	2.35×10^{-7}	2.19×10^{-7}
3, Idaho Option	0	0	0	0	0	0	0	0	0
Waste Management									
1	0	0	0	0	0	0	0	0	0
2, DG1	2.19×10^{-13}	2.23×10^{-12}	4.53×10^{-15}	1.52×10^{-14}	6.25×10^{-14}	3.23×10^{-14}	6.21×10^{-15}	5.10×10^{-15}	4.62×10^{-15}
2, DG2	2.19×10^{-13}	2.23×10^{-12}	4.53×10^{-15}	1.52×10^{-14}	6.25×10^{-14}	3.23×10^{-14}	6.21×10^{-15}	5.10×10^{-15}	4.62×10^{-15}
2, DG3	2.19×10^{-13}	2.23×10^{-12}	4.53×10^{-15}	1.52×10^{-14}	6.25×10^{-14}	3.23×10^{-14}	6.21×10^{-15}	5.10×10^{-15}	4.62×10^{-15}
3, DG1	2.19×10^{-13}	2.23×10^{-12}	4.53×10^{-15}	1.52×10^{-14}	6.25×10^{-14}	3.23×10^{-14}	6.21×10^{-15}	5.10×10^{-15}	4.62×10^{-15}
3, DG2	2.19×10^{-13}	2.23×10^{-12}	4.53×10^{-15}	1.52×10^{-14}	6.25×10^{-14}	3.23×10^{-14}	6.21×10^{-15}	5.10×10^{-15}	4.62×10^{-15}
3, DG3	2.19×10^{-13}	2.23×10^{-12}	4.53×10^{-15}	1.52×10^{-14}	6.25×10^{-14}	3.23×10^{-14}	6.21×10^{-15}	5.10×10^{-15}	4.62×10^{-15}
Alternative Combination									
1	1.16×10^{-6}	9.80×10^{-6}	1.16×10^{-5}	1.03×10^{-5}	1.40×10^{-5}	1.12×10^{-5}	1.37×10^{-5}	1.34×10^{-5}	1.21×10^{-5}
2	1.03×10^{-5}	1.17×10^{-5}	8.83×10^{-6}	6.66×10^{-6}	2.30×10^{-5}	3.55×10^{-5}	1.35×10^{-5}	1.05×10^{-5}	1.98×10^{-5}
3	1.25×10^{-5}	1.56×10^{-5}	1.15×10^{-5}	7.99×10^{-6}	3.21×10^{-5}	5.16×10^{-5}	1.84×10^{-5}	1.40×10^{-5}	2.81×10^{-5}

Note: The maximum Hazard Index is indicated by **bold** text. Hazard Index is unitless.

Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility.

Table P–7. Long-Term Impacts of Chemical COPC Air Deposition on Terrestrial Resources at the Offsite Maximum-Exposure Location: Maximum Risk Index by Alternative

Alternative	Maximum Hazard Quotient	Chemical COPC	Receptor
Tank Closure			
1	4.20×10^{-3}	Xylene	Great Basin pocket mouse
2A	3.30×10^{-1}	Mercury	Western meadowlark
2B	3.60×10^{-1}	Mercury	Western meadowlark
3A	4.30×10^{-1}	Mercury	Western meadowlark
3B	2.45×10^{-1}	Mercury	Western meadowlark
3C	4.30×10^{-1}	Mercury	Western meadowlark
4	3.10×10^{-1}	Mercury	Western meadowlark
5	2.96×10^{-1}	Mercury	Western meadowlark
6A, Base Case	3.33×10^{-1}	Mercury	Western meadowlark
6A, Option Case	3.32×10^{-1}	Mercury	Western meadowlark
6B, Base Case	3.73×10^{-1}	Mercury	Western meadowlark
6B, Option Case	3.73×10^{-1}	Mercury	Western meadowlark
6C	3.73×10^{-1}	Mercury	Western meadowlark
FFTF Decommissioning			
1	2.41	Xylene	Great Basin pocket mouse
2, Hanford Option	8.69×10^{-3}	Xylene	Great Basin pocket mouse
2, Idaho Option	4.22×10^{-3}	Xylene	Great Basin pocket mouse
3, Hanford Option	8.75×10^{-3}	Xylene	Great Basin pocket mouse
3, Idaho Option	4.28×10^{-3}	Xylene	Great Basin pocket mouse
Waste Management			
1	3.53×10^{-3}	Xylene	Great Basin pocket mouse
2, DG1	1.01×10^{-1}	Xylene	Great Basin pocket mouse
2, DG2	3.95×10^{-1}	Xylene	Great Basin pocket mouse
2, DG3	5.32×10^{-1}	Xylene	Great Basin pocket mouse
3, DG1	9.85×10^{-2}	Xylene	Great Basin pocket mouse
3, DG2	3.93×10^{-1}	Xylene	Great Basin pocket mouse
3, DG3	5.30×10^{-1}	Xylene	Great Basin pocket mouse
Alternative Combination			
1	**2.42**	Xylene	Great Basin pocket mouse
2	3.60×10^{-1}	Mercury	Western meadowlark
3	5.73×10^{-1}	Xylene	Great Basin pocket mouse

Note: The maximum Hazard Quotient of all receptors is indicated by **bold** text. Risk indices are unitless.
Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility.

Table P–8. Long-Term Impacts of Chemical COPC Air Deposition on Terrestrial Resources at the Offsite Maximum-Exposure Location: Maximum Risk Index by Receptor

Receptor	Alternative	Maximum Hazard Quotient	Chemical COPC
Plants	Alternative Combination 1	5.34×10^{-2}	Toluene
Soil-dwelling invertebrates	Tank Closure Alternatives 3A, 3C	4.26×10^{-3}	Mercury
Woodhouse's toad	Tank Closure Alternatives 3A, 3C	2.97×10^{-1}	Mercury
Great Basin pocket mouse	Alternative Combination 1	2.42	Xylene
Coyote	Alternative Combination 1	3.07×10^{-1}	Xylene
Mule deer	Waste Management Alternative 2, DG3	1.16×10^{-1}	Formaldehyde
Western meadowlark	Tank Closure Alternatives 3A, 3C	4.30×10^{-1}	Mercury
Mourning dove	Tank Closure Alternatives 3A, 3C	3.55×10^{-2}	Mercury
Burrowing owl	Tank Closure Alternatives 3A, 3C	2.99×10^{-2}	Mercury

Note: Risk indices are unitless.

Key: COPC=constituent of potential concern; DG=Disposal Group.

Exposures to chemicals from air emissions under all alternatives would exceed the Hazard Quotient criterion of 1 only for the Great Basin pocket mouse exposed to xylene under FFTF Decommissioning Alternative 1 and Alternative Combination 1, which includes FFTF Decommissioning Alternative 1 (see Table P–7). No other chemical COPCs had Hazard Quotients exceeding 1 for terrestrial receptors at the offsite maximum-exposure location. The maximum Hazard Quotient from emissions under all alternatives for all receptors was calculated to be 2.42 for the Great Basin pocket mouse exposed to xylene (see Table P–8). The highest Hazard Quotient for each alternative or alternative combination was either for the western meadowlark exposed to mercury or the Great Basin pocket mouse exposed to xylene (see Table P–7). Table P–8 summarizes the maximum Hazard Quotient for each receptor. Mercury had the highest Hazard Quotient for soil-dwelling invertebrates, the Woodhouse's toad, and the three bird species—mourning dove, western meadowlark, and burrowing owl (Tank Closure Alternatives 3A and 3C). Xylene had the highest Hazard Quotient for the Great Basin pocket mouse and the coyote (Alternative Combination 1). Toluene had the highest Hazard Quotient for plants (Alternative Combination 1), and formaldehyde the highest Hazard Quotient for the mule deer (Waste Management Alternative 2, Disposal Group 3).

Estimated hazards for the representative species indicate that no adverse effects are expected for offsite terrestrial receptors from exposure to chemicals from air emissions. The xylene Hazard Quotients above 1 are unlikely to indicate significant risk to small mammals for the reasons discussed for the onsite terrestrial maximum-exposure location, i.e., short environmental half-life, overestimated bioaccumulation, and conservative toxicological benchmarks (see Section P.2.2.1). Because the direct impacts of air exposure are expected to be small, any associated, potential indirect impacts on the ecosystem would be correspondingly minor.

As discussed in Section P.2.2.1, the deposition of nitrogen and sulfur dioxides in air emissions from the Tank Closure, FFTF Decommissioning, and Waste Management alternatives would be unlikely to acidify offsite soils because of the natural buffering capacity of area soils. Thus, soil acidification due to deposition of chemical COPCs from site and WTP emissions would not be a concern.

P.2.2.3 Uncertainties

Uncertainty exists about the actual magnitude of future exposures and the threshold doses or benchmark concentration TRVs used to evaluate the long-term impact on terrestrial ecological resources of air releases. The uncertainties for chemical and radiological exposure estimates come from uncertainties in the source terms and transport models. Additional uncertainties are found in the BAFs and uptake factors, which are linear models based on simplifying assumptions. The uncertainties for toxicity and radiological effects thresholds arise from extrapolating from laboratory experiments on test species to Hanford receptor species in natural environments, as well as uncertainty about the chemical to which ecological receptors would be exposed (e.g., chemical COPC breakdown products, which can have greater toxicity than the COPC itself). The lack of TRVs for some chemical COPCs and some receptors also results in uncertainties. TRVs for some chemical COPCs were not available for soil-dwelling invertebrates or the Woodhouse's toad, western meadowlark, mourning dove, and burrowing owl. As a result, there were uncertainties associated with the ecological risk evaluation. For example, it was not known whether these receptors would be more sensitive than mammals. The effects of chemicals deposited on microbial crusts also were not known. Together, these uncertainties produced limited underestimates of risk and moderate overestimates of risk for different combinations of receptors and chemical or radioactive COPCs. The effects of these uncertainties were unbiased with respect to the alternatives being evaluated in this *TC & WM EIS*; thus, the results presented above accurately reflect the relative impacts of alternatives on ecological resources. In addition, conservative exposure assumptions and TRVs mitigated these uncertainties and allowed for confidence in "no risk" conclusions.

P.2.3 Summary of Terrestrial Impacts

Estimated radiation doses resulting from any of the alternatives were less than the 0.1-rad-per-day benchmark and did not exceed the 1-rad-per-day benchmark for terrestrial receptors at the on- and offsite maximum-exposure locations. All of the Hazard Indices associated with these alternatives were below 1. Estimated chemical doses resulting from any of the alternatives exceeded the Hazard Quotient criterion of 1 at the offsite terrestrial maximum-exposure location (the Columbia River) only for the Great Basin pocket mouse exposed to xylene under FFTF Decommissioning Alternative 1 and Alternative Combination 1, which includes FFTF Decommissioning Alternative 1. The low magnitude of the Hazard Quotients and the conservative exposure assumptions mean that long-term impacts on populations of small mammals under these alternatives would not be likely at the offsite maximum-exposure location. Although there were Hazard Quotients above 1 for mammals exposed to xylene and for plants, soil-dwelling invertebrates, lizards, mammals, and birds exposed to mercury at the onsite maximum-exposure location for many alternatives, the conservative exposure assumptions and toxicity benchmarks suggest that adverse impacts, while possible, would not be likely. Calculated risk indices for terrestrial resources from air releases were used in this *TC & WM EIS* to compare alternatives (Chapter 5) and evaluate cumulative impacts (Chapter 6).

P.3 IMPACTS ON COLUMBIA RIVER AQUATIC AND RIPARIAN RESOURCES RESULTING FROM CONTAMINANT RELEASES

Ecological resources in the Columbia River and its riparian habitat would potentially be adversely impacted by two types of contaminant releases: air releases during site and WTP operations in the near-term future and groundwater releases in the distant future. The different actions involved in the different alternatives would result in different amounts and timing of air releases, different amounts of waste remaining in the tanks, and different waste forms disposed of at the site, thereby potentially contributing to future groundwater releases to the Columbia River. The focus was on long-term future impacts on the river because no additional fast-moving substances would be added to the tanks under any of the alternatives. Groundwater modeling for Hanford has shown that the discharge of fast-moving substances in the plumes has already peaked, and there is no evidence of adverse impacts on aquatic and riparian receptors (Bryce et al. 2002). Concentrations of radionuclides and chemicals resulting from deposition of airborne contaminants were predicted over the construction and operation periods associated with the alternatives, as described in Appendix G. Groundwater contaminated by leaching from the 200 Areas would eventually reach and discharge into the Hanford Reach of the Columbia River; discharges over 10,000 years were predicted, as described in Appendix O. These predicted release concentrations were used to evaluate the long-term impacts on Columbia River aquatic and riparian ecological resources.

The potential for adverse effects on Columbia River aquatic and riparian ecological resources resulting from potential releases of radionuclides and chemicals through air emissions during waste handling and WTP operations, as well as future groundwater releases under the different alternatives, was evaluated using a quantitative risk assessment approach (63 FR 26846; EPA 1992, 1997). The general approach to this assessment is discussed in Section P.2.1. Impacts of sulfur and nitrogen oxide deposition on the water's pH were evaluated based on buffering capacity and predicted concentrations.

P.3.1 Impacts of Air Releases During Operations

Potential adverse impacts on Columbia River aquatic and riparian ecological resources resulting from air releases of radionuclides or chemicals during WTP operations were evaluated for all alternatives. Under all alternatives, radionuclides and chemicals emitted to the air during WTP operations would potentially be transported away from the source to the Columbia River and to offsite terrestrial locations. The potential impacts on terrestrial ecological resources (i.e., terrestrial biota) at the offsite maximum-exposure location (the Columbia River) of contaminants released by air emission are discussed in Section P.2. The evaluation of potential adverse impacts on aquatic and riparian ecological resources (e.g., aquatic biota and their predators) at the Columbia River is described below.

P.3.1.1 Methods

The general approach for assessing potential adverse effects on aquatic and riparian ecological resources is discussed in Section P.2.1. The assumptions; receptors; exposure pathways and uptake mechanisms (routes); predicted air, soil, sediment, and surface-water concentrations; exposure model equations; and benchmarks used to model exposure for aquatic and riparian ecological resources potentially impacted by contaminant releases are described in the relevant sections below. The quantitative evaluations of long-term adverse impacts on aquatic and riparian resources of air releases, based on Hazard Quotients, Hazard Indices, and river water pH, are summarized and discussed in Section P.3.1.2. Impacts of sulfur and nitrogen oxide deposition on the pH were evaluated based on buffering capacity and predicted concentrations.

P.3.1.1.1 Key Assumptions

The following key assumptions were made in the evaluation of potential impacts on Columbia River aquatic and riparian resources resulting from exposure to radionuclides and chemicals released to air during closure operations:

- There would be no riparian soil contamination prior to tank closure activities.
- Soil contamination from air releases would not coincide with soil contamination from groundwater releases because material released to air during site and WTP operations would dissipate before slow-moving constituents discharge to riparian soil at the Columbia River.
- The concentrations of constituents in the tissues of fish preyed upon by predators (least weasel and bald eagle) would be in equilibrium with the concentrations in nearshore surface water.
- The concentrations of inorganic chemical and radioactive COPCs in Columbia River nearshore sediment would be equal to riparian soil concentrations.
- The concentrations of organic chemical COPCs in Columbia River sediment would be in equilibrium with concentrations in nearshore surface water.

These assumptions allowed a conservative assessment of the impact of air releases on ecological resources.

P.3.1.1.2 Receptors and Exposure Pathways and Routes

The receptors selected to represent the Columbia River aquatic and riparian ecological resources, including special status species (see Chapter 3, Section 3.2.7.4), are listed in Table P–2. These receptors were selected because they are among those expected to have higher exposures than those not selected from their group due to their higher ingestion rates per unit body weight for prey, water, and sediment or soil. Special status species are not expected to be more highly exposed or more sensitive to contaminants than the selected species. The selected representative receptors were sediment-dwelling benthic invertebrates, aquatic biota, including Woodhouse's toad tadpoles and salmonids, raccoon, spotted sandpiper, least weasel, and bald eagle. All were ECEM receptors except the spotted sandpiper, which was substituted for the common snipe because the spotted sandpiper has a more aquatic diet.

The exposure pathways evaluated in the ecological risk analysis for this *TC & WM EIS* are shown in Table P–2 for all ecological receptors. The exposure medium, exposure route, and receptor are indicated for each pathway evaluated in the analysis of impacts on aquatic and riparian resources of air releases.

P.3.1.1.3 Predicted Sediment and Surface-Water Concentrations

The riparian soil, sediment, and surface-water concentrations under Tank Closure Alternatives 1 through 6C; FFTF Decommissioning Alternatives 1, 2, and 3 (Hanford and Idaho Options); and Waste Management Alternatives 1, 2, and 3 were calculated from the modeled air deposition rates at the Columbia River (see Appendix G). The riparian soil concentrations resulting from air deposition would be cumulative and were calculated assuming deposition on the riparian shoreline and accumulation on the ground surface over the operations period. Sediment concentrations of inorganic chemical and radioactive COPCs would be the cumulative soil concentrations calculated as described in Section P.2.1. Sediment concentrations of organic chemical COPCs were calculated as the product of the maximum nearshore surface-water concentration, the organic carbon-partitioning coefficient (K_{oc}) and the fraction of organic carbon content, which was conservatively assumed to be 0.04, four times greater than the ECEM value (DOE 1998). The maximum nearshore surface-water concentration (C_w) and water-column surface-water concentration (C_{wc}) were calculated assuming that the amount of material deposited on the water surface of the Hanford Reach on an annual basis is mixed into a 0.5-meter-deep (1.6-foot-deep) nearshore zone extending 40 meters (44 yards) into the river and throughout the water column. The resulting sediment and surface-water concentrations under Tank Closure Alternatives 1 through 6C; FFTF Decommissioning Alternatives 1, 2, and 3 (Hanford and Idaho Options); and Waste Management Alternatives 1, 2, and 3 were used as the source terms in the exposure model described below.

P.3.1.1.4 Exposure Model Calculations

The exposure model calculated external and internal doses from radioactive COPCs for all receptors and ingestion doses from chemical COPCs for wildlife receptors. To calculate internal doses for radioactive COPCs in receptors exposed by direct contact with sediment (benthic invertebrates) and surface water (aquatic biota, including salmonids) and to calculate the ingested doses for wildlife receptors exposed to chemical COPCs in these biota (spotted sandpipers, raccoons, least weasels, and bald eagles), the concentrations of radioactive and chemical COPCs in benthic invertebrates and aquatic biota were required.

For benthic invertebrates, the concentration of COPCs was calculated as follows:

$$C_a = C_{\text{sed}} \times BASF$$

For trophic-level-3 fish (salmonids), the concentration was calculated as follows:

$$C_a = C_w \times BCF_{\text{fish}} \times FCM_3 \times CF$$

where:

C_a	=	concentration in animal food, milligrams per kilogram wet weight or picocuries per gram wet weight
C_{sed}	=	sediment concentration, milligrams per kilogram dry sediment or picocuries per gram dry sediment
BASF	=	sediment-to-benthic invertebrate bioaccumulation factor, kilograms dry sediment per kilogram wet tissue
C_w	=	nearshore surface-water concentration, milligrams per liter or picocuries per liter
BCF_{fish}	=	water-to-fish bioconcentration factor, liters water per kilogram wet tissue
FCM_3	=	food chain multiplier for trophic-level-3 fish
CF	=	unit conversion factor, 1 kilogram per kilogram for chemical COPCs, 0.001 kilograms per gram for radioactive COPCs

Food chain multipliers are factors accounting for the accumulation and biomagnification in fish via the food web (EPA 1995).

P.3.1.1.4.1 External Doses from Radionuclides

External doses to all aquatic receptors would result from exposure to radioactive COPCs in soil, air, water, and sediment. External doses to Woodhouse's toad adults from radionuclides in soil and air are evaluated in Section P.2.2. Exposure of Woodhouse's toad tadpoles was evaluated along with aquatic biota and salmonids. Wildlife receptors (raccoon, spotted sandpiper, bald eagle, and least weasel) would be exposed externally to radionuclides in soil, air, and water. External radiation from soil, sediment, and water was modeled as described in *Methodology for Estimating Radiation Dose Rates to Freshwater Biota Exposed to Radionuclides in the Environment* (Blaylock, Frank, and O'Neal 1993). External radiation doses for aquatic biota, including Woodhouse's toad tadpoles and salmonids, raccoons, spotted sandpipers, benthic invertebrates, bald eagles, and least weasels were adjusted for the fraction of time the receptors were assumed to be immersed in water away from sediment, sufficiently near the water to receive external radiation, on nearshore soil, resting on sediment, and immersed in sediment (see Table P–2). Those fractions (based on professional judgment) were as follows:

- Aquatic biota: immersed in water, 0.9; resting on sediment, 0.1; and immersed in sediment, 0.
- Raccoon: near water, 0.083; above ground, 0.5; below ground, 0.5; resting on sediment, 0; and immersed in sediment, 0.
- Spotted sandpiper: near water, 0.5; above ground, 1; resting on sediment, 0; and immersed in sediment, 0.
- Benthic invertebrates: immersed in sediment, 0.9; immersed in water, 0.1; and resting on sediment, 0.
- Bald eagle: near water, 0.05; resting on sediment, 0; and immersed in sediment, 0.
- Least weasel: immersed in water, 0.2; above ground, 0.5; below ground, 0.5; resting on sediment, 0; and immersed in sediment, 0.

For this *TC & WM EIS*, aquatic biota and benthic invertebrates were assumed to spend their entire lives in water. Therefore, the fractions of time spent immersed in water (F_{imm}), at the sediment-water interface (F_s), and immersed in sediment (F_{in}) sum to unity (1) for these receptors. For aquatic biota and benthic invertebrates, F_{imm} can be calculated by subtraction (i.e., $1 - F_s - F_{\text{in}}$).

The external doses (rad per day) to all aquatic receptors from water and sediment were calculated, respectively, as follows:

$$RD_{\text{Ext-water, imm}} = C_w \times DF_{\text{water, imm}}$$

and

$$RD_{\text{Ext-sed}} = C_{\text{sed}} \times DF_{\text{sediment}}$$

where:

$RD_{\text{Ext-water, imm}}$	=	external radiation dose from immersion in water, rad per day
C_w	=	total activity of radioactive COPC in water, picocuries per liter
$DF_{\text{water, imm}}$	=	factor for converting activity in water to external dose from water immersion
$RD_{\text{Ext-sed}}$	=	external radiation dose from sediment, rad per day
C_{sed}	=	activity of radionuclide in sediment, picocuries per gram
DF_{sediment}	=	factor for converting activity in sediment to external dose from sediment

The external dose factor for immersion in water ($DF_{\text{water, imm}}$) was calculated as follows (Blaylock, Frank, and O'Neal 1993):

$$DF_{\text{water, imm}} = (F_{\text{imm}}) \times 0.001 \times CFa \times [(1 - \Phi_\beta) \times E_\beta n_\beta + (1 - \Phi_\gamma) \times E_\gamma n_\gamma]$$

where:

F_{imm}	=	fraction of time receptor spends immersed in water, unitless
0.001	=	factor for converting liters to grams
CFa	=	unit conversion factor, 5.11×10^{-5} rad per day per picocurie per gram per MeV per disintegration
Φ_β	=	absorbed fraction of energy from beta energy E_β
$E_\beta n_\beta$	=	average energy emitted as beta radiation, MeV per disintegration × proportion of disintegrations producing a beta particle
Φ_γ	=	absorbed fraction of energy from gamma energy E_γ
$E_\gamma n_\gamma$	=	photon energy emitted during transition from a higher to a lower energy state, MeV × proportion of disintegrations producing gamma radiation

Values of F_{imm} are given in the first paragraph of this subsection. The calculation of exposure of ecological receptors to radioactive COPCs in sediment included the dose from the decay products, known as daughters. This conservative approach to calculating dose was adopted because sediment is likely to have a longer residence time than water and air, and radioactive COPCs and their daughters would remain longer in sediment than in soil; soil-loss processes are ignored in the calculation of dose from COPCs in soil. The activity of each of the daughter radionuclides equals the activity of the parent multiplied by the fraction of the decays in the immediately preceding generation that yield the daughter. Exposure factors for the daughter radionuclides were used to calculate the contribution of the daughters to the summed exposure from the parent and all daughter radionuclides for both external and internal radiation doses from radioactive COPCs in sediment.

The external dose factor for sediment ($DF_{sediment}$) was calculated as follows (Blaylock, Frank, and O'Neal 1993):

$$DF_{sediment} = (0.5 \times F_s + F_{in}) \times CFa \times [(1 - \Phi_\beta) \times E_\beta n_\beta + (1 - \Phi_\gamma) \times E_\gamma n_\gamma]$$

where:

0.5	=	factor accounting for assumption that a receptor at the sediment–water interface receives external radiation from sediment only from below, so the dose is only half of the dose from immersion
F_s	=	fraction of time receptor spends at the sediment–water interface, unitless
F_{in}	=	fraction of time receptor spends buried in sediment, unitless
CFa	=	unit conversion factor, 5.11×10^{-5} rad per day per picocurie per gram per MeV per disintegration
Φ_β	=	absorbed fraction of energy from beta energy E_β
$E_\beta n_\beta$	=	average energy emitted as beta radiation, MeV per disintegration × proportion of disintegrations producing a beta particle
Φ_γ	=	absorbed fraction of energy from gamma energy E_γ
$E_\gamma n_\gamma$	=	photon energy emitted during transition from a higher to a lower energy state, MeV × proportion of disintegrations producing gamma radiation

Values of F_s and F_{in} are given in the first paragraph of this subsection. To calculate external exposure to all aquatic receptors from radioactive COPCs in water and sediment, $DF_{water, imm}$ and $DF_{sediment}$ values were multiplied by the modeled activities of the corresponding radionuclides in surface water and the corresponding radionuclides and their daughters in sediment.

The external dose (rad per day) to all wildlife receptors from air (Eckerman and Ryman 1993) was calculated per the equations presented in Section P.2.1.4. To calculate external exposure to all aquatic receptors from radioactive COPCs in air, DCF values were multiplied by the modeled activities of the corresponding radionuclides in air.

The external dose (rad per day) for all wildlife receptors from proximity to water containing radioactive COPCs was calculated as follows (Eckerman and Ryman 1993):

$$RD_{Ext\text{-}water,\ near} = C_w \times DF_{water,\ near}$$

where:

$RD_{Ext\text{-}water,\ near}$	=	external radiation dose from proximity to water, rad per day
C_w	=	total activity of radioactive COPC in nearshore surface water, picocuries per liter
$DF_{water,\ near}$	=	factor for converting activity in water to external dose from water

The external dose factor for water ($DF_{water,\ near}$) for wildlife receptors was calculated as follows (Blaylock, Frank, and O'Neal 1993):

$$DF_{water,\ near} = C_w \times F_{near} \times 0.001 \times CFa \times [(1 - \Phi_\gamma) \times E_\gamma n_\gamma]$$

where:

C_w	=	total activity of radioactive COPC in nearshore surface water, picocuries per liter
F_{near}	=	fraction of time receptor spends near the water, unitless
0.001	=	factor for converting liters to grams

CFa	=	unit conversion factor, 5.11×10^{-5} rad per day per picocuries per gram per MeV per disintegration
Φ_γ	=	absorbed fraction of energy from gamma energy E_γ
$E_\gamma n_\gamma$	=	photon energy emitted during transition from a higher to a lower energy state, MeV × proportion of disintegrations producing gamma radiation

To calculate external exposure to all aquatic receptors from radioactive COPCs in water, $DF_{\text{water, near}}$ values were multiplied by the modeled total activities of the corresponding radionuclides in surface water.

P.3.1.1.4.2 Internal Doses from Radionuclides

Internal exposure to radionuclides was calculated from activity in tissues, rather than from daily ingestion, using the equations presented in Section P.2.1.4. The internal activities of radioactive COPCs were calculated by using BAFs and BCFs, along with radioactive COPC activities in sediment and water. For radionuclides in sediment, radiation by daughter radionuclides was also included in internal dose calculations. Decay energies and absorption fractions for gamma radiation for radioactive COPCs and daughter radionuclides came from Eckerman and Ryman (1993); Blaylock, Frank, and O'Neal (1993); and Sample et al. (1997).

The internal dose to aquatic receptors and wildlife receptors was calculated as follows (Sample et al. 1997):

$$RD_{\text{Int}} = C_n \times DF_{\text{Int}}$$

where:

$$DF_{\text{Int}} = CFa \times (QF \times E_\alpha n_\alpha \times \Phi_\alpha + E_\beta n_\beta \times \Phi_\beta + E_\gamma n_\gamma \times \Phi_\gamma)$$

and

RD_{Int}	=	internal radiation dose from ingestion of radioactive COPCs, rad per day
C_n	=	activity of radionuclide in receptor tissue, picocuries per gram
DF_{Int}	=	factor for converting radioactive COPC activity in tissue to internal dose
CFa	=	unit conversion factor, 5.11×10^{-5} rad per day per picocuries per gram per MeV per disintegration
QF	=	5, quality factor for biological effect of alpha radiation (Kocher and Trabalka 2000), unitless
$E_\alpha n_\alpha$	=	average energy emitted as alpha radiation, MeV per disintegration × proportion of disintegrations producing an alpha particle
Φ_α	=	absorbed fraction of energy from alpha energy E_α
$E_\beta n_\beta$	=	average energy emitted as beta radiation, MeV per disintegration × proportion of disintegrations producing a beta particle
Φ_β	=	absorbed fraction of energy from beta energy E_β
$E_\gamma n_\gamma$	=	photon energy emitted during transition from a higher to a lower energy state, MeV × proportion of disintegrations producing gamma radiation
Φ_γ	=	absorbed fraction of energy from gamma energy E_γ

To calculate internal exposure to all aquatic receptors from ingested radioactive COPCs, DF_{Int} values were multiplied by the modeled activities of the corresponding radionuclides in receptor tissues. For receptors ingesting sediment or prey exposed to sediment, only the fraction of tissue activity or concentration coming from sediment directly or indirectly through ingested prey was multiplied by the DF_{Int} values for daughters of radioactive COPCs.

Following the approach for terrestrial plants (see Section P.2.1.4), the concentration of carbon-14 in benthic invertebrates was calculated assuming that the ratio of carbon-14 to the natural carbon in tissue would be equal to the ratio of carbon-14 to the natural carbon in Columbia River nearshore surface water:

$$C_a = C_w \times 0.11/0.014$$

where:

C_a	=	concentration of carbon-14 in benthic invertebrates, picocuries per gram wet tissue
C_w	=	concentration of carbon-14 in nearshore surface water, picocuries per liter
0.11	=	fraction of the total animal mass that is natural carbon, grams carbon per gram wet tissue
0.014	=	concentration of natural carbon in Columbia River nearshore surface water, grams carbon per liter water

The concentration of natural carbon in Columbia River nearshore surface water was calculated from median alkalinity (57 milligrams calcium carbonate per liter) and pH (7.8) values for the Columbia River (Poston et al. 2007), as well as equilibrium constants for the aqueous carbonate solution, $pK_1 = 6.3$ and $pK_2 = 10.25$ (Stumm and Morgan 1970).

Likewise, the concentration of tritium in benthic invertebrates was calculated assuming that the specific activity of tritium in tissue would be equal to the specific activity in Columbia River nearshore surface water, as follows:

$$C_a = C_w \times 0.8/1{,}000$$

where:

C_a	=	concentration of tritium in benthic invertebrates, picocuries per gram
C_w	=	concentration of tritium in nearshore surface water, picocuries per liter
0.8	=	fraction of animal mass that is water
1,000	=	grams water per liter

The concentrations of carbon-14 and tritium in fish would be equal to those of benthic invertebrates. The concentrations of carbon-14 and tritium in wildlife receptors would be equal to the concentrations in their animal prey.

P.3.1.1.4.3 Exposure Doses from Chemicals

For aquatic and riparian receptors exposed to chemicals by multiple pathways (direct contact, ingestion, respiration) resulting from living in sediment or surface water, exposure was not calculated. The assessment of impacts for these receptors was made by comparing estimated sediment, sediment pore water, or surface-water concentrations to appropriate benchmark concentrations for these receptors (see Section P.3.1.1.5). Exposure was estimated only for wildlife receptors exposed to chemical and radioactive COPCs via ingestion. Inhalation was not included because there would be little to no resuspension of sediment or riparian soil into air. The ingestion ADD for chemical COPCs was compared with benchmark doses to characterize risk.

The ingestion doses to aquatic wildlife receptors from chemical COPCs in surface water and sediment were calculated as the sum of doses from ingesting water, sediment, and food as follows:

$$ADD_{\text{total}} = ADD_{\text{water}} + ADD_{\text{sediment}} + ADD_{\text{food}}$$

where:

ADD_{total} = total dose of chemical from ingestion of water, animal food, and sediment, milligrams per kilogram body weight per day
ADD_{water} = dose of chemical from ingestion of water, milligrams per kilogram body weight per day
ADD_{sediment} = dose of chemical from ingestion of sediment, milligrams per kilogram body weight per day
ADD_{food} = dose of chemical from ingestion of animal food, milligrams per kilogram body weight per day

and

$$ADD_{\text{water}} = C_w \times IR_w \times CF$$

where:

C_w = nearshore surface-water concentration, milligrams per liter
IR_w = ingestion rate of water by the receptor, liters per kilogram body weight per day
CF = unit conversion factor, 1 for chemical COPCs

and

$$ADD_{\text{sediment}} = C_{\text{sed}} \times IR_s = C_{\text{sed}} \times IR_f \times SF$$

where:

C_{sed} = concentration in sediment, milligrams per kilogram dry sediment
IR_s = ingestion rate of sediment by the receptor, kilograms dry sediment per kilogram body weight per day
IR_f = daily food ingestion rate, kilograms wet weight per kilogram body weight per day
SF = sediment ingested as a fraction of food ingested, kilograms dry sediment per kilogram wet weight food

and

$$ADD_{\text{food}} = C_a \times IR_a = C_a \times IR_f \times AF$$

where:

C_a = concentration of chemical COPC in animal food, milligrams per kilogram wet food
IR_a = ingestion rate of animal food by the receptor, kilograms wet food per kilogram body weight per day
IR_f = daily food ingestion rate, kilograms wet weight per kilogram body weight per day
AF = animal fraction of diet: prey

Spotted sandpipers and raccoons were assumed to eat benthic invertebrates living in nearshore sediment and exposed to nearshore sediment pore water. Bald eagles and least weasels were assumed to eat fish, such as salmonids, exposed to nearshore surface water.

The area use and temporal use factors were assumed to equal 1 for conservatism, so they did not appear in the exposure equations.

P.3.1.1.5 Toxicological Benchmarks

The benchmark for combined internal and external exposure from all radionuclides is 0.1 rad per day for the spotted sandpiper, raccoon, least weasel, and bald eagle (IAEA 1992) and l rad per day for aquatic biota and benthic invertebrates (NCRP 1991). Chemical benchmarks for aquatic biota, including

Woodhouse's toad larval forms and salmonids, were surface-water concentrations (milligrams per liter); TRVs for benthic invertebrates exposed to water and sediment were sediment concentrations (milligrams per kilogram); and TRVs for wildlife receptors potentially impacted by chemicals released to the Columbia River via air emissions were doses (milligrams per kilogram per day). All TRVs were chemical-specific literature values from a variety of published sources (e.g., Jones, Suter, and Hull 1997; Sample, Opresko, and Suter 1996; Suter and Tsao 1996).

P.3.1.1.6 Risk Indices

As discussed in Section P.2.1, the long-term impacts on ecological resources of potential radionuclide and chemical releases were evaluated by comparing estimates of exposure for a given ecological receptor for a given chemical or radioactive COPC under each alternative to threshold exposures associated with a known level of adverse effect of the COPC on that type of receptor. The estimate of chemical exposure concentration under each alternative for sediment-dwelling (benthic) invertebrates was the predicted sediment concentration; for aquatic biota, including salmonids, it was the predicted surface-water concentration (see Appendix G). The methods for estimating exposure doses for aquatic and riparian receptors from predicted air, water, and sediment concentrations were defined in Section P.3.1.1.4. The exposure concentrations or doses associated with a known level of adverse effect were the TRVs (see Section P.3.1.1.5). A comparison of these two values was made by calculating a risk index, the dimensionless ratio of the exposure estimate (concentration or dose) to corresponding TRV (concentration or dose). These calculated risk indices, i.e., the Hazard Quotients for individual chemical COPCs and the Hazard Indices for all radioactive COPCs combined, were used to compare the long-term impacts of the *TC & WM EIS* alternatives (see Chapter 5) and to identify exposures posing little or no risk (Hazard Quotient or Hazard Index less than or equal to unity [1]).

The risk indices were calculated as follows:

For benthic invertebrates exposed to chemical COPCs in sediments,

$$HQ = C_{\mathrm{sed}} / TRV$$

where:

HQ = Hazard Quotient
C_{sed} = concentration in sediment, milligrams per kilogram dry sediment
TRV = toxicity reference value, milligrams per kilogram

For aquatic biota, including salmonids exposed to chemical COPCs in surface water,

$$HQ = C_w / TRV$$

where:

HQ = Hazard Quotient
C_w = nearshore surface-water concentration, milligrams per liter
TRV = toxicity reference value, milligrams per liter

For wildlife receptors exposed to chemical COPCs in air, sediment and surface water,

$$HQ = ADD_{\mathrm{total}} / TRV$$

where:

HQ = Hazard Quotient
ADD_{total} = total dose of chemical from ingestion of water, animal food, and sediment, milligrams per kilogram body weight per day
TRV = toxicity reference and value, milligrams per kilogram body weight per day

and for all receptors, the Hazard Index is the sum of external and internal doses from all radioactive COPCs divided by the TRV; that is,

$$HI = (RD_{Ext} + RD_{Int}) \,/\, TRV$$

where:

HI = Hazard Index
RD_{Ext} = external radiation dose from exposure to radioactive COPCs in air, soil, sediment, and/or water, rad per day
RD_{Int} = internal radiation dose from radioactive COPCs, rad per day
TRV = toxicity reference value, rad per day

Except where an exposure parameter or TRV was not available for a given receptor or COPC, the dose (ADD_{total}) and Hazard Quotient for all chemical COPCs and the dose (RD_{Ext} + RD_{Int}) summed over all radioactive COPCs and the Hazard Index were calculated for all aquatic and riparian receptors that potentially would be exposed at the Columbia River under all *TC & WM EIS* alternatives using predicted air, surface-water, and sediment concentrations resulting from air releases during operations. Tables with predicted air, surface-water, and sediment concentrations; input parameters; and calculations of dose and risk indices are available in *Calculating Risk Indices for Long-Term Impacts to Ecological Receptors – Releases to Air* (SAIC 2011a).

Radiological and chemical hazards estimated for potential aquatic receptors and terrestrial wildlife feeding in the Columbia River due to exposure to contaminants released to the air and subsequently deposited in the Columbia River are summarized below using maximum Hazard Quotients and Hazard Indices. Hazards due to discharge from groundwater for aquatic receptors and terrestrial wildlife feeding in the Columbia River are discussed in Section P.3.2.

P.3.1.2 Results and Discussion

The results of the screening analysis for radioactive contaminant releases to air and subsequent deposition estimated for aquatic receptors and terrestrial wildlife feeding in the Columbia River under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives, as well as the alternative combinations, are summarized in Tables P–9, P–10, and P–11.

The maximum combined radiological Hazard Index from emissions under all alternatives was calculated to be 0.00134 for the spotted sandpiper under Tank Closure Alternative 6A, Option Case. Table P–9 presents the maximum Hazard Indices associated with air emissions calculated to reach the Columbia River under all alternatives. Exposure to radioactive COPCs from air emissions under all alternatives would be below the 1-rad-per-day benchmark for benthic invertebrates and aquatic biota, including salmonids, and the 0.1-rad-per-day benchmark for terrestrial wildlife receptors (i.e., the spotted sandpiper, raccoon, bald eagle, and least weasel). Estimated hazards for the representative species indicate that no adverse effects are expected for aquatic receptors and terrestrial wildlife feeding in the Columbia River from exposure to radioactive COPCs from air emissions. Because the direct impacts of air exposure are expected to be small, any associated, potentially indirect impacts on the ecosystem would be correspondingly minor.

Table P–9. Long-Term Impacts of Radioactive COPC Air Deposition on Aquatic and Riparian Resources at the Columbia River: Hazard Indices by Receptor and Alternative

Alternative	Hazard Index by Receptor					
	Benthic Invertebrates	Spotted Sandpiper	Raccoon	Bald Eagle	Least Weasel	Aquatic Biota/ Salmonids
Tank Closure						
1	2.86×10^{-4}	1.04×10^{-4}	4.99×10^{-5}	1.24×10^{-7}	3.17×10^{-6}	6.57×10^{-7}
2A	4.91×10^{-4}	9.33×10^{-4}	4.49×10^{-4}	2.33×10^{-5}	4.67×10^{-5}	8.36×10^{-6}
2B	2.10×10^{-4}	8.41×10^{-4}	4.16×10^{-4}	4.40×10^{-5}	6.50×10^{-5}	9.97×10^{-6}
3A	2.11×10^{-4}	8.90×10^{-4}	4.60×10^{-4}	8.31×10^{-5}	1.03×10^{-4}	1.37×10^{-5}
3B	1.98×10^{-4}	7.87×10^{-4}	3.79×10^{-4}	2.26×10^{-5}	4.28×10^{-5}	7.50×10^{-6}
3C	2.12×10^{-4}	8.99×10^{-4}	4.64×10^{-4}	8.31×10^{-5}	1.04×10^{-4}	1.38×10^{-5}
4	2.10×10^{-4}	8.50×10^{-4}	4.16×10^{-4}	3.75×10^{-5}	5.79×10^{-5}	9.19×10^{-6}
5	1.99×10^{-4}	8.35×10^{-4}	4.20×10^{-4}	5.70×10^{-5}	7.72×10^{-5}	1.10×10^{-5}
6A, Base Case	2.77×10^{-4}	1.19×10^{-3}	5.69×10^{-4}	1.74×10^{-5}	3.88×10^{-5}	8.69×10^{-6}
6A, Option Case	3.10×10^{-4}	$\mathbf{1.34\times10^{-3}}$	6.38×10^{-4}	1.76×10^{-5}	3.94×10^{-5}	9.32×10^{-6}
6B, Base Case	2.85×10^{-4}	1.25×10^{-3}	6.11×10^{-4}	4.47×10^{-5}	6.71×10^{-5}	1.17×10^{-5}
6B, Option Case	2.93×10^{-4}	1.27×10^{-3}	6.17×10^{-4}	4.48×10^{-5}	6.72×10^{-5}	1.18×10^{-5}
6C	2.06×10^{-4}	8.40×10^{-4}	4.15×10^{-4}	4.39×10^{-5}	6.49×10^{-5}	9.89×10^{-6}
FFTF Decommissioning						
1	0	0	0	0	0	0
2, Hanford Option	1.54×10^{-7}	1.09×10^{-6}	5.98×10^{-7}	2.42×10^{-8}	1.19×10^{-7}	9.60×10^{-9}
2, Idaho Option	1.40×10^{-12}	1.05×10^{-11}	5.02×10^{-12}	3.39×10^{-13}	9.70×10^{-13}	1.15×10^{-13}
3, Hanford Option	1.54×10^{-7}	1.09×10^{-6}	5.97×10^{-7}	2.42×10^{-8}	1.19×10^{-7}	9.60×10^{-9}
3, Idaho Option	0	0	0	0	0	0
Waste Management						
1	0	0	0	0	0	0
2, DG1	1.09×10^{-11}	8.34×10^{-13}	3.62×10^{-13}	9.10×10^{-16}	5.06×10^{-15}	5.33×10^{-14}
2, DG2	1.09×10^{-11}	8.34×10^{-13}	3.62×10^{-13}	9.10×10^{-16}	5.06×10^{-15}	5.33×10^{-14}
2, DG3	1.09×10^{-11}	8.34×10^{-13}	3.62×10^{-13}	9.10×10^{-16}	5.06×10^{-15}	5.33×10^{-14}
3, DG1	1.09×10^{-11}	8.34×10^{-13}	3.62×10^{-13}	9.10×10^{-16}	5.06×10^{-15}	5.33×10^{-14}
3, DG2	1.09×10^{-11}	8.34×10^{-13}	3.62×10^{-13}	9.10×10^{-16}	5.06×10^{-15}	5.33×10^{-14}
3, DG3	1.09×10^{-11}	8.34×10^{-13}	3.62×10^{-13}	9.10×10^{-16}	5.06×10^{-15}	5.33×10^{-14}
Alternative Combination						
1	2.86×10^{-4}	1.04×10^{-4}	4.99×10^{-5}	1.24×10^{-7}	3.17×10^{-6}	6.57×10^{-7}
2	2.11×10^{-4}	8.42×10^{-4}	4.16×10^{-4}	4.40×10^{-5}	6.51×10^{-5}	9.98×10^{-6}
3	2.85×10^{-4}	1.25×10^{-3}	6.11×10^{-4}	4.47×10^{-5}	6.72×10^{-5}	1.18×10^{-5}

Note: The maximum Hazard Index is indicated by **bold** text. Hazard Index is unitless.
Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility.

No receptor exposed to chemical COPCs deposited in the Columbia River as a result of air emissions under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives had a screening Hazard Quotient exceeding 1 (see Table P–10). The highest Hazard Quotient was 0.508 for the spotted sandpiper exposed to mercury in nearshore surface water under Tank Closure Alternatives 3A and 3C. Hazard Quotients for such terrestrial mammals as the raccoon and least weasel, as well as piscivorous birds, which feed in the Columbia River on benthic invertebrates and salmonids, respectively, did not exceed 0.1 (see Table P–11). Given the conservative exposure assumptions and toxicological benchmarks, ecological receptors in the Hanford Reach would be unlikely to be at unacceptable risk due to the deposition of chemical COPCs emitted to the air under any alternative.

Table P–10. Long-Term Impacts of Chemical COPC Air Deposition on Aquatic and Riparian Resources at the Columbia River: Maximum Risk Index by Alternative

Alternative	Maximum Hazard Quotient	Chemical COPC	Receptor
Tank Closure			
1	4.35×10^{-2}	Ammonia	Aquatic Biota/Salmonids
2A	3.90×10^{-1}	Mercury	Spotted sandpiper
2B	4.25×10^{-1}	Mercury	Spotted sandpiper
3A	$\mathbf{5.08\times10^{-1}}$	Mercury	Spotted sandpiper
3B	2.89×10^{-1}	Mercury	Spotted sandpiper
3C	$\mathbf{5.08\times10^{-1}}$	Mercury	Spotted sandpiper
4	3.66×10^{-1}	Mercury	Spotted sandpiper
5	3.50×10^{-1}	Mercury	Spotted sandpiper
6A, Base Case	3.93×10^{-1}	Mercury	Spotted sandpiper
6A, Option Case	3.92×10^{-1}	Mercury	Spotted sandpiper
6B, Base Case	4.41×10^{-1}	Mercury	Spotted sandpiper
6B, Option Case	4.40×10^{-1}	Mercury	Spotted sandpiper
6C	4.40×10^{-1}	Mercury	Spotted sandpiper
FFTF Decommissioning			
1	6.89×10^{-2}	Benzene	Aquatic Biota/Salmonids
2, Hanford Option	4.15×10^{-2}	Ammonia	Aquatic Biota/Salmonids
2, Idaho Option	9.33×10^{-3}	Benzene	Aquatic Biota/Salmonids
3, Hanford Option	4.10×10^{-2}	Ammonia	Aquatic Biota/Salmonids
3, Idaho Option	4.82×10^{-3}	Benzene	Aquatic Biota/Salmonids
Waste Management			
1	6.97×10^{-3}	Benzene	Aquatic Biota/Salmonids
2, DG1	1.24×10^{-1}	Benzene	Aquatic Biota/Salmonids
2, DG2	4.01×10^{-1}	Benzene	Aquatic Biota/Salmonids
2, DG3	4.01×10^{-1}	Benzene	Aquatic Biota/Salmonids
3, DG1	1.20×10^{-1}	Benzene	Aquatic Biota/Salmonids
3, DG2	3.96×10^{-1}	Benzene	Aquatic Biota/Salmonids
3, DG3	3.96×10^{-1}	Benzene	Aquatic Biota/Salmonids
Alternative Combination			
1	8.51×10^{-2}	Benzene	Aquatic Biota/Salmonids
2	4.25×10^{-1}	Mercury	Spotted sandpiper
3	4.61×10^{-1}	Benzene	Aquatic Biota/Salmonids

Note: The maximum Hazard Quotient of all receptors is indicated by **bold** text. Risk indices are unitless.
Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility.

Table P–11. Long-Term Impacts of Chemical COPC Air Deposition on Aquatic and Riparian Resources at the Columbia River: Maximum Risk Index by Receptor

Receptor	Alternative	Maximum Hazard Quotient	Chemical COPC
Benthic invertebrates	Tank Closure Alternative 2A	6.83×10^{-2}	Ammonia
Aquatic biota/salmonids	Alternative Combination 3	4.61×10^{-1}	Benzene
Spotted sandpiper	Tank Closure Alternatives 3A, 3C	5.08×10^{-1}	Mercury
Raccoon	Tank Closure Alternatives 3A, 3C	4.31×10^{-2}	Mercury
Least weasel	Tank Closure Alternative 6B, Base Case Alternative Combination 3	2.38×10^{-2}	Mercury
Bald eagle	Tank Closure Alternative 6B, Base Case Alternative Combination 3	4.16×10^{-2}	Mercury

Note: Risk indices are unitless.
Key: COPC=constituent of potential concern.

As was the case for Hanford soils, the buffering capacity of the Hanford Reach would be sufficient to maintain the pH within the National Ambient Water Quality Criteria acceptable range for aquatic life (pH = 5.0–9.0) and Washington Ambient Surface-water Quality Standards for the Hanford Reach (pH = 6.5–8.5) despite deposition of nitrogen and sulfur dioxides from air emissions under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives. Two weak acids (sulfurous acid and nitrous acid) and a strong acid (nitric acid) potentially result from the dissolution of nitrogen and sulfur dioxides in river water. According to the *Hanford Site Environmental Report for Calendar Year 2010 (Including Some Early 2011 Information)* (Poston, Duncan, and Dirkes 2011), the Hanford Reach has a reported alkalinity ranging from 52 to 64 milligrams calcium carbonate per liter and a pH between 7.4 and 8.3. An alkalinity of 52 milligrams calcium carbonate per liter would keep the pH at or above 7.4, given the addition of 0.041 milligrams nitrogen dioxide per liter and 0.00016 milligrams sulfur dioxide per liter (Alternative Combination 3), the maximum predicted nearshore surface-water concentrations. The resulting pH would not fall outside the permissible range of pH for the Hanford Reach (6.5–8.5), and the estimated change in the pH would not exceed the maximum allowable 0.5 induced variation limit (Poston, Duncan, and Dirkes 2011). The pH of the Hanford Reach is thus potentially lowered only slightly by the deposition of nitrogen and sulfur dioxides released into the air under all *TC & WM EIS* alternatives, and aquatic biota are unlikely to be adversely impacted by pH changes.

P.3.1.3 Uncertainties

Uncertainty exists about the actual magnitude of future exposures and the threshold doses or benchmark concentration TRVs used to evaluate the long-term impact on aquatic and riparian ecological resources of air releases. The uncertainties regarding the chemical and radiological exposure estimates come from uncertainties in the source terms and transport models. Additional uncertainties are found in the BAFs and uptake factors, which are linear models based on simplifying assumptions. The uncertainties for toxicity and radiological effects thresholds arise from extrapolations from laboratory experiments on test species to Hanford receptor species in natural environments, as well as uncertainty about the chemical to which ecological receptors would be exposed (e.g., chemical COPC breakdown products, which can be more toxic than the COPC itself). The lack of TRVs for some chemical COPCs and some receptors also resulted in uncertainties. Combined, these uncertainties produced limited underestimates of risk and moderate overestimates of risk for different combinations of receptors and chemical or radioactive COPCs. The effects of these uncertainties were unbiased with respect to the alternatives being evaluated in this *TC & WM EIS*; thus, the results presented above accurately reflect the relative impacts of the alternatives on ecological resources. In addition, the use of conservative exposure assumptions and TRVs mitigated these uncertainties, providing confidence in the "no risk" conclusions.

P.3.2 Impacts of Groundwater Releases

The potential for adverse effects on Columbia River aquatic and riparian resources from potential releases of radionuclides and chemicals to groundwater under the different Tank Closure, FFTF Decommissioning, and Waste Management alternatives was evaluated using a quantitative risk assessment approach (63 FR 26846; EPA 1992, 1997). Groundwater contamination in the distant future (up to 10,000 years) would be possible under all alternatives because some waste would be generated and disposed of on site or contaminated soil would be left in place under all alternatives. Radionuclides and chemicals potentially would be transported to the Columbia River and its riparian habitat. The potential for adverse impacts on aquatic and riparian resources at the Columbia River is described below.

P.3.2.1 Methods

The general approach for assessing potential adverse effects on aquatic and riparian ecological resources was discussed in Section P.2.1. The assumptions, receptors, exposure pathways and uptake mechanisms (routes); predicted sediment and surface-water concentrations; exposure model equations; and benchmarks used to model exposure for aquatic and riparian ecological resources potentially impacted by contaminant releases are described in the relevant sections below. The quantitative evaluations of long-term adverse impacts on aquatic and riparian resources of groundwater releases, based on Hazard Quotients, Hazard Indices, and river-water nitrate concentrations, are summarized and discussed in Section P.3.2.2. The impact of nitrate discharge on the eutrophication of surface water was evaluated based on ambient and predicted concentrations.

P.3.2.1.1 Key Assumptions

The following key assumptions were made in the evaluation of potential impacts on Columbia River aquatic and riparian resources of exposure to radionuclides and chemicals through groundwater releases:

- Exposure of riparian vegetation and soil-dwelling biota to seep water was inconsequential because groundwater discharges at discrete points along the shore and either discharges underwater or flows only a short distance—less than 5 meters (16.4 feet)—through the riparian zone before entering the river.
- Concentrations in groundwater at the Columbia River overestimated concentrations of seep and sediment pore water because Columbia River water mixes with those waters to varying degrees.
- Groundwater flux was assumed to be approximately 1 cubic meter (35.3 cubic feet, or 264 gallons) per second because the river flux is approximately 3,000 times greater than the flux from groundwater, and the flux of the Columbia River is approximately 3,300 cubic meters (116,540 cubic feet, or 871,761 gallons) per second (Bryce et al. 2002).
- The tissue concentrations in fish preyed upon by predators (least weasel and bald eagle) would be in equilibrium with nearshore surface-water concentrations.
- Surface-water and sediment contamination from groundwater releases would not coincide with soil contamination from air releases because material released to air during site and WTP operations would dissipate before slow-moving constituents discharge to the Columbia River.

P.3.2.1.2 Receptors and Exposure Pathways and Routes

The receptors selected to represent the Columbia River aquatic and riparian ecological resources potentially exposed to groundwater releases, including special status species (Chapter 3, Section 3.2.7.4), are listed in Table P–2. These receptors were selected because they are expected to have higher exposures than those not selected from their group due to their higher ingestion rates per unit body weight for prey, water, and sediment or soil. Special status species were not expected to be more highly exposed or more sensitive to contaminants than the selected species. The selected representative receptors were benthic invertebrates; muskrat; spotted sandpiper; raccoon; bald eagle; least weasel; and aquatic biota, including salmonids. All were ECEM receptors, except the spotted sandpiper, which was substituted for the common snipe because the spotted sandpiper has a more aquatic diet. The muskrat was added as a receptor exposed primarily to groundwater discharging at seeps along the river because of its relatively high water-ingestion rate and small size compared with other mammals such as the mule deer or coyote. For this evaluation, the muskrat was assumed to be exposed by ingestion of only seep water to assess the importance of this pathway.

The exposure pathways evaluated in the ecological risk analysis for this *TC & WM EIS* are shown in Table P–2 for all ecological receptors. The exposure medium, exposure route, and receptor are indicated for each pathway evaluated in the analysis of impacts on aquatic and riparian resources of releases to groundwater.

P.3.2.1.3 Predicted Seep, Sediment, and Surface-Water Concentrations

Tank Closure Alternatives 1 through 6C; FFTF Decommissioning Alternatives 1 and 2; and Waste Management Alternatives 1, 2, and 3 (Disposal Groups 1, 2, and 3) have groundwater modeling results for 10,000 years. Separate groundwater modeling results do not exist for FFTF Decommissioning Alternative 3 because it would not result in a release to groundwater. The previously mentioned alternatives would potentially impact seep, sediment pore water, sediment, and surface water. The concentrations were calculated from the modeled groundwater concentrations at the Columbia River resulting from the varying radioactive and chemical COPC inventories in place under the different alternatives (see Appendix O).

Seep and sediment pore-water concentrations were equal to the modeled peak annual average groundwater concentration at the Columbia River. Seep concentrations were used to assess potential impacts on wildlife receptors drinking water in the riparian zone. Peak annual average nearshore surface-water concentrations were used to estimate adverse impacts on aquatic biota (e.g., periphyton, plankton, larval mayflies, juvenile salmonids, and lower-trophic-level fish). Sediment concentrations for nonpolar hydrophobic organic compounds were calculated assuming equilibrium partitioning between sediment and sediment pore water. Sediment and sediment pore-water concentrations were used to assess potential impacts on sediment-dwelling biota and their predators. Nearshore surface-water concentrations used to estimate body burdens in fish (e.g., salmonids) and dose to predators of fish were calculated assuming that the groundwater would be mixed throughout a 0.5-meter-deep (1.6-foot-deep), 40-meter-wide (131-foot-wide) shallow zone along the facility side of the river. With a reported maximum velocity of 0.25 meters (0.8 feet) per second in the nearshore environment of redds (USGS 2000), the nearshore flux was estimated as 5 cubic meters (177 cubic feet, or 1,321 gallons) per second. The flux of groundwater into the river over this reach was one three-thousandth of the flux of the Columbia River in the Hanford Reach, approximately 1 cubic meter (35.3 cubic feet, or 264 gallons) per second (Bryce et al. 2002). The groundwater (seep and sediment pore water), sediment, and nearshore surface-water concentrations under Tank Closure Alternatives 1 through 6C; FFTF Decommissioning Alternatives 1 and 2 (Hanford and Idaho Options); and Waste Management Alternatives 1, 2, and 3 (Disposal Groups 1, 2, and 3) were used as the source terms in the exposure model described in the following subsections.

P.3.2.1.4 Exposure Model Calculations

The exposure model calculated ingestion doses from chemicals for wildlife receptors, as well as external and internal doses from radionuclides for all receptors, using the equations for $RD_{\text{Ext-water, imm}}$,

$RD_{\text{Ext-water near}}$, $RD_{\text{Ext-sed}}$, and RD_{Int} presented in Section P.3.1.1. There was no external dose to receptors from air for radionuclides released to the groundwater and discharged to the Columbia River.

Exposure was not calculated for aquatic and riparian receptors exposed to chemicals by multiple pathways (direct contact, ingestion, respiration) resulting from living in sediment or surface water. The assessment of impacts on aquatic and sediment-dwelling biota was made by comparing estimated sediment or nearshore surface-water concentrations to appropriate benchmark concentrations for these receptors (see Section P.3.2.1.5).

P.3.2.1.5 Toxicological Benchmarks

The benchmark for combined internal and external exposure from all radionuclides was 0.1 rad per day for the muskrat (IAEA 1992). Radiological and chemical benchmarks for the other receptors were the same as those in Section P.3.1.1.5.

P.3.2.1.6 Risk Indices

As discussed in Section P.2.1, the long-term impacts of potential radionuclide and chemical releases on ecological resources were evaluated by comparing estimated ecological receptor exposures to given chemical or radioactive COPCs under each alternative to the threshold COPC exposures associated with known adverse effects on those receptors. The estimate of chemical exposure concentration under each alternative for sediment-dwelling (benthic) invertebrates was the predicted sediment concentration; for aquatic biota, including salmonids, it was the predicted nearshore surface-water concentration (see Appendix O). The methods for estimating exposure doses to aquatic and riparian receptors from the predicted groundwater concentrations and discharge at the Columbia River were defined in Section P.3.1.1.4. The exposure concentrations or doses associated with a known level of adverse effect were the TRVs (see Section P.3.1.1.5). A comparison of the estimated and threshold COPC exposures was made by calculating a risk index, the dimensionless ratio of the exposure estimate (concentration or dose) to corresponding TRV (concentration or dose). These calculated risk indices, i.e., the Hazard Quotients for individual chemical COPCs and the Hazard Indices for all radioactive COPCs combined, were used to compare the *TC & WM EIS* alternatives (see Chapter 5) and to identify exposures posing little or no risk (Hazard Quotient or Hazard Index less than or equal to unity [1]).

The risk indices were calculated as follows:

For benthic invertebrates exposed to chemical COPCs in sediment:

$$HQ = C_{\text{sed}} / TRV$$

where:

HQ = Hazard Quotient
C_{sed} = concentration in sediment, milligrams per kilogram dry sediment
TRV = toxicity reference value, milligrams per kilogram

For aquatic biota, including salmonids, exposed to chemical COPCS in nearshore surface water:

$$HQ = C_w / TRV$$

where:

HQ = Hazard Quotient
C_w = nearshore surface-water concentration, milligrams per liter
TRV = toxicity reference value, milligrams per liter

For wildlife receptors exposed to chemical COPCs in groundwater, sediment, and nearshore surface water:

$$HQ = ADD_{\text{total}} / TRV$$

where:

HQ = Hazard Quotient
ADD_{total} = total dose of chemical from ingestion of water, animal food, and sediment, milligrams per kilogram body weight per day
TRV = toxicity reference value, milligrams per kilogram body weight per day

For all receptors, the Hazard Index is the sum of external and internal doses from all radioactive COPCs divided by the TRV, as follows:

$$HI = (RD_{\text{Ext}} + RD_{\text{Int}}) / TRV$$

where:

HI = Hazard Index
RD_{Ext} = external radiation dose from exposure to all radioactive COPCs in air, soil, sediment, and/or water, rad per day
RD_{Int} = internal radiation dose from all radioactive COPCs, rad per day
TRV = toxicity reference value, rad per day

Except where an exposure parameter or TRV was not available for a given receptor or COPC, the dose (ADD_{total}) and Hazard Quotient for all chemical COPCs and the dose (RD_{Ext} + RD_{Int}) summed over all radioactive COPCs and the Hazard Index were calculated for all aquatic and riparian receptors potentially exposed at the Columbia River under all *TC & WM EIS* alternatives using predicted groundwater, seep, nearshore surface-water, and sediment concentrations resulting from releases to groundwater. Tables with predicted surface-water and sediment concentrations, input parameters, and calculations of dose and risk indices are available in *Calculating Risk Indices for Long-Term Impacts to Ecological Receptors – Releases to Groundwater* (SAIC 2011b).

P.3.2.2 Results and Discussion

The results of the screening analysis for radioactive and chemical contaminant releases to groundwater due to site and WTP operations and subsequent discharge to the Columbia River estimated for aquatic receptors and riparian wildlife feeding in the Columbia River under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives are summarized in Tables P–12, P–13, and P–14.

Table P–12. Long-Term Impacts of Radioactive COPC Groundwater Discharge on Aquatic and Riparian Resources at the Columbia River: Hazard Indices by Receptor and Alternative

Alternative	Hazard Index by Receptor						
	Benthic Invertebrates	Muskrat	Spotted Sandpiper	Raccoon	Bald Eagle	Least Weasel	Aquatic Biota/ Salmonids
Tank Closure							
1	**2.03×10^{-3}**	4.11×10^{-5}	6.76×10^{-4}	3.08×10^{-4}	5.51×10^{-4}	1.56×10^{-3}	2.81×10^{-4}
2A	9.53×10^{-4}	3.38×10^{-5}	3.33×10^{-4}	1.60×10^{-4}	2.22×10^{-4}	6.29×10^{-4}	1.11×10^{-4}
2B, 3A, 3B, 3C, 6C	4.43×10^{-4}	3.38×10^{-5}	2.07×10^{-4}	1.05×10^{-4}	2.23×10^{-4}	6.31×10^{-4}	1.09×10^{-4}
4	4.28×10^{-4}	3.38×10^{-5}	2.04×10^{-4}	1.04×10^{-4}	2.23×10^{-4}	6.31×10^{-4}	1.09×10^{-4}
5	4.35×10^{-4}	3.38×10^{-5}	2.05×10^{-4}	1.05×10^{-4}	2.23×10^{-4}	6.31×10^{-4}	1.09×10^{-4}
6A, Base Case	2.72×10^{-4}	3.38×10^{-5}	1.66×10^{-4}	8.75×10^{-5}	2.23×10^{-4}	6.30×10^{-4}	1.08×10^{-4}
6A, Option Case	9.92×10^{-6}	3.41×10^{-5}	1.04×10^{-4}	6.09×10^{-5}	2.23×10^{-4}	6.31×10^{-4}	1.07×10^{-4}
6B, Base Case	2.72×10^{-4}	3.38×10^{-5}	1.66×10^{-4}	8.75×10^{-5}	2.23×10^{-4}	6.30×10^{-4}	1.08×10^{-4}
6B, Option Case	1.01×10^{-5}	3.45×10^{-5}	1.06×10^{-4}	6.21×10^{-5}	2.23×10^{-4}	6.30×10^{-4}	1.07×10^{-4}
FFTF Decommissioning							
1	2.20×10^{-7}	2.80×10^{-7}	2.77×10^{-6}	1.23×10^{-6}	2.36×10^{-6}	6.76×10^{-6}	1.11×10^{-6}
2	2.32×10^{-7}	2.94×10^{-7}	2.92×10^{-6}	1.30×10^{-6}	2.36×10^{-6}	6.75×10^{-6}	1.10×10^{-6}
3	8.78×10^{-14}	1.11×10^{-13}	1.10×10^{-12}	4.91×10^{-13}	5.48×10^{-13}	1.58×10^{-12}	2.48×10^{-13}
Waste Management							
1	8.74×10^{-9}	1.07×10^{-8}	1.08×10^{-7}	4.81×10^{-8}	4.47×10^{-8}	1.29×10^{-7}	1.99×10^{-8}
2, DG1, SG1-A	2.78×10^{-6}	3.32×10^{-6}	3.39×10^{-5}	1.51×10^{-5}	3.05×10^{-5}	8.72×10^{-5}	1.43×10^{-5}
2, DG1, SG1-B	4.37×10^{-6}	5.35×10^{-6}	5.39×10^{-5}	2.40×10^{-5}	5.30×10^{-5}	1.51×10^{-4}	2.50×10^{-5}
2, DG1, SG1-C	6.41×10^{-6}	7.95×10^{-6}	7.97×10^{-5}	3.54×10^{-5}	6.52×10^{-5}	1.87×10^{-4}	3.05×10^{-5}
2, DG1, SG1-D	3.54×10^{-6}	4.28×10^{-6}	4.34×10^{-5}	1.93×10^{-5}	3.93×10^{-5}	1.12×10^{-4}	1.85×10^{-5}
2, DG1, SG1-E	8.25×10^{-6}	1.03×10^{-5}	1.03×10^{-4}	4.57×10^{-5}	7.95×10^{-5}	2.28×10^{-4}	3.70×10^{-5}
2, DG1, SG1-F	4.03×10^{-6}	4.91×10^{-6}	4.96×10^{-5}	2.21×10^{-5}	4.90×10^{-5}	1.40×10^{-4}	2.31×10^{-5}
2, DG1, SG1-G	2.79×10^{-6}	3.34×10^{-6}	3.41×10^{-5}	1.52×10^{-5}	3.04×10^{-5}	8.68×10^{-5}	1.43×10^{-5}
2, DG2, SG2-A	2.72×10^{-6}	3.28×10^{-6}	3.33×10^{-5}	1.48×10^{-5}	3.05×10^{-5}	8.71×10^{-5}	1.43×10^{-5}
2, DG2, SG2-B, Base Case	2.75×10^{-6}	3.32×10^{-6}	3.37×10^{-5}	1.50×10^{-5}	3.00×10^{-5}	8.59×10^{-5}	1.41×10^{-5}
2, DG2, SG2-B, Option Case	2.77×10^{-6}	3.33×10^{-6}	3.39×10^{-5}	1.51×10^{-5}	3.03×10^{-5}	8.67×10^{-5}	1.42×10^{-5}
2, DG3, Base Case	2.70×10^{-6}	3.25×10^{-6}	3.31×10^{-5}	1.47×10^{-5}	3.13×10^{-5}	8.94×10^{-5}	1.47×10^{-5}
2, DG3, Option Case	2.72×10^{-6}	3.28×10^{-6}	3.33×10^{-5}	1.48×10^{-5}	3.16×10^{-5}	9.03×10^{-5}	1.49×10^{-5}
3, DG1, SG1-A	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.56×10^{-5}	1.89×10^{-4}	2.94×10^{-5}
3, DG1, SG1-B	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.56×10^{-5}	1.89×10^{-4}	2.94×10^{-5}
3, DG1, SG1-C	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.56×10^{-5}	1.89×10^{-4}	2.94×10^{-5}
3, DG1, SG1-D	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.56×10^{-5}	1.89×10^{-4}	2.94×10^{-5}
3, DG1, SG1-E	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.92×10^{-5}	1.99×10^{-4}	3.11×10^{-5}
3, DG1, SG1-F	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.51×10^{-5}	1.88×10^{-4}	2.92×10^{-5}
3, DG1, SG1-G	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.56×10^{-5}	1.89×10^{-4}	2.94×10^{-5}
3, DG2, SG2-A	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	6.51×10^{-5}	1.88×10^{-4}	2.92×10^{-5}
3, DG2, SG2-B, Base Case	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.64×10^{-5}	7.15×10^{-5}	2.06×10^{-4}	3.22×10^{-5}

Table P–12. Long-Term Impacts of Radioactive COPC Groundwater Discharge on Aquatic and Riparian Resources at the Columbia River: Hazard Indices by Receptor and Alternative *(continued)*

Alternative	Hazard Index by Receptor						
	Benthic Invertebrates	Muskrat	Spotted Sandpiper	Raccoon	Bald Eagle	Least Weasel	Aquatic Biota/ Salmonids
Waste Management *(continued)*							
3, DG2, SG2-B, Option Case	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	7.54×10^{-5}	2.17×10^{-4}	3.42×10^{-5}
3, DG3, Base Case	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	7.13×10^{-5}	2.05×10^{-4}	3.22×10^{-5}
3, DG3, Option Case	1.22×10^{-5}	1.47×10^{-5}	1.49×10^{-4}	6.63×10^{-5}	7.52×10^{-5}	2.16×10^{-4}	3.41×10^{-5}
Alternative Combination							
1	$\mathbf{2.03\times10^{-3}}$	4.11×10^{-5}	6.76×10^{-4}	3.08×10^{-4}	5.52×10^{-4}	1.56×10^{-3}	2.81×10^{-4}
2	4.43×10^{-4}	3.38×10^{-5}	2.07×10^{-4}	1.05×10^{-4}	2.23×10^{-4}	6.31×10^{-4}	1.09×10^{-4}
3	2.72×10^{-4}	3.38×10^{-5}	1.66×10^{-4}	8.75×10^{-5}	2.23×10^{-4}	6.30×10^{-4}	1.08×10^{-4}

Note: The maximum Hazard Index is indicated by **bold** text. Hazard Index is unitless.
Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility; SG=Subgroup.

Table P–13. Long-Term Impacts of Radioactive and Chemical COPC Groundwater Discharge on Aquatic and Riparian Resources at the Columbia River: Maximum Risk Index by Alternative

Alternative	Maximum Hazard Quotient or Hazard Index	Chemical or Radioactive COPC	Receptor
Tank Closure			
1	4.32×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
2A	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
2B, 3A, 3B, 3C, 6C	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
4	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
5	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
6A, Base Case	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
6A, Option Case	4.44×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
6B, Base Case	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
6B, Option Case	$\mathbf{4.45\times10^{1}}$	Chromium[a]	Aquatic Biota/Salmonids
FFTF Decommissioning			
1	2.91×10^{-2}	Uranium	Raccoon
2	6.75×10^{-6}	All radionuclides	Least Weasel
3	1.58×10^{-12}	All radionuclides	Least Weasel
Waste Management			
1	3.14×10^{-3}	Chromium[a]	Aquatic Biota/Salmonids
2, DG1, SG1-A	2.05×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
2, DG1, SG1-B	1.66×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
2, DG1, SG1-C	2.90	Chromium[a]	Aquatic Biota/Salmonids
2, DG1, SG1-D	1.83×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
2, DG1, SG1-E	1.63	Chromium[a]	Aquatic Biota/Salmonids

Table P–13. Long-Term Impacts of Radioactive and Chemical COPC Groundwater Discharge on Aquatic and Riparian Resources at the Columbia River: Maximum Risk Index by Alternative *(continued)*

Alternative	Maximum Hazard Quotient or Hazard Index	Chemical or Radioactive COPC	Receptor
Waste Management *(continued)*			
2, DG1, SG1-F	2.55	Chromium[a]	Aquatic Biota/Salmonids
2, DG1, SG1-G	2.07×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
2, DG2, SG2-A	2.04×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
2, DG2, SG2-B, Base Case	1.03×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
2, DG2, SG2-B, Option Case	9.72×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
2, DG3, Base Case	1.04×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
2, DG3, Option Case	9.60×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-A	2.25×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-B	2.25×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-C	2.90	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-D	1.83×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-E	1.63	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-F	2.54	Chromium[a]	Aquatic Biota/Salmonids
3, DG1, SG1-G	2.25×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
3, DG2, SG2-A	1.85×10^{-2}	Chromium[a]	Aquatic Biota/Salmonids
3, DG2, SG2-B, Base Case	1.09×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
3, DG2, SG2-B, Option Case	9.77×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
3, DG3, Base Case	1.10×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
3, DG3, Option Case	9.66×10^{-1}	Chromium[a]	Aquatic Biota/Salmonids
Alternative Combination			
1	4.32×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
2	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids
3	4.31×10^{1}	Chromium[a]	Aquatic Biota/Salmonids

[a] For purposes of long-term impacts, it was assumed that this is hexavalent chromium.

Note: The maximum Hazard Quotient or Hazard Index is indicated by **bold** text. Hazard Quotient and Hazard Index are unitless.

Key: COPC=constituent of potential concern; DG=Disposal Group; FFTF=Fast Flux Test Facility; SG=Subgroup.

Table P–14. Long-Term Impacts of Chemical COPC Groundwater Discharge on Aquatic and Riparian Resources at the Columbia River: Maximum Risk Index by Receptor

Receptor	Alternative	Maximum Hazard Quotient	Chemical COPC
Benthic invertebrates	Tank Closure Alternative 1 Alternative Combination 1	1.69×10^{-1}	Chromium[a]
Aquatic biota/Salmonids	Tank Closure Alternative 6B, Option Case	4.45×10^{1}	Chromium[a]
Muskrat	Tank Closure Alternatives 2B; 3A; 3B; 3C; 6C; 4; 5; 6A, Base Case; 6B, Base Case Alternative Combinations 2, 3	1.43×10^{-2}	Nitrate
Spotted sandpiper	Tank Closure Alternative 1 Alternative Combination 1	1.15	Chromium[a]
Raccoon	Tank Closure Alternative 1 Alternative Combination 1	1.39×10^{-1}	Chromium[a]
Least weasel	Tank Closure Alternatives 2B, 3A, 3B, 3C, 6C Alternative Combination 2	1.37	Nitrate
Bald eagle	Tank Closure Alternative 1 Alternative Combination 1	3.71×10^{-2}	Chromium[a]

[a] For purposes of long-term impacts, it was assumed that this is hexavalent chromium.
Key: COPC=constituent of potential concern.

The maximum combined radionuclide Hazard Index from groundwater discharge under all of the alternatives was calculated to be 0.002 for benthic invertebrates under Tank Closure Alternative 1. Table P–12 presents the Hazard Indices associated with groundwater discharge to the Columbia River under all of the alternatives. Exposure to radioactive COPCs from groundwater discharge under all of the alternatives was below the 0.1-rad-per-day benchmark for wildlife receptors (i.e., muskrat, spotted sandpiper, raccoon, bald eagle, least weasel) and the 1-rad-per-day benchmark for benthic invertebrates and aquatic biota, including salmonids. Estimated hazards for the representative species indicated that no adverse effects are expected for aquatic receptors and terrestrial wildlife feeding in the Columbia River from exposure to radioactive COPCs from groundwater discharge. Because the direct impacts of groundwater discharge are expected to be small, any associated potential indirect impacts on the ecosystem would be correspondingly minor.

Exposure to chemical COPCs discharged into the Columbia River as a result of releases to groundwater under the various Tank Closure, FFTF Decommissioning, and Waste Management alternatives exceeded the Hazard Quotient criterion of 1 under all Tank Closure alternatives; Waste Management Alternative 1; and Waste Management Alternatives 2 and 3, Disposal Group 1, Subgroups 1-C, 1-E, and 1-F. In all cases, the maximum Hazard Quotient was for aquatic biota, including salmonids, exposed to chromium, assuming it was in hexavalent form (see Table P–13). The highest Hazard Quotient was 44.5 for aquatic biota, including salmonids exposed to hexavalent chromium in nearshore surface water under Tank Closure Alternative 6B, Option Case (see Table P–14). Hazard Quotients for terrestrial predators (i.e., spotted sandpiper, raccoon, bald eagle, and least weasel) feeding on Columbia River benthic invertebrates and aquatic biota, including salmonids, did not exceed the Hazard Quotient of 1.37 for nitrate. Only chromium and nitrate had Hazard Quotients exceeding 1 for aquatic and riparian receptors at the Columbia River.

The chromium Hazard Quotients above 1 did not necessarily indicate high risk to aquatic biota, including salmonids, at the Columbia River. The TRV for hexavalent chromium used to calculate salmonid Hazard

Quotients was the sensitive-species-test-effect concentration affecting 20 percent of the test population (EC_{20}). Hexavalent chromium is highly toxic compared with the trivalent form of chromium, which is more likely to occur in oxygenated aquatic environments. Hexavalent chromium Hazard Quotients can be used to compare alternatives, but they should not be used as the sole basis for concluding that ecological resources at the Columbia River would be adversely impacted.

Given the magnitude of the Hazard Quotients and the conservative exposure assumptions and toxicological benchmarks, aquatic biota and sediment-dwelling biota in the Hanford Reach and their terrestrial predators would be unlikely to be at unacceptable risk due to the discharge of chemical COPCs in groundwater under any alternative. The modeled concentrations in nearshore surface water and sediment overestimated risk due to the conservative model assumptions, namely that all groundwater discharge occurs in the 40-meter (131-foot) nearshore zone, when in reality groundwater would likely discharge throughout the riverbed and thus be highly diluted. The model also assumed that nearshore sediment would be in equilibrium with discharging groundwater, which ignored the likely movement of surface water into the uppermost sediment layer where benthic organisms are found.

Nitrate in discharging groundwater under Tank Closure alternatives could potentially contribute to eutrophication in nearshore surface water of the Hanford Reach. Dissolved concentrations of nitrite and nitrate as nitrogen in surface water at the Richland Pumphouse immediately downstream of Hanford did not exceed 1.0 milligram per liter during 2006 and 2010 (Poston et al. 2007; Poston, Duncan, and Dirkes 2011). Modeled maximum nitrate concentrations in Columbia River nearshore surface water ranged from 0 milligrams per liter (FFTF Decommissioning alternatives) to 3.18 milligrams per liter (e.g., Alternative Combinations 2 and 3). Only the Tank Closure alternatives and, as a result, the alternative combinations, have predicted maximum nearshore surface-water concentrations exceeding ambient concentrations. Whether increased nitrate inputs would actually result in eutrophication depends on the amount of available phosphorus.

P.3.2.3 Uncertainties

Uncertainty exists about the actual magnitude of future exposures and the threshold doses or benchmark concentration TRVs used to evaluate the long-term impacts on aquatic and riparian ecological resources of groundwater releases. The uncertainties for chemical and radiological exposure estimates result from uncertainties in the source terms and transport models. Additional uncertainties were found in the BAFs and uptake factors, which were linear models based on simplifying assumptions. The uncertainties for toxicity and radiological-effects thresholds arose from extrapolating from laboratory experiments on test species to Hanford receptor species in natural environments and uncertainty about the chemical form to which ecological receptors would be exposed, e.g., hexavalent or trivalent chromium. The lack of TRVs for some chemical COPCs and some receptors resulted in uncertainties. Combined, these uncertainties produced limited underestimates of risk and moderate overestimates of risk for different combinations of receptors and chemical or radioactive COPCs. Conservative exposure assumptions and TRVs mitigated these uncertainties, allowing confidence in “no risk” conclusions. There were large uncertainties about the impact of nitrate in groundwater releases on potential eutrophication in the Columbia River. The effects of these uncertainties on the risk indices and nitrate impacts on eutrophication were unbiased with respect to the alternatives being evaluated in this *TC & WM EIS;* thus, the results accurately reflect the relative impacts of alternatives on ecological resources.

P.3.3 Summary of Aquatic Impacts

Estimated radiation doses resulting from air deposition and groundwater discharge for any of the alternatives were less than the 0.1-rad-per-day and 1-rad-per-day benchmarks for ecological receptors exposed to radioactive COPCs at the Columbia River. All Hazard Indices for radioactive COPCs associated with these alternatives were below 1. Only estimated exposures of aquatic biota to hexavalent chromium in nearshore surface water under all Tank Closure alternatives; Waste Management

Alternatives 2 and 3, Disposal Group 1, Subgroups 1-C, 1-E, and 1-F; and all three alternative combinations, as well as of least weasel to nitrate under all Tank Closure alternatives, exceeded the Hazard Quotient criterion of 1 at the Columbia River. Based on the conservative nature of the exposure assumptions, the estimated Hazard Indices and Hazard Quotients for the representative receptors indicated that no adverse effects of radioactive or chemical COPCs in air and groundwater releases to the Columbia River under the various alternatives evaluated are expected. No long-term impacts are expected on water pH of additional nitrogen and sulfur dioxides resulting from air emission and deposition in the Hanford Reach. The potential impact on aquatic biota in the Hanford Reach of nitrate in groundwater discharge is uncertain. Calculated risk indices for aquatic and riparian resources from air and groundwater releases were used in this *TC & WM EIS* to compare alternatives (Chapter 5) and evaluate cumulative impacts (Chapter 6).

P.4 REFERENCES

ANL (Argonne National Laboratory), 1999, *Risk/Impact Technical Report for the Hanford Groundwater/Vadose Zone Integration Project*, DOE/CH/CRE-7-1999, U.S. Department of Energy Center for Risk Excellence, December.

Baes C.F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor, 1984, *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture*, ORNL-5786, Oak Ridge National Laboratory, Oak Ridge, Tennessee, September.

Baker, D.A., and J.K. Soldat, 1992, *Methods for Estimating Doses to Organisms from Radioactive Materials Released into the Aquatic Environment*, PNL-8150, Pacific Northwest Laboratory, Richland, Washington, June.

Blaylock, B.G., M.L. Frank, and B.R. O'Neal, 1993, *Methodology for Estimating Radiation Dose Rates to Freshwater Biota Exposed to Radionuclides in the Environment*, ES/ER/TM-78, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, Tennessee, September.

Bryce, R.W., C.T. Kincaid, P.W. Eslinger, and L.F. Morasch, eds., 2002, *An Initial Assessment of Hanford Impact Performed with the System Assessment Capability*, PNNL-14027, Pacific Northwest National Laboratory, Richland, Washington, September.

DOE (U.S. Department of Energy), 1995, *Hanford Site Risk Assessment Methodology*, DOE/RL-91-45, Rev. 3, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 1998, *Screening Assessment and Requirements for a Comprehensive Assessment, Columbia River Comprehensive Impact Assessment*, DOE/RL-96-16, Rev. 1, Pacific Northwest National Laboratory and CRCIA Management Team, March.

DOE and Ecology (U.S. Department of Energy, Richland Operations Office, Richland, Washington, and Washington State Department of Ecology, Olympia, Washington), 1996, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, Washington, August.

Eckerman, K.F., and J.C. Ryman, 1993, *External Exposure to Radionuclides in Air, Water, and Soil*, Federal Guidance Report No. 12, EPA-402-R-93-081, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C., September.

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

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

EPA (U.S. Environmental Protection Agency), 1992, *Framework for Ecological Risk Assessment*, EPA/630/R-92/001, Risk Assessment Forum, Washington, D.C., February.

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

EPA (U.S. Environmental Protection Agency), 1995, *Great Lakes Water Quality Initiative Technical Support Document for the Procedure to Determine Bioaccumulation Factors*, EPA-820-B-95-005, Office of Water, Washington, D.C., March.

EPA (U.S. Environmental Protection Agency), 1997, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final*, EPA 540-R-97-006, Office of Solid Waste and Emergency Response, Washington, D.C., June.

EPA (U.S. Environmental Protection Agency), 1999, *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Vol. 3, Peer Review Draft, EPA530-D-99-001C, Office of Solid Waste and Emergency Response, Washington, D.C., August.

EPA (U.S. Environmental Protection Agency), 2000, *Ecological Soil Screening Level Guidance-Draft*. Exhibit 1-3, "Evaluation of Dermal Contact and Inhalation Exposure Pathways for the Purpose of Setting Eco-SSLs," Washington, D.C., June 27.

EPA (U.S. Environmental Protection Agency), 2005 *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities,* EPA530-R-05-006, Office of Solid Waste and Emergency Response, Washington, D.C., September.

EPA (U.S. Environmental Protection Agency), 2009, *Integrated Risk Information System*, accessed through: http://www.epa.gov/iris/ on March 5.

Eslinger, P.W., C. Arimescu, B.A. Kanyid, and T.B. Miley, 2002, *User Instructions for the Systems Assessment Capability, Rev. 0, Computer Codes:* Vol. 2, *Impact Modules*, PNNL-13932, Pacific Northwest National Laboratory, Richland, Washington, June.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991, *Handbook of Environmental Degradation Rates*, Lewis Publishers, Inc., Chelsea, Michigan.

IAEA (International Atomic Energy Agency), 1992, *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards*, Technical Reports Series No. 332, Vienna, Austria, March.

Jones, D.S., G.W. Suter II, and R.N. Hull, 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision*, ES/ER/TM-95/R4, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, Tennessee, November.

Kocher, D.C., and J.R. Trabalka, 2000, "On the Application of a Radiation Weighting Factor for Alpha Particles in Protection of Non-Human Biota," *Health Physics Society Journal*, Vol. 79, No. 4, pp. 407-411, October.

NCRP (National Council on Radiation Protection and Measurements), 1991, *Effects of Ionizing Radiation on Aquatic Organisms*, NCRP Report No. 109, Bethesda, Maryland, August 30.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*, Regulatory Guide 1.109, Rev. 1, Office of Standard Development, Washington, D.C., October.

NRCS (Natural Resources Conservation Service), 2008, *Official Soil Series Descriptions (OSD) with Series Extent Mapping Capabilities: Quincy Series*, accessed through http://ortho.ftw.nrcs.usda.gov/osd/osd.html, November.

Paragon Analytics (Paragon Analytics, Inc.), 2003, *Inorganics Case Narrative, Washington State Dept. of Ecology WTPTOC on Soil Samples*, Order Number - 0307058, Fort Collins, Colorado, August 5.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2011, *Hanford Site Environmental Report for Calendar Year 2010 (Including Some Early 2011 Information)*, PNNL-20548, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., R.W. Hanf, J.P. Duncan, and R.L. Dirkes, eds. 2007, *Hanford Site Environmental Report for Calendar Year 2006 (Including Some Early 2007 Information)*, PNNL-16623, Pacific Northwest National Laboratory, Richland, Washington, September.

Rasmussen, J.J., 1971, *Soil Survey of Benton County Area, Washington*, U.S. Department of Agriculture, Soil Conservation Service, July.

SAIC (Science Applications International Corporation), 2011a, *Calculating Risk Indices for Long-Term Impacts to Ecological Receptors – Releases to Air*, Germantown, Maryland.

SAIC (Science Applications International Corporation), 2011b, *Calculating Risk Indices for Long-Term Impacts to Ecological Receptors – Releases to Groundwater*, Germantown, Maryland.

Sample, B.E., D.M. Opresko, and G.W. Suter II, 1996, *Toxicological Benchmarks for Wildlife: 1996 Revision*, ES/ER/TM-86/R3, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, Tennessee, June.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter II, and C.J.E. Welsh, 1997, *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants*, ORNL/TM-13391, Oak Ridge National Laboratory, Oak Ridge, Tennessee, October.

Stumm, W., and J.J. Morgan, 1970, *Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters*, Wiley-Interscience, New York, New York.

Suter, G.W., II, 1993, *Ecological Risk Assessment*, Lewis Publishers, Boca Raton, Florida.

Suter, G.W., II, and C.L. Tsao, 1996, *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*, ES/ER/TM-96/R2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, Tennessee, June.

USFS, NPS, and USFWS (U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service), 2000, *Federal Land Managers' Air Quality Related Values Workgroup (FLAG), Phase I Report*, December.

USGS (U.S. Geological Survey), 2000, *Use of Rearing Habitat by Juvenile Fall Chinook Salmon in the Hanford Reach of the Columbia River, Washington*, accessed through http://biology.usgs.gov/wfrc/crrlhome/rearing.htm, October 13.

Zach, R., 1985, "Contribution of Inhalation by Food Animals to Man's Ingestion Dose," *Health Physics*, Vol. 49, No. 5, pp. 737–745, November.

Federal Register

63 FR 26846, U.S. Environmental Protection Agency, 1998, "Guidelines for Ecological Risk Assessment," May 14.

United States Code

16 U.S.C. 1531 et seq., Endangered Species Act of 1973, as amended.

U.S. Department of Energy Standards

DOE Standard 1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, July 2002.

APPENDIX Q
LONG-TERM HUMAN HEALTH DOSE AND RISK ANALYSIS

This appendix presents methods and results for assessment of potential human health impacts due to releases of radionuclides and chemicals from the high-level radioactive waste tanks, Fast Flux Test Facility decommissioning, and waste management activities over long periods of time following stabilization or closure.

Q.1 INTRODUCTION

Adverse impacts on human health and the environment may occur over long periods of time following stabilization or closure of the Hanford Site (Hanford) tanks, decommissioning of the Fast Flux Test Facility (FFTF), and closure of the Integrated Disposal Facility in the 200-East (IDF-East) and 200-West (IDF-West) Areas and the River Protection Project Disposal Facility (RPPDF). Because these impacts would occur in the future and cannot be known solely from measurements made at this time, mathematical models were used to estimate the magnitude of the potential impacts. This appendix presents methods and results for assessment of potential human health impacts due to releases of radionuclides and chemicals from the high-level radioactive waste (HLW) tanks, FFTF decommissioning, and waste management activities over long periods of time following stabilization or closure. The objectives of the analysis include development of (1) objective measures of potential impacts on human health, (2) quantitative measures for comparison with regulatory criteria, and (3) understanding of the dependence of human health impacts on facility designs and environmental processes. Because of the large uncertainties involved in projection of impacts beyond a period of 1,000 years, U.S. Department of Energy (DOE) guidance recommends a period of analysis of 1,000 years for assessment of performance of low-level radioactive waste disposal facilities (DOE Guide 435.1-1). However, the low rate of movement of water and solutes through the vadose zone at Hanford and the objective of identifying peak impacts support selection of a longer period of analysis for this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (*TC & WM EIS*). Analysis of travel time in the vadose zone presented in Appendix N, Section N.5.1, appropriate for constituents that move at the velocity of water, and in Appendix O, Section O.6.4, for uranium, a constituent that moves slower than groundwater, supports selection of a 10,000-year period of analysis. Thus, long-term groundwater impacts in this *TC & WM EIS* are estimated for a 10,000-year period of analysis extending over calendar years (CYs) 1940 to 11,939.

Q.2 APPROACH FOR LONG-TERM PERFORMANCE ASSESSMENT

The approach used for estimation of long-term impacts on human health is development and analysis of a set of scenarios that provides a reasonable bound on potential impacts. Each scenario includes a combination of releases from a facility, transport through the environment, and exposure of receptors that could produce an adverse impact. Steps in the procedure include the following:

- Development of a conceptual model of the site
- Characterization of sources of residual contamination
- Identification of environmental transport pathways
- Identification of receptors
- Development of exposure scenarios
- Selection and development of models for the analysis of scenarios
- Estimation of impacts of reasonably conservative deterministic conditions
- Characterization of sensitivity and uncertainty

The process of impacts analysis is iterative in nature, with execution of initial passes through the steps at a high level so as to screen out less important conditions and produce a manageable set of scenarios for analysis. An initial iteration through the procedure was used to establish the number of constituents to be included in the analysis. For radionuclides in this screening analysis, groundwater release and direct intrusion scenarios were considered. For the groundwater release screening scenario, only drinking water consumption was considered, release was assumed to be partition limited, and decay during transport was considered. For the direct intrusion scenario, inadvertent soil ingestion and inhalation pathways were considered. The analysis involved estimation of relative impacts based on the distribution of radionuclides in all tanks; FFTF decommissioning; waste proposed for disposal at IDF-East, IDF-West, and the RPPDF; and contamination in place at cumulative analysis sites. In reviewing constituents at a given source area, radionuclides contributing in combination less than 1 percent of impacts for intruder or well scenarios were not included in the detailed analysis. The inventories for these sources are provided in Appendix D for the alternatives sources and Appendix S for the cumulative impacts analysis. To account for hazardous chemicals in this screening analysis, drinking water impacts were estimated for each constituent, and those contributing more than 99 percent of impacts were selected for detailed analysis. The list of radionuclides and chemicals used in the analysis is presented in Table Q–1. The screening resulted in reduction of the original set of radioactive and chemical constituents to a final set of 14 radioactive and 26 chemical constituents, which represents both alternatives and cumulative impact sources. In the screening analysis, consideration of one-space dimensional, transient movement of chains of radionuclides through the vadose zone established that progeny radionuclides contributed a small fraction of dose relative to that due to parent radionuclides present in the HLW tank farm Best-Basis Inventory and that consideration of ingrowth in transport through the vadose zone and unconfined aquifer was not required for *TC & WM EIS* detailed analysis of groundwater release scenarios. Ingrowth of radionuclides was considered in *TC & WM EIS* detailed analysis of intruder scenarios. Degradation of chemical constituents and production of chemical constituent degradation products are not considered in *TC & WM EIS* detailed analysis.

Table Q–1. Constituents Selected for Detailed Analysis

Radionuclides	Chemicals	
Hydrogen-3 (tritium)	1,2-Dichloroethane	Lead
Carbon-14	1,4-Dioxane	Manganese
Potassium-40	1-Butanol	Mercury
Strontium-90	2,4,6-Trichlorophenol	Molybdenum
Zirconium-93	Acetonitrile	Nickel (soluble salts)
Technetium-99	Arsenic, inorganic	Nitrate
Iodine-129	Benzene	Polychlorinated biphenyls
Cesium-137	Boron and compounds	Silver
Gadolinium-152	Cadmium	Strontium (stable)
Thorium-232	Carbon tetrachloride	Total uranium
Uranium isotopes (includes U-233, -234, -235, -238)	Chromium	Trichloroethylene
Neptunium-237	Dichloromethane	Vinyl chloride
Plutonium isotopes (includes Pu-239, -240)	Fluoride	
Americium-241	Hydrazine/hydrazine sulfate	

Key: Pu=plutonium; U=uranium.

Q.2.1 Identification of Receptors

Identification of potential receptors is based on current demography and guidance developed by state and Federal agencies. Currently, there are no permanent onsite receptors, and the population assumed to use the Columbia River water each year for the foreseeable future is approximately 5 million people (DOE 1987). A detailed description of the population distribution is presented in Chapter 3 of this *TC & WM EIS*. Recent agency guidance recommends consideration of the average member of the critical group as the basis for comparison with regulatory criteria (DOE 1995; NRC 2000). The average member of the critical group is a member of a group reasonably expected to receive the greatest exposure to releases from a facility. The range of activities of the average member of the critical group includes inhalation of contaminated air, ingestion of contaminated drinking water, establishment of a residence on or near contaminated material, and establishment of a garden on contaminated soil. For these scenarios, use of contaminated groundwater from a well is the source of contamination of the surface soil. Guidance for performance analysis of waste disposal facilities also recommends consideration of individuals directly intruding into residual contamination (DOE Guide 435.1-1). In addition, Executive Order 12898 directs Federal decisionmakers to identify and address high and adverse environmental impacts that disproportionately affect minority and low-income populations.

On the basis of this agency guidance, onsite use of groundwater and offsite use of surface water were selected for consideration. The groundwater receptors are a drinking-water well user, a resident farmer, and an American Indian resident farmer located on the site near the source of contamination, at the Core Zone Boundary, or at the Columbia River. In addition, an American Indian hunter-gatherer contacting a combination of groundwater and surface water is located on the Columbia River nearshore. The surface-water receptors are a resident farmer and American Indian resident farmer located on the Columbia River near the site and a member of the population located downstream from the site. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location. The final receptor is an intruder located on a tank farm barrier, waste disposal facility, or FFTF barrier whose activities lead to direct contact with residual contamination.

The human health impacts on each of these receptors were estimated for each alternative and are presented with the appropriate discussion throughout the main text. In addition, estimated impacts for a hunter-gatherer that is representative of a member of the Confederated Tribes of the Umatilla Indian Reservation and another that is representative of a member of the Confederated Tribes and Bands of the Yakama Nation, each based on exposure parameters provided by the tribes, are reported in Appendix W, Section W.3.

Q.2.2 Development of Exposure Scenarios

Scenarios identified for analysis are the combinations of the sources, environmental transport pathways, receptors, and locations described in the preceding paragraphs. The locations of the Core Zone Boundary, barriers, and Columbia River are illustrated in Appendix O, Figure O–16. Given 12 potential onsite locations (the10 barriers, the Core Zone Boundary, and the Columbia River nearshore), 3 groundwater receptor types (drinking-water well user, resident farmer, and American Indian resident farmer), and 19 alternatives (as described in Chapter 2 of this *TC & WM EIS*), and noting that not all receptors are present at each location for each alternative, a total of 148 onsite groundwater scenarios have been identified. Taking into account a river location with the surface-water receptors (resident farmer, American Indian resident farmer, American Indian hunter-gatherer, and downstream population) for

19 alternatives adds 76 scenarios, for a total of 224 scenarios. Each scenario involves release of radionuclides and chemicals to produce the impacts summarized in Section Q.3.

Q.2.2.1 Approach for Selection and Development of Mathematical Models

The preferred approach for impacts analysis is use of generally available, peer-reviewed models. However, no single model is available for the variety of sources, environmental conditions, and receptors under consideration in this analysis. Thus, the approach selected is use of a combination of generally available and site-specific models representing physical processes expected to occur. The approach for development of site-specific models, involving conceptualization and the formulation, solution, and use of mathematical models, is summarized in Table Q–2. Details of groundwater flow, release from source, vadose zone transport, and saturated zone transport are described in Appendices L, M, N, and O, respectively.

Table Q–2. Procedure for Development and Use of Site-Specific Models

Step	Action
1	Characterize physical processes
2	Develop conceptual model of physical processes
3	Formulate mathematical equations describing the concept
4	Develop algorithm for solution of equations
5	Implement algorithm in computer code
6	Verify computer code
7	Document procedure
8	Apply model

Q.2.2.2 Mathematical Models for Long-Term Performance Assessment

Two sets of mathematical models have been developed for analysis of scenarios describing potential human health impacts occurring over long periods of time following stabilization or closure of the HLW tanks at Hanford, final decommissioning of FFTF, and stabilization and closure of waste management disposal facilities. The first set of models assesses impacts of release to groundwater using modules simulating release to the vadose zone, transport through the vadose zone, and transport through the unconfined aquifer. Potential receptors for the release-to-groundwater impact models indirectly contact contamination transported from the tank farms, six sets of cribs and trenches (ditches) analyzed in the alternatives, and waste disposal areas. The second set assesses impacts on individuals who directly intrude into residual contamination at the tank farms and waste disposal areas.

The release-to-groundwater impacts analysis uses a set of physical-mechanism-specific release models described in Appendix M. The vadose zone transport analysis uses the STOMP [Subsurface Transport Over Multiple Phases] model (White and Oostrom 2000, 2006), which simulates transient movement of water through a three-dimensional study volume. Details of the vadose zone analysis using the STOMP model are presented in Appendix N. Direction and rate of groundwater movement through the unconfined aquifer are simulated using MODFLOW [modular three-dimensional finite-difference groundwater flow model] (USGS 2004). MODFLOW is a transient, three-dimensional simulation of Hanford and is described in Appendix O. Transport of solutes through the unconfined aquifer is simulated using the particle-tracking model described in Appendix O. For release-to-groundwater scenarios, concentrations of contaminants calculated using the above-described sequence of models serve as input data for estimation of human health impacts. Methods used for estimation of human health impacts are described in the following section.

The intruder impact model evaluates impacts of construction of a home or drilling of a well at a tank farm, decommissioned facility, or disposal area. Residual contamination is brought to the surface, resulting in exposure of construction or drilling workers and subsequent exposure of resident farmers. A detailed description of the intruder model is presented in Section Q.2.3.

The health effects module estimates dose, hazard, and cancer morbidity risk at a specified time for one of the following six exposure scenarios:

1. Use of groundwater for drinking water only
2. Use of surface water by a resident farmer
3. Use of surface water by an American Indian resident farmer
4. Use of groundwater by a resident farmer
5. Use of groundwater by an American Indian resident farmer
6. Use of a combination of groundwater and surface water by an American Indian hunter-gatherer

In the resident farmer scenarios (the second through the fifth cases), contaminated groundwater or surface water is used by the average member of the critical group for domestic purposes and irrigation of a garden. The primary functions performed in developing the estimate of health impact using a calculated value of contaminant concentration in water are calculation of contaminant concentration in soil and calculation of dose, Hazard Quotient, and risk. Information used to initiate the calculations includes concentration of the contaminant in groundwater or surface water at the access point and physical constants such as distribution coefficient, irrigation rate, and infiltration rate affecting rate of buildup of contamination in soil irrigated with contaminated water. The contaminant concentration in soil is calculated as:

$$C_s = (1/f_v)\, K_d\, C_w$$

where:

C_s	=	contaminant concentration in soil, grams per gram
f_v	=	conversion constant, 1×10^6 milliliters per cubic meter
K_d	=	distribution coefficient for contaminant and water, milliliters per gram
C_w	=	contaminant concentration in either groundwater or surface water in contact with the soil, grams per cubic meter

The exposure model calculates health impacts for a specified contaminant and time for one of the six scenarios identified above. Because of the differing nature of health endpoints, slightly different approaches are used for radionuclides and chemicals. For radionuclides, impacts are estimated as dose and risk. Cumulative impacts of a mixture of radionuclides are estimated as the sum of dose or risk of the individual radionuclides. For chemicals, health impacts are represented as Hazard Quotient for noncarcinogens and as risk for carcinogens. Cumulative impacts of a mixture are represented as the sum of the Hazard Quotients, termed "Hazard Index," of the individual chemicals or as the sum of risk of the individual chemicals. Methods used for each of the six exposure scenarios are described in the following paragraphs. Values for physical constants, dose and risk factors, and model parameters are presented in Section Q.2.4.

SCENARIO 1: USE OF GROUNDWATER FOR DRINKING WATER ONLY

For a radionuclide, the dose due to consumption of contaminated water is estimated as:

$$D_{dw} = C_r \, IR_{dw} \, DCF_{\mathrm{ing}}$$

where:

D_{dw}	=	drinking water dose for an individual radionuclide, rem per year
C_r	=	concentration of radionuclide in water, curies per cubic meter
IR_{dw}	=	drinking water consumption rate, cubic meters per year
DCF_{ing}	=	radionuclide-specific dose conversion factor for ingestion, rem per curie

Lifetime risk from the radionuclide is estimated as:

$$R_{dw} = f_a \, C_r \, IR_{dw} \, ED_{dw} \, SF_{dw}$$

where:

R_{dw}	=	lifetime risk due to ingestion of the radionuclide in drinking water, unitless
f_a	=	conversion constant, 1×10^{12} picocuries per curie
C_r	=	concentration of radionuclide in water, curies per cubic meter
IR_{dw}	=	drinking water consumption rate, cubic meters per year
ED_{dw}	=	exposure duration for the drinking water scenario, years
SF_{dw}	=	Health Effects Assessment Summary Tables (HEAST) radionuclide-specific slope factor for drinking water ingestion, 1 per picocurie

For ingestion of a chemical in drinking water, intake is defined as:

$$I_{dw} = (f_m \,/\, f_t) \, [\, (IR_{dw} \, EF_{dw} \, ED_{dw}) \,/\, (BW \, AT) \,] \, C_c$$

where:

I_{dw}	=	chronic intake rate of chemical in drinking water, milligrams per kilogram-day
f_m	=	conversion constant, 1,000 milligrams per gram
f_t	=	conversion constant, 365 days per year
IR_{dw}	=	drinking water consumption rate, cubic meters per year
EF_{dw}	=	exposure frequency for drinking water ingestion, days per year
ED_{dw}	=	exposure duration for the drinking water scenario, years
BW	=	body weight, kilograms
AT	=	averaging time, days
C_c	=	concentration of chemical in water, grams per cubic meter

The averaging time depends on the type of effect being considered. In the case of noncarcinogens, averaging is over the time of exposure, assumed to be 30 years. In the case of carcinogens, averaging is over a lifetime, assumed to be 70 years.

The Hazard Quotient, a measure of noncarcinogenic risk or toxic effects, is calculated as:

$$HQ_{dw} = I_{dw} / RfD$$

where:

HQ_{dw}	=	Hazard Quotient for ingestion of the chemical in drinking water, unitless
I_{dw}	=	chronic intake rate of chemical in drinking water, milligrams per kilogram-day
RfD	=	Integrated Risk Information System (IRIS) reference dose for chronic ingestion of the chemical, milligrams per kilogram-day

Lifetime risk is estimated as:

$$R_{dw} = I_{dw} \, SF_{\mathrm{ing}}$$

where:

R_{dw}	=	lifetime risk due to ingestion of the chemical in drinking water, unitless
I_{dw}	=	chronic intake rate of chemical in drinking water, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for ingestion of the chemical, 1 per milligram per kilogram-day

SCENARIOS 2 AND 3: USE OF SURFACE WATER

Use of contaminated surface water involves drinking water, fish consumption, and residential agriculture exposure. The resident farmer and American Indian receptors differ in consumption rates and exposure conditions, but the same approach is used for each type of receptor. The receptors also differ in that the American Indian uses a sweat lodge and produces more food and products and consequently has a larger-area garden than the resident farmer. Dose, Hazard Quotient, and risk from ingestion of drinking water are calculated as described for Scenario 1, except contaminant surface-water concentrations are used.

For radionuclides, dose for fish consumption is calculated as:

$$D_f = C_{sw} \, (B_f / f_v) \, IR_f \, DCF_{\mathrm{ing}}$$

where:

D_f	=	dose for a radionuclide due to consumption of fish, rem per year
C_{sw}	=	radionuclide concentration in surface water, curies per cubic meter
B_f	=	radionuclide bioaccumulation factor for fish, picocuries per kilogram/picocuries per liter
f_v	=	conversion constant, 1,000 liters per cubic meter
IR_f	=	consumption rate for fish, kilograms per year
DCF_{ing}	=	radionuclide-specific dose conversion factor for ingestion, rem per curie

Lifetime risk due to ingestion of the radionuclide in fish is calculated as:

$$R_f = C_{sw}\,(B_f/f_v)\,IR_f\,f_a\,ED_f\,SF_{\mathrm{ing}}$$

where:

R_f = lifetime risk from ingestion of contaminant in fish, unitless
C_{sw} = radionuclide concentration in surface water, curies per cubic meter
B_f = radionuclide bioaccumulation factor for fish, picocuries per kilogram/picocuries per liter
f_v = conversion constant, 1,000 liters per cubic meter
IR_f = consumption rate for fish, kilograms per year
f_a = conversion constant, 1×10^{12} picocuries per curie
ED_f = exposure duration for fish consumption, years
SF_{ing} = HEAST radionuclide-specific slope factor for food ingestion, 1 per picocurie

For chemicals, intake due to consumption of fish is calculated as:

$$I_f = (f_m/f_v)\;[\;(IR_f\,ED_f\,B_f)\,/\,(\;BW\,AT\;)\;]\;C_{sw}$$

where:

I_f = intake of chemical in fish, milligrams per kilogram-day
f_m = conversion constant, 1,000 milligrams per gram
f_v = conversion constant, 1,000 liters per cubic meter
IR_f = consumption rate of fish, kilograms per year
ED_f = exposure duration for fish consumption, years
B_f = bioaccumulation factor of chemical in fish, milligrams per kilogram/milligrams per liter
BW = body weight, kilograms
AT = averaging time, days
C_{sw} = concentration of chemical in surface water, grams per cubic meter

Hazard Quotient for consumption of the chemical in fish is:

$$HQ_f = I_f\;/\;RfD$$

where:

HQ_f = Hazard Quotient for ingestion of chemical in fish, unitless
I_f = intake of chemical in fish, milligrams per kilogram-day
RfD = IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to ingestion of the chemical in fish is calculated as:

$$R_f = I_f\,SF_{ing}$$

where:

R_f = lifetime risk from ingestion of chemical in fish, unitless
I_f = intake of chemical in fish, milligrams per kilogram-day
SF_{ing} = IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

Residential agriculture activities for the resident farmer and American Indian resident farmer involve exposure to radionuclides through a variety of pathways. These include the following:

1. External exposure from radionuclides in soil
2. Inadvertent ingestion of radionuclides in soil
3. Inhalation of fugitive dust containing radionuclides
4. Ingestion of crops grown on contaminated soil
5. Ingestion of animal products (beef and milk) from animals raised on contaminated soil
6. Ingestion of animal products (beef and milk) from animals who drink contaminated water

For radionuclides, Version 6.4 of the RESRAD [RESidual RADioactivity] computer code (Yu et al. 2001) is used to calculate unit dose and risk factors for those exposure pathways based on soil concentrations (the first five pathways listed above). The last pathway, involving exposure via animals' drinking water, is calculated outside of RESRAD.

Dose due to intake of a radionuclide is then estimated as:

$$D_{ra} = C_s \, DuRSRD + C_{sw} \, B_{\text{water-beef}} \, IR_{\text{beef-DW}} \, IR_{\text{beef}} \, DCF_{\text{ing}} + C_{sw} \, B_{\text{water-milk}} IR_{\text{dairy-DW}} \, IR_{\text{milk}} \, DCF_{\text{ing}}$$

where:

D_{ra}	=	dose for residential agriculture, rem per year
C_s	=	concentration of radionuclide in soil, picocuries per gram
$DuRSRD$	=	RESRAD unit dose factor for residential agriculture, rem per year/picocuries per gram
C_{sw}	=	concentration of the radionuclide i in the surface water, curies per liter
$B_{\text{water-beef}}$	=	radionuclide-specific water-to-beef biotransfer factor, days per kilogram
$IR_{\text{beef-DW}}$	=	consumption rate of drinking water by beef cattle, liters per day
IR_{beef}	=	consumption rate of beef by the farmer, kilograms per year
DCF_{ing}	=	radionuclide-specific dose conversion factor for ingestion, rem per curie
$B_{\text{water-milk}}$	=	radionuclide-specific water-to-milk biotransfer factor, days per liter
$IR_{\text{dairy-DW}}$	=	consumption rate of drinking water by dairy cattle, liters per day
IR_{milk}	=	consumption rate of milk by the resident farmer, liters per year

In general, values for water-to-beef and water-to-milk biotransfer factors are not available; hence, the plant-to-beef and plant-to-milk biotransfer factors ($B_{\text{plant-beef}}$, days per kilogram, and $B_{\text{plant-milk}}$, days per liter) are used in their place, that is:

$$B_{\text{water-beef}} = B_{\text{plant-beef}}$$

and

$$B_{\text{water-milk}} = B_{\text{plant-milk}} \, \rho_{\text{milk}}$$

where ρ_{milk} is the appropriate density of milk, 1.0 kilogram per liter.

Lifetime risk is calculated in a similar manner:

$$R_{ra} = C_s\ RuRSRD\ ED_{ra} + C_{sw}\ f_a\ (\ B_{\text{water-beef}}\ IR_{\text{beef-DW}}\ IR_{\text{beef}} + B_{\text{water-milk}} IR_{\text{dairy-DW}}\ IR_{\text{milk}}\ )\ ED_{ra}\ SF_{\text{ing}}$$

where:

R_{ra}	=	lifetime risk from residential agriculture, unitless
C_s	=	radionuclide concentration in soil, picocuries per gram
$RuRSRD$	=	RESRAD unit risk factor for residential agriculture, 1 per year per picocuries per gram
ED_{ra}	=	exposure duration for residential agriculture, years
C_{sw}	=	concentration of the radionuclide *i* in the surface water, curies per liter
f_a	=	conversion factor, 1×10^{12} picocuries per curie
$B_{\text{water-beef}}$	=	radionuclide-specific water-to-beef biotransfer factor, days per kilogram
$IR_{\text{beef-DW}}$	=	consumption rate of drinking water by beef cattle, liters per day
IR_{beef}	=	consumption rate of beef by the farmer, kilograms per year
$B_{\text{water-milk}}$	=	radionuclide-specific water-to-milk biotransfer factor, days per liter
$IR_{\text{dairy-DW}}$	=	consumption rate of drinking water by dairy cattle, liters per day
IR_{milk}	=	consumption rate of milk by the resident farmer, liters per year
SF_{ing}	=	HEAST radionuclide-specific slope factor for food ingestion, 1 per picocurie

The values of the RESRAD unit dose and risk factors differ for different radionuclides and for the resident farmer and American Indian resident farmer.

The agriculture activities of the resident farmer and American Indian resident farmer involve exposure to chemicals through all of the same pathways as radionuclides except the external (direct radiation) pathway. However, for hazardous chemicals, hazard and risk from residential agriculture exposures are estimated using individual algebraic equations for each of the pathways: inadvertent soil ingestion, fugitive dust inhalation, crop ingestion, and consumption of animal and dairy products consistent with agency guidance (EPA 1996a, 1996b, 2002).

For inadvertent ingestion of soil, intake of a chemical is estimated as:

$$I_{si} = [\ (\ IR_s\ EF_{si}\ ED_{si}\ )\ /\ (\ BW\ AT\ )\ ]\ C_s$$

where:

I_{si}	=	intake rate of chemical by inadvertent ingestion of soil, milligrams per kilogram-day
IR_s	=	rate of inadvertent ingestion of soil, milligrams per day
EF_{si}	=	exposure frequency for inadvertent ingestion of soil, days per year
ED_{si}	=	exposure duration for inadvertent ingestion of soil, years
BW	=	body weight, kilograms
AT	=	averaging time, days
C_s	=	contaminant concentration in soil, grams per gram

Hazard Quotient for the chemical is calculated as:

$$HQ_{si} = I_{si}\ /\ RfD$$

where:

HQ_{si}	=	Hazard Quotient for inadvertent ingestion of chemical in soil, unitless
I_{si}	=	intake rate of chemical by inadvertent ingestion of soil, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to inadvertent ingestion of the chemical in soil is calculated as:

$$R_{si} = I_{si}\, SF_{ing}$$

where:

R_{si}	=	lifetime risk, unitless
I_{si}	=	intake rate of chemical by inadvertent ingestion of soil, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

For inhalation of a contaminant in fugitive dust, intake concentration is calculated as:

$$I_{fd} = \{\ (f_m/PEF)\ EF_{fd}\ ED_{fd}\ [\ ET_o + (\ ET_i\ DF_i\ )\ ]\ C_s\ \}\ /\ AT$$

where:

I_{fd}	=	intake concentration of chemical in fugitive dust, milligrams per cubic meter
f_m	=	conversion constant, 1×10^6 milligrams per kilogram
PEF	=	particulate emission factor, cubic meters per kilogram
EF_{fd}	=	exposure frequency for inhalation of fugitive dust, days per year
ED_{fd}	=	exposure duration for inhalation of fugitive dust, years
ET_o	=	exposure time fraction, outdoors, unitless
ET_i	=	exposure time fraction, indoors, unitless
DF_i	=	dilution factor for indoor inhalation of fugitive dust, unitless
C_s	=	contaminant concentration in soil, grams per gram
AT	=	averaging time, days

The Hazard Quotient is calculated as:

$$HQ_{fd} = I_{fd}\ /\ RfC$$

where:

HQ_{fd}	=	Hazard Quotient for inhalation of the chemical in fugitive dust, unitless
I_{fd}	=	intake concentration of chemical in fugitive dust, milligrams per cubic meter
RfC	=	IRIS reference concentration for inhalation of the chemical, milligrams per cubic meter

Lifetime risk due to ingestion of the chemical in fugitive dust is:

$$R_{fd} = I_{fd}\, IUR$$

where:

R_{fd}	=	lifetime risk from inhalation of the chemical in fugitive dust, unitless
I_{fd}	=	intake concentration of chemical in fugitive dust, milligrams per cubic meter
IUR	=	inhalation unit risk for the chemical, 1 per milligram per cubic meter

For ingestion of a chemical in crops, intake is calculated as:

$$I_c = [\ (IR_{vf} + IR_{lv}\ )\ (f_{m1}\ ED_c\ f_{m2})\ TF_p\ /\ (BW\ AT)\ ]\ C_{cs}$$

where:

I_c	=	intake from chemical in crops, milligrams per kilogram-day
IR_{vf}	=	consumption rate of vegetables and fruit, kilograms per year
IR_{lv}	=	consumption rate of leafy vegetables, kilograms per year
f_{m1}	=	conversion factor, 1,000 grams per kilogram
ED_c	=	exposure duration for crop ingestion, years
f_{m2}	=	conversion constant, 1,000 milligrams per gram
TF_p	=	soil-to-plant transfer factor of chemical, milligrams per kilogram/milligrams per kilogram
BW	=	body weight, kilograms
AT	=	averaging time, days
C_{cs}	=	concentration of chemical in soil, grams per gram

Hazard Quotient for ingestion of the chemical in crops is calculated as:

$$HQ_c = I_c / RfD$$

where:

HQ_c	=	Hazard Quotient for ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to ingestion of a chemical in crops is calculated as:

$$R_c = I_c \, SF_{\mathrm{ing}}$$

where:

R_c	=	lifetime risk due to ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

The farmer's intake I_{beef} for ingestion of a chemical in meat results from consumption of an animal that has ingested fodder and/or forage grown in contaminated soil, directly ingested the soil, and ingested contaminated water:

$$I_{\mathrm{beef}} = I_{\mathrm{fodder}} + I_{\mathrm{soil}} + I_{\mathrm{water}}$$

where:

$$I_{\mathrm{fodder}} = C_{cs}\, f_{m1}\, f_{m2}\, TF_p\, IR_{\mathrm{beef;v}}\, B_{\mathrm{plant\text{-}beef}}\, IR_{\mathrm{beef}}\, ED_c / (BW\, AT)$$

$$I_{\mathrm{soil}} = C_{cs}\, f_{m1}\, f_{m2}\, B_{\mathrm{soil\text{-}beef}}\, IR_{\mathrm{beef\text{-}soil}}\, IR_{\mathrm{beef}}\, ED_c / (BW\, AT)$$

$$I_{\mathrm{water}} = C_{sw}\, (f_{m2} / \rho_{\mathrm{water}})\, B_{\mathrm{water\text{-}beef}}\, IR_{\mathrm{beef\text{-}DW}}\, IR_{\mathrm{beef}}\, ED_c / (BW\, AT)$$

and where:

I_{beef}	=	total intake of chemical by the farmer from consumption of the beef, milligrams per kilogram-day
I_{fodder}	=	animal-fodder-ingestion-related intake by the farmer from consumption of the beef, milligrams per kilogram-day

I_{soil}	=	animal-soil-ingestion-related intake by the farmer from consumption of the beef, milligrams per kilogram-day
I_{water}	=	animal-drinking-water-related intake by the farmer from consumption of the beef, milligrams per kilogram-day
C_{cs}	=	concentration of chemical in soil, grams per gram
f_{m1}	=	conversion factor, 1,000 grams per kilogram
f_{m2}	=	conversion constant, 1,000 milligrams per gram
TF_p	=	soil-to-plant transfer factor of chemical, milligrams per kilogram/milligrams per kilogram
$IR_{\text{beef;v}}$	=	consumption rate of air-dried fodder/forage by beef cattle, kilograms per day
$B_{\text{plant-beef}}$	=	chemical-specific plant-to-beef biotransfer factor, days per kilogram
IR_{beef}	=	consumption rate of beef by farmer, kilograms per year
ED_c	=	exposure duration for crop ingestion, years
BW	=	body weight, kilograms
AT	=	averaging time, days
$B_{\text{soil-beef}}$	=	chemical-specific soil-to-beef biotransfer factor, days per kilogram
$IR_{\text{beef-soil}}$	=	consumption rate of soil by beef cattle, kilograms per day
C_{sw}	=	concentration of the chemical in the surface water, grams per cubic meter
ρ_{water}	=	density of water, 1,000 kilograms per cubic meter
$B_{\text{water-beef}}$	=	chemical-specific water-to-beef biotransfer factor, days per liter
$IR_{\text{beef-DW}}$	=	consumption rate of drinking water by beef cattle, liters per day

In general, values for the soil-to-beef and water-to-beef biotransfer factors ($B_{\text{soil-beef}}$ and $B_{\text{water-beef}}$, respectively) are not available; hence, the plant-to-beef biotransfer factor ($B_{\text{plant-beef}}$, days per kilogram) is used in their place, that is:

$$B_{\text{soil-beef}} = B_{\text{plant-beef}}$$

and

$$B_{\text{water-beef}} = B_{\text{plant-beef}}\,\rho_{\text{water}}$$

where ρ_{water} is the density of water, 1.0 kilogram per liter

The Hazard Quotient for ingestion of the chemical in crops is calculated as:

$$HQ_c = I_c / RfD$$

where:

HQ_c	=	Hazard Quotient for ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to ingestion of a chemical in crops is calculated as:

$$R_c = I_c\, SF_{\text{ing}}$$

where:

R_c	=	lifetime risk due to ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

Doses occurring in use of a sweat lodge are due to inhalation of radionuclides in liquid droplets suspended in air and inhalation of radionuclides conveyed into the air during evaporation of water. In each case, the concentration of a radionuclide in the water used in the sweat lodge is the concentration of the radionuclide in the source surface water. The approach for estimating the concentration of droplets in air is to use a value representative of that observed in fog (Mann and Puigh 2001). The approach for estimating the concentration of a radionuclide in air due to water evaporation is to estimate the quantity of liquid water evaporated to produce the quantity of water vapor present at equilibrium saturation at the temperature of the sweat lodge followed by application of a radionuclide-specific decontamination factor to reflect incomplete entrainment of nonvolatile radionuclides (Mann and Puigh 2001).

The concentration of a radionuclide in air due to droplets in air is estimated as:

$$C_{sn,d} = VR_{d,a}\, C_{sw}$$

where:

$C_{sn,d}$	=	concentration of a radionuclide in air in the sweat lodge due to presence of droplets, curies per cubic meter
$VR_{d,a}$	=	ratio of volume of droplets to volume of air in the sweat lodge, unitless
C_{sw}	=	concentration of radionuclide in surface water, curies per cubic meter

The concentration of a radionuclide in the air in the sweat lodge due to evaporation of water was estimated as:

$$C_{sn,e} = \{\, DF_{sn,e}\, [(\rho_{wv}\, V_{sn}) / \rho_{wl}\,]\, C_{sw}\, \} / V_{sn}$$

where:

$C_{sn,e}$	=	concentration of a radionuclide in air in the sweat lodge due to evaporation of water, curies per cubic meter
$DF_{sn,e}$	=	entrainment factor for a radionuclide due to evaporation, unitless
ρ_{wv}	=	density of water vapor in air in the sweat lodge, grams per cubic meter
V_{sn}	=	volume of the sweat lodge, cubic meters
ρ_{wl}	=	density of liquid water, grams per cubic meter
C_{sw}	=	concentration of a radionuclide in surface water, curies per cubic meter

Annual dose due to inhalation of a radionuclide in the sweat lodge was estimated as:

$$D_{sn} = (C_{sn,d} + C_{sn,e})\, (\, BR_{sn}\, DCF_{\mathrm{inh}}\, EF_{sn}\,)$$

where:

D_{sn}	=	dose due to use of the sweat lodge, rem per year
$C_{sn,d}$	=	concentration of a radionuclide in air in the sweat lodge due to presence of droplets, curies per cubic meter
$C_{sn,e}$	=	concentration of a radionuclide in air in the sweat lodge due to evaporation of water, curies per cubic meter
BR_{sn}	=	breathing rate in the sweat lodge, cubic meters per year
DCF_{inh}	=	radionuclide-specific dose conversion factor for inhalation, rem per curie
EF_{sn}	=	exposure frequency for the sweat lodge, years per year

Lifetime risk due to inhalation of a radionuclide during use of the sweat lodge was estimated as:

$$R_{sn} = (C_{sn,d} + C_{sn,e}) \, (BR_{sn} \, EF_{sn} \, ED_{sn} \, f_a \, SF_{\text{inh}})$$

where:

R_{sn}	=	lifetime risk from use of the sweat lodge, unitless
$C_{sn,d}$	=	concentration of a radionuclide in air in the sweat lodge due to presence of droplets, curies per cubic meter
$C_{sn,e}$	=	concentration of a radionuclide in air in the sweat lodge due to evaporation of water, curies per cubic meter
BR_{sn}	=	breathing rate in the sweat lodge, cubic meters per year
EF_{sn}	=	exposure frequency for the sweat lodge, years per year
ED_{sn}	=	exposure duration for use of the sweat lodge, years
f_a	=	conversion factor, 1×10^{12} picocuries per curie
SF_{inh}	=	HEAST radionuclide-specific slope factor for inhalation, 1 per picocurie

Hazard Quotient and risk from exposure to chemicals in a sweat lodge were estimated using the approach applied for radionuclides. The concentration of a chemical in air due to droplets in air was estimated as:

$$C_{sn,d} = VR_{d,a} \, f_m \, C_{sw}$$

where:

$C_{sn,d}$	=	concentration of chemical in air in the sweat lodge due to presence of droplets, milligrams per cubic meter
$VR_{d,a}$	=	ratio of volume of droplets to volume of air in the sweat lodge, unitless
f_m	=	conversion factor, 1,000 milligrams per gram
C_{sw}	=	concentration of chemical in surface water, grams per cubic meter

The concentration of a chemical in air in the sweat lodge due to evaporation of water was estimated as:

$$C_{sn,e} = \{ \, DF_{sn,e} \, f_m \, [(\rho_{wv} \, V_{sn}) \, / \, \rho_{wl} \,] \, C_{sw} \, \} \, / \, V_{sn}$$

where:

$C_{sn,e}$	=	concentration of chemical in air in the sweat lodge due to evaporation of water, milligrams per cubic meter
$DF_{sn,e}$	=	entrainment factor for chemical due to evaporation, unitless
f_m	=	conversion factor, 1,000 milligrams per gram
ρ_{wv}	=	density of water vapor in air in the sweat lodge, grams per cubic meter
V_{sn}	=	volume of the sweat lodge, cubic meters
ρ_{wl}	=	density of liquid water, grams per cubic meter
C_{sw}	=	concentration of chemical in surface water, grams per cubic meter

Hazard Quotient for a chemical from use of the sweat lodge was estimated as:

$$HQ_{sn} = \{ \, (C_{sn,d} + C_{sn,e}) \, [(EF_{sn} \, ED_{sn} \, f_t) \, / \, AT \,] \, \} \, / \, RfC$$

where:

HQ_{sn}	=	Hazard Quotient for inhalation of chemical during use of a sweat lodge, unitless
$C_{sn,d}$	=	concentration of chemical in air in the sweat lodge due to presence of droplets, milligrams per cubic meter
$C_{sn,e}$	=	concentration of chemical in air in the sweat lodge due to evaporation of water, milligrams per cubic meter
EF_{sn}	=	exposure frequency for use of the sweat lodge, years per year
ED_{sn}	=	exposure duration for use of the sweat lodge, years
f_t	=	conversion factor, 365 days per year
AT	=	averaging time, days
RfC	=	reference concentration for the chemical, milligrams per cubic meter

Lifetime risk from inhalation of a chemical during use of a sweat lodge was estimated as:

$$R_{sn} = (C_{sn,d} + C_{sn,e})\ [(EF_{sn}\ ED_{sn}\ f_t) / AT]\ IUR$$

where:

R_{sn}	=	lifetime risk from inhalation of chemical during use of the sweat lodge, unitless
$C_{sn,d}$	=	concentration of chemical in air in the sweat lodge due to presence of droplets, milligrams per cubic meter
$C_{sn,e}$	=	concentration of chemical in air in the sweat lodge due to evaporation of water, milligrams per cubic meter
EF_{sn}	=	exposure frequency for use of the sweat lodge, years per year
ED_{sn}	=	exposure duration for use of the sweat lodge, years
f_t	=	conversion factor, 365 days per year
AT	=	averaging time, days
IUR	=	inhalation unit risk for the chemical, 1 per milligram per cubic meter

SCENARIOS 4 AND 5: USE OF GROUNDWATER

The methods and models used in the analysis of groundwater use are the same as those described above for the drinking water scenario and for the residential agriculture pathway of the surface-water use scenarios. The differences are absence of fish consumption and use of the contaminant concentration in groundwater in place of that in surface water.

SCENARIO 6: AMERICAN INDIAN HUNTER-GATHERER PATHWAYS

This scenario is similar to the American Indian resident farmer scenarios in that it considers radiological and chemical exposures from drinking contaminated water, consuming contaminated meat, inadvertently ingesting soil, consuming contaminated fish, inhaling contaminated dust, and participating in ceremonial sweat lodge ceremonies. However, in this hunter-gatherer scenario, the exposed adult American Indian is assumed to live a more traditional American Indian lifestyle. The domestic-garden exposure pathway of the resident farmer scenarios is replaced by the consumption of wild plants, and the consumption of domestic livestock is replaced with that of game, specifically deer, although the annual consumption rates for plants, meats, and fish, regardless of origin, are similar in magnitude. As is the case with the resident farmer and American Indian resident farmer assessments, this exposure assessment is directed toward a representative or typical adult member of the population of interest.

An important difference between this scenario and the resident farmer scenarios described in the preceding section is that the individual of interest, or receptor in the scenario, is exposed to contamination from both surface water and groundwater. In each of the resident farmer scenarios described in the preceding paragraphs, the source of exposure is either surface water or groundwater, but not both. The American Indian hunter-gatherer is exposed to groundwater-related contamination through the consumption of wild plants and deer meat, inadvertent soil ingestion, and participation in sweat lodge ceremonies. The link with groundwater occurs as a direct result of the location of the scenario—near the river where groundwater, i.e., the saturated zone, is assumed to be near the land surface and extending up into the root zone. In the root zone, groundwater contamination then is available for uptake by plants that can be consumed either directly by the receptor or by deer, which in turn may be consumed by the receptor. The proximity of the groundwater to the land surface is also assumed to be sufficient at times for soil at the land surface to become contaminated, resulting in exposure through the inhalation of resuspended soil. Exposure pathways involving surface water, i.e., the Columbia River, include the hunter-gatherer's drinking water (100 percent) and consumption of fish. The deer are also assumed to use the river for drinking water (100 percent), resulting in an additional component to the exposure through the consumption of deer meat. Depending on the purpose, sweat lodge ceremonies may use either groundwater or surface water, and so this scenario assumes 50 percent use of the former and 50 percent use of the latter.

The equations needed for estimation of the chemical health impacts in the hunter-gatherer scenario are the same as given above for the surface-water (and groundwater) estimates. However, the groundwater concentrations are used to arrive at soil concentrations used in the food (plants and deer [forage]), soil ingestion, and dust inhalation pathways, while surface-water concentrations are used in the drinking water, fish, and deer (drinking water) calculations. Like the deer pathway, the sweat lodge exposure pathway uses both groundwater and surface-water concentrations. Most of the exposure parameters in the hunter-gatherer scenario are the same as used in the American Indian resident farmer scenario. This includes annual intake of meat and produce/wild plants, duration of exposures, and chemical- and radionuclide-specific parameters. Aside from the simultaneous use of groundwater and surface water, a primary difference in exposure parameterization for the two scenarios relates to animals in terms of their sizes, forage intakes, soil ingestion, and drinking water intakes.

The radiological calculations for the hunter-gatherer are the same as those for the American Indian resident farmer in that RESRAD was employed in the calculation of agricultural activity unit dose factors or unit risk factors. However, separate RESRAD calculations were needed—one for a groundwater component and one for a surface-water component.

Q.2.3 Intruder Scenario Models

Past practice, current regulatory frameworks, and site-specific conditions (DOE Guide 435.1-1; NRC 1982) were reviewed to develop two site-specific intrusion scenarios for exposure to radionuclides. These are characterized as home construction and well drilling, and each comprises two phases. For the home construction scenario, a worker excavates soil to construct the foundation for a home. In this activity, the worker is subject to inhalation of contaminated soil and external exposure from the floor and walls of the excavation. Subsequently, soil removed from the excavation is mixed across the surrounding area used for a residence and garden. In the well-drilling scenario, a worker completes a well intersecting subsurface contamination and deposits contaminated drill cuttings in a pond. In the course of this activity, the worker inhales suspended dust and experiences external exposure from the contamination in the pond. Subsequently, soil removed from the cuttings pond is mixed across the surrounding area used for a residence and garden. Impacts are estimated for receptors present at the site at a series of times specified for analysis, including a delay representing a period of institutional control. The first of the following sections discusses the upper-level organization of the model, while the second section discusses details of the dose calculation for each of the receptors. As in prior analysis, American Indian and resident farmer receptors are considered. For direct intrusion scenarios of limited extent in time as anticipated in DOE guidance, acceptance criteria have been established for radioactive constituents but not for chemical constituents.

Q.2.3.1 Organization of the Model

The intruder model comprises two major elements: an executive routine and a dose module. Functions performed in the executive routine include interpretation of input data, control of sequence of calculations, and writing of results to output files. The overall organization of the code is represented in Figure Q–1. The input data include specification of radionuclides and radionuclide inventories and of time periods for which dose will be estimated. As indicated in this figure, the code cycles through each radionuclide and time step and calculates dose at each step in the process. Following completion of the dose calculation at each time step, the code identifies the maximum dose and time of maximum dose.

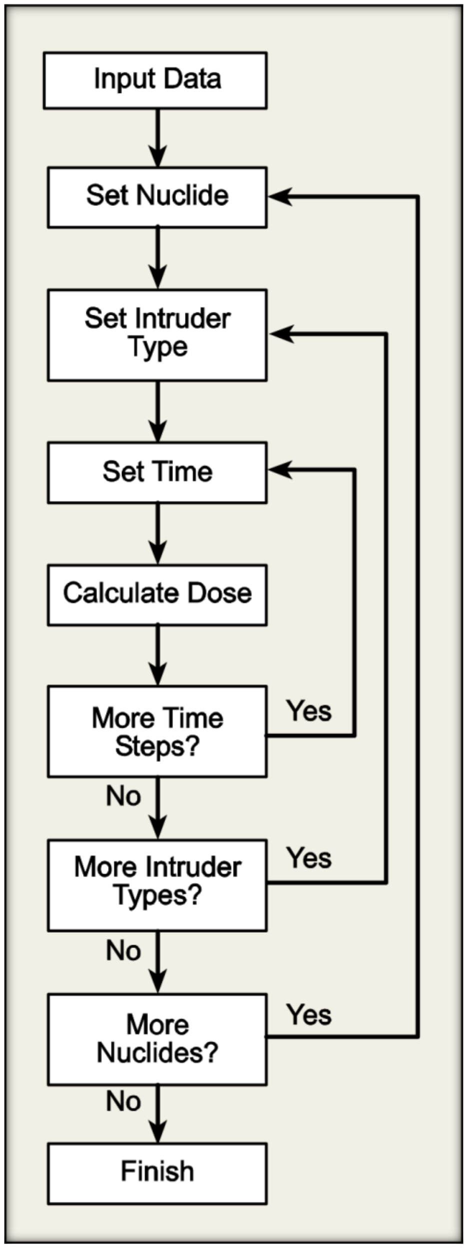


Figure Q–1. Algorithm for Intruder Scenario Analysis Computer Code

The time sequence of total dose and the dose for each radionuclide for the time of maximum dose for each intruder are provided as output data.

Q.2.3.2 Intruder Dose Models

The magnitude of dose estimated for each intruder depends in part on the range of intruder activities. The following sections present equations used for calculation of dose for each type of intruder. Intruder activities and scenario parameter values are consistent with past analyses and current guidance (DOE Guide 435.1-1; NRC 1982), and dose conversion factors used in the analysis are consistent with current Federal guidance (Eckerman and Ryman 1993; Eckerman et al. 1999). Values used for dose factors and model parameters are presented in the following subsection. At each time step during the calculation of dose, radionuclide concentrations are adjusted to reflect decay and ingrowth.

Q.2.3.2.1 Home Construction Worker

The home construction intruder excavates a foundation for a home, spending a specified length of time in the excavation. The excavation work generates airborne dust that is inhaled by the worker. The worker is also simultaneously exposed to direct radiation emitted from radioactive material in the surrounding soil. In the course of the work, residual contamination is brought to the surface. The amount of activity brought to the surface during home construction is estimated as:

$$A_{hc} = W_{\mathrm{exc}}\, L_{\mathrm{exc}}\, H_{\mathrm{rmvd}}\, \rho_w\, f_v\, C_w$$

where:

A_{hc}	=	activity of a radionuclide removed from the excavation during home construction, picocuries
W_{exc}	=	width of the excavation, meters
L_{exc}	=	length of the excavation, meters
H_{rmvd}	=	height of waste removed from the excavation, meters
ρ_w	=	density of waste removed from the excavation, grams per cubic centimeter
f_v	=	conversion constant, 1×10^6 cubic centimeters per cubic meter
C_w	=	concentration of radionuclide in waste, picocuries per gram

The dose due to inhalation of a given radionuclide was estimated as:

$$D_{\mathrm{inh}} = (1 / f_a\, f_m)\, M_{\mathrm{load}}\, BR\, T_{\mathrm{exc}}\, C_{\mathrm{soil}}\, DCF_{\mathrm{inh}}$$

where:

D_{inh}	=	inhalation dose, rem
f_{a}	=	conversion factor, 1×10^{12} picocuries per curie
f_m	=	conversion, 1,000 milligrams per gram
M_{load}	=	mass loading of dust in the air, milligrams per cubic meter
BR	=	breathing rate, cubic meters per year
T_{exc}	=	time spent in the excavation, years
$\mathrm{C}_{\mathrm{soil}}$	=	radionuclide concentration in the soil, picocuries per gram
DCF_{inh}	=	radionuclide-specific dose conversion factor for inhalation, rem per curie

Direct external dose was estimated as:

$$D_{\mathrm{ext}} = N_s\, DEN_s\, C_s\, T_{\mathrm{exc}}\, DCF_{exV}$$

where:

D_{ext} = external dose, rem
N_s = number of surfaces in excavation, unitless
DEN_s = density of soil, grams per cubic centimeter
C_s = concentration of radionuclide in the soil, picocuries per gram
T_{exc} = time spent in the excavation, years
DCF_{exV} = dose conversion factor for external radiation from a volume source, rem per year/picocuries per cubic centimeter

Five surfaces (four walls and a floor) and dose factors for semi-infinite media not corrected for finite size of the excavation were used in the calculations.

Q.2.3.2.2 Well-Drilling Worker

In this scenario, a worker completing a well is assumed to inhale dust mobilized by drilling activity and to be exposed to radiation emitted by waste brought to the surface in the drilling mud. Dose due to inhalation was estimated using the same approach and equation as described above for the home construction scenario worker. The drilling mud is pumped to a pond where it is covered by 0.6 meters (2 feet) of water. The worker remains in the vicinity of the pond and is exposed to direct radiation emitted from the radioactive material in the pond. The activity brought to the surface is:

$$A_{wd} = (\pi/4)\,(D_{\mathrm{well}})^{2}\,Z_w\,DEN_w\,f_v\,\mathrm{C_w}$$

where:

A_{wd} = activity of a radionuclide deposited in the pond, picocuries
π = mathematical constant, value = 3.1415
D_{well} = diameter of the well, meters
Z_w = thickness of waste horizon intersected by the well, meters
DEN_w = density of waste, grams per cubic centimeter
f_v = conversion factor, 1×10^{6} cubic centimeters per cubic meter
C_w = radionuclide concentration in the waste, picocuries per gram

The activity was distributed at the upper surface of the mud layer, below the overlying water. The shielding of the pond water would reduce the dose by a factor of approximately 75. The dose to a receptor near the pond was estimated as:

$$D_{\mathrm{drill}} = [(A_{wd}/f_a)/A_p]\,(1.0/f_{\mathrm{shld}})\,T_{\mathrm{drill}}\,DCF_{exS}$$

where:

D_{drill} = dose during drilling activity, rem
A_{wd} = activity of a radionuclide deposited in the pond, picocuries
f_a = conversion factor, 1×10^{12} picocuries per curie
A_p = area of pond, square meters
f_{shld} = factor for reduction of dose due to shielding by water in pond, unitless
T_{drill} = time of exposure near pond, years
DCF_{exS} = dose conversion factor for external radiation from a source of surface contamination, rem per year/curies per square meter

Q.2.3.2.3 Residential Agriculture Intruder

In the residential agriculture scenario, an individual lives in a home and cultivates a garden on soil containing residual contamination, resulting in exposure to radionuclides through a variety of direct radiation and inhalation and ingestion pathways. Analysis of this scenario was conducted using the RESRAD computer code (Yu et al. 2001) developed for the Formerly Utilized Sites Remedial Action Program. RESRAD estimates annual dose to an individual who establishes a residence on a site having residual contamination; raises and consumes crops; raises livestock and consumes meat, poultry, and milk; drinks contaminated groundwater; and obtains fish from a contaminated pond. Use of the model for site-specific application requires selection of appropriate operating modes of the model and specification of values for parameters characterizing site physical conditions and the range of likely activity of the individual. For this *TC & WM EIS*, American Indian and resident farmer receptors having different production rates were selected for analysis. Parameter values for intruder analysis are the same as those presented for the residential agriculture scenarios of long-term analysis and are presented in the following section. For the above considerations, exposure pathways included in this analysis are as follows:

- Direct radiation
- Inhalation of volatile compounds
- Inhalation of dust
- Ingestion of vegetables, grain, fruit, meat (not fish), poultry, and milk
- Inadvertent ingestion of soil

Intrusion impacts for the above pathways result from transport of waste to the surface due to human activity and occur primarily in the near term. Impacts for the drinking water pathway involve transport of radionuclides through the vadose zone to groundwater and occur in the future, with reduction of dose due to decay of short-lived radionuclides. For these reasons, doses due to ingestion of drinking water are not included in the intruder analysis. Doses due to ingestion of drinking water are reported in the long-term impacts analysis. The concentration of a radionuclide in the soil for residential agriculture is determined by the amount of activity brought to the surface, the area required for the residence and garden, and the mixing depth into the soil.

The concentration in soil for residential agriculture is estimated as:

$$C_{ra} = A_{\mathrm{rmvd}} / (A_{ra}\, H_{\mathrm{mix}}\, f_v\, \rho_s)$$

where:

C_{ra}	=	concentration of radionuclide in soil for residential agriculture, picocuries per gram
A_{rmvd}	=	activity removed from the home construction excavation or well borehole, picocuries
A_{ra}	=	area required for the residence and garden, square meters
H_{mix}	=	height for mixing activity into soil, meters
f_v	=	conversion constant, cubic centimeters per cubic meter
ρ_s	=	density of soil in the garden, grams per cubic centimeter

Unit impact factors derived using RESRAD allow calculation of dose as:

$$D_{ra} = C_{ra}\, DCF_{ra}$$

where:

D_{ra} = dose to a resident farmer, rem per year
C_{ra} = radionuclide concentration in soil, picocuries per gram
DCF_{ra} = unit dose conversion factor reflecting dose through RESRAD pathways, rem per year/picocuries per gram

Q.2.4 Values of Physical Constants and Parameters for Long-Term Impacts Analysis

The mathematical models used for estimation of long-term human health impacts described in Sections Q.2.2 and Q.2.3 require specification of a number of physical constants and parameter values. This section provides the values used for these constants and parameters in the exposure modeling. First, values of constants and parameters used in radionuclide and chemical contaminant release and transport analysis are presented. Next, values of dose and health effect coefficients are presented. Lastly, values used in scenario analysis are presented.

Q.2.4.1 Constants and Parameters Used in Scenario Analysis

The models used in analysis of drinking water and residential agriculture scenarios and described in Sections Q.2.2 and Q.2.3 depend on a number of physical constants and parameters that must be quantified, i.e., values assigned. For consumption of drinking water, the primary parameter is ingestion rate. The receptors in the drinking water only, the residential farmer, and the American Indian resident farmer scenarios are each assumed to drink 2.0 liters (0.53 gallons) per day. This corresponds to the 90th percentile of use for the United States (Beyeler et al. 1999). The American Indian hunter-gatherer is assumed to drink 4.0 liters (1.06 gallons) per day, including in the sweat lodge.

There are both many similarities and some differences in the exposure models used in the evaluation of impacts due to radionuclides and chemical contaminants. As a consequence, the two sets of calculations share a number of parameters, but each also has some unique data requirements. For the radionuclides, RESRAD (Yu et al. 2001) was used to estimate impacts due to exposure in the residential garden scenarios, the terrestrial components of the hunter-gatherer scenario, and the intruder scenarios. A set of approximately 70 parameters was employed in RESRAD, but many of these same parameters are also used in the chemical calculations. Both for radionuclides and chemicals, the two initial steps of model implementation are (1) the identification of activities and utilization rates for the selected average member of the critical group and (2) the specification of physical conditions of the site. Tables Q–3 through Q–8 present values for the utilization parameters and general site hydraulic parameters used in the RESRAD and other radiological calculations described in the preceding sections. The organization of these tables reflects the organization of the RESRAD input: utilization parameters quantify the behavioral aspects, e.g., exposure frequencies, human and animal dietary data, etc., of the exposure scenarios being modeled, and the hydraulic and most of the other site parameters are grouped in four zones—contaminated, uncontaminated, unsaturated, and saturated zones. Also, some of the data are radionuclide or chemical specific, whereas other data are independent of the contaminant being considered.

Activities modeled in the RESRAD calculations include occupation of a residence and cultivation of a garden for crops and animal products. Two average members of the critical group were considered as receptors. The first is a resident farmer whose consumption rates of vegetables and produce are approximately 25 percent of national average values. This receptor is consistent with the *Hanford Site Risk Assessment Methodology* (DOE 1995). The second is an American Indian whose utilization rates of produce and animal products are 100 percent of the national average values. Based upon these utilization rates; site-specific crop yields (Napier et al. 2004), where available; and national average yields (Beyeler et al. 1999), where site data were unavailable, the area of the garden was estimated as the quotient of utilization rate and yield. Utilization data for these receptors are summarized in Tables Q–3 through Q–5.

Table Q–3. Dietary Data

Parameter	Parameter Value: American Indian Scenario	Parameter Value: American Indian Hunter-Gatherer	Residential Agriculture Scenario	Source
Fruit, vegetable, and grain consumption rate	330 kilograms per year	330 kilograms per year	58 kilograms per year	Site specific, *HSRAM* [a, b]
Leafy vegetable consumption rate	65 kilograms per year	65 kilograms per year	21 kilograms per year	Site specific, *HSRAM* [a]
Milk consumption rate	219 liters per year	0 liters per year	110 liters per year	Site specific, *HSRAM* [a]
Meat and poultry consumption rate	154 kilograms per year	154 kilograms per year	57 kilograms per year	Site specific, *HSRAM* [a, c]
Soil ingestion rate	0.044 kilograms per year	0.044 kilograms per year	0.044 kilograms per year	Agency guidance[d]
Fraction of contaminated livestock water	1	1	1	Site specific
Fraction of contaminated irrigation water	1	1	1	Site specific
Fraction of contaminated plant food	1	1	1	Site specific
Fraction of contaminated meat	1	1	1	Site specific
Fraction of contaminated milk	1	1	1	Site specific

[a] Value from *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE and Ecology 1996) for American Indian scenario and *Hanford Site Risk Assessment Methodology* (DOE 1995) for residential agriculture scenario.
[b] Sum of individual means for fruit, grain, and other vegetables.
[c] Sum of individual means for meat and poultry.
[d] Exposure duration weighted average of child and adult ingestion rates (EPA 2000).

Note: To convert kilograms to pounds, multiply by 2.2046; liters to gallons, by 0.26417.

Key: *HSRAM=Hanford Site Risk Assessment Methodology*.

Table Q–4. Nondietary Data

Parameter	Parameter Value	Source
Livestock fodder intake for meat	27.3 kilograms per day[a]	Beyeler et al. 1999
Livestock fodder intake for milk	64.2 kilograms per day[b]	Beyeler et al. 1999
Deer forage intake for meat	1.63 kilograms per day	Sample et al. 1997
Livestock water intake for meat	50 liters per day	Site specific
Livestock water intake for milk	60 liters per day	Site specific
Livestock intake of soil	0.5 kilograms per day[c]	Yu et al. 2001
Deer water intake for meat	3.27 liters per day	Sample et al. 1997
Deer intake of soil	0.033 kilograms per day	Sample et al. 1997
Mass loading for foliar deposition	4×10^{-4} grams per cubic meter[d]	Beyeler et al. 1999
Depth of soil mixing layer	0.15 meters	Beyeler et al. 1999
Depth of roots	0.9 meters[c]	Yu et al. 2001
Fraction of livestock water from groundwater	0	Site specific
Fraction of irrigation water from groundwater	0	Site specific

[a] National average values.
[b] Sum of individual medians for forage, hay, and grain.
[c] Default parameter value from RESRAD.
[d] Value for gardening.
Note: To convert kilograms to pounds, multiply by 2.2046; liters to gallons, by 0.26417; meters to feet, by 3.281.

Table Q–5. Dust Inhalation and External Gamma Data

Parameter	Parameter Value	Source
Inhalation rate	8,400 cubic meters per year[a]	Beyeler et al. 1999
Mass loading for inhalation	4.5×10^{-6} grams per cubic meter[b]	Beyeler et al. 1999
Exposure duration	1 year	Site specific
Indoor dust filtration factor	1	Site specific
Shielding factor, external gamma	0.59[c]	Beyeler et al. 1999
Fraction of time indoors, on site	0.66[a]	Beyeler et al. 1999
Fraction of time outdoors, on site	0.12[a]	Beyeler et al. 1999
Shape factor, external gamma	1[d]	Yu et al. 2001

[a] National average values.
[b] Activity at time average of national average values.
[c] Sum of products of the means of the fraction of time and shielding factors for indoor and outdoor exposure.
[d] Default parameter value from RESRAD.
Note: To convert cubic meters to cubic feet, multiply by 35.315.

Three values were used for fish consumption in the surface-water usage scenarios:

1. 0.003 kilograms per year (0.007 pounds per year) for the resident farmer. This is an estimated average Columbia River fish consumption for members of the regional population (Mann and Puigh 2001). That is, most of the fish consumed are obtained from other sources.
2. 25.6 kilograms per year (56.4 pounds per year) for the American Indian using surface water. This is the average American Indian annual subsistence fish consumption (EPA 1999a).
3. 226 kilograms per year (500 pounds per year) for the American Indian hunter-gatherer. This rate is an often high-end estimate of tribal subsistence rates (e.g., Harper and Harris 2008).

Where possible, the properties of the soil and subsurface sediments were based on site-specific measurements, e.g., texture, available water content; descriptions of the soil; and a compilation of national average values of soil characteristics by texture class (Beyeler et al. 1999). For soil at the surface in the contaminated zone, U.S. Department of Agriculture Soil Conservation Service data for Benton County, Washington, soils (Evans, Hattendorf, and Kincaid 2000) were used to fit the RESRAD soil hydraulic parameters. First, the soil parameters were estimated using observed textures for site soils and a RESRAD compilation of parameter values delineated by texture (Yu et al. 2001: Appendix E). Hydraulic conductivity and field capacity were estimated using the Benton County data with deep percolation assumed to be 5 percent. As a last step, the water balance was then iteratively solved for the evapotranspiration coefficient, also needed by RESRAD. Parameterization of the deeper sediments was based on site data (Mann and Puigh 2001) and Beyeler's compilation (Beyeler et al. 1999). Note that of the four RESRAD delineations of hydrologic zones, the parameterization of the contaminated zone is of principal importance in determination of the impacts. Data for the four hydrologic zones are presented in Tables Q–6 through Q–8.

Table Q–6. Contaminated Zone Data

Parameter	Parameter Value		Source
	American Indian Scenario	Residential Agriculture Scenario	
Area	4,200 square meters	1,500 square meters	Kennedy and Strenge 1992[a]
Thickness	1 meter	1 meter	Site specific[b]
Length parallel to aquifer flow	65 meters	40 meters	Derived from area
Bulk density	1.6 grams per cubic centimeter	1.6 grams per cubic centimeter	Site specific[b]
Erosion rate	1×10^{-5} meters per year	1×10^{-5} meters per year	Site specific[b]
Total porosity	0.41	0.41	Composite based on site texture data and literature[b]
Field capacity	0.159	0.159	Based on data in Evans, Hattendorf, and Kincaid 2000
Hydraulic conductivity	876 meters per year	876 meters per year	Based on permeability data in Evans, Hattendorf, and Kincaid 2000
b parameter	4.5	4.5	Composite based on site data and literature[b]
Evapotranspiration coefficient	0.959	0.959	Water balance using data in Evans, Hattendorf, and Kincaid 2000
Windspeed	3.4 meters per second	3.4 meters per second	Site specific[c]
Precipitation	0.17 meters per year	0.17 meters per year	Site specific[c]
Irrigation rate	0.66 meters per year	0.66 meters per year	Beyeler et al. 1999[d]
Runoff coefficient	0.1	0.1	Estimate based on Yu et al. 2001[e]

[a] Estimated using method and national average production rates from Kennedy and Strenge (1992) and site-specific crop yields and site-specific utilization rates from Table 5.
[b] Value is consistent with site conditions, e.g., values found in Meyer and Gee (1999).
[c] Hoitink et al. 2005.
[d] Average value for State of Washington (Beyeler et al. 1999).
[e] Table E–1 (Yu et al. 2001).
Note: To convert meters to feet, multiply by 3.281; square meters to square feet, by 10.7639.

Table Q–7. Saturated Zone Hydrologic Data

Parameter	Parameter Value	Source
Bulk density	1.6 grams per cubic centimeter	Site specific[a]
Total porosity	0.43	Site specific[a]
Effective porosity	0.35	Site specific[a]
Hydraulic conductivity	4.7 meters per year	Site specific[a]
Hydraulic gradient	0.01	Site specific[a]
Water table drop rate	0 meters per year	Site specific
Well pump intake depth	2 meters (below water table)	Site specific
Mixing model	Nondispersion	Site specific
Well pumping rate	0 cubic meters per year	Site specific

[a] Value for silty clay loam (Meyer and Gee 1999) is based on site conditions.
Note: To convert meters to feet, multiply by 3.281.

Table Q–8. Uncontaminated and Unsaturated Zone Hydrologic Data

Parameter	Parameter Value	Source
Number of strata	1	Site specific
Thickness	75 meters	Site specific
Bulk density	1.6 grams per cubic centimeter	Site specific[a]
Total porosity	0.43	Site specific[a]
Effective porosity	0.35	Site specific[a]
Hydraulic conductivity	4.7 meters per year	Site specific[a]
b parameter	7.1	Site specific[a]

[a] Value for silty clay loam (Meyer and Gee 1999) is based on site conditions.
Note: To convert meters to feet, multiply by 3.281.

The surface soil in the contaminated zone is assumed to be a coarse-textured agricultural soil. While it might be expected to differ from the deeper sediments from which it is derived as a result of weathering and biological processes, its properties are influenced by the characteristics of those materials. The collection of distribution coefficients (K_d) for the radionuclides shown in Table Q–9 is a composite taken from several sources. Where possible, values taken from site-specific guidance for this *TC & WM EIS* (DOE 2005) are used. One exception is hydrogen-3 (tritium). The small, but not zero (0), value used for tritium is based on the discussion in the 1999 review of distribution coefficients for several key radionuclides in the environment (EPA 1999b). In other cases, distribution coefficents were taken from compilations presented in Sheppard and Thibault (1990) and Beyeler et al. (1999). The radionuclide-specific values for the soil-to-plant, plant-to-beef, and water-to-fish transfer factors (Lee and Coffield 2007) compiled for use at the site are presented in Table Q–10.

Table Q–9. Distribution Coefficients for Radionuclides

Constituent	Distribution Coefficient, K_d (milliliters per gram)	Constituent	Distribution Coefficient, K_d (milliliters per gram)
Hydrogen-3 (tritium)	0.04[a]	Cesium-137	280[b]
Carbon-14	5[b]	Gadolinium-152	5[c]
Potassium-40	15[b]	Thorium-232	3,200[b]
Strontium-90	15[b]	Uranium-238	35[b]
Zirconium-93	600[b]	Neptunium-237	5[b]
Technetium-99	0.1[b]	Plutonium-239	550[b]
Iodine-129	1[b]	Americium-241	2,000[b]

[a] EPA 1999b.
[b] Sheppard and Thibault 1990.
[c] Beyeler et al. 1999.

Table Q–10. Exposure Pathway Transfer Factors for Radionuclides

Radionuclide	Transfer Factors			
	Soil-plant[a, b] (unitless)	**Plant-meat[c] (day per kilogram)**	**Water-fish[d] (liters per kilogram)**	**Plant-milk[e] (day per liter)**
Hydrogen-3 (tritium)	4.80×10	1.20×10^{-2}	1	1×10^{-2}
Carbon-14	1.37×10^{-1}	4.89×10^{-2}	5×10^{4}	1.2×10^{-2}
Potassium-40	1.07×10^{-1}	2×10^{-2}	1×10^{4}	7×10^{-3}
Strontium-90	9.75×10^{-2}	1×10^{-2}	5.01×10^{2}	2×10^{-3}
Zirconium-93	1.95×10^{-4}	3.40×10^{-2}	3×10^{2}	6×10^{-7}
Technetium-99	4.68×10^{-2}	4×10^{-1}	2×10^{1}	1×10^{-3}
Iodine-129	7.80×10^{-3}	4×10^{-2}	5×10^{2}	1×10^{-2}
Cesium-137	9×10^{-1}	5×10^{-2}	4.70×10^{3}	8×10^{-3}
Gadolinium-152	3.90×10^{-3}	3.50×10^{-3}	3×10^{1}	2×10^{-5}
Thorium-232	6.44×10^{-5}	2×10^{-4}	1×10^{2}	5×10^{-6}
Uranium-238	2.34×10^{-3}	8×10^{-4}	5×10^{1}	6×10^{-4}
Neptunium-237	2.54×10^{-3}	1×10^{-3}	2.50×10^{2}	5×10^{-6}
Plutonium-239	2.15×10^{-4}	1×10^{-4}	4.70×10^{3}	1×10^{-6}
Americium-241	6.83×10^{-5}	2×10^{-4}	2.40×10^{3}	2×10^{-6}

[a] Transfer factors are updated values taken from Lee and Coffield (2007:Table B–1).
[b] These are wet basis numbers. To obtain corresponding values for fodder, multiply by 5.13 (Lee and Coffield 2007:Table B–1).
[c] Transfer factors are maximum values taken from Lee and Coffield (2007:Table B–3).
[d] Transfer factors are maximum values taken from Lee and Coffield (2007:Table B–4).
[e] RESRAD default value from Yu et al. (2001).

For impacts due to ingestion or inhalation of chemical contaminants in the residential agriculture scenario, the set of algebraic equations presented in Section Q.2.2.2 was used. Values for crop and soil ingestion rates were the same as for the analysis of impacts for radionuclides, while other model-specific values were based on agency guidance (EPA 1991, 1996a, 1996b, 2000, 2002). The fugitive dust models used by RESRAD and the chemical models are different, with the former using mass loading in the air and the latter using a particulate emission factor. Also, the chemical calculations in the present analyses consider the total vegetable intake. These differences are reflected in Table Q–11. Other values of parameters common to each of the contributing pathways were the exposure frequency of 365 days per year, exposure duration of 30 years, and averaging time of 70 years.

Table Q–11. Residential Agriculture Scenario Parameter Values for Chemical Contaminants

Parameter/Pathway	Value	Source
Fugitive Dust Inhalation		
Particulate emission factor	1.36×10^{9}	EPA 2002
Exposure time fraction, outdoors	0.073	EPA 2000
Exposure time fraction, indoors	0.683	EPA 2000
Dilution factor, indoors	0.4	EPA 2000
Crop Ingestion		
Ingestion rate, vegetables and fruit[a]	79 kilograms per year (RF) 395 kilograms per year (AI&AIHG)	DOE 1995 Beyeler et al. 1999

[a] Total for leafy vegetables, other vegetables, grains, and fruit.
Note: To convert milligrams to ounces, multiply by 0.00003527; kilograms to pounds, by 2.2046.
Key: AI=American Indian; AIHG=American Indian hunter-gatherer; RF=resident farmer.

Except for hydrazine, the distribution coefficients for the inorganic contaminants were taken from existing compilations (Sheppard and Thibault 1990; Baes et al. 1984; Serne 2007; Yu et al. 2001). The hydrazine value, taken from the U.S. Environmental Protection Agency's Risk Assessment Information System website, operated by Oak Ridge National Laboratory (RAIS 2009), was estimated using the empirical relationship between the distribution coefficient and the octanol-water partition coefficient described for organic contaminants in the next paragraph. Except for boron, nitrate, and hydrazine, the transfer factors are again from Lee and Coffield (2007). The boron fish transfer factor is based on information in the *Borax Pesticide Fact Sheet* (USDA 1994), and the remaining boron transfer factors are taken from Baes et al. (1984). All of the hydrazine transfer factors and nitrate fish transfer factors were taken from the U.S. Environmental Protection Agency's Risk Assessment Information System (RAIS 2009). The remaining nitrate transfer factors are based on default values taken from Baes et al. (1984).

Organic contaminant distribution coefficients were estimated using an empirical formula (following EPA 1996b) that uses the octanol-water partition coefficient, K_{ow}, as follows:

$$\log K_d = 1.01 \log K_{ow} - 0.36$$

One adjustment is for the partially ionizing organic acid 2,4,6-trichlorophenol, or 2,4,6-TCP. That distribution coefficient is calculated using a modified procedure described for ionized organics (EPA 1996b). Similar empirical formulas were used to estimate transfer factors for the organics. These include expressions for the soil-to-plant transfer factor, B_v (McKone 1994):

$$\log B_v = 1.58 - 0.58 \log K_{ow}$$

the plant-to-beef transfer factor $B_{\text{plant-beef}}$ (McKone 1994):

$$\log B_{\text{plant-beef}} = \log K_{ow} - 7.6$$

the plant-to-milk transfer factor $B_{\text{plant-milk}}$ (McKone 1994):

$$\log B_{\text{plant-milk}} = \log K_{ow} - 8.1$$

and the water-to-fish transfer factor B_{fish} (Chiao, Currie, and McKone 1995):

$$B_{\text{fish}} = 0.048\, K_{ow}$$

The values for the chemical distribution coefficients and food-chain transfer factors used in the impacts calculations are shown in Tables Q–12 and Q–13, respectively.

Table Q–12. Distribution Coefficients for Chemicals

Chemical	K_d	K_{ow}	Source
1,2-Dichloroethane	13.3	29.5	a
1,4-Dioxane	0.23	0.54	b
1-Butanol	3.14	7.1	a
2,4,6-Trichlorophenol	0.38	4,900	b
Acetonitrile	0.20	0.46	b
Arsenic, inorganic	7	–	c, d
Benzene	61.6	135	b
Boron and compounds	3	–	e
Cadmium	6.4	–	c
Carbon tetrachloride	249	537	b
Chromium	3	–	f
Dichloromethane	7.96	17.8	b
Fluoride	150	–	e
Hydrazine/hydrazine sulfate	0.5	–	b
Lead	600	–	f
Manganese	65	–	g
Mercury	10	–	c
Molybdenum	20	–	g
Nickel (soluble salts)	200	–	f
Nitrate	0.5	–	e
Polychlorinated biphenyls	188,000	380,000	b
Silver	46	–	c
Strontium (stable)	15	–	h
Total uranium	35	–	h
Trichloroethylene	237	513	b
Vinyl chloride	14.2	31.6	b

[a] K_{ow} source: EPA 1996b: Table 39.
[b] K_{ow} source: Risk Assessment Information System (RAIS) database (RAIS 2009).
[c] K_d source: EPA 1996b: Table 43.
[d] A high oxidation state assumed, e.g., $HAsO4^{-2}$.
[e] K_d source: Baes et al. 1984.
[f] K_d source: Serne 2007.
[g] K_d source: Sheppard and Thibault 1990.
[h] K_d source: DOE 2005.

Key: K_d=distribution coefficient; K_{ow}=octanol-water partition coefficient.

Table Q–13. Exposure Pathway Transfer Factors for Chemicals[a]

Constituent	Soil-to-Plant (B_v) (unitless)	Soil-to-Fodder (B_{fodder}) (unitless)[b]	Plant-to-Beef (B_{beef}) (d/kg)	Plant-to-Milk (B_{milk}) (d/L)	Water-to-Fish (B_{fish}) (L/kg)	Entrainment Factor ($DF_{sn,e}$) (unitless)[c]
1,2-Dichloroethane	1.05[d]	5.37	7.41×10^{-7}[e]	2.34×10^{-7}[f]	1.42[g]	1
1,4-Dioxane	1.06×10^{1}[d]	5.44×10^{1}	1.35×10^{-8}[e]	4.27×10^{-9}[f]	2.58×10^{-2}[g]	1
1-Butanol	2.39[d]	1.23×10^{1}	1.78×10^{-7}[e]	5.62×10^{-8}[f]	3.40×10^{-1}[g]	1
2,4,6-Trichlorophenol	5.46×10^{-2}[d]	2.80×10^{-1}	1.23×10^{-4}[e]	3.89×10^{-5}[f]	2.35×10^{2}[g]	1
Acetonitrile	1.17×10^{1}[d]	5.97×10^{1}	1.15×10^{-8}[e]	3.63×10^{-9}[f]	2.19×10^{-2}[g]	1
Arsenic, inorganic	1.17×10^{-3}	6×10^{-3}	2×10^{-3}	6×10^{-5}	1.70×10^{3}	0.01
Benzene	4.35×10^{-1}[d]	2.23	3.39×10^{-6}[e]	1.07×10^{-6}[f]	6.48[g]	1
Boron and compounds	3.90×10^{-2}[h]	2×10^{-1}	8×10^{-4}[h]	1.50×10^{-3}[h]	1[i]	0.01
Cadmium	2.93×10^{-2}	1.50×10^{-1}	4×10^{-4}	1×10^{-3}	2×10^{2}	0.01
Carbon tetrachloride	1.96×10^{-1}[d]	1	1.35×10^{-5}[e]	4.27×10^{-6}[f]	2.58×10^{1}[g]	1
Chromium	8.78×10^{-4}	4.50×10^{-3}	9×10^{-3}	1×10^{-5}	4	0.01
Dichloromethane	1.40[d]	7.20	4.47×10^{-7}[e]	1.41×10^{-7}[f]	8.54×10^{-1}[g]	1
Fluoride	1.17×10^{-3}	6×10^{-3}	1.50×10^{-1}	1×10^{-3}	1×10^{1}	0.01
Hydrazine/hydrazine sulfate	1.30×10^{2}[j]	6.67×10^{2}	2×10^{-10}[j]	6.30×10^{-11}[j]	1.50×10^{5}[j]	1
Lead	1.17×10^{-3}	6×10^{-3}	4×10^{-4}	2.60×10^{-4}	3×10^{2}	0.01
Manganese	3.90×10^{-2}	2×10^{-1}	5×10^{-4}	3×10^{-5}	4×10^{2}	0.01
Mercury	3.90×10^{-2}	2×10^{-1}	2.50×10^{-1}	4.70×10^{-4}	1×10^{3}	0.01
Molybdenum	1.56×10^{-1}	8×10^{-1}	1×10^{-3}	1.70×10^{-3}	1×10^{1}	0.01
Nickel (soluble salts)	1.17×10^{-2}	6×10^{-2}	5×10^{-3}	1.60×10^{-2}	1×10^{2}	0.01
Nitrate	5.85[k]	3×10^{1}	7.50×10^{-2}[k]	2.50×10^{-2}[k]	1.50×10^{5}[i]	0.01
Polychlorinated biphenyls	4.41×10^{-3}[d]	2.26×10^{-2}	9.55×10^{-3}[e]	3.02×10^{-3}[f]	1.82×10^{4}[g]	1
Silver	2.54×10^{-4}	1.30×10^{-3}	3×10^{-3}	5×10^{-5}	5	0.01
Strontium (stable)	9.75×10^{-2}	5×10^{-1}	8×10^{-3}	2.80×10^{-3}	6×10^{1}	0.01
Total uranium	2.34×10^{-3}	1.20×10^{-2}	3×10^{-4}	4×10^{-4}	1×10^{1}	0.01
Trichloroethylene	2.01×10^{-1}[d]	1.03	1.29×10^{-5}[e]	4.07×10^{-6}[f]	2.46×10^{1}[g]	1
Vinyl chloride	1.01[d]	5.16	7.94×10^{-7}[e]	2.51×10^{-7}[f]	1.52[g]	1

a Value taken from Staven et al. (2003) unless indicated otherwise.
b $B_{fodder} = B_v$ 10.195 (Lee and Coffield 2007).
c A value of 0.01 is assumed for all organic chemicals and hydrazine. The remaining chemicals are inorganic and are assumed to have an entrainment factor of 0.01.
d $\log B_v = 1.58 - 0.58 \log K_{ow}$ (McKone 1994).
e $\log B_{plant\text{-}beef} = \log K_{ow} - 7.6$ (McKone 1994).
f $\log B_{plant\text{-}milk} = \log K_{ow} - 8.1$ (McKone 1994).
g $B_{fish} = 0.048\, K_{ow}$ (Chiao, Currie, and McKone 1995).
h Baes et al. 1984.
i There is very little bioaccumulation of boron (borate) in fish (USDA 1994). The value is set equal to 1.0.
j Risk Assessment Information System (RAIS) database (RAIS 2009).
k Default value for nitrogen (N) from Baes et al. (1984).

Key: d=day; kg=kilogram; L=liter.

For impacts due to use of a sweat lodge, the scenario-specific parameters are those related to temperature of the sweat lodge and amounts of water droplets and water vapor in the air in the sweat lodge. Values for scenario-specific parameters are summarized in Table Q–14. Description of the scenario and equations for estimation of impact are presented in Section Q.2.2.2.

Table Q–14. Values of Parameters for Estimation of Impact Due to Use of a Sweat Lodge

Parameter	Value
Temperature of sweat lodge,[a] degrees Celsius	50
Ratio of volume of airborne droplets to volume of air in the sweat lodge,[a] unitless	1.0×10^{-8}
Entrainment factor for evaporation,[a] unitless	1.0 for hydrogen-3 (tritium), organics, and hydrazine; 0.01 for all other constituents
Density of water vapor in the sweat lodge,[b] grams per cubic meter	82.6
Density of liquid water, grams per cubic meter	1.0×10^{6}
Frequency of use,[c] year per year	0.042, 0.083[c]

[a] Value adopted from Mann and Puigh (2001).
[b] Calculated using the ideal gas law and assumption of water vapor at saturation pressure (1.79 pounds per square inch absolute) at the temperature of the sweat lodge.
[c] Assumes use of 1 hour per day each day of the year for the American Indian resident farmer. The American Indian hunter-gatherer use is assumed to be 2 hours per day each day of the year.
Note: To convert degrees Celsius to degrees Fahrenheit, multiply by 1.8, then add 32.

Physical constants and parameters are also required in the site-specific direct intrusion scenario model described in Section Q.2.3. For the home construction intruder scenarios, parameter values for worker impacts are an excavation depth of 3 meters (10 feet), a breathing rate of 8,400 cubic meters per year (297,000 cubic feet per year), a mass loading for inhalation of 0.4 milligrams per cubic meter (2.5×10^{-8} pounds per cubic foot), and an exposure duration of 0.057 years (500 hours). For the well-drilling intruder scenario, parameter values for worker impacts are a drill diameter of 0.15 meters (0.5 feet), a drill advance rate of 80,000 meters per year (30 feet per hour), a mass loading for inhalation of 0.4 milligrams per cubic meter (2.5×10^{-8} pounds per cubic foot), and a breathing rate of 8,400 cubic meters per year (297,000 cubic feet per year). For the resident farmer exposure initiated by both home construction and well drilling, values of exposure parameters are those presented in Tables Q–3 through Q–8, and dose impacts were estimated using Version 6.4 of the RESRAD computer code (Yu et al. 2001).

Q.2.4.2 Values for Health Effect Conversion Factors

Health effect conversion factors are used for estimation of dose, hazard, and risk from radionuclides and chemical contaminants. For radiation dose conversion factors, Federal guidance (Eckerman and Ryman 1993; Eckerman et al. 1999) was used. The recommended factors apply to the average adult members of the population, taking into account averaging over age and gender. Values for radionuclide-specific dose conversion factors are presented in Table Q–15. For carcinogenicity slope factors (risk coefficients) for radionuclides, values recommended in Federal guidance (EPA 2001) were used. These values are summarized in Table Q–16. For chemical contaminants, Federal guidance also recommends health coefficient values for measures of noncancer and cancer impacts (EPA 2009a). Values for these parameters used in this *TC & WM EIS* are presented in Table Q–17.

Table Q–15. Values of Radiation Dose Conversion Factors

Radionuclide	Ingestion[a] (rem per curie)	Inhalation[a] (rem per curie)	External Surface Source[b] (rem per year/ curies per square meter)	External Volume Source[b] (rem per year/ picocuries per cubic centimeter)
Hydrogen-3 (tritium)	1.60×10^{2}	2.30×10^{1}	0	0
Carbon-14	2.20×10^{3}	7.60×10^{2}	1.90	8.40×10^{-9}
Potassium-40	2.28×10^{4}	3.14×10^{5}	1.70×10^{4}	6.50×10^{-4}
Strontium-90	1×10^{5}	8.90×10^{4}	3.30×10^{1}	4.40×10^{-7}
Zirconium-93	4.11×10^{3}	9.28×10^{4}	0	0
Technetium-99	2.40×10^{3}	1.10×10^{3}	9.10	7.90×10^{-8}
Iodine-129	3.90×10^{5}	1.30×10^{5}	3×10^{3}	8.10×10^{-6}
Cesium-137	5×10^{4}	1.70×10^{4}	6.50×10^{4}	2.10×10^{-3}
Gadolinium-152	1.52×10^{5}	7.04×10^{7}	0	0
Thorium-232	8.50×10^{5}	4.10×10^{8}	6.40×10^{1}	3.30×10^{-7}
Uranium-238	1.70×10^{5}	1.10×10^{7}	6.40×10^{1}	6.50×10^{-8}
Neptunium-237	4×10^{5}	1.80×10^{8}	3.40×10^{3}	4.90×10^{-5}
Plutonium-239	9.30×10^{5}	4.40×10^{8}	4.30×10^{1}	1.80×10^{-7}
Americium-241	7.60×10^{5}	3.60×10^{8}	3.20×10^{3}	2.70×10^{-5}

a Eckerman et al. 1999.
b Eckerman and Ryman 1993.

Table Q–16. Radionuclide Carcinogenicity Slope Factors (1 per picocurie)

Radionuclide	Water Ingestion	Food Ingestion	Inhalation
Hydrogen-3 (tritium)	5.07×10^{-14}	6.51×10^{-14}	5.62×10^{-14}
Carbon-14	1.55×10^{-12}	2×10^{-12}	7.07×10^{-12}
Potassium-40	2.47×10^{-11}	3.43×10^{-11}	1.03×10^{-11}
Strontium-90	5.59×10^{-11}	6.88×10^{-11}	1.05×10^{-10}
Zirconium-93	1.11×10^{-12}	1.44×10^{-12}	7.29×10^{-12}
Technetium-99	2.75×10^{-12}	4×10^{-12}	1.41×10^{-11}
Iodine-129	1.48×10^{-10}	3.22×10^{-10}	6.07×10^{-11}
Cesium-137	3.04×10^{-11}	3.74×10^{-11}	1.19×10^{-11}
Gadolinium-152	2.97×10^{-11}	3.85×10^{-11}	9.10×10^{-9}
Thorium-232	1.01×10^{-10}	1.33×10^{-10}	4.33×10^{-8}
Uranium-238	6.40×10^{-11}	8.66×10^{-11}	9.32×10^{-9}
Neptunium-237	6.18×10^{-11}	8.29×10^{-11}	1.77×10^{-8}
Plutonium-239	1.35×10^{-10}	1.74×10^{-10}	3.33×10^{-8}
Americium-241	1.04×10^{-10}	1.34×10^{-10}	2.81×10^{-8}

Source: EPA 2001.

Table Q–17. Health Effect Factors for Chemical Contaminants[a]

Contaminant	Ingestion Reference Dose (mg/kg-d)	Inhalation Reference Concentration (mg/m^3)	Cancer Morbidity: Ingestion Slope Factor [1/(mg/kg-d)]	Cancer Morbidity: Inhalation Unit Risk [$1/(mg/m^3)$]
1,2-Dichloroethane	2×10^{-2}[b]	N/A	9.10×10^{-2}	2.60×10^{-2}
1,4-Dioxane	N/A	N/A	1.09×10^{-2}[c]	N/A
1-Butanol	1×10^{-1}[b]	N/A	N/A	N/A
2,4,6-Trichlorophenol	N/A	N/A	1.09×10^{-2}[c]	3.10×10^{-3}[d]
Acetonitrile	6×10^{-3}[b]	6×10^{-2}	N/A	N/A
Arsenic, inorganic	3×10^{-4}	N/A	1.50	4.30
Benzene	4×10^{-3}	3×10^{-2}	5.50×10^{-2}	7.80×10^{-3}
Boron and compounds	2×10^{-1}	2×10^{-2}[b]	N/A	N/A
Cadmium	1×10^{-3}	N/A	N/A	1.80
Carbon tetrachloride	7×10^{-4}	N/A	1.30×10^{-1}	1.50×10^{-2}
Chromium	3×10^{-3}	8×10^{-6}	N/A	1.20×10^{1}
Dichloromethane	6×10^{-2}	3[b]	7.50×10^{-3}	4.70×10^{-4}
Fluoride	6×10^{-2}	N/A	N/A	N/A
Hydrazine/hydrazine sulfate	N/A	N/A	3	4.90
Lead	N/A	N/A	N/A	N/A
Manganese	1.40×10^{-1}	5×10^{-5}	N/A	N/A
Mercury	3×10^{-4}	N/A	N/A	N/A
Molybdenum	5×10^{-3}	N/A	N/A	N/A
Nickel (soluble salts)	2×10^{-2}	N/A	N/A	N/A
Nitrate	1.60	N/A	N/A	N/A
Polychlorinated biphenyls	N/A	N/A	4×10^{-1}	1×10^{-1}
Silver	5×10^{-3}	N/A	N/A	N/A
Strontium (stable)	6×10^{-1}	N/A	N/A	N/A
Total uranium	3×10^{-3}	N/A	N/A	N/A
Trichloroethylene	3×10^{-4}[b]	4×10^{-2}[b]	4×10^{-1}[b]	N/A
Vinyl chloride	3×10^{-3}	1×10^{-1}	1.50	8.80×10^{-3}

[a] EPA IRIS database (EPA 2009a).
[b] Risk Assessment Information System (RAIS) database (RAIS 2009).
[c] Calculated from EPA IRIS oral unit risk (EPA 2009a).
[d] Calculated from EPA IRIS inhalation unit risk (EPA 2009a, 2009b).

Key: EPA=U.S. Environmental Protection Agency; IRIS=Integrated Risk Information System; mg/kg-d=milligrams per kilogram-day; mg/m^3=milligrams per cubic meter; N/A=not assessed in guidance document.

Q.3 RESULTS OF HUMAN HEALTH IMPACTS

This section discusses the potential long-term human health impacts of each set of proposed actions: Section Q.3.1, the Tank Closure alternatives; Section Q.3.2, the FFTF Decommissioning alternatives; and Section Q.3.3, the Waste Management alternatives.

Q.3.1 Long-Term Human Health Impacts of Tank Closure Alternatives

Impacts on human health over the long time period following stabilization or closure of the HLW tanks would be due primarily to discharges to cribs and trenches (ditches) and releases from the tanks and related equipment. These releases would involve both radioactive and chemical constituents. Because a large number of constituents, sources, and scenarios have been considered, screening analysis was used to identify a reduced number of controlling scenarios. The results of this human health impacts analysis for onsite, offsite, and intruder receptors are summarized in the following sections.

Q.3.1.1 Impacts on Onsite and Offsite Receptors of Expected Conditions Under Tank Closure Alternatives

Implementation of activities defined for the Tank Closure alternatives could lead to releases of radioactive and chemical constituents to the environment over long periods of time. In the case of Tank Closure Alternatives 1 and 2A, these releases would not be controlled by engineered closure of the tanks, while under the other Tank Closure alternatives, releases would be controlled by stabilization of the tanks and of wastes generated during retrieval and closure activities. Potential human health impacts due to release of radioactive constituents are estimated as dose and as lifetime risk of incidence of cancer. Potential human health effects due to release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to the highest intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of the group of chemicals contributing to impacts through the exposure pathways evaluated in a particular scenario. Further information on the nature of human health effects in response to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. As previously discussed in Section Q.2 of this appendix, the screening analysis identified 14 radioactive and 26 chemical constituents as contributing the greatest risk of adverse impacts. Impacts due to exposure to these constituents are presented in this appendix.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year from CYs 1940 through 11,939 (i.e., 10,000 years) for each receptor at eight locations (i.e., A, B, S, T and U Barriers; Core Zone Boundary; Columbia River nearshore; and Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observation that peak risk and peak noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. The significance of dose impacts is evaluated by comparison against the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. The level of protection provided for the drinking water pathway is evaluated by comparison against the maximum contaminant levels (MCLs) of the "National Primary Drinking Water Regulations" (40 CFR 141) and other benchmarks presented in Appendix O. In addition, only those radioactive and chemical constituents that resulted in a lifetime risk or Hazard Index greater than 1×10^{-10} for all impacts analysis locations for a given source are included in the human health impact tables presented in this section to reduce the size of the tables. Although a regulatory standard for risk has not been proposed for tank closure impacts, perspective on magnitude of estimated risks may be gained by comparison against the Hanford site-specific cleanup goal of 1×10^{-5}. Also, to provide a basis for understanding the evolution of impacts over time, graphs are presented to depict the lifetime radiological risk for the drinking-water well user at the Core Zone Boundary due to releases from individual sources and due to releases from the combined sources. In interpreting these figures, note that the graph of time series of risk for the combined sources may overlay or obscure the time series of risk for a single dominant source.

Impacts related to tank farm operations, retrieval and closure are due to three types of release. The first type of release is the past practice of direct discharge of liquid to cribs and trenches (ditches). The second type of release is due to past activity at the tank farms and includes past leaks from damaged tanks. The third type of release is due to future activities and includes leaks during retrieval of waste from the tanks, and long-term leaching of waste material in tanks and ancillary equipment. The combination of unplanned releases from past events and retrieval leaks and releases from tank residuals on ancillary equipment in the future is referred to as "other tank farm sources" in subsequent text.

The balance of this section summarizes the potential human health effects due to implementation of each Tank Closure alternative. Seven onsite locations at which an individual may contact groundwater and an offsite location were selected for analysis. The seven onsite locations are the boundaries of tank farm barriers, the Core Zone Boundary, and the Columbia River nearshore. The offsite location is an access point to Columbia River surface water, which could be at various points near the site and at population centers downstream of the site. Total offsite population is 5 million people.

Consistent with DOE guidance (DOE Guide 435.1-1), the potential consequences of loss of administrative or institutional control are considered by estimation of impacts on onsite receptors. Because DOE does not anticipate loss of control of the site, these onsite receptors are considered hypothetical and are applied to develop estimates for past and future periods of time.

Four types of receptors are considered. The first type, a drinking-water well user, uses groundwater as a source of drinking water. The second type, a resident farmer, uses either groundwater or surface water, but not both, for drinking water consumption and irrigation of crops. Garden size and crop yield are adequate to produce approximately 25 percent of average requirements of crops and animal products. The third type, an American Indian resident farmer, also uses either groundwater or surface water, but not both, for drinking water consumption and irrigation of crops. Garden size and crop yield are adequate to produce the entirety of average requirements of crops and animal products. The fourth type, an American Indian hunter-gatherer, is impacted by both groundwater and surface water because he uses surface water for drinking water consumption and consumes wild plant materials, which use groundwater, and game, which use surface water. In subsequent subsections, estimates of impacts are presented in two sets of tables, one set for receptors using groundwater and one set for users of surface water. To facilitate presentation, estimates of impact on the American Indian hunter-gatherer are presented in the set of tables for surface-water users. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location.

Impacts that depend upon or would be affected by Tank Closure alternatives would be evident after CY 2050, the approximate time assumed for placement of engineered caps. However, releases to the vadose zone associated with past practices such as planned discharges to cribs and trenches (ditches) and with leaks from tanks occurring after CY 1940 but before CY 2050, may continue to produce impacts into the future. Because of uncertainties in estimates of the time of occurrence of impacts and the perspective that could be added by knowledge of past impacts, estimates of peak impacts are provided for time periods beginning in CY 1940 and in CY 2050. In addition, a time series of estimates of radiological risk for the drinking-water well user at the Core Zone Boundary is presented to provide a view of the evolution of impacts over the entire period of analysis. Further discussion about these receptors is provided in Section Q.2 of this appendix.

The results of the analysis for drinking-water well users after CY 2050 are summarized in Tables Q–18 through Q–21 for radioactive and chemical constituents. Impacts due to ingestion of drinking water under Tank Closure Alternative 1, which assumes catastrophic failure of the tanks, would approach but not exceed the 100-millirem-per-year dose standard at the A Barrier. For the other Tank Closure alternatives, the results indicate that planned discharges to cribs and trenches (ditches) and past leaks at the B, BX, BY, T, and TX tank farms would be important contributors to radiological and chemical impacts (see subsequent text for detailed results). Under Tank Closure Alternatives 2A, 2B, 3A, 3B, 3C, 4, 5, 6A (Base and Option Cases), 6B (Base and Option Cases), and 6C, doses would not be greater than the 100-millirem-per-year standard at any location. Under all Tank Closure alternatives, doses estimated for drinking water ingestion are less than 10 millirem per year at the Columbia River nearshore location. For impacts occurring prior to CY 5000, radiological impacts would be due to tritium, technetium-99 and iodine-129; chemical impacts would be due to chromium and nitrate. For impacts occurring after CY 5000, radiological impacts would be due to uranium isotopes; chemical impacts would be due to total uranium.

Table Q–18. Summary of Radiation Dose at Year of Peak Dose for the Drinking-Water Well User (millirem per year)

	Tank Closure Alternative								
Location	**1**	**2A**	**2B, 3A, 3B, 3C, 6C**	**4**	**5**	**6A, Base Case**	**6A, Option Case**	**6B, Base Case**	**6B, Option Case**
A Barrier	8.37×10^{1} (2121)	2.17 (2095)	1.74 (2102)	1.78 (2100)	2.00 (4155)	2.16 (2103)	2.16 (2103)	1.99 (2093)	1.99 (2093)
B Barrier	5.88×10^{1} (4313)	8.64 (2069)	7.55 (2056)	7.38 (2056)	7.54 (2056)	7.34 (2056)	7.64 (2066)	7.32 (2056)	7.92 (2065)
S Barrier	4.73×10^{1} (3072)	3.50 (2051)	3.43 (2051)	4.54×10^{-1} (2050)	6.15 (4321)	3.36 (2052)	3.36 (2052)	3.42 (2050)	3.42 (2050)
T Barrier	1.52×10^{1} (2051)	1.51×10^{1} (2050)	1.55×10^{1} (2050)	1.55×10^{1} (2050)	1.56×10^{1} (2050)	1.54×10^{1} (2050)	1.53×10^{1} (2050)	1.52×10^{1} (2050)	1.51×10^{1} (2051)
U Barrier	2.23×10^{1} (4002)	1.14 (2100)	5.20×10^{-1} (3296)	3.14×10^{-1} (2058)	2.58 (3949)	2.89×10^{-1} (2067)	2.89×10^{-1} (2067)	2.86×10^{-1} (2067)	2.86×10^{-1} (2067)
Core Zone Boundary	5.88×10^{1} (4313)	8.64 (2069)	7.58 (2056)	7.41 (2056)	7.57 (2056)	7.37 (2056)	7.64 (2066)	7.35 (2056)	7.92 (2065)
Columbia River nearshore	4.37 (4978)	9.41×10^{-1} (2317)	8.85×10^{-1} (2242)	8.82×10^{-1} (2242)	8.94×10^{-1} (4809)	8.76×10^{-1} (2251)	8.99×10^{-1} (2251)	8.22×10^{-1} (2218)	8.07×10^{-1} (2218)

Note: Dose for year of peak dose, with calendar year of peak dose in parentheses.

Table Q–19. Summary of Radiological Risk at Year of Peak Radiological Risk for the Drinking-Water Well User

Location	Tank Closure Alternative								
	1	2A	2B, 3A, 3B, 3C, 6C	4	5	6A, Base Case	6A, Option Case	6B, Base Case	6B, Option Case
A Barrier	2.63×10^{-3} (2121)	6.35×10^{-5} (2095)	5.09×10^{-5} (2102)	5.20×10^{-5} (2100)	6.76×10^{-5} (4155)	6.33×10^{-5} (2103)	6.33×10^{-5} (2103)	5.79×10^{-5} (2093)	5.79×10^{-5} (2093)
B Barrier	1.73×10^{-3} (3957)	2.59×10^{-4} (2069)	2.30×10^{-4} (2056)	2.25×10^{-4} (2056)	2.38×10^{-4} (3616)	2.24×10^{-4} (2056)	2.34×10^{-4} (2066)	2.23×10^{-4} (2056)	2.41×10^{-4} (2065)
S Barrier	1.46×10^{-3} (3072)	1.02×10^{-4} (2051)	9.97×10^{-5} (2051)	1.31×10^{-5} (2050)	2.08×10^{-4} (4314)	9.76×10^{-5} (2052)	9.76×10^{-5} (2052)	9.87×10^{-5} (2050)	9.87×10^{-5} (2050)
T Barrier	4.33×10^{-4} (2050)	4.33×10^{-4} (2050)	4.41×10^{-4} (2050)	4.41×10^{-4} (2050)	4.44×10^{-4} (2050)	4.37×10^{-4} (2050)	4.36×10^{-4} (2050)	4.32×10^{-4} (2050)	4.31×10^{-4} (2051)
U Barrier	6.48×10^{-4} (3985)	3.34×10^{-5} (2100)	1.63×10^{-5} (3296)	9.47×10^{-6} (2058)	8.64×10^{-5} (3949)	8.84×10^{-6} (2067)	8.84×10^{-6} (2067)	8.76×10^{-6} (2067)	8.76×10^{-6} (2067)
Core Zone Boundary	1.73×10^{-3} (3957)	2.59×10^{-4} (2069)	2.30×10^{-4} (2056)	2.25×10^{-4} (2056)	2.38×10^{-4} (3616)	2.24×10^{-4} (2056)	2.34×10^{-4} (2066)	2.24×10^{-4} (2056)	2.41×10^{-4} (2065)
Columbia River nearshore	1.11×10^{-4} (4978)	2.75×10^{-5} (2317)	2.60×10^{-5} (2254)	2.58×10^{-5} (2242)	2.94×10^{-5} (4809)	2.54×10^{-5} (2251)	2.61×10^{-5} (2239)	2.38×10^{-5} (2221)	2.33×10^{-5} (2256)

Note: Radiological risk for year of peak radiological risk, with calendar year of peak radiological risk in parentheses.

Table Q–20. Summary of Hazard Index at Year of Peak Hazard Index for the Drinking-Water Well User

Location	Tank Closure Alternative								
	1	2A	2B, 3A, 3B, 3C, 6C	4	5	6A, Base Case	6A, Option Case	6B, Base Case	6B, Option Case
A Barrier	3.64 (3710)	1.43 (2170)	1.05 (2168)	9.48×10^{-1} (2168)	1.03 (2168)	1.06 (2168)	1.07 (2164)	9.53×10^{-1} (2168)	8.26×10^{-1} (2097)
B Barrier	9.20 (3696)	5.26 (2068)	4.81 (2050)	4.80 (2050)	4.81 (2050)	4.80 (2050)	5.22 (2051)	4.80 (2050)	5.23 (2083)
S Barrier	5.91 (3242)	1.58 (2050)	1.57 (2051)	2.72×10^{-1} (2059)	1.59 (2050)	1.56 (2050)	1.56 (2050)	1.58 (2051)	1.58 (2051)
T Barrier	4.28 (2051)	4.32 (2053)	4.47 (2051)	4.47 (2051)	4.48 (2051)	4.48 (2051)	4.35 (2050)	4.47 (2051)	4.31 (2050)
U Barrier	2.33 (4027)	2.44×10^{-1} (2092)	6.73×10^{-2} (2056)	6.73×10^{-2} (2056)	3.42×10^{-1} (3565)	6.09×10^{-2} (2050)	6.09×10^{-2} (2050)	6.18×10^{-2} (2050)	6.18×10^{-2} (2050)
Core Zone Boundary	9.20 (3696)	5.26 (2068)	4.81 (2050)	4.80 (2050)	4.81 (2050)	4.80 (2050)	5.22 (2051)	4.80 (2050)	5.23 (2083)
Columbia River nearshore	1.01 (4498)	1.01 (2079)	9.71×10^{-1} (2076)	9.71×10^{-1} (2076)	9.71×10^{-1} (2076)	9.71×10^{-1} (2076)	9.12×10^{-1} (2076)	9.72×10^{-1} (2076)	8.30×10^{-1} (2074)

Note: Hazard Index for year of peak Hazard Index, with calendar year of Hazard Index peak in parentheses.

Table Q–21. Summary of Nonradiological Risk at Year of Peak Nonradiological Risk for the Drinking-Water Well User

Tank Closure Alternative	Location						
	A Barrier	**B Barrier**	**S Barrier**	**T Barrier**	**U Barrier**	**Core Zone Boundary**	**Columbia River Nearshore**
1	1.93×10^{-12} (11,778)	5.39×10^{-13} (11,929)	3.50×10^{-12} (11,843)	0.00 (1940)	0.00 (1940)	1.13×10^{-12} (11,776)	2.41×10^{-13} (11,904)
2A–6C[a]	Not applicable						

[a] Including Alternatives 6A and 6B, Base and Option Cases.

Note: Nonradiological risk for year of peak radiological risk, with calendar year of peak nonradiological risk in parentheses. The nonradiological risk driver is 2,4,6-trichlorophenol, which is below the 1×10^{-10} cutoff concentration and is therefore not shown in the alternative-specific table.

Q.3.1.1.1 Tank Closure Alternative 1

Under Tank Closure Alternative 1, the tank farms would be maintained in the current condition indefinitely but, for analysis purposes, are assumed to fail after an institutional control period of 100 years. At this time, the salt cake in the single-shell tanks is assumed available for leaching into the vadose zone, and the liquid contents of the double-shell tanks are assumed to be discharged directly to the vadose zone. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–22 through Q–26; to past leaks after CY 1940, in Tables Q–27 through Q–34; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–35 through Q–42.

Table Q–22. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.60×10^{-4}	7.72×10^{1}	7.32×10^{-4}	6.60×10^{-4}	8.97×10^{1}	8.84×10^{-4}	6.60×10^{-4}	1.07×10^{2}	1.12×10^{-3}
Technetium-99	3.50×10^{-5}	6.13×10^{1}	2.11×10^{-3}	3.50×10^{-5}	1.58×10^{2}	6.94×10^{-3}	3.50×10^{-5}	3.23×10^{2}	1.52×10^{-2}
Iodine-129	4.40×10^{-8}	1.25×10^{1}	1.43×10^{-4}	4.40×10^{-8}	1.57×10^{1}	2.20×10^{-4}	4.40×10^{-8}	2.02×10^{1}	3.34×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.98×10^{-3}**	**N/A**	**2.63×10^{2}**	**8.04×10^{-3}**	**N/A**	**4.50×10^{2}**	**1.66×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1964	1964	1964
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.08	5.79×10^{1}	0.00	2.88	2.84×10^{1}	2.39×10^{-8}	2.88	4.27×10^{1}	1.09×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.03×10^{3}	2.84×10^{2}	0.00	2.03×10^{3}	6.34×10^{2}	0.00
Total	**N/A**	**8.84×10^{1}**	**0.00**	**N/A**	**3.13×10^{2}**	**2.39×10^{-8}**	**N/A**	**6.77×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–23. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.59×10^{-3}	8.88×10^{2}	8.42×10^{-3}	7.59×10^{-3}	1.03×10^{3}	1.02×10^{-2}	7.59×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.20×10^{-7}	2.11×10^{-1}	7.25×10^{-6}	1.20×10^{-7}	5.43×10^{-1}	2.38×10^{-5}	1.20×10^{-7}	1.11	5.21×10^{-5}
Iodine-129	1.10×10^{-9}	3.13×10^{-1}	3.56×10^{-6}	1.10×10^{-9}	3.91×10^{-1}	5.50×10^{-6}	1.10×10^{-9}	5.05×10^{-1}	8.32×10^{-6}
Total	**N/A**	**8.88×10^{2}**	**8.43×10^{-3}**	**N/A**	**1.03×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.72	6.40×10^{1}	0.00	6.72	6.64×10^{1}	2.64×10^{-8}	6.72	9.99×10^{1}	1.21×10^{-3}
Nitrate	1.56×10^{3}	2.78×10^{1}	0.00	1.56×10^{3}	2.19×10^{2}	0.00	1.56×10^{3}	4.88×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.85×10^{2}**	**2.64×10^{-8}**	**N/A**	**5.88×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–24. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.60×10^{-4}	7.72×10^{1}	7.32×10^{-4}	6.60×10^{-4}	8.97×10^{1}	8.84×10^{-4}	6.60×10^{-4}	1.07×10^{2}	1.12×10^{-3}
Technetium-99	3.50×10^{-5}	6.13×10^{1}	2.11×10^{-3}	3.50×10^{-5}	1.58×10^{2}	6.94×10^{-3}	3.50×10^{-5}	3.23×10^{2}	1.52×10^{-2}
Iodine-129	4.40×10^{-8}	1.25×10^{1}	1.43×10^{-4}	4.40×10^{-8}	1.57×10^{1}	2.20×10^{-4}	4.40×10^{-8}	2.02×10^{1}	3.34×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.98×10^{-3}**	**N/A**	**2.63×10^{2}**	**8.04×10^{-3}**	**N/A**	**4.50×10^{2}**	**1.66×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.08	5.79×10^{1}	0.00	2.88	2.84×10^{1}	2.39×10^{-8}	2.88	4.27×10^{1}	1.09×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.03×10^{3}	2.84×10^{2}	0.00	2.03×10^{3}	6.34×10^{2}	0.00
Total	**N/A**	**8.84×10^{1}**	**0.00**	**N/A**	**3.13×10^{2}**	**2.39×10^{-8}**	**N/A**	**6.77×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–25. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.06×10^{-5}	1.24	1.18×10^{-5}	1.06×10^{-5}	1.45	1.43×10^{-5}	1.06×10^{-5}	1.72	1.81×10^{-5}
Technetium-99	8.61×10^{-7}	1.51	5.18×10^{-5}	8.61×10^{-7}	3.88	1.70×10^{-4}	8.61×10^{-7}	7.93	3.73×10^{-4}
Iodine-129	1.10×10^{-9}	3.13×10^{-1}	3.56×10^{-6}	1.10×10^{-9}	3.91×10^{-1}	5.50×10^{-6}	1.10×10^{-9}	5.05×10^{-1}	8.32×10^{-6}
Total	**N/A**	**3.06**	**6.72×10^{-5}**	**N/A**	**5.72**	**1.90×10^{-4}**	**N/A**	**1.02×10^{1}**	**3.99×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.32×10^{-1}	2.21	0.00	1.35×10^{-1}	1.34	9.09×10^{-10}	1.35×10^{-1}	2.01	4.17×10^{-5}
Nitrate	4.26×10^{1}	7.61×10^{-1}	0.00	7.16×10^{1}	1.01×10^{1}	0.00	7.16×10^{1}	2.24×10^{1}	0.00
Total	**N/A**	**2.97**	**0.00**	**N/A**	**1.14×10^{1}**	**9.09×10^{-10}**	**7.18×10^{1}**	**2.44×10^{1}**	**4.17×10^{-5}**
Year of peak impact	2017	2017	N/A	1964	1964	2017	1964	1964	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–26. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.24×10^{-10}	9.85×10^{-5}	9.70×10^{-10}	7.24×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.06×10^{-5}	6.76×10^{-2}	1.25×10^{-6}
Technetium-99	4.92×10^{-11}	2.22×10^{-4}	9.74×10^{-9}	4.92×10^{-11}	5.12×10^{-4}	2.43×10^{-8}	8.61×10^{-7}	2.59×10^{-2}	1.39×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.19×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.31×10^{-9}	1.10×10^{-9}	3.98×10^{-3}	9.77×10^{-8}
Total	**N/A**	**3.43×10^{-4}**	**1.10×10^{-8}**	**N/A**	**9.78×10^{-4}**	**3.39×10^{-8}**	**N/A**	**9.75×10^{-2}**	**2.73×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.85×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.14×10^{-9}	3.04×10^{-2}	1.34×10^{-1}	4.17×10^{-5}
Nitrate	4.78×10^{-3}	7.24×10^{-4}	0.00	4.78×10^{-3}	4.51×10^{-1}	0.00	1.33×10^{1}	4.44	0.00
Total	**N/A**	**8.90×10^{-4}**	**6.85×10^{-14}**	**N/A**	**4.51×10^{-1}**	**3.14×10^{-9}**	**N/A**	**4.58**	**4.17×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–27. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.91×10^{-7}	2.24×10^{-2}	2.12×10^{-7}	1.91×10^{-7}	2.60×10^{-2}	2.56×10^{-7}	1.91×10^{-7}	3.10×10^{-2}	3.25×10^{-7}
Technetium-99	1.36×10^{-6}	2.39	8.21×10^{-5}	1.36×10^{-6}	6.15	2.70×10^{-4}	1.36×10^{-6}	1.26×10^{1}	5.90×10^{-4}
Iodine-129	5.41×10^{-10}	1.54×10^{-1}	1.75×10^{-6}	5.41×10^{-10}	1.93×10^{-1}	2.71×10^{-6}	5.41×10^{-10}	2.49×10^{-1}	4.10×10^{-6}
Total	**N/A**	**2.56**	**8.40×10^{-5}**	**N/A**	**6.37**	**2.73×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.95×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.67×10^{-2}	6.35×10^{-1}	0.00	6.67×10^{-2}	6.59×10^{-1}	2.62×10^{-10}	6.67×10^{-2}	9.91×10^{-1}	1.20×10^{-5}
Nitrate	2.23	3.99×10^{-2}	0.00	2.23	3.13×10^{-1}	0.00	2.23	6.99×10^{-1}	0.00
Total	**N/A**	**6.75×10^{-1}**	**0.00**	**N/A**	**9.72×10^{-1}**	**2.62×10^{-10}**	**N/A**	**1.69**	**1.20×10^{-5}**
Year of peak impact	2102	2102	N/A	2102	2102	2102	2102	2102	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–28. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.23×10^{-9}	2.61×10^{-4}	2.48×10^{-9}	2.23×10^{-9}	3.04×10^{-4}	2.99×10^{-9}	2.23×10^{-9}	3.62×10^{-4}	3.80×10^{-9}
Technetium-99	2.43×10^{-6}	4.26	1.47×10^{-4}	2.43×10^{-6}	1.10×10^{1}	4.82×10^{-4}	2.43×10^{-6}	2.24×10^{1}	1.05×10^{-3}
Iodine-129	4.73×10^{-9}	1.35	1.53×10^{-5}	4.73×10^{-9}	1.68	2.37×10^{-5}	4.73×10^{-9}	2.18	3.58×10^{-5}
Total	**N/A**	**5.61**	**1.62×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.06×10^{-4}**	**N/A**	**2.46×10^{1}**	**1.09×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15×10^{-2}	5.86×10^{-1}	0.00	6.15×10^{-2}	6.07×10^{-1}	2.45×10^{-10}	6.15×10^{-2}	9.14×10^{-1}	1.12×10^{-5}
Nitrate	4.09	7.31×10^{-2}	0.00	4.09	5.74×10^{-1}	0.00	4.09	1.28	0.00
Total	**N/A**	**6.59×10^{-1}**	**0.00**	**N/A**	**1.18**	**2.45×10^{-10}**	**N/A**	**2.19**	**1.12×10^{-5}**
Year of peak impact	2096	2096	N/A	2096	2096	2115	2096	2096	2115

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–29. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.62×10^{-7}	1.90×10^{-2}	1.80×10^{-7}	1.62×10^{-7}	2.20×10^{-2}	2.17×10^{-7}	1.62×10^{-7}	2.63×10^{-2}	2.76×10^{-7}
Technetium-99	2.47×10^{-6}	4.32	1.49×10^{-4}	2.47×10^{-6}	1.11×10^{1}	4.89×10^{-4}	2.47×10^{-6}	2.27×10^{1}	1.07×10^{-3}
Iodine-129	4.64×10^{-9}	1.32	1.50×10^{-5}	4.64×10^{-9}	1.65	2.32×10^{-5}	4.64×10^{-9}	2.13	3.52×10^{-5}
Total	**N/A**	**5.66**	**1.64×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.12×10^{-4}**	**N/A**	**2.49×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.44×10^{-1}	2.32	0.00	2.43×10^{-1}	2.40	9.59×10^{-10}	2.43×10^{-1}	3.62	4.40×10^{-5}
Nitrate	6.92	1.24×10^{-1}	0.00	6.98	9.80×10^{-1}	0.00	6.98	2.18	0.00
Total	**N/A**	**2.45**	**0.00**	**N/A**	**3.38**	**9.59×10^{-10}**	**N/A**	**5.80**	**4.40×10^{-5}**
Year of peak impact	2030	2030	N/A	2026	2026	2030	2026	2026	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–30. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.06×10^{-6}	2.41×10^{-1}	2.29×10^{-6}	2.06×10^{-6}	2.80×10^{-1}	2.76×10^{-6}	2.06×10^{-6}	3.34×10^{-1}	3.50×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.36×10^{-4}	1.06×10^{-5}	4.76×10^{1}	2.09×10^{-3}	1.06×10^{-5}	9.73×10^{1}	4.57×10^{-3}
Iodine-129	2.05×10^{-8}	5.84	6.64×10^{-5}	2.05×10^{-8}	7.29	1.03×10^{-4}	2.05×10^{-8}	9.42	1.55×10^{-4}
Total	**N/A**	**2.46×10^{1}**	**7.04×10^{-4}**	**N/A**	**5.52×10^{1}**	**2.20×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.73×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.03×10^{-1}	2.88	0.00	3.00×10^{-1}	2.96	1.19×10^{-9}	3.00×10^{-1}	4.46	5.45×10^{-5}
Nitrate	2.38×10^{1}	4.25×10^{-1}	0.00	2.40×10^{1}	3.37	0.00	2.40×10^{1}	7.52	0.00
Total	**N/A**	**3.31**	**0.00**	**N/A**	**6.34**	**1.19×10^{-9}**	**N/A**	**1.20×10^{1}**	**5.45×10^{-5}**
Year of peak impact	2023	2023	N/A	2024	2024	2023	2024	2024	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–31. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.81×10^{-9}	5.63×10^{-4}	5.34×10^{-9}	4.81×10^{-9}	6.54×10^{-4}	3.57×10^{-9}	4.81×10^{-9}	7.79×10^{-4}	4.53×10^{-9}
Technetium-99	1.36×10^{-7}	2.38×10^{-1}	8.19×10^{-6}	1.36×10^{-7}	6.13×10^{-1}	2.69×10^{-5}	1.36×10^{-7}	1.25	5.89×10^{-5}
Iodine-129	1.61×10^{-10}	4.60×10^{-2}	5.23×10^{-7}	1.61×10^{-10}	5.74×10^{-2}	7.99×10^{-7}	1.61×10^{-10}	7.42×10^{-2}	1.21×10^{-6}
Total	**N/A**	**2.85×10^{-1}**	**8.72×10^{-6}**	**N/A**	**6.71×10^{-1}**	**2.77×10^{-5}**	**N/A**	**1.33**	**6.01×10^{-5}**
Year of peak impact	2071	2071	2071	2071	2071	2081	2071	2071	2081
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.21×10^{-3}	5.91×10^{-2}	0.00	6.21×10^{-3}	6.13×10^{-2}	2.44×10^{-11}	6.21×10^{-3}	9.23×10^{-2}	1.12×10^{-6}
Nitrate	4.46×10^{-1}	7.96×10^{-3}	0.00	4.46×10^{-1}	6.25×10^{-2}	0.00	4.46×10^{-1}	1.39×10^{-1}	0.00
Total	**N/A**	**6.71×10^{-2}**	**0.00**	**N/A**	**1.24×10^{-1}**	**2.44×10^{-11}**	**N/A**	**2.32×10^{-1}**	**1.12×10^{-6}**
Year of peak impact	2040	2040	N/A	2040	2040	2040	2040	2040	2040

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–32. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.23×10^{-9}	2.61×10^{-4}	2.48×10^{-9}	2.23×10^{-9}	3.04×10^{-4}	2.99×10^{-9}	2.23×10^{-9}	3.62×10^{-4}	3.80×10^{-9}
Technetium-99	2.43×10^{-6}	4.26	1.47×10^{-4}	2.43×10^{-6}	1.10×10^{1}	4.82×10^{-4}	2.43×10^{-6}	2.24×10^{1}	1.05×10^{-3}
Iodine-129	4.73×10^{-9}	1.35	1.53×10^{-5}	4.73×10^{-9}	1.68	2.37×10^{-5}	4.73×10^{-9}	2.18	3.58×10^{-5}
Total	**N/A**	**5.61**	$\mathbf{1.62\times10^{-4}}$	**N/A**	$\mathbf{1.27\times10^{1}}$	$\mathbf{5.06\times10^{-4}}$	**N/A**	$\mathbf{2.46\times10^{1}}$	$\mathbf{1.09\times10^{-3}}$
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.27×10^{-2}	7.87×10^{-1}	0.00	7.89×10^{-2}	7.79×10^{-1}	3.25×10^{-10}	7.89×10^{-2}	1.17	1.49×10^{-5}
Nitrate	3.25	5.80×10^{-2}	0.00	4.09	5.74×10^{-1}	0.00	4.09	1.28	0.00
Total	**N/A**	$\mathbf{8.45\times10^{-1}}$	**0.00**	**N/A**	**1.35**	$\mathbf{3.25\times10^{-10}}$	**N/A**	**2.45**	$\mathbf{1.49\times10^{-5}}$
Year of peak impact	2110	2110	N/A	2096	2096	2110	2096	2096	2110

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–33. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.41×10^{-7}	5.97×10^{-1}	2.08×10^{-5}	3.45×10^{-7}	1.56	6.84×10^{-5}	3.45×10^{-7}	3.18	1.50×10^{-4}
Iodine-129	6.63×10^{-10}	1.89×10^{-1}	2.03×10^{-6}	6.28×10^{-10}	2.24×10^{-1}	3.15×10^{-6}	6.28×10^{-10}	2.89×10^{-1}	4.76×10^{-6}
Total	**3.42×10^{-7}**	**7.86×10^{-1}**	**2.28×10^{-5}**	**3.46×10^{-7}**	**1.78**	**7.15×10^{-5}**	**3.46×10^{-7}**	**3.47**	**1.54×10^{-4}**
Year of peak impact	2222	2222	2214	2214	2214	2214	2214	2214	2214

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	8.54×10^{-3}	8.13×10^{-2}	0.00	8.38×10^{-3}	8.28×10^{-2}	3.35×10^{-11}	8.38×10^{-3}	1.25×10^{-1}	1.54×10^{-6}
Nitrate	6.22×10^{-1}	1.11×10^{-2}	0.00	6.34×10^{-1}	8.90×10^{-2}	0.00	6.34×10^{-1}	1.98×10^{-1}	0.00
Total	**6.30×10^{-1}**	**9.24×10^{-2}**	**0.00**	**6.42×10^{-1}**	**1.72×10^{-1}**	**3.35×10^{-11}**	**6.42×10^{-1}**	**3.23×10^{-1}**	**1.54×10^{-6}**
Year of peak impact	2239	2239	N/A	2245	2245	2239	2245	2245	2239

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–34. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.85×10^{-12}	3.54×10^{-5}	1.55×10^{-9}	7.71×10^{-12}	8.02×10^{-5}	3.88×10^{-9}	3.45×10^{-7}	1.04×10^{-2}	5.57×10^{-7}
Iodine-129	1.46×10^{-14}	5.20×10^{-6}	7.33×10^{-11}	1.49×10^{-14}	8.12×10^{-5}	1.91×10^{-9}	6.28×10^{-10}	2.45×10^{-3}	6.01×10^{-8}
Total	**N/A**	$\mathbf{4.06\times10^{-5}}$	$\mathbf{1.63\times10^{-9}}$	**N/A**	$\mathbf{1.61\times10^{-4}}$	$\mathbf{5.79\times10^{-9}}$	**N/A**	$\mathbf{1.29\times10^{-2}}$	$\mathbf{6.18\times10^{-7}}$
Year of peak impact	2188	2188	2188	2185	2185	2188	2214	2214	2214

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.03×10^{-7}	2.99×10^{-6}	1.19×10^{-15}	2.88×10^{-7}	4.66×10^{-6}	5.45×10^{-11}	8.54×10^{-3}	3.76×10^{-2}	1.54×10^{-6}
Nitrate	1.61×10^{-5}	2.44×10^{-6}	0.00	1.63×10^{-5}	1.53×10^{-3}	0.00	6.22×10^{-1}	3.29×10^{-2}	0.00
Total	**N/A**	$\mathbf{5.43\times10^{-6}}$	$\mathbf{1.19\times10^{-15}}$	**N/A**	$\mathbf{1.54\times10^{-3}}$	$\mathbf{5.45\times10^{-11}}$	**N/A**	$\mathbf{7.05\times10^{-2}}$	$\mathbf{1.54\times10^{-6}}$
Year of peak impact	2199	2199	2199	2193	2193	2199	2239	2239	2239

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–35. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.82×10^{-6}	2.13×10^{-1}	2.02×10^{-6}	1.82×10^{-6}	2.48×10^{-1}	2.44×10^{-6}	1.82×10^{-6}	2.95×10^{-1}	3.09×10^{-6}
Technetium-99	4.17×10^{-5}	7.30×10^{1}	2.51×10^{-3}	4.17×10^{-5}	1.88×10^{2}	8.25×10^{-3}	4.17×10^{-5}	3.84×10^{2}	1.81×10^{-2}
Iodine-129	3.69×10^{-8}	1.05×10^{1}	1.19×10^{-4}	3.69×10^{-8}	1.31×10^{1}	1.85×10^{-4}	3.69×10^{-8}	1.70×10^{1}	2.79×10^{-4}
Total	**N/A**	**8.37×10^{1}**	**2.63×10^{-3}**	**N/A**	**2.01×10^{2}**	**8.44×10^{-3}**	**N/A**	**4.01×10^{2}**	**1.83×10^{-2}**
Year of peak impact	2121	2121	2121	2121	2121	2121	2121	2121	2121

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	5.46×10^{-3}	2.60×10^{-2}	0.00	5.01×10^{-2}	2.98×10^{-1}	0.00	5.01×10^{-2}	5.39×10^{-1}	0.00
Chromium	3.23×10^{-1}	3.08	0.00	1.36×10^{-1}	1.34	1.27×10^{-9}	1.36×10^{-1}	2.01	5.82×10^{-5}
Nitrate	3.02×10^{1}	5.38×10^{-1}	0.00	4.69×10^{1}	6.58	0.00	4.69×10^{1}	1.47×10^{1}	0.00
Total uranium	3.90×10^{-7}	3.71×10^{-6}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**3.64**	**0.00**	**N/A**	**8.22**	**1.27×10^{-9}**	**N/A**	**1.72×10^{1}**	**5.82×10^{-5}**
Year of peak impact	3710	3710	N/A	2136	2136	3710	2136	2136	3710

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–36. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.59×10^{-5}	4.53×10^{1}	1.59×10^{-3}	2.65×10^{-5}	1.19×10^{2}	5.24×10^{-3}	2.65×10^{-5}	2.44×10^{2}	1.15×10^{-2}
Iodine-129	4.73×10^{-8}	1.35×10^{1}	1.34×10^{-4}	4.13×10^{-8}	1.47×10^{1}	2.07×10^{-4}	4.13×10^{-8}	1.90×10^{1}	3.13×10^{-4}
Uranium-238	1.22×10^{-12}	1.52×10^{-4}	1.09×10^{-9}	7.77×10^{-13}	1.00×10^{-4}	1.17×10^{-9}	7.77×10^{-13}	1.08×10^{-4}	1.34×10^{-9}
Total	**N/A**	**5.88×10^{1}**	**1.73×10^{-3}**	**N/A**	**1.34×10^{2}**	**5.45×10^{-3}**	**N/A**	**2.63×10^{2}**	**1.18×10^{-2}**
Year of peak impact	4313	4313	3957	3957	3957	3957	3957	3957	3957

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.05×10^{-3}	9.74×10^{-3}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	8.62×10^{-1}	8.21	0.00	1.82×10^{-1}	1.80	3.39×10^{-9}	1.58×10^{-1}	2.35	1.56×10^{-4}
Nitrate	5.49×10^{1}	9.79×10^{-1}	0.00	1.86×10^{2}	2.61×10^{1}	0.00	1.87×10^{2}	5.86×10^{1}	0.00
Total uranium	1.80×10^{-5}	1.71×10^{-4}	0.00	1.09×10^{-6}	1.05×10^{-5}	0.00	3.25×10^{-6}	3.29×10^{-5}	0.00
Total	**N/A**	**9.20**	**0.00**	**N/A**	**2.79×10^{1}**	**3.39×10^{-9}**	**N/A**	**6.10×10^{1}**	**1.56×10^{-4}**
Year of peak impact	3696	3696	N/A	2065	2065	3882	2066	2066	3882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A/=not applicable.

Table Q–37. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	2.28×10^{-5}	4.00×10^{1}	1.37×10^{-3}	2.28×10^{-5}	1.03×10^{2}	4.52×10^{-3}	2.28×10^{-5}	2.10×10^{2}	9.89×10^{-3}
Iodine-129	2.57×10^{-8}	7.32	8.33×10^{-5}	2.57×10^{-8}	9.15	1.29×10^{-4}	2.57×10^{-8}	1.18×10^{1}	1.95×10^{-4}
Total	**N/A**	**4.73×10^{1}**	**1.46×10^{-3}**	**N/A**	**1.12×10^{2}**	**4.65×10^{-3}**	**N/A**	**2.22×10^{2}**	**1.01×10^{-2}**
Year of peak impact	3072	3072	3072	3072	3072	3072	3072	3072	3072
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.24×10^{-2}	1.06×10^{-1}	0.00	2.24×10^{-2}	1.33×10^{-1}	0.00	2.24×10^{-2}	2.41×10^{-1}	0.00
Chromium	5.41×10^{-1}	5.15	0.00	5.41×10^{-1}	5.34	2.12×10^{-9}	5.41×10^{-1}	8.03	9.74×10^{-5}
Nitrate	3.66×10^{1}	6.53×10^{-1}	0.00	3.66×10^{1}	5.14	0.00	3.66×10^{1}	1.15×10^{1}	0.00
Total uranium	3.89×10^{-7}	3.71×10^{-6}	0.00	3.89×10^{-7}	3.78×10^{-6}	0.00	3.89×10^{-7}	3.94×10^{-6}	0.00
Total	**N/A**	**5.91**	**0.00**	**N/A**	**1.06×10^{1}**	**2.12×10^{-9}**	**N/A**	**1.97×10^{1}**	**9.74×10^{-5}**
Year of peak impact	3242	3242	N/A	3242	3242	3242	3242	3242	3242

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–38. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.64×10^{-6}	3.09×10^{-1}	2.47×10^{-6}	2.23×10^{-6}	3.03×10^{-1}	2.98×10^{-6}	2.23×10^{-6}	3.61×10^{-1}	3.78×10^{-6}
Technetium-99	6.46×10^{-6}	1.13×10^{1}	3.90×10^{-4}	6.48×10^{-6}	2.92×10^{1}	1.28×10^{-3}	6.48×10^{-6}	5.97×10^{1}	2.81×10^{-3}
Iodine-129	1.26×10^{-8}	3.58	4.07×10^{-5}	1.26×10^{-8}	4.47	6.30×10^{-5}	1.26×10^{-8}	5.78	9.53×10^{-5}
Uranium-238	1.51×10^{-11}	1.87×10^{-3}	2.14×10^{-8}	1.53×10^{-11}	1.97×10^{-3}	2.31×10^{-8}	1.53×10^{-11}	2.12×10^{-3}	2.63×10^{-8}
Total	**N/A**	**1.52×10^{1}**	**4.33×10^{-4}**	**N/A**	**3.40×10^{1}**	**1.35×10^{-3}**	**N/A**	**6.58×10^{1}**	**2.90×10^{-3}**
Year of peak impact	2051	2051	2050	2050	2050	2050	2050	2050	2050

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.36×10^{-1}	3.20	0.00	3.22×10^{-1}	3.18	1.32×10^{-9}	3.22×10^{-1}	4.78	6.06×10^{-5}
Nitrate	6.03×10^{1}	1.08	0.00	6.20×10^{1}	8.71	0.00	6.20×10^{1}	1.94×10^{1}	0.00
Total uranium	2.26×10^{-5}	2.15×10^{-4}	0.00	2.24×10^{-5}	2.18×10^{-4}	0.00	2.24×10^{-5}	2.27×10^{-4}	0.00
Total	**N/A**	**4.28**	**0.00**	**N/A**	**1.19×10^{1}**	**1.32×10^{-9}**	**N/A**	**2.42×10^{1}**	**6.06×10^{-5}**
Year of peak impact	2051	2051	N/A	2056	2056	2036	2056	2056	2036

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–39. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.70×10^{-6}	1.70×10^{1}	5.92×10^{-4}	9.83×10^{-6}	4.43×10^{1}	1.95×10^{-3}	9.83×10^{-6}	9.05×10^{1}	4.26×10^{-3}
Iodine-129	1.85×10^{-8}	5.28	5.58×10^{-5}	1.72×10^{-8}	6.13	8.62×10^{-5}	1.72×10^{-8}	7.92	1.30×10^{-4}
Uranium-238	1.95×10^{-13}	2.41×10^{-5}	2.72×10^{-10}	1.94×10^{-13}	2.51×10^{-5}	2.93×10^{-10}	1.94×10^{-13}	2.70×10^{-5}	3.34×10^{-10}
Total	**N/A**	**2.23×10^{1}**	**6.48×10^{-4}**	**N/A**	**5.05×10^{1}**	**2.03×10^{-3}**	**N/A**	**9.85×10^{1}**	**4.39×10^{-3}**
Year of peak impact	4002	4002	3985	3985	3985	3985	3985	3985	3985
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.87×10^{-5}	1.37×10^{-4}	0.00	2.02×10^{-7}	1.20×10^{-6}	0.00	2.02×10^{-7}	2.17×10^{-6}	0.00
Chromium	2.08×10^{-1}	1.98	0.00	2.01×10^{-1}	1.98	8.18×10^{-10}	2.01×10^{-1}	2.98	3.75×10^{-5}
Nitrate	1.93×10^{1}	3.44×10^{-1}	0.00	2.25×10^{1}	3.15	0.00	2.25×10^{1}	7.03	0.00
Total uranium	1.89×10^{-7}	1.80×10^{-6}	0.00	2.84×10^{-7}	2.75×10^{-6}	0.00	2.84×10^{-7}	2.87×10^{-6}	0.00
Total	**N/A**	**2.33**	**0.00**	**N/A**	**5.13**	**8.18×10^{-10}**	**N/A**	**1.00×10^{1}**	**3.75×10^{-5}**
Year of peak impact	4027	4027	N/A	3957	3957	4027	3957	3957	4027

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–40. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.59×10^{-5}	4.53×10^{1}	1.59×10^{-3}	2.65×10^{-5}	1.19×10^{2}	5.24×10^{-3}	2.65×10^{-5}	2.44×10^{2}	1.15×10^{-2}
Iodine-129	4.73×10^{-8}	1.35×10^{1}	1.34×10^{-4}	4.13×10^{-8}	1.47×10^{1}	2.07×10^{-4}	4.13×10^{-8}	1.90×10^{1}	3.13×10^{-4}
Uranium-238	2.13×10^{-12}	2.64×10^{-4}	1.09×10^{-9}	7.77×10^{-13}	1.00×10^{-4}	1.17×10^{-9}	7.77×10^{-13}	1.08×10^{-4}	1.34×10^{-9}
Total	**N/A**	**5.88×10^{1}**	**1.73×10^{-3}**	**N/A**	**1.34×10^{2}**	**5.45×10^{-3}**	**N/A**	**2.63×10^{2}**	**1.18×10^{-2}**
Year of peak impact	4313	4313	3957	3957	3957	3957	3957	3957	3957

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.88×10^{-3}	1.37×10^{-2}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	8.62×10^{-1}	8.21	0.00	1.82×10^{-1}	1.80	3.39×10^{-9}	1.58×10^{-1}	2.35	1.56×10^{-4}
Nitrate	5.49×10^{1}	9.79×10^{-1}	0.00	1.86×10^{2}	2.61×10^{1}	0.00	1.87×10^{2}	5.86×10^{1}	0.00
Total uranium	1.80×10^{-5}	1.71×10^{-4}	0.00	1.09×10^{-6}	1.05×10^{-5}	0.00	3.25×10^{-6}	3.29×10^{-5}	0.00
Total	**N/A**	**9.20**	**0.00**	**N/A**	**2.79×10^{1}**	**3.39×10^{-9}**	**N/A**	**6.10×10^{1}**	**1.56×10^{-4}**
Year of peak impact	3696	3696	N/A	2065	2065	3882	2066	2066	3882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–41. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.53×10^{-6}	2.68	9.20×10^{-5}	1.53×10^{-6}	6.90	3.36×10^{-4}	1.53×10^{-6}	1.41×10^{1}	7.35×10^{-4}
Iodine-129	5.94×10^{-9}	1.69	1.92×10^{-5}	5.94×10^{-9}	2.11	9.42×10^{-6}	5.94×10^{-9}	2.73	1.43×10^{-5}
Uranium-238	3.03×10^{-13}	3.76×10^{-5}	4.24×10^{-10}	3.03×10^{-13}	3.91×10^{-5}	3.78×10^{-10}	3.03×10^{-13}	4.21×10^{-5}	4.30×10^{-10}
Total	**N/A**	**4.37**	**1.11×10^{-4}**	**N/A**	**9.01**	**3.45×10^{-4}**	**N/A**	**1.68×10^{1}**	**7.49×10^{-4}**
Year of peak impact	4978	4978	4978	4978	4978	2999	4978	4978	2999
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.03×10^{-4}	1.44×10^{-3}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	8.35×10^{-2}	7.95×10^{-1}	0.00	6.62×10^{-2}	6.54×10^{-1}	3.28×10^{-10}	6.04×10^{-2}	8.98×10^{-1}	1.50×10^{-5}
Nitrate	1.19×10^{1}	2.12×10^{-1}	0.00	1.58×10^{1}	2.21	0.00	1.61×10^{1}	5.03	0.00
Total uranium	3.91×10^{-7}	3.72×10^{-6}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**1.01**	**0.00**	**N/A**	**2.86**	**3.28×10^{-10}**	**N/A**	**5.92**	**1.50×10^{-5}**
Year of peak impact	4498	4498	N/A	2067	2067	4498	2062	2062	4498

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–42. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.23×10^{-10}	5.56×10^{-4}	2.44×10^{-8}	1.23×10^{-10}	1.28×10^{-3}	6.09×10^{-8}	1.53×10^{-6}	4.62×10^{-2}	2.79×10^{-6}
Iodine-129	1.91×10^{-13}	6.82×10^{-5}	9.61×10^{-10}	1.91×10^{-13}	1.04×10^{-3}	2.50×10^{-8}	5.94×10^{-9}	2.20×10^{-2}	2.94×10^{-7}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	3.03×10^{-13}	3.76×10^{-6}	6.78×10^{-11}
Total	**N/A**	**6.24×10^{-4}**	**2.54×10^{-8}**	**N/A**	**2.32×10^{-3}**	**8.59×10^{-8}**	**N/A**	**6.82×10^{-2}**	**3.08×10^{-6}**
Year of peak impact	3394	3394	3394	3394	3394	3394	4978	4978	2999
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.08×10^{-8}	4.81×10^{-7}	0.00	0.00	0.00	0.00	4.06×10^{-4}	2.44×10^{-3}	0.00
Chromium	2.73×10^{-6}	2.70×10^{-5}	1.09×10^{-14}	1.04×10^{-6}	1.69×10^{-5}	5.02×10^{-10}	7.94×10^{-2}	3.49×10^{-1}	1.50×10^{-5}
Nitrate	3.10×10^{-4}	4.70×10^{-5}	0.00	3.32×10^{-4}	3.13×10^{-2}	0.00	1.39×10^{1}	6.72×10^{-1}	0.00
Total uranium	0.00	0.00	0.00	0.00	0.00	0.00	4.24×10^{-7}	1.88×10^{-7}	0.00
Total	**N/A**	**7.44×10^{-5}**	**1.09×10^{-14}**	**N/A**	**3.13×10^{-2}**	**5.02×10^{-10}**	**N/A**	**1.02**	**1.50×10^{-5}**
Year of peak impact	3848	3848	3912	2155	2155	3912	4619	4619	4498

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Due to the large magnitude of the liquid release, transport through the vadose zone is rapid, and impacts exceeding dose standards are estimated for onsite locations. The largest contributor at the year of peak dose are the cribs and trenches (ditches) and the presence of tritium, technetium-99, iodine-129, uranium-238, chromium, nitrates, and total uranium. Due to large dilution in the Columbia River, offsite impacts on individuals are small. Population dose is estimated as 3.12 person-rem per year for the year of maximum impact.

Figure Q–2 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by technetium-99 and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by technetium-99 and iodine-129. After CY 2150, peak radiological risk is dominated by the contributions from other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 3960 and is dominated by technetium-99 and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

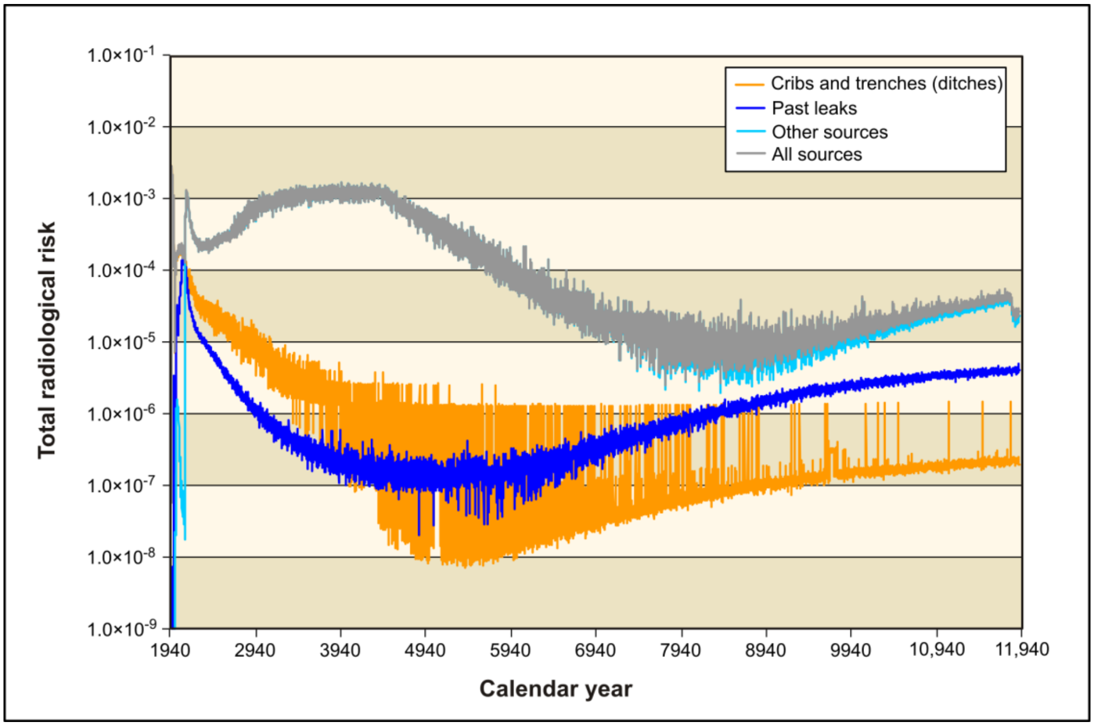


Figure Q–2. Tank Closure Alternative 1 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.2 Tank Closure Alternative 2A

Under Tank Closure Alternative 2A, tank waste would be retrieved to a volume corresponding to 99 percent retrieval, but the residual material in tanks would not be stabilized. After an institutional control period of 100 years, salt cake in the tanks is assumed available for dissolution in infiltrating water.

Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–43 through Q–47; to past leaks after CY 1940, in Tables Q–48 through Q–55; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–56 through Q–63.

Table Q–43. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.75×10^{-4}	7.90×10^{1}	7.50×10^{-4}	6.75×10^{-4}	9.19×10^{1}	9.05×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.35×10^{-5}	5.86×10^{1}	2.01×10^{-3}	3.35×10^{-5}	1.51×10^{2}	6.63×10^{-3}	3.35×10^{-5}	3.08×10^{2}	1.45×10^{-2}
Iodine-129	4.37×10^{-8}	1.25×10^{1}	1.42×10^{-4}	4.37×10^{-8}	1.56×10^{1}	2.19×10^{-4}	4.37×10^{-8}	2.01×10^{1}	3.32×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.75×10^{-3}**	**N/A**	**4.38×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.03	5.74×10^{1}	0.00	2.79	2.76×10^{1}	2.37×10^{-8}	2.79	4.15×10^{1}	1.09×10^{-3}
Nitrate	1.77×10^{3}	3.16×10^{1}	0.00	2.04×10^{3}	2.87×10^{2}	0.00	2.04×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.90×10^{1}**	**0.00**	**N/A**	**3.14×10^{2}**	**2.37×10^{-8}**	**N/A**	**6.81×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–44. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.59×10^{-3}	8.88×10^{2}	8.42×10^{-3}	7.59×10^{-3}	1.03×10^{3}	1.02×10^{-2}	7.59×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.24×10^{-7}	2.17×10^{-1}	7.47×10^{-6}	1.24×10^{-7}	5.60×10^{-1}	2.46×10^{-5}	1.24×10^{-7}	1.14	5.37×10^{-5}
Iodine-129	1.10×10^{-9}	3.12×10^{-1}	3.55×10^{-6}	1.10×10^{-9}	3.90×10^{-1}	5.49×10^{-6}	1.10×10^{-9}	5.04×10^{-1}	8.31×10^{-6}
Total	**N/A**	**8.89×10^{2}**	**8.44×10^{-3}**	**N/A**	**1.03×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.71	6.39×10^{1}	0.00	6.71	6.62×10^{1}	2.63×10^{-8}	6.71	9.97×10^{1}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.86×10^{2}	0.00
Total	**N/A**	**9.16×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.63×10^{-8}**	**N/A**	**5.86×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–45. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.75×10^{-4}	7.90×10^{1}	7.50×10^{-4}	6.75×10^{-4}	9.19×10^{1}	9.05×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.35×10^{-5}	5.86×10^{1}	2.01×10^{-3}	3.35×10^{-5}	1.51×10^{2}	6.63×10^{-3}	3.35×10^{-5}	3.08×10^{2}	1.45×10^{-2}
Iodine-129	4.37×10^{-8}	1.25×10^{1}	1.42×10^{-4}	4.37×10^{-8}	1.56×10^{1}	2.19×10^{-4}	4.37×10^{-8}	2.01×10^{1}	3.32×10^{-4}
Total	**N/A**	$\mathbf{1.50\times10^{2}}$	$\mathbf{2.91\times10^{-3}}$	**N/A**	$\mathbf{2.58\times10^{2}}$	$\mathbf{7.75\times10^{-3}}$	**N/A**	$\mathbf{4.38\times10^{2}}$	$\mathbf{1.60\times10^{-2}}$
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.03	5.74×10^{1}	0.00	2.79	2.76×10^{1}	2.37×10^{-8}	2.79	4.15×10^{1}	1.09×10^{-3}
Nitrate	1.77×10^{3}	3.16×10^{1}	0.00	2.04×10^{3}	2.87×10^{2}	0.00	2.04×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	$\mathbf{8.90\times10^{1}}$	**0.00**	**N/A**	$\mathbf{3.14\times10^{2}}$	$\mathbf{2.37\times10^{-8}}$	**N/A**	$\mathbf{6.81\times10^{2}}$	$\mathbf{1.09\times10^{-3}}$
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–46. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.07×10^{-5}	1.25	1.18×10^{-5}	1.07×10^{-5}	1.45	1.43×10^{-5}	1.07×10^{-5}	1.73	1.81×10^{-5}
Technetium-99	8.63×10^{-7}	1.51	5.19×10^{-5}	8.63×10^{-7}	3.89	1.71×10^{-4}	8.63×10^{-7}	7.95	3.74×10^{-4}
Iodine-129	1.06×10^{-9}	3.03×10^{-1}	3.45×10^{-6}	1.06×10^{-9}	3.79×10^{-1}	5.33×10^{-6}	1.06×10^{-9}	4.89×10^{-1}	8.07×10^{-6}
Total	**N/A**	**3.06**	**6.72×10^{-5}**	**N/A**	**5.72**	**1.90×10^{-4}**	**N/A**	**1.02×10^{1}**	**4.00×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.22×10^{-1}	2.11	0.00	1.38×10^{-1}	1.36	8.70×10^{-10}	1.38×10^{-1}	2.05	3.99×10^{-5}
Nitrate	4.49×10^{1}	8.02×10^{-1}	0.00	7.01×10^{1}	9.84	0.00	7.01×10^{1}	2.19×10^{1}	0.00
Total	**N/A**	**2.91**	**0.00**	**N/A**	**1.12×10^{1}**	**8.70×10^{-10}**	**N/A**	**2.40×10^{1}**	**3.99×10^{-5}**
Year of peak impact	2016	2016	N/A	1964	1964	2016	1964	1964	2016

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–47. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.24×10^{-10}	9.84×10^{-5}	9.70×10^{-10}	7.24×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.07×10^{-5}	6.77×10^{-2}	1.25×10^{-6}
Technetium-99	4.94×10^{-11}	2.23×10^{-4}	9.77×10^{-9}	4.94×10^{-11}	5.13×10^{-4}	2.44×10^{-8}	8.63×10^{-7}	2.60×10^{-2}	1.39×10^{-6}
Iodine-129	6.33×10^{-14}	2.26×10^{-5}	3.18×10^{-10}	6.33×10^{-14}	3.45×10^{-4}	8.29×10^{-9}	1.06×10^{-9}	3.88×10^{-3}	9.53×10^{-8}
Total	**N/A**	$\mathbf{3.44\times10^{-4}}$	$\mathbf{1.11\times10^{-8}}$	**N/A**	$\mathbf{9.78\times10^{-4}}$	$\mathbf{3.39\times10^{-8}}$	**N/A**	$\mathbf{9.76\times10^{-2}}$	$\mathbf{2.73\times10^{-6}}$
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.66×10^{-5}	1.64×10^{-4}	6.83×10^{-14}	1.66×10^{-5}	2.69×10^{-4}	3.13×10^{-9}	2.92×10^{-2}	1.29×10^{-1}	3.99×10^{-5}
Nitrate	4.79×10^{-3}	7.26×10^{-4}	0.00	4.79×10^{-3}	4.52×10^{-1}	0.00	1.42×10^{1}	4.48	0.00
Total	**N/A**	$\mathbf{8.90\times10^{-4}}$	$\mathbf{6.83\times10^{-14}}$	**N/A**	$\mathbf{4.52\times10^{-1}}$	$\mathbf{3.13\times10^{-9}}$	**N/A**	**4.61**	$\mathbf{3.99\times10^{-5}}$
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2016

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–48. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.88×10^{-7}	2.20×10^{-2}	2.09×10^{-7}	1.88×10^{-7}	2.56×10^{-2}	2.52×10^{-7}	1.88×10^{-7}	3.05×10^{-2}	3.20×10^{-7}
Technetium-99	1.39×10^{-6}	2.43	8.37×10^{-5}	1.39×10^{-6}	6.27	2.75×10^{-4}	1.39×10^{-6}	1.28×10^{1}	6.02×10^{-4}
Iodine-129	5.43×10^{-10}	1.55×10^{-1}	1.76×10^{-6}	5.43×10^{-10}	1.93×10^{-1}	2.72×10^{-6}	5.43×10^{-10}	2.50×10^{-1}	4.12×10^{-6}
Total	**N/A**	**2.61**	**8.57×10^{-5}**	**N/A**	**6.49**	**2.78×10^{-4}**	**N/A**	**1.31×10^{1}**	**6.07×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.07×10^{-2}	6.73×10^{-1}	0.00	7.07×10^{-2}	6.98×10^{-1}	2.78×10^{-10}	7.07×10^{-2}	1.05	1.27×10^{-5}
Nitrate	2.19	3.90×10^{-2}	0.00	2.19	3.07×10^{-1}	0.00	2.19	6.84×10^{-1}	0.00
Total	**N/A**	**7.12×10^{-1}**	**0.00**	**N/A**	**1.00**	**2.78×10^{-10}**	**N/A**	**1.73**	**1.27×10^{-5}**
Year of peak impact	2106	2106	N/A	2106	2106	2106	2106	2106	2106

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–49. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.41×10^{-9}	2.82×10^{-4}	2.67×10^{-9}	2.41×10^{-9}	3.27×10^{-4}	3.22×10^{-9}	2.41×10^{-9}	3.90×10^{-4}	4.09×10^{-9}
Technetium-99	2.45×10^{-6}	4.29	1.48×10^{-4}	2.45×10^{-6}	1.11×10^{1}	4.86×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.69×10^{-9}	1.34	1.52×10^{-5}	4.69×10^{-9}	1.67	2.35×10^{-5}	4.69×10^{-9}	2.16	3.55×10^{-5}
Total	**N/A**	**5.63**	$\mathbf{1.63\times10^{-4}}$	**N/A**	$\mathbf{1.27\times10^{1}}$	$\mathbf{5.09\times10^{-4}}$	**N/A**	$\mathbf{2.47\times10^{1}}$	$\mathbf{1.10\times10^{-3}}$
Year of peak impact	2088	2088	2088	2088	2088	2088	2088	2088	2088
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.75×10^{-2}	6.43×10^{-1}	0.00	6.05×10^{-2}	5.98×10^{-1}	2.65×10^{-10}	6.05×10^{-2}	8.99×10^{-1}	1.22×10^{-5}
Nitrate	3.44	6.14×10^{-2}	0.00	4.01	5.63×10^{-1}	0.00	4.01	1.26	0.00
Total	**N/A**	$\mathbf{7.04\times10^{-1}}$	**0.00**	**N/A**	**1.16**	$\mathbf{2.65\times10^{-10}}$	**N/A**	**2.15**	$\mathbf{1.22\times10^{-5}}$
Year of peak impact	2101	2101	N/A	2093	2093	2101	2093	2093	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–50. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.58×10^{-7}	1.85×10^{-2}	1.75×10^{-7}	1.58×10^{-7}	2.15×10^{-2}	2.11×10^{-7}	1.58×10^{-7}	2.56×10^{-2}	2.68×10^{-7}
Technetium-99	2.48×10^{-6}	4.34	1.49×10^{-4}	2.48×10^{-6}	1.12×10^{1}	4.91×10^{-4}	2.48×10^{-6}	2.28×10^{1}	1.07×10^{-3}
Iodine-129	4.66×10^{-9}	1.33	1.51×10^{-5}	4.66×10^{-9}	1.66	2.33×10^{-5}	4.66×10^{-9}	2.14	3.53×10^{-5}
Total	**N/A**	**5.69**	**1.65×10^{-4}**	**N/A**	**1.29×10^{1}**	**5.15×10^{-4}**	**N/A**	**2.50×10^{1}**	**1.11×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.44×10^{-1}	2.32	0.00	2.44×10^{-1}	2.41	9.58×10^{-10}	2.44×10^{-1}	3.63	4.39×10^{-5}
Nitrate	7.10	1.27×10^{-1}	0.00	7.10	9.97×10^{-1}	0.00	7.10	2.22	0.00
Total	**N/A**	**2.45**	**0.00**	**N/A**	**3.41**	**9.58×10^{-10}**	**N/A**	**5.85**	**4.39×10^{-5}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2032	2032	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–51. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.14×10^{-6}	2.50×10^{-1}	2.37×10^{-6}	2.14×10^{-6}	2.91×10^{-1}	2.86×10^{-6}	2.14×10^{-6}	3.46×10^{-1}	3.63×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.38×10^{-4}	1.06×10^{-5}	4.78×10^{1}	2.10×10^{-3}	1.06×10^{-5}	9.75×10^{1}	4.59×10^{-3}
Iodine-129	1.98×10^{-8}	5.65	6.42×10^{-5}	1.98×10^{-8}	7.06	9.93×10^{-5}	1.98×10^{-8}	9.12	1.50×10^{-4}
Total	**N/A**	$\mathbf{2.44\times10^{1}}$	$\mathbf{7.04\times10^{-4}}$	**N/A**	$\mathbf{5.51\times10^{1}}$	$\mathbf{2.20\times10^{-3}}$	**N/A**	$\mathbf{1.07\times10^{2}}$	$\mathbf{4.74\times10^{-3}}$
Year of peak impact	2022	2022	2022	2022	2022	2022	2022	2022	2022

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.02×10^{-1}	2.87	0.00	3.02×10^{-1}	2.98	1.18×10^{-9}	3.02×10^{-1}	4.48	5.43×10^{-5}
Nitrate	2.41×10^{1}	4.30×10^{-1}	0.00	2.41×10^{1}	3.38	0.00	2.41×10^{1}	7.55	0.00
Total	**N/A**	**3.30**	**0.00**	**N/A**	**6.36**	$\mathbf{1.18\times10^{-9}}$	**N/A**	$\mathbf{1.20\times10^{1}}$	$\mathbf{5.43\times10^{-5}}$
Year of peak impact	2024	2024	N/A	2024	2024	2024	2024	2024	2024

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–52. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.73×10^{-9}	3.20×10^{-4}	3.03×10^{-9}	2.73×10^{-9}	3.71×10^{-4}	3.66×10^{-9}	2.73×10^{-9}	4.42×10^{-4}	4.64×10^{-9}
Technetium-99	1.37×10^{-7}	2.40×10^{-1}	8.27×10^{-6}	1.37×10^{-7}	6.20×10^{-1}	2.72×10^{-5}	1.37×10^{-7}	1.27	5.95×10^{-5}
Iodine-129	1.63×10^{-10}	4.65×10^{-2}	5.28×10^{-7}	1.63×10^{-10}	5.81×10^{-2}	8.17×10^{-7}	1.63×10^{-10}	7.50×10^{-2}	1.24×10^{-6}
Total	**N/A**	**2.87×10^{-1}**	**8.80×10^{-6}**	**N/A**	**6.78×10^{-1}**	**2.80×10^{-5}**	**N/A**	**1.34**	**6.07×10^{-5}**
Year of peak impact	2081	2081	2081	2081	2081	2081	2081	2081	2081
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.07×10^{-3}	5.78×10^{-2}	0.00	6.07×10^{-3}	5.99×10^{-2}	2.39×10^{-11}	6.07×10^{-3}	9.01×10^{-2}	1.09×10^{-6}
Nitrate	4.40×10^{-1}	7.85×10^{-3}	0.00	4.40×10^{-1}	6.17×10^{-2}	0.00	4.40×10^{-1}	1.38×10^{-1}	0.00
Total	**N/A**	**6.56×10^{-2}**	**0.00**	**N/A**	**1.22×10^{-1}**	**2.39×10^{-11}**	**N/A**	**2.28×10^{-1}**	**1.09×10^{-6}**
Year of peak impact	2040	2040	N/A	2040	2040	2041	2040	2040	2041

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–53. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.60×10^{-9}	3.04×10^{-4}	2.88×10^{-9}	2.60×10^{-9}	3.53×10^{-4}	3.48×10^{-9}	2.60×10^{-9}	4.21×10^{-4}	4.41×10^{-9}
Technetium-99	2.45×10^{-6}	4.29	1.48×10^{-4}	2.45×10^{-6}	1.11×10^{1}	4.86×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.69×10^{-9}	1.34	1.52×10^{-5}	4.69×10^{-9}	1.67	2.35×10^{-5}	4.69×10^{-9}	2.16	3.55×10^{-5}
Total	**N/A**	**5.63**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2088	2088	2088	2088	2088	2088	2088	2088	2088
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.34×10^{-2}	7.94×10^{-1}	0.00	8.06×10^{-2}	7.96×10^{-1}	3.27×10^{-10}	8.06×10^{-2}	1.20	1.50×10^{-5}
Nitrate	3.44	6.14×10^{-2}	0.00	3.85	5.41×10^{-1}	0.00	3.85	1.21	0.00
Total	**N/A**	**8.55×10^{-1}**	**0.00**	**N/A**	**1.34**	**3.27×10^{-10}**	**N/A**	**2.40**	**1.50×10^{-5}**
Year of peak impact	2101	2101	N/A	2102	2102	2101	2102	2102	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–54. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.46×10^{-7}	6.06×10^{-1}	2.08×10^{-5}	3.46×10^{-7}	1.56	6.85×10^{-5}	3.46×10^{-7}	3.19	1.50×10^{-4}
Iodine-129	6.12×10^{-10}	1.74×10^{-1}	1.98×10^{-6}	6.12×10^{-10}	2.18×10^{-1}	3.06×10^{-6}	6.12×10^{-10}	2.81×10^{-1}	4.64×10^{-6}
Total	**N/A**	**7.80×10^{-1}**	**2.28×10^{-5}**	**N/A**	**1.78**	**7.16×10^{-5}**	**N/A**	**3.47**	**1.54×10^{-4}**
Year of peak impact	2317	2317	2317	2317	2317	2317	2317	2317	2317
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.37×10^{-3}	7.98×10^{-2}	0.00	8.03×10^{-3}	7.93×10^{-2}	3.29×10^{-11}	8.03×10^{-3}	1.19×10^{-1}	1.51×10^{-6}
Nitrate	6.30×10^{-1}	1.12×10^{-2}	0.00	6.67×10^{-1}	9.36×10^{-2}	0.00	6.67×10^{-1}	2.09×10^{-1}	0.00
Total	**N/A**	**9.10×10^{-2}**	**0.00**	**N/A**	**1.73×10^{-1}**	**3.29×10^{-11}**	**N/A**	**3.28×10^{-1}**	**1.51×10^{-6}**
Year of peak impact	2275	2275	N/A	2271	2271	2275	2271	2271	2275

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–55. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	7.85×10^{-12}	3.54×10^{-5}	1.55×10^{-9}	7.76×10^{-12}	8.07×10^{-5}	3.86×10^{-9}	3.46×10^{-7}	1.04×10^{-2}	5.56×10^{-7}
Iodine-129	1.45×10^{-14}	5.17×10^{-6}	7.29×10^{-11}	1.48×10^{-14}	8.04×10^{-5}	1.92×10^{-9}	6.12×10^{-10}	2.12×10^{-3}	5.21×10^{-8}
Total	**N/A**	$\mathbf{4.06\times10^{-5}}$	$\mathbf{1.63\times10^{-9}}$	**N/A**	$\mathbf{1.61\times10^{-4}}$	$\mathbf{5.78\times10^{-9}}$	**N/A**	$\mathbf{1.25\times10^{-2}}$	$\mathbf{6.08\times10^{-7}}$
Year of peak impact	2189	2189	2189	2186	2186	2191	2317	2317	2317

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.05×10^{-7}	3.02×10^{-6}	1.20×10^{-15}	2.95×10^{-7}	4.77×10^{-6}	5.50×10^{-11}	8.06×10^{-3}	3.55×10^{-2}	1.51×10^{-6}
Nitrate	1.61×10^{-5}	2.44×10^{-6}	0.00	1.63×10^{-5}	1.53×10^{-3}	0.00	6.12×10^{-1}	3.40×10^{-2}	0.00
Total	**N/A**	$\mathbf{5.45\times10^{-6}}$	$\mathbf{1.20\times10^{-15}}$	**N/A**	$\mathbf{1.54\times10^{-3}}$	$\mathbf{5.50\times10^{-11}}$	**N/A**	$\mathbf{6.95\times10^{-2}}$	$\mathbf{1.51\times10^{-6}}$
Year of peak impact	2200	2200	2200	2194	2194	2200	2200	2200	2275

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–56. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.42×10^{-9}	1.66×10^{-4}	1.57×10^{-9}	1.42×10^{-9}	1.93×10^{-4}	1.90×10^{-9}	1.42×10^{-9}	2.30×10^{-4}	2.41×10^{-9}
Technetium-99	9.64×10^{-7}	1.69	5.80×10^{-5}	9.64×10^{-7}	4.35	1.91×10^{-4}	9.64×10^{-7}	8.88	4.17×10^{-4}
Iodine-129	1.69×10^{-9}	4.81×10^{-1}	5.47×10^{-6}	1.69×10^{-9}	6.01×10^{-1}	8.46×10^{-6}	1.69×10^{-9}	7.76×10^{-1}	1.28×10^{-5}
Total	**N/A**	**2.17**	**6.35×10^{-5}**	**N/A**	**4.95**	**1.99×10^{-4}**	**N/A**	**9.66**	**4.30×10^{-4}**
Year of peak impact	2095	2095	2095	2095	2095	2095	2095	2095	2095
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.08×10^{-1}	1.03	0.00	1.08×10^{-1}	1.07	4.25×10^{-10}	1.08×10^{-1}	1.61	1.95×10^{-5}
Nitrate	2.21×10^{1}	3.95×10^{-1}	0.00	2.21×10^{1}	3.10	0.00	2.21×10^{1}	6.92	0.00
Total	**N/A**	**1.43**	**0.00**	**N/A**	**4.17**	**4.25×10^{-10}**	**N/A**	**8.53**	**1.95×10^{-5}**
Year of peak impact	2170	2170	N/A	2170	2170	2170	2170	2170	2170

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–57. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.47×10^{-7}	1.72×10^{-2}	1.63×10^{-7}	1.47×10^{-7}	2.00×10^{-2}	4.91×10^{-7}	1.47×10^{-7}	2.38×10^{-2}	6.23×10^{-7}
Technetium-99	3.99×10^{-6}	6.97	2.40×10^{-4}	3.99×10^{-6}	1.80×10^{1}	7.92×10^{-4}	3.99×10^{-6}	3.67×10^{1}	1.73×10^{-3}
Iodine-129	5.79×10^{-9}	1.65	1.88×10^{-5}	5.79×10^{-9}	2.06	2.57×10^{-5}	5.79×10^{-9}	2.66	3.89×10^{-5}
Uranium-238	0.00	0.00	0.00	0.00	0.00	1.31×10^{-9}	0.00	0.00	1.50×10^{-9}
Total	**N/A**	**8.64**	**2.59×10^{-4}**	**N/A**	**2.01×10^{1}**	**8.19×10^{-4}**	**N/A**	**3.94×10^{1}**	**1.77×10^{-3}**
Year of peak impact	2069	2069	2069	2069	2069	2068	2069	2069	2068

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.93×10^{-1}	1.84	0.00	1.93×10^{-1}	1.91	8.94×10^{-10}	1.93×10^{-1}	2.87	4.10×10^{-5}
Nitrate	1.92×10^{2}	3.42	0.00	1.92×10^{2}	2.69×10^{1}	0.00	1.92×10^{2}	6.00×10^{1}	0.00
Total uranium	1.27×10^{-6}	1.21×10^{-5}	0.00	1.27×10^{-6}	1.23×10^{-5}	0.00	1.27×10^{-6}	1.28×10^{-5}	0.00
Total	**N/A**	**5.26**	**0.00**	**N/A**	**2.88×10^{1}**	**8.94×10^{-10}**	**N/A**	**6.29×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2068	2068	N/A	2068	2068	2158	2068	2068	2158

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–58. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.86×10^{-8}	3.34×10^{-3}	3.17×10^{-8}	2.86×10^{-8}	3.88×10^{-3}	3.83×10^{-8}	2.86×10^{-8}	4.63×10^{-3}	4.85×10^{-8}
Technetium-99	1.54×10^{-6}	2.69	9.26×10^{-5}	1.54×10^{-6}	6.94	3.05×10^{-4}	1.54×10^{-6}	1.42×10^{1}	6.66×10^{-4}
Iodine-129	2.83×10^{-9}	8.07×10^{-1}	9.18×10^{-6}	2.83×10^{-9}	1.01	1.42×10^{-5}	2.83×10^{-9}	1.30	2.15×10^{-5}
Total	**N/A**	**3.50**	$\mathbf{1.02\times10^{-4}}$	**N/A**	**7.95**	$\mathbf{3.19\times10^{-4}}$	**N/A**	$\mathbf{1.55\times10^{1}}$	$\mathbf{6.88\times10^{-4}}$
Year of peak impact	2051	2051	2051	2051	2051	2051	2051	2051	2051
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.57×10^{-1}	1.49	0.00	1.57×10^{-1}	1.55	6.15×10^{-10}	1.57×10^{-1}	2.33	2.82×10^{-5}
Nitrate	4.70	8.40×10^{-2}	0.00	4.70	6.60×10^{-1}	0.00	4.70	1.47	0.00
Total	**N/A**	**1.58**	**0.00**	**N/A**	**2.21**	$\mathbf{6.15\times10^{-10}}$	**N/A**	**3.80**	$\mathbf{2.82\times10^{-5}}$
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–59. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.50×10^{-6}	1.75×10^{-1}	1.66×10^{-6}	1.50×10^{-6}	2.04×10^{-1}	2.01×10^{-6}	1.50×10^{-6}	2.43×10^{-1}	2.55×10^{-6}
Technetium-99	6.48×10^{-6}	1.13×10^{1}	3.90×10^{-4}	6.48×10^{-6}	2.92×10^{1}	1.28×10^{-3}	6.48×10^{-6}	5.97×10^{1}	2.81×10^{-3}
Iodine-129	1.27×10^{-8}	3.61	4.11×10^{-5}	1.27×10^{-8}	4.51	6.35×10^{-5}	1.27×10^{-8}	5.83	9.60×10^{-5}
Uranium-238	1.51×10^{-11}	1.88×10^{-3}	2.12×10^{-8}	1.51×10^{-11}	1.95×10^{-3}	2.29×10^{-8}	1.51×10^{-11}	2.10×10^{-3}	2.60×10^{-8}
Total	**N/A**	**1.51×10^{1}**	**4.33×10^{-4}**	**N/A**	**3.39×10^{1}**	**1.35×10^{-3}**	**N/A**	**6.58×10^{1}**	**2.90×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.37×10^{-1}	3.21	0.00	3.37×10^{-1}	3.33	1.34×10^{-9}	3.37×10^{-1}	5.00	6.15×10^{-5}
Nitrate	6.23×10^{1}	1.11	0.00	6.23×10^{1}	8.75	0.00	6.23×10^{1}	1.95×10^{1}	0.00
Total uranium	2.28×10^{-5}	2.17×10^{-4}	0.00	2.28×10^{-5}	2.21×10^{-4}	0.00	2.28×10^{-5}	2.31×10^{-4}	0.00
Total	**N/A**	**4.32**	**0.00**	**N/A**	**1.21×10^{1}**	**1.34×10^{-9}**	**N/A**	**2.45×10^{1}**	**6.15×10^{-5}**
Year of peak impact	2053	2053	N/A	2053	2053	2051	2053	2053	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–60. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.89×10^{-9}	3.38×10^{-4}	3.21×10^{-9}	2.89×10^{-9}	3.93×10^{-4}	3.87×10^{-9}	2.89×10^{-9}	4.68×10^{-4}	4.91×10^{-9}
Technetium-99	5.08×10^{-7}	8.89×10^{-1}	3.06×10^{-5}	5.08×10^{-7}	2.29	1.01×10^{-4}	5.08×10^{-7}	4.68	2.20×10^{-4}
Iodine-129	8.75×10^{-10}	2.49×10^{-1}	2.84×10^{-6}	8.75×10^{-10}	3.12×10^{-1}	4.38×10^{-6}	8.75×10^{-10}	4.03×10^{-1}	6.63×10^{-6}
Total	**N/A**	**1.14**	**3.34×10^{-5}**	**N/A**	**2.60**	**1.05×10^{-4}**	**N/A**	**5.08**	**2.27×10^{-4}**
Year of peak impact	2100	2100	2100	2100	2100	2100	2100	2100	2100
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.50×10^{-2}	1.43×10^{-1}	0.00	1.45×10^{-2}	1.43×10^{-1}	5.90×10^{-11}	1.45×10^{-2}	2.15×10^{-1}	2.71×10^{-6}
Nitrate	5.64	1.01×10^{-1}	0.00	5.69	7.98×10^{-1}	0.00	5.69	1.78	0.00
Total	**N/A**	**2.44×10^{-1}**	**0.00**	**N/A**	**9.41×10^{-1}**	**5.90×10^{-11}**	**N/A**	**2.00**	**2.71×10^{-6}**
Year of peak impact	2092	2092	N/A	2099	2099	2092	2099	2099	2092

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–61. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.47×10^{-7}	1.72×10^{-2}	1.63×10^{-7}	1.47×10^{-7}	2.00×10^{-2}	4.91×10^{-7}	1.47×10^{-7}	2.38×10^{-2}	6.23×10^{-7}
Technetium-99	3.99×10^{-6}	6.97	2.40×10^{-4}	3.99×10^{-6}	1.80×10^{1}	7.92×10^{-4}	3.99×10^{-6}	3.67×10^{1}	1.73×10^{-3}
Iodine-129	5.79×10^{-9}	1.65	1.88×10^{-5}	5.79×10^{-9}	2.06	2.57×10^{-5}	5.79×10^{-9}	2.66	3.89×10^{-5}
Uranium-238	0.00	0.00	0.00	0.00	0.00	1.31×10^{-9}	0.00	0.00	1.50×10^{-9}
Total	**N/A**	**8.64**	**2.59×10^{-4}**	**N/A**	**2.01×10^{1}**	**8.19×10^{-4}**	**N/A**	**3.94×10^{1}**	**1.77×10^{-3}**
Year of peak impact	2069	2069	2069	2069	2069	2068	2069	2069	2068

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.93×10^{-1}	1.84	0.00	1.93×10^{-1}	1.91	8.94×10^{-10}	1.93×10^{-1}	2.87	4.10×10^{-5}
Nitrate	1.92×10^{2}	3.42	0.00	1.92×10^{2}	2.69×10^{1}	0.00	1.92×10^{2}	6.00×10^{1}	0.00
Total uranium	1.27×10^{-6}	1.21×10^{-5}	0.00	1.27×10^{-6}	1.23×10^{-5}	0.00	1.27×10^{-6}	1.28×10^{-5}	0.00
Total	**N/A**	**5.26**	**0.00**	**N/A**	**2.88×10^{1}**	**8.94×10^{-10}**	**N/A**	**6.29×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2068	2068	N/A	2068	2068	2158	2068	2068	2158

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–62. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.18×10^{-7}	7.31×10^{-1}	2.52×10^{-5}	4.18×10^{-7}	1.88	8.27×10^{-5}	4.18×10^{-7}	3.85	1.81×10^{-4}
Iodine-129	7.38×10^{-10}	2.10×10^{-1}	2.39×10^{-6}	7.38×10^{-10}	2.63×10^{-1}	3.70×10^{-6}	7.38×10^{-10}	3.39×10^{-1}	5.59×10^{-6}
Total	**N/A**	**9.41×10^{-1}**	**2.75×10^{-5}**	**N/A**	**2.15**	**8.64×10^{-5}**	**N/A**	**4.19**	**1.87×10^{-4}**
Year of peak impact	2317	2317	2317	2317	2317	2317	2317	2317	2317
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.44×10^{-2}	7.08×10^{-1}	0.00	7.44×10^{-2}	7.34×10^{-1}	2.92×10^{-10}	7.44×10^{-2}	1.10	1.34×10^{-5}
Nitrate	1.69×10^{1}	3.02×10^{-1}	0.00	1.69×10^{1}	2.38	0.00	1.69×10^{1}	5.30	0.00
Total	**N/A**	**1.01**	**0.00**	**N/A**	**3.11**	**2.92×10^{-10}**	**N/A**	**6.40**	**1.34×10^{-5}**
Year of peak impact	2079	2079	N/A	2079	2079	2079	2079	2079	2079

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–63. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.04×10^{-11}	4.70×10^{-5}	2.06×10^{-9}	1.04×10^{-11}	1.08×10^{-4}	5.15×10^{-9}	4.18×10^{-7}	1.26×10^{-2}	6.73×10^{-7}
Iodine-129	1.85×10^{-14}	6.62×10^{-6}	9.33×10^{-11}	1.85×10^{-14}	1.01×10^{-4}	2.43×10^{-9}	7.38×10^{-10}	2.69×10^{-3}	6.59×10^{-8}
Total	**N/A**	**5.37×10^{-5}**	**2.16×10^{-9}**	**N/A**	**2.10×10^{-4}**	**7.58×10^{-9}**	**N/A**	**1.53×10^{-2}**	**7.39×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2317	2317	2317

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.05×10^{-6}	1.04×10^{-5}	4.13×10^{-15}	1.05×10^{-6}	1.70×10^{-5}	1.89×10^{-10}	7.44×10^{-2}	3.27×10^{-1}	1.34×10^{-5}
Nitrate	3.55×10^{-4}	5.37×10^{-5}	0.00	3.55×10^{-4}	3.34×10^{-2}	0.00	1.69×10^{1}	7.32×10^{-1}	0.00
Total	**N/A**	**6.41×10^{-5}**	**4.13×10^{-15}**	**N/A**	**3.34×10^{-2}**	**1.89×10^{-10}**	**N/A**	**1.06**	**1.34×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2079	2079	2079

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

The dose standard would be exceeded at the B Barrier, T Barrier, and Core Zone Boundary for the drinking-water well user, resident farmer, and American Indian resident farmer due to the presence of tritium, technetium-99, and iodine-129 released from the cribs and trenches (ditches), but would not be exceeded at the other locations. The Hazard Index guideline would be exceeded at the B Barrier, T Barrier, Core Zone Boundary, and Columbia River nearshore location for the same receptors due primarily to release of chromium and nitrate from the cribs and trenches (ditches). The Hazard Index guideline would also be exceeded for the American Indian hunter-gatherer located near the Columbia River.

The dose standard would be exceeded at the T Barrier for the American Indian resident farmer due to the presence of tritium, technetium-99, and iodine-129 released from past leaks. The Hazard Index guideline would be exceeded for the drinking-water well user at the S Barrier and T Barrier and for the resident farmer and American Indian resident farmer at the A Barrier, B Barrier, S Barrier, T Barrier, and the Core Zone Boundary due primarily to release of chromium and nitrate from past leaks.

After CY 2050, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the A Barrier, B Barrier, S Barrier, T Barrier, Core Zone Boundary, and Columbia River nearshore for the drinking-water well user, resident farmer, and the American Indian resident farmer due primarily to chromium, nitrate, and total uranium. In addition, the Hazard Index guideline would be exceeded for the American Indian hunter-gatherer located near the Columbia River. Population dose is estimated as 2.68×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–3 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2300 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. For the period of time between CYs 2650 and 4950, peak radiological risk is due to other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 2090 and is dominated by tritium, technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

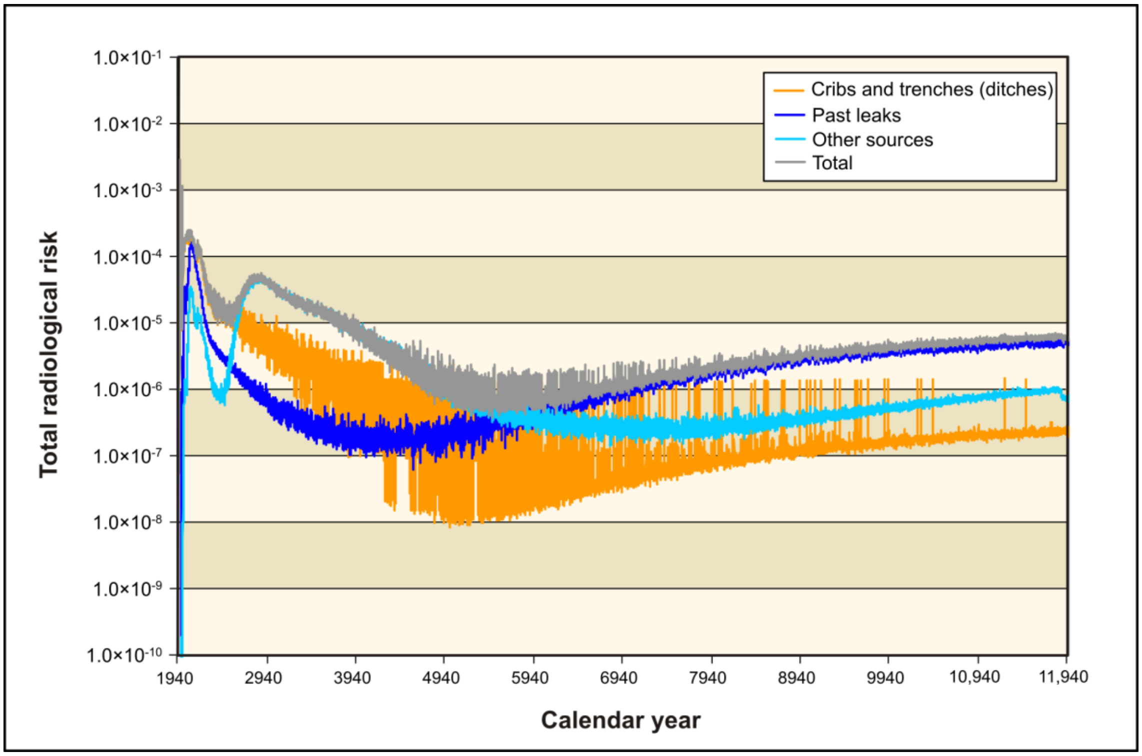


Figure Q–3. Tank Closure Alternative 2A Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.3 Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C

Activities under Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C would be similar to those under Tank Closure Alternative 2A, except that residual material in tanks would be stabilized in place. Soil would be removed down to 4.6 meters (15 feet) for the BX and SX tank farms and replaced with clean soils from onsite sources. The tank farms and six sets of adjacent cribs and trenches (ditches) would be covered with an engineered, modified Resource Conservation and Recovery Act (RCRA) Subtitle C barrier.

Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–64 through Q–68; to past leaks after CY 1940, in Tables Q–69 through Q–76; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after the year 2050, in Tables Q–77 through Q–84.

The risk and hazard drivers are tritium, technetium-99, iodine-129, uranium-238, chromium, nitrate, and total uranium. Impacts would be slightly less than those under Alternative 2A, and standards would be exceeded, as under Alternative 2A. Prior to CY 2050, exceedances of both radioactive and chemical constituent standards are due primarily to releases from cribs and trenches (ditches). Following CY 2050, exceedances of radiological standards are not projected to occur, but exceedances of standards for chemical constituents are expected to occur. Population dose is estimated as 2.51×10^{-1} person-rem per year for the year of maximum impact.

Table Q–64. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	$\mathbf{1.50\times10^{2}}$	$\mathbf{2.91\times10^{-3}}$	**N/A**	$\mathbf{2.58\times10^{2}}$	$\mathbf{7.78\times10^{-3}}$	**N/A**	$\mathbf{4.39\times10^{2}}$	$\mathbf{1.60\times10^{-2}}$
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	$\mathbf{8.96\times10^{1}}$	**0.00**	**N/A**	$\mathbf{3.25\times10^{2}}$	$\mathbf{2.41\times10^{-8}}$	**N/A**	$\mathbf{7.04\times10^{2}}$	$\mathbf{1.11\times10^{-3}}$
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–65. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–66. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–67. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–68. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–69. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.90×10^{-7}	2.23×10^{-2}	2.11×10^{-7}	1.90×10^{-7}	2.59×10^{-2}	2.55×10^{-7}	1.90×10^{-7}	3.08×10^{-2}	3.23×10^{-7}
Technetium-99	1.40×10^{-6}	2.44	8.40×10^{-5}	1.40×10^{-6}	6.30	2.76×10^{-4}	1.40×10^{-6}	1.29×10^{1}	6.04×10^{-4}
Iodine-129	5.45×10^{-10}	1.55×10^{-1}	1.76×10^{-6}	5.45×10^{-10}	1.94×10^{-1}	2.73×10^{-6}	5.45×10^{-10}	2.51×10^{-1}	4.13×10^{-6}
Total	**N/A**	**2.62**	**8.60×10^{-5}**	**N/A**	**6.52**	**2.79×10^{-4}**	**N/A**	**1.31×10^{1}**	**6.09×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.58×10^{-2}	6.26×10^{-1}	0.00	6.58×10^{-2}	6.49×10^{-1}	2.58×10^{-10}	6.58×10^{-2}	9.77×10^{-1}	1.18×10^{-5}
Nitrate	2.13	3.81×10^{-2}	0.00	2.13	2.99×10^{-1}	0.00	2.13	6.67×10^{-1}	0.00
Total	**N/A**	**6.64×10^{-1}**	**0.00**	**N/A**	**9.49×10^{-1}**	**2.58×10^{-10}**	**N/A**	**1.64**	**1.18×10^{-5}**
Year of peak impact	2104	2104	N/A	2104	2104	2104	2104	2104	2104

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–70. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.02×10^{-9}	2.36×10^{-4}	2.24×10^{-9}	2.02×10^{-9}	2.75×10^{-4}	2.71×10^{-9}	2.02×10^{-9}	3.27×10^{-4}	3.43×10^{-9}
Technetium-99	1.55×10^{-6}	2.71	9.34×10^{-5}	1.55×10^{-6}	7.00	3.07×10^{-4}	1.55×10^{-6}	1.43×10^{1}	6.72×10^{-4}
Iodine-129	2.72×10^{-9}	7.76×10^{-1}	8.82×10^{-6}	2.72×10^{-9}	9.69×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.49**	**1.02×10^{-4}**	**N/A**	**7.96**	**3.21×10^{-4}**	**N/A**	**1.55×10^{1}**	**6.92×10^{-4}**
Year of peak impact	2084	2084	2084	2084	2084	2084	2084	2084	2084

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.83×10^{-2}	5.55×10^{-1}	0.00	5.78×10^{-2}	5.71×10^{-1}	2.29×10^{-10}	5.06×10^{-2}	7.52×10^{-1}	1.05×10^{-5}
Nitrate	2.54	4.54×10^{-2}	0.00	2.68	3.76×10^{-1}	0.00	3.03	9.49×10^{-1}	0.00
Total	**N/A**	**6.01×10^{-1}**	**0.00**	**N/A**	**9.47×10^{-1}**	**2.29×10^{-10}**	**N/A**	**1.70**	**1.05×10^{-5}**
Year of peak impact	2104	2104	N/A	2097	2097	2104	2095	2095	2104

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–71. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.58×10^{-7}	1.85×10^{-2}	1.75×10^{-7}	1.58×10^{-7}	2.15×10^{-2}	2.12×10^{-7}	1.58×10^{-7}	2.56×10^{-2}	2.69×10^{-7}
Technetium-99	2.48×10^{-6}	4.33	1.49×10^{-4}	2.48×10^{-6}	1.12×10^{1}	4.90×10^{-4}	2.48×10^{-6}	2.28×10^{1}	1.07×10^{-3}
Iodine-129	4.58×10^{-9}	1.30	1.48×10^{-5}	4.58×10^{-9}	1.63	2.29×10^{-5}	4.58×10^{-9}	2.11	3.47×10^{-5}
Total	**N/A**	**5.65**	**1.64×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.13×10^{-4}**	**N/A**	**2.49×10^{1}**	**1.11×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.47×10^{-1}	2.35	0.00	2.47×10^{-1}	2.44	9.68×10^{-10}	2.47×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.03	1.26×10^{-1}	0.00	7.03	9.88×10^{-1}	0.00	7.03	2.20	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.42**	**9.68×10^{-10}**	**N/A**	**5.87**	**4.44×10^{-5}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2032	2032	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–72. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.07×10^{-6}	2.42×10^{-1}	2.30×10^{-6}	2.07×10^{-6}	2.82×10^{-1}	2.78×10^{-6}	2.07×10^{-6}	3.36×10^{-1}	3.52×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.34×10^{-4}	1.05×10^{-5}	4.75×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.70×10^{1}	4.56×10^{-3}
Iodine-129	2.00×10^{-8}	5.70	6.48×10^{-5}	2.00×10^{-8}	7.12	1.00×10^{-4}	2.00×10^{-8}	9.20	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.01×10^{-4}**	**N/A**	**5.49×10^{1}**	**2.19×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.03×10^{-1}	2.88	0.00	3.03×10^{-1}	2.99	1.19×10^{-9}	3.03×10^{-1}	4.50	5.46×10^{-5}
Nitrate	2.41×10^{1}	4.30×10^{-1}	0.00	2.41×10^{1}	3.38	0.00	2.41×10^{1}	7.53	0.00
Total	**N/A**	**3.31**	**0.00**	**N/A**	**6.37**	**1.19×10^{-9}**	**N/A**	**1.20×10^{1}**	**5.46×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–73. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.49×10^{-8}	1.74×10^{-3}	1.65×10^{-8}	1.49×10^{-8}	2.03×10^{-3}	2.00×10^{-8}	1.49×10^{-8}	2.41×10^{-3}	2.53×10^{-8}
Technetium-99	1.29×10^{-7}	2.26×10^{-1}	7.79×10^{-6}	1.29×10^{-7}	5.84×10^{-1}	2.56×10^{-5}	1.29×10^{-7}	1.19	5.60×10^{-5}
Iodine-129	1.55×10^{-10}	4.41×10^{-2}	5.02×10^{-7}	1.55×10^{-10}	5.51×10^{-2}	7.76×10^{-7}	1.55×10^{-10}	7.12×10^{-2}	1.17×10^{-6}
Total	**N/A**	**2.72×10^{-1}**	**8.31×10^{-6}**	**N/A**	**6.41×10^{-1}**	**2.64×10^{-5}**	**N/A**	**1.27**	**5.72×10^{-5}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.16×10^{-3}	5.86×10^{-2}	0.00	6.16×10^{-3}	6.08×10^{-2}	2.42×10^{-11}	5.99×10^{-3}	8.90×10^{-2}	1.11×10^{-6}
Nitrate	4.28×10^{-1}	7.64×10^{-3}	0.00	4.28×10^{-1}	6.01×10^{-2}	0.00	4.38×10^{-1}	1.37×10^{-1}	0.00
Total	**N/A**	**6.63×10^{-2}**	**0.00**	**N/A**	**1.21×10^{-1}**	**2.42×10^{-11}**	**N/A**	**2.26×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2041	2041	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–74. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.82×10^{-9}	4.47×10^{-4}	4.24×10^{-9}	3.82×10^{-9}	5.19×10^{-4}	5.12×10^{-9}	3.82×10^{-9}	6.19×10^{-4}	6.49×10^{-9}
Technetium-99	1.55×10^{-6}	2.71	9.34×10^{-5}	1.55×10^{-6}	7.00	3.07×10^{-4}	1.55×10^{-6}	1.43×10^{1}	6.72×10^{-4}
Iodine-129	2.72×10^{-9}	7.76×10^{-1}	8.82×10^{-6}	2.72×10^{-9}	9.69×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.49**	**1.02×10^{-4}**	**N/A**	**7.96**	**3.21×10^{-4}**	**N/A**	**1.55×10^{1}**	**6.92×10^{-4}**
Year of peak impact	2084	2084	2084	2084	2084	2084	2084	2084	2084

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.81×10^{-2}	7.44×10^{-1}	0.00	7.38×10^{-2}	7.29×10^{-1}	3.07×10^{-10}	7.38×10^{-2}	1.10	1.41×10^{-5}
Nitrate	2.63	4.69×10^{-2}	0.00	3.03	4.26×10^{-1}	0.00	3.03	9.49×10^{-1}	0.00
Total	**N/A**	**7.90×10^{-1}**	**0.00**	**N/A**	**1.15**	**3.07×10^{-10}**	**N/A**	**2.05**	**1.41×10^{-5}**
Year of peak impact	2105	2105	N/A	2095	2095	2105	2095	2095	2105

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–75. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.58×10^{-7}	6.27×10^{-1}	2.17×10^{-5}	3.61×10^{-7}	1.63	7.15×10^{-5}	3.61×10^{-7}	3.33	1.56×10^{-4}
Iodine-129	6.26×10^{-10}	1.78×10^{-1}	1.96×10^{-6}	6.04×10^{-10}	2.15×10^{-1}	3.03×10^{-6}	6.04×10^{-10}	2.78×10^{-1}	4.58×10^{-6}
Total	**N/A**	**8.05×10^{-1}**	**2.37×10^{-5}**	**N/A**	**1.84**	**7.45×10^{-5}**	**N/A**	**3.60**	**1.61×10^{-4}**
Year of peak impact	2242	2242	2228	2228	2228	2228	2228	2228	2228

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.49×10^{-3}	7.13×10^{-2}	0.00	7.22×10^{-3}	7.13×10^{-2}	2.94×10^{-11}	6.72×10^{-3}	9.99×10^{-2}	1.35×10^{-6}
Nitrate	5.84×10^{-1}	1.04×10^{-2}	0.00	6.14×10^{-1}	8.61×10^{-2}	0.00	6.48×10^{-1}	2.03×10^{-1}	0.00
Total	**N/A**	**8.18×10^{-2}**	**0.00**	**N/A**	**1.57×10^{-1}**	**2.94×10^{-11}**	**N/A**	**3.03×10^{-1}**	**1.35×10^{-6}**
Year of peak impact	2253	2253	N/A	2266	2266	2253	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–76. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.49×10^{-12}	3.38×10^{-5}	1.48×10^{-9}	7.42×10^{-12}	7.72×10^{-5}	3.70×10^{-9}	3.61×10^{-7}	1.09×10^{-2}	5.82×10^{-7}
Iodine-129	1.41×10^{-14}	5.05×10^{-6}	7.11×10^{-11}	1.43×10^{-14}	7.79×10^{-5}	1.85×10^{-9}	6.04×10^{-10}	2.28×10^{-3}	5.60×10^{-8}
Total	**N/A**	**3.88×10^{-5}**	**1.55×10^{-9}**	**N/A**	**1.55×10^{-4}**	**5.55×10^{-9}**	**N/A**	**1.32×10^{-2}**	**6.38×10^{-7}**
Year of peak impact	2180	2180	2180	2189	2189	2180	2228	2228	2228
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.88×10^{-7}	2.85×10^{-6}	1.15×10^{-15}	2.66×10^{-7}	4.30×10^{-6}	5.27×10^{-11}	6.72×10^{-3}	2.96×10^{-2}	1.35×10^{-6}
Nitrate	1.56×10^{-5}	2.36×10^{-6}	0.00	1.57×10^{-5}	1.48×10^{-3}	0.00	6.48×10^{-1}	3.39×10^{-2}	0.00
Total	**N/A**	**5.21×10^{-6}**	**1.15×10^{-15}**	**N/A**	**1.48×10^{-3}**	**5.27×10^{-11}**	**N/A**	**6.35×10^{-2}**	**1.35×10^{-6}**
Year of peak impact	2192	2192	2204	2184	2184	2204	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–77. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.76×10^{-10}	9.08×10^{-5}	8.62×10^{-10}	7.76×10^{-10}	1.06×10^{-4}	1.04×10^{-9}	7.76×10^{-10}	1.26×10^{-4}	1.32×10^{-9}
Technetium-99	7.74×10^{-7}	1.35	4.66×10^{-5}	7.74×10^{-7}	3.49	1.53×10^{-4}	7.74×10^{-7}	7.13	3.35×10^{-4}
Iodine-129	1.34×10^{-9}	3.80×10^{-1}	4.33×10^{-6}	1.34×10^{-9}	4.75×10^{-1}	6.69×10^{-6}	1.34×10^{-9}	6.14×10^{-1}	1.01×10^{-5}
Total	**N/A**	**1.74**	**5.09×10^{-5}**	**N/A**	**3.97**	**1.60×10^{-4}**	**N/A**	**7.74**	**3.45×10^{-4}**
Year of peak impact	2102	2102	2102	2102	2102	2102	2102	2102	2102
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.09×10^{-2}	7.71×10^{-1}	0.00	6.65×10^{-2}	6.56×10^{-1}	3.18×10^{-10}	6.65×10^{-2}	9.88×10^{-1}	1.46×10^{-5}
Nitrate	1.56×10^{1}	2.78×10^{-1}	0.00	1.79×10^{1}	2.51	0.00	1.79×10^{1}	5.60	0.00
Total	**N/A**	**1.05**	**0.00**	**N/A**	**3.17**	**3.18×10^{-10}**	**N/A**	**6.59**	**1.46×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–78. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.31×10^{-7}	2.70×10^{-2}	2.56×10^{-7}	2.31×10^{-7}	3.14×10^{-2}	3.09×10^{-7}	2.31×10^{-7}	3.74×10^{-2}	3.92×10^{-7}
Technetium-99	3.57×10^{-6}	6.25	2.15×10^{-4}	3.57×10^{-6}	1.61×10^{1}	7.07×10^{-4}	3.57×10^{-6}	3.29×10^{1}	1.55×10^{-3}
Iodine-129	4.49×10^{-9}	1.28	1.45×10^{-5}	4.49×10^{-9}	1.60	2.25×10^{-5}	4.49×10^{-9}	2.06	3.40×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.55**	**2.30×10^{-4}**	**N/A**	**1.77×10^{1}**	**7.30×10^{-4}**	**N/A**	**3.50×10^{1}**	**1.58×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.74×10^{-1}	1.72	8.44×10^{-10}	1.74×10^{-1}	2.58	3.87×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	**2.57×10^{1}**	**8.44×10^{-10}**	**N/A**	**5.62×10^{1}**	**3.87×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–79. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	3.01×10^{-8}	3.52×10^{-3}	3.34×10^{-8}	3.01×10^{-8}	4.09×10^{-3}	4.03×10^{-8}	3.01×10^{-8}	4.87×10^{-3}	5.11×10^{-8}
Technetium-99	1.51×10^{-6}	2.64	9.08×10^{-5}	1.51×10^{-6}	6.80	2.99×10^{-4}	1.51×10^{-6}	1.39×10^{1}	6.53×10^{-4}
Iodine-129	2.75×10^{-9}	7.85×10^{-1}	8.92×10^{-6}	2.75×10^{-9}	9.80×10^{-1}	1.38×10^{-5}	2.75×10^{-9}	1.27	2.09×10^{-5}
Total	**N/A**	**3.43**	**9.97×10^{-5}**	**N/A**	**7.79**	**3.12×10^{-4}**	**N/A**	**1.52×10^{1}**	**6.74×10^{-4}**
Year of peak impact	2051	2051	2051	2051	2051	2051	2051	2051	2051
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.56×10^{-1}	1.49	0.00	1.56×10^{-1}	1.54	6.14×10^{-10}	1.56×10^{-1}	2.32	2.81×10^{-5}
Nitrate	4.78	8.53×10^{-2}	0.00	4.78	6.71×10^{-1}	0.00	4.78	1.50	0.00
Total	**N/A**	**1.57**	**0.00**	**N/A**	**2.21**	**6.14×10^{-10}**	**N/A**	**3.82**	**2.81×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–80. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.59×10^{-6}	1.15×10^{1}	3.97×10^{-4}	6.59×10^{-6}	2.97×10^{1}	1.31×10^{-3}	6.59×10^{-6}	6.07×10^{1}	2.86×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.49	6.32×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.55×10^{1}**	**4.41×10^{-4}**	**N/A**	**3.46×10^{1}**	**1.37×10^{-3}**	**N/A**	**6.70×10^{1}**	**2.96×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.53×10^{-1}	3.36	0.00	3.53×10^{-1}	3.49	1.39×10^{-9}	3.53×10^{-1}	5.25	6.36×10^{-5}
Nitrate	6.20×10^{1}	1.11	0.00	6.20×10^{1}	8.70	0.00	6.20×10^{1}	1.94×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.47**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.36×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2045	2051	2051	2045

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–81. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.59×10^{-7}	4.53×10^{-1}	1.56×10^{-5}	2.59×10^{-7}	1.17	5.13×10^{-5}	2.59×10^{-7}	2.38	1.12×10^{-4}
Iodine-129	2.33×10^{-10}	6.64×10^{-2}	7.55×10^{-7}	2.33×10^{-10}	8.30×10^{-2}	1.17×10^{-6}	2.33×10^{-10}	1.07×10^{-1}	1.77×10^{-6}
Total	**N/A**	**5.20×10^{-1}**	**1.63×10^{-5}**	**N/A**	**1.25**	**5.24×10^{-5}**	**N/A**	**2.49**	**1.14×10^{-4}**
Year of peak impact	3296	3296	3296	3296	3296	3296	3296	3296	3296

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.76×10^{-3}	5.48×10^{-2}	0.00	4.90×10^{-3}	4.84×10^{-2}	2.30×10^{-11}	4.90×10^{-3}	7.28×10^{-2}	1.06×10^{-6}
Nitrate	7.01×10^{-1}	1.25×10^{-2}	0.00	9.09×10^{-1}	1.28×10^{-1}	0.00	9.09×10^{-1}	2.85×10^{-1}	0.00
Total	**N/A**	**6.73×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**2.30×10^{-11}**	**N/A**	**3.57×10^{-1}**	**1.06×10^{-6}**
Year of peak impact	2056	2056	N/A	2071	2071	2050	2071	2071	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–82. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	5.27×10^{-7}	4.75×10^{-7}	6.46×10^{-2}	6.37×10^{-7}	4.75×10^{-7}	7.70×10^{-2}	8.08×10^{-7}
Technetium-99	3.57×10^{-6}	6.25	2.15×10^{-4}	3.57×10^{-6}	1.61×10^{1}	7.07×10^{-4}	3.57×10^{-6}	3.29×10^{1}	1.55×10^{-3}
Iodine-129	4.49×10^{-9}	1.28	1.45×10^{-5}	4.49×10^{-9}	1.60	2.25×10^{-5}	4.49×10^{-9}	2.06	3.40×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.58**	$\mathbf{2.30\times10^{-4}}$	**N/A**	$\mathbf{1.78\times10^{1}}$	$\mathbf{7.30\times10^{-4}}$	**N/A**	$\mathbf{3.50\times10^{1}}$	$\mathbf{1.58\times10^{-3}}$
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.74×10^{-1}	1.72	8.44×10^{-10}	1.74×10^{-1}	2.58	3.87×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	$\mathbf{2.57\times10^{1}}$	$\mathbf{8.44\times10^{-10}}$	**N/A**	$\mathbf{5.62\times10^{1}}$	$\mathbf{3.87\times10^{-5}}$
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–83. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.90×10^{-11}	2.22×10^{-6}	1.07×10^{-11}	9.64×10^{-12}	1.31×10^{-6}	1.29×10^{-11}	9.64×10^{-12}	1.56×10^{-6}	1.64×10^{-11}
Technetium-99	3.93×10^{-7}	6.88×10^{-1}	2.38×10^{-5}	3.96×10^{-7}	1.79	7.84×10^{-5}	3.96×10^{-7}	3.65	1.71×10^{-4}
Iodine-129	6.93×10^{-10}	1.98×10^{-1}	2.19×10^{-6}	6.76×10^{-10}	2.41×10^{-1}	3.39×10^{-6}	6.76×10^{-10}	3.11×10^{-1}	5.13×10^{-6}
Total	**N/A**	**8.85×10^{-1}**	**2.60×10^{-5}**	**N/A**	**2.03**	**8.18×10^{-5}**	**N/A**	**3.96**	**1.77×10^{-4}**
Year of peak impact	2242	2242	2254	2254	2254	2254	2254	2254	2254
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.09×10^{-2}	6.75×10^{-1}	0.00	7.09×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.09×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–84. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	0.00	0.00	0.00	0.00	0.00	0.00	1.90×10^{-11}	1.21×10^{-7}	1.13×10^{-12}
Technetium-99	9.81×10^{-12}	4.42×10^{-5}	1.94×10^{-9}	9.81×10^{-12}	1.02×10^{-4}	4.84×10^{-9}	3.93×10^{-7}	1.19×10^{-2}	6.38×10^{-7}
Iodine-129	1.68×10^{-14}	5.98×10^{-6}	8.43×10^{-11}	1.68×10^{-14}	9.13×10^{-5}	2.19×10^{-9}	6.93×10^{-10}	2.60×10^{-3}	6.17×10^{-8}
Total	**N/A**	**5.02×10^{-5}**	**2.03×10^{-9}**	**N/A**	**1.93×10^{-4}**	**7.04×10^{-9}**	**N/A**	**1.45×10^{-2}**	**6.99×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2242	2242	2254

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.79×10^{-7}	9.67×10^{-6}	3.85×10^{-15}	9.79×10^{-7}	1.59×10^{-5}	1.76×10^{-10}	7.09×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.17×10^{-4}	4.80×10^{-5}	0.00	3.17×10^{-4}	2.99×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.77×10^{-5}**	**3.85×10^{-15}**	**N/A**	**2.99×10^{-2}**	**1.76×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figure Q–4 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g. tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2080 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. For the period of time between CYs 2900 and 7000, peak radiological risk is due to other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by tritium, technetium-99, and iodine-129.

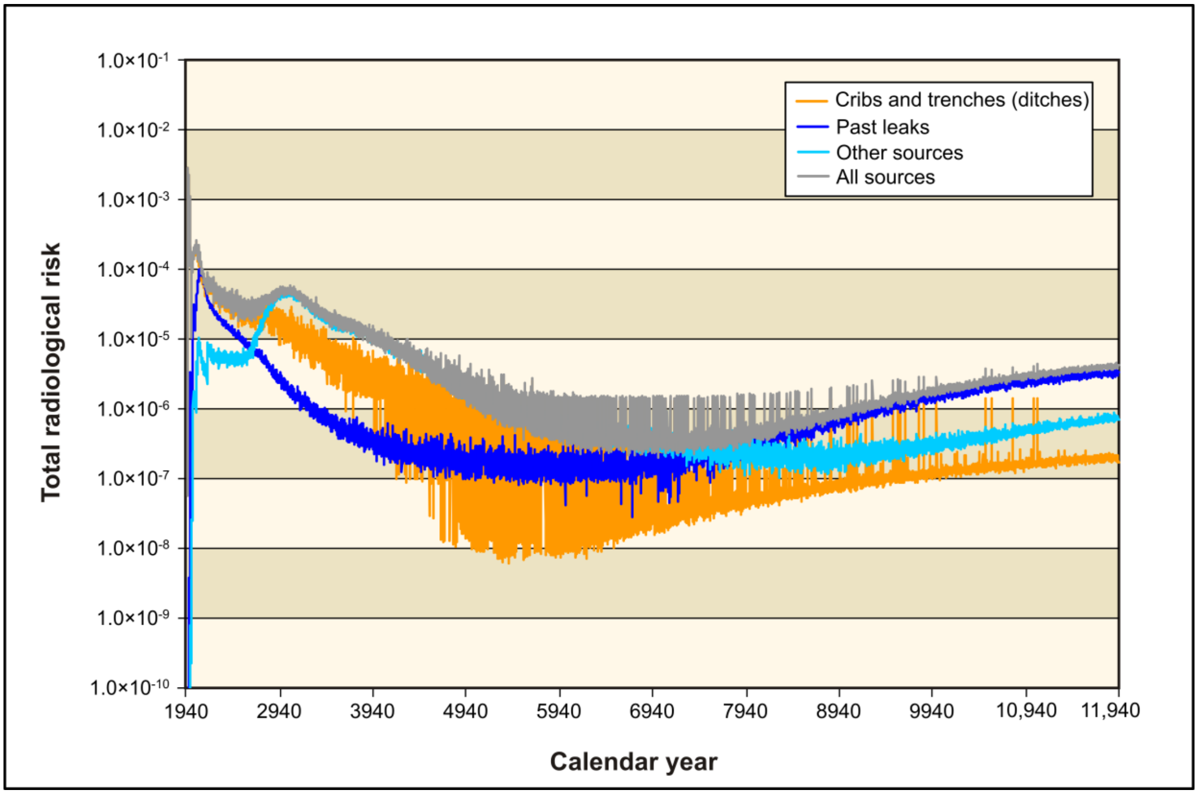


Figure Q–4. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Estimates of peak impacts for sources comprising unplanned releases, retrieval leaks, and releases from ancillary equipment and tank residuals are presented in Tables Q–85 through Q–115. In addition, the time series of radiological risk for the drinking-water well user at the Core Zone Boundary from these types of releases is presented in Figure Q–5. Exceedances of the radiological standard are not projected for these sources. Exceedances of chemical constituent standards are also not projected, except for the American Indian resident farmer at the A Barrier due to retrieval leaks. The peak radiological risk for the drinking-water well user at the Core Zone Boundary of approximately 3×10^{-5} is projected to occur around CY 2940 due primarily to releases from tank residuals. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

Table Q–85. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.88×10^{-8}	6.79×10^{-2}	2.34×10^{-6}	3.88×10^{-8}	1.75×10^{-1}	7.69×10^{-6}	3.88×10^{-8}	3.58×10^{-1}	1.68×10^{-5}
Iodine-129	1.78×10^{-11}	5.07×10^{-3}	5.76×10^{-8}	1.78×10^{-11}	6.33×10^{-3}	8.91×10^{-8}	1.78×10^{-11}	8.18×10^{-3}	1.35×10^{-7}
Total	**N/A**	**7.30×10^{-2}**	**2.39×10^{-6}**	**N/A**	**1.81×10^{-1}**	**7.78×10^{-6}**	**N/A**	**3.66×10^{-1}**	**1.69×10^{-5}**
Year of peak impact	2901	2901	2901	2901	2901	2901	2901	2901	2901

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.04×10^{-3}	9.88×10^{-3}	0.00	1.04×10^{-3}	1.02×10^{-2}	4.24×10^{-12}	1.04×10^{-3}	1.54×10^{-2}	1.94×10^{-7}
Nitrate	3.63×10^{-1}	6.47×10^{-3}	0.00	3.63×10^{-1}	5.09×10^{-2}	0.00	3.63×10^{-1}	1.14×10^{-1}	0.00
Total	**N/A**	**1.64×10^{-2}**	**0.00**	**N/A**	**6.12×10^{-2}**	**4.24×10^{-12}**	**N/A**	**1.29×10^{-1}**	**1.94×10^{-7}**
Year of peak impact	2038	2038	N/A	2038	2038	2032	3648	2038	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–86. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.06×10^{-13}	3.61×10^{-7}	1.24×10^{-11}	2.06×10^{-13}	9.30×10^{-7}	4.08×10^{-11}	2.06×10^{-13}	1.90×10^{-6}	8.92×10^{-11}
Total	**N/A**	**3.61×10^{-7}**	**1.24×10^{-11}**	**N/A**	**9.30×10^{-7}**	**4.08×10^{-11}**	**N/A**	**1.90×10^{-6}**	**8.92×10^{-11}**
Year of peak impact	5396	5396	5396	5396	5396	5396	5396	5396	5396

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–87. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.22×10^{-11}	2.60×10^{-6}	2.59×10^{-11}	2.33×10^{-11}	3.17×10^{-6}	3.12×10^{-11}	2.33×10^{-11}	3.77×10^{-6}	3.96×10^{-11}
Technetium-99	2.85×10^{-11}	4.98×10^{-5}	1.79×10^{-9}	2.97×10^{-11}	1.34×10^{-4}	5.88×10^{-9}	2.97×10^{-11}	2.74×10^{-4}	1.29×10^{-8}
Iodine-129	2.59×10^{-13}	7.38×10^{-5}	7.89×10^{-10}	2.44×10^{-13}	8.67×10^{-5}	1.22×10^{-9}	2.44×10^{-13}	1.12×10^{-4}	1.85×10^{-9}
Total	**N/A**	**1.26×10^{-4}**	**2.60×10^{-9}**	**N/A**	**2.24×10^{-4}**	**7.13×10^{-9}**	**N/A**	**3.89×10^{-4}**	**1.47×10^{-8}**
Year of peak impact	2064	2064	2063	2063	2063	2063	2063	2063	2063

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.96×10^{-5}	4.73×10^{-4}	0.00	4.96×10^{-5}	4.90×10^{-4}	1.95×10^{-13}	4.96×10^{-5}	7.38×10^{-4}	8.96×10^{-9}
Nitrate	1.55×10^{-2}	2.77×10^{-4}	0.00	1.55×10^{-2}	2.18×10^{-3}	0.00	1.55×10^{-2}	4.86×10^{-3}	0.00
Total	**N/A**	**7.50×10^{-4}**	**0.00**	**N/A**	**2.67×10^{-3}**	**1.95×10^{-13}**	**N/A**	**5.59×10^{-3}**	**8.96×10^{-9}**
Year of peak impact	2061	2061	N/A	2061	2061	2062	2061	2061	2062

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–88. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.21×10^{-10}	2.11×10^{-4}	7.26×10^{-9}	1.21×10^{-10}	5.44×10^{-4}	2.39×10^{-8}	1.21×10^{-10}	1.11×10^{-3}	5.22×10^{-8}
Iodine-129	1.23×10^{-13}	3.50×10^{-5}	3.98×10^{-10}	1.23×10^{-13}	4.38×10^{-5}	6.16×10^{-10}	1.23×10^{-13}	5.65×10^{-5}	9.32×10^{-10}
Total	**N/A**	$\mathbf{2.46\times10^{-4}}$	$\mathbf{7.66\times10^{-9}}$	**N/A**	$\mathbf{5.88\times10^{-4}}$	$\mathbf{2.45\times10^{-8}}$	**N/A**	$\mathbf{1.17\times10^{-3}}$	$\mathbf{5.32\times10^{-8}}$
Year of peak impact	2698	2698	2698	2698	2698	2698	2698	2698	2698
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.11×10^{-6}	2.01×10^{-5}	0.00	1.96×10^{-6}	1.94×10^{-5}	8.27×10^{-15}	1.96×10^{-6}	2.91×10^{-5}	3.79×10^{-10}
Nitrate	1.26×10^{-4}	2.25×10^{-6}	0.00	1.37×10^{-4}	1.92×10^{-5}	0.00	1.37×10^{-4}	4.28×10^{-5}	0.00
Total	**N/A**	$\mathbf{2.23\times10^{-5}}$	**0.00**	**N/A**	$\mathbf{3.86\times10^{-5}}$	$\mathbf{8.27\times10^{-15}}$	**N/A**	$\mathbf{7.20\times10^{-5}}$	$\mathbf{3.79\times10^{-10}}$
Year of peak impact	2703	2703	N/A	2697	2697	2703	2697	2697	2703

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–89. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.64×10^{-8}	8.12×10^{-2}	2.79×10^{-6}	4.64×10^{-8}	2.09×10^{-1}	9.19×10^{-6}	4.64×10^{-8}	4.27×10^{-1}	2.01×10^{-5}
Iodine-129	8.16×10^{-11}	2.32×10^{-2}	2.64×10^{-7}	8.16×10^{-11}	2.90×10^{-2}	4.09×10^{-7}	8.16×10^{-11}	3.75×10^{-2}	6.18×10^{-7}
Total	**N/A**	$\mathbf{1.04\times10^{-1}}$	$\mathbf{3.06\times10^{-6}}$	**N/A**	$\mathbf{2.38\times10^{-1}}$	$\mathbf{9.60\times10^{-6}}$	**N/A**	$\mathbf{4.65\times10^{-1}}$	$\mathbf{2.07\times10^{-5}}$
Year of peak impact	2970	2970	2970	2970	2970	2970	2970	2970	2970
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.04×10^{-3}	9.88×10^{-3}	0.00	1.04×10^{-3}	1.02×10^{-2}	4.24×10^{-12}	1.04×10^{-3}	1.54×10^{-2}	1.94×10^{-7}
Nitrate	3.63×10^{-1}	6.47×10^{-3}	0.00	3.63×10^{-1}	5.09×10^{-2}	0.00	3.63×10^{-1}	1.14×10^{-1}	0.00
Total	**N/A**	$\mathbf{1.64\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{6.12\times10^{-2}}$	$\mathbf{4.24\times10^{-12}}$	**N/A**	$\mathbf{1.29\times10^{-1}}$	$\mathbf{1.94\times10^{-7}}$
Year of peak impact	2038	2038	N/A	2038	2038	2032	2038	2038	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–90. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the Columbia River Nearshore

	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	8.66×10^{-10}	1.52×10^{-3}	5.21×10^{-8}	8.66×10^{-10}	3.91×10^{-3}	1.71×10^{-7}	8.66×10^{-10}	7.98×10^{-3}	3.97×10^{-7}
Iodine-129	5.53×10^{-12}	1.58×10^{-3}	1.79×10^{-8}	5.53×10^{-12}	1.97×10^{-3}	2.77×10^{-8}	5.53×10^{-12}	2.54×10^{-3}	2.42×10^{-8}
Total	**N/A**	$\mathbf{3.09\times10^{-3}}$	$\mathbf{7.01\times10^{-8}}$	**N/A**	$\mathbf{5.88\times10^{-3}}$	$\mathbf{1.99\times10^{-7}}$	**N/A**	$\mathbf{1.05\times10^{-2}}$	$\mathbf{4.21\times10^{-7}}$
Year of peak impact	3081	3081	3081	3081	3081	3081	3081	3081	3196
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.40×10^{-5}	2.28×10^{-4}	0.00	1.89×10^{-5}	1.87×10^{-4}	9.41×10^{-14}	1.89×10^{-5}	2.81×10^{-4}	4.32×10^{-9}
Nitrate	5.59×10^{-3}	9.98×10^{-5}	0.00	6.37×10^{-3}	8.94×10^{-4}	0.00	6.37×10^{-3}	1.99×10^{-3}	0.00
Total	**N/A**	$\mathbf{3.28\times10^{-4}}$	**0.00**	**N/A**	$\mathbf{1.08\times10^{-3}}$	$\mathbf{9.41\times10^{-14}}$	**N/A**	$\mathbf{2.28\times10^{-3}}$	$\mathbf{4.32\times10^{-9}}$
Year of peak impact	2770	2770	N/A	2781	2781	2770	2781	2781	2770

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–91. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	0.00	0.00	0.00	0.00	0.00	0.00	8.66×10^{-10}	2.59×10^{-5}	1.39×10^{-9}
Iodine-129	3.78×10^{-16}	1.35×10^{-7}	1.90×10^{-12}	3.78×10^{-16}	2.06×10^{-6}	4.95×10^{-11}	5.53×10^{-12}	3.16×10^{-5}	7.76×10^{-10}
Total	**N/A**	**1.35×10^{-7}**	**1.90×10^{-12}**	**N/A**	**2.06×10^{-6}**	**4.95×10^{-11}**	**N/A**	**5.75×10^{-5}**	**2.16×10^{-9}**
Year of peak impact	2939	2939	2939	2939	2939	2939	3081	3081	3081

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.89×10^{-5}	8.33×10^{-5}	4.31×10^{-9}
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	6.37×10^{-3}	2.24×10^{-4}	0.00
Total	**N/A**	**0.00**	**0.00**	**N/A**	**0.00**	**0.00**	**N/A**	**3.08×10^{-4}**	**4.31×10^{-9}**
Year of peak impact	N/A	N/A	N/A	N/A	N/A	N/A	2781	2781	2770

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–92. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.63×10^{-9}	1.91×10^{-4}	1.81×10^{-9}	1.63×10^{-9}	2.22×10^{-4}	2.18×10^{-9}	1.63×10^{-9}	2.64×10^{-4}	2.77×10^{-9}
Technetium-99	9.44×10^{-8}	1.65×10^{-1}	5.68×10^{-6}	9.44×10^{-8}	4.26×10^{-1}	1.87×10^{-5}	9.44×10^{-8}	8.70×10^{-1}	4.09×10^{-5}
Iodine-129	1.62×10^{-10}	4.62×10^{-2}	5.26×10^{-7}	1.62×10^{-10}	5.77×10^{-2}	8.13×10^{-7}	1.62×10^{-10}	7.46×10^{-2}	1.23×10^{-6}
Total	**N/A**	$\mathbf{2.12\times10^{-1}}$	$\mathbf{6.21\times10^{-6}}$	**N/A**	$\mathbf{4.84\times10^{-1}}$	$\mathbf{1.95\times10^{-5}}$	**N/A**	$\mathbf{9.45\times10^{-1}}$	$\mathbf{4.21\times10^{-5}}$
Year of peak impact	2063	2063	2063	2063	2063	2063	2063	2063	2063
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.35×10^{-3}	1.28×10^{-2}	0.00	1.35×10^{-3}	1.33×10^{-2}	1.27×10^{-11}	1.35×10^{-3}	2.00×10^{-2}	5.82×10^{-7}
Nitrate	3.19	5.69×10^{-2}	0.00	3.19	4.47×10^{-1}	0.00	3.19	9.98×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.97\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.61\times10^{-1}}$	$\mathbf{1.27\times10^{-11}}$	**N/A**	**1.02**	$\mathbf{5.82\times10^{-7}}$
Year of peak impact	2062	2062	N/A	2062	2062	2163	2062	2062	2163

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–93. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.72×10^{-9}	5.52×10^{-4}	5.24×10^{-9}	4.72×10^{-9}	6.42×10^{-4}	6.32×10^{-9}	4.72×10^{-9}	7.64×10^{-4}	8.02×10^{-9}
Technetium-99	1.60×10^{-7}	2.81×10^{-1}	9.66×10^{-6}	1.60×10^{-7}	7.23×10^{-1}	3.20×10^{-5}	1.60×10^{-7}	1.48	6.99×10^{-5}
Iodine-129	3.12×10^{-10}	8.89×10^{-2}	1.01×10^{-6}	3.12×10^{-10}	1.11×10^{-1}	1.42×10^{-6}	3.12×10^{-10}	1.43×10^{-1}	2.15×10^{-6}
Total	**N/A**	**3.70×10^{-1}**	**1.07×10^{-5}**	**N/A**	**8.35×10^{-1}**	**3.34×10^{-5}**	**N/A**	**1.62**	**7.21×10^{-5}**
Year of peak impact	2064	2064	2064	2064	2064	2065	2064	2064	2065

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.47×10^{-3}	4.26×10^{-2}	0.00	3.66×10^{-3}	3.62×10^{-2}	2.24×10^{-11}	3.66×10^{-3}	5.44×10^{-2}	1.03×10^{-6}
Nitrate	1.74	3.11×10^{-2}	0.00	2.11	2.96×10^{-1}	0.00	2.11	6.59×10^{-1}	0.00
Total	**N/A**	**7.37×10^{-2}**	**0.00**	**N/A**	**3.32×10^{-1}**	**2.24×10^{-11}**	**N/A**	**7.14×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2079	2079	N/A	2090	2090	2064	2090	2090	2064

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–94. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.97×10^{-9}	2.31×10^{-4}	2.19×10^{-9}	1.97×10^{-9}	2.68×10^{-4}	2.64×10^{-9}	1.97×10^{-9}	3.20×10^{-4}	3.35×10^{-9}
Technetium-99	9.89×10^{-8}	1.73×10^{-1}	5.95×10^{-6}	9.89×10^{-8}	4.46×10^{-1}	1.96×10^{-5}	9.89×10^{-8}	9.11×10^{-1}	4.28×10^{-5}
Iodine-129	1.66×10^{-10}	4.74×10^{-2}	5.39×10^{-7}	1.66×10^{-10}	5.92×10^{-2}	8.33×10^{-7}	1.66×10^{-10}	7.65×10^{-2}	1.26×10^{-6}
Total	**N/A**	**2.21×10^{-1}**	**6.49×10^{-6}**	**N/A**	**5.05×10^{-1}**	**2.04×10^{-5}**	**N/A**	**9.87×10^{-1}**	**4.41×10^{-5}**
Year of peak impact	2082	2082	2082	2082	2082	2082	2082	2082	2082
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.77×10^{-3}	7.40×10^{-2}	0.00	7.77×10^{-3}	7.67×10^{-2}	3.05×10^{-11}	7.77×10^{-3}	1.15×10^{-1}	1.40×10^{-6}
Nitrate	9.86×10^{-1}	1.76×10^{-2}	0.00	9.86×10^{-1}	1.38×10^{-1}	0.00	9.86×10^{-1}	3.09×10^{-1}	0.00
Total	**N/A**	**9.16×10^{-2}**	**0.00**	**N/A**	**2.15×10^{-1}**	**3.05×10^{-11}**	**N/A**	**4.24×10^{-1}**	**1.40×10^{-6}**
Year of peak impact	2082	2082	N/A	2082	2082	2082	2082	2082	2082

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–95. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	3.72×10^{-9}	4.35×10^{-4}	4.13×10^{-9}	3.72×10^{-9}	5.06×10^{-4}	4.98×10^{-9}	3.72×10^{-9}	6.02×10^{-4}	6.32×10^{-9}
Technetium-99	2.18×10^{-7}	3.82×10^{-1}	1.31×10^{-5}	2.18×10^{-7}	9.85×10^{-1}	4.32×10^{-5}	2.18×10^{-7}	2.01	9.46×10^{-5}
Iodine-129	4.10×10^{-10}	1.17×10^{-1}	1.33×10^{-6}	4.10×10^{-10}	1.46×10^{-1}	2.06×10^{-6}	4.10×10^{-10}	1.89×10^{-1}	3.11×10^{-6}
Total	**N/A**	**5.00×10^{-1}**	**1.45×10^{-5}**	**N/A**	**1.13**	**4.53×10^{-5}**	**N/A**	**2.20**	**9.77×10^{-5}**
Year of peak impact	2080	2080	2080	2080	2080	2080	2080	2080	2080
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.44×10^{-3}	4.23×10^{-2}	0.00	4.27×10^{-3}	4.22×10^{-2}	1.74×10^{-11}	4.27×10^{-3}	6.35×10^{-2}	8.00×10^{-7}
Nitrate	8.05×10^{-1}	1.44×10^{-2}	0.00	8.18×10^{-1}	1.15×10^{-1}	0.00	8.18×10^{-1}	2.56×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-2}**	**0.00**	**N/A**	**1.57×10^{-1}**	**1.74×10^{-11}**	**N/A**	**3.20×10^{-1}**	**8.00×10^{-7}**
Year of peak impact	2080	2080	N/A	2079	2079	2080	2079	2079	2080

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–96. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.99×10^{-10}	9.35×10^{-5}	9.00×10^{-10}	8.11×10^{-10}	1.10×10^{-4}	8.07×10^{-10}	8.11×10^{-10}	1.31×10^{-4}	1.02×10^{-9}
Technetium-99	4.86×10^{-8}	8.50×10^{-2}	2.96×10^{-6}	4.92×10^{-8}	2.22×10^{-1}	9.76×10^{-6}	4.92×10^{-8}	4.53×10^{-1}	2.13×10^{-5}
Iodine-129	9.95×10^{-11}	2.84×10^{-2}	3.02×10^{-7}	9.33×10^{-11}	3.32×10^{-2}	4.58×10^{-7}	9.33×10^{-11}	4.29×10^{-2}	6.94×10^{-7}
Total	**N/A**	$\mathbf{1.13\times10^{-1}}$	$\mathbf{3.27\times10^{-6}}$	**N/A**	$\mathbf{2.55\times10^{-1}}$	$\mathbf{1.02\times10^{-5}}$	**N/A**	$\mathbf{4.96\times10^{-1}}$	$\mathbf{2.20\times10^{-5}}$
Year of peak impact	2082	2082	2081	2081	2081	2085	2081	2081	2085

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.36×10^{-3}	1.29×10^{-2}	0.00	1.27×10^{-3}	1.25×10^{-2}	5.36×10^{-12}	1.27×10^{-3}	1.88×10^{-2}	2.46×10^{-7}
Nitrate	6.88×10^{-1}	1.23×10^{-2}	0.00	7.12×10^{-1}	1.00×10^{-1}	0.00	7.12×10^{-1}	2.23×10^{-1}	0.00
Total	**N/A**	$\mathbf{2.52\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.12\times10^{-1}}$	$\mathbf{5.36\times10^{-12}}$	**N/A**	$\mathbf{2.42\times10^{-1}}$	$\mathbf{2.46\times10^{-7}}$
Year of peak impact	2079	2079	N/A	2082	2082	2074	2082	2082	2074

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–97. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.72×10^{-9}	5.52×10^{-4}	5.24×10^{-9}	4.72×10^{-9}	6.42×10^{-4}	6.32×10^{-9}	4.72×10^{-9}	7.64×10^{-4}	8.02×10^{-9}
Technetium-99	1.60×10^{-7}	2.81×10^{-1}	9.66×10^{-6}	1.60×10^{-7}	7.23×10^{-1}	3.20×10^{-5}	1.60×10^{-7}	1.48	6.99×10^{-5}
Iodine-129	3.12×10^{-10}	8.89×10^{-2}	1.01×10^{-6}	3.12×10^{-10}	1.11×10^{-1}	1.42×10^{-6}	3.12×10^{-10}	1.43×10^{-1}	2.15×10^{-6}
Total	**N/A**	**3.70×10^{-1}**	**1.07×10^{-5}**	**N/A**	**8.35×10^{-1}**	**3.34×10^{-5}**	**N/A**	**1.62**	**7.21×10^{-5}**
Year of peak impact	2064	2064	2064	2064	2064	2065	2064	2064	2065
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.58×10^{-3}	5.31×10^{-2}	0.00	3.66×10^{-3}	3.62×10^{-2}	2.24×10^{-11}	3.66×10^{-3}	5.44×10^{-2}	1.03×10^{-6}
Nitrate	1.62	2.89×10^{-2}	0.00	2.11	2.96×10^{-1}	0.00	2.11	6.59×10^{-1}	0.00
Total	**N/A**	**8.20×10^{-2}**	**0.00**	**N/A**	**3.32×10^{-1}**	**2.24×10^{-11}**	**N/A**	**7.14×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2070	2070	N/A	2090	2090	2064	2090	2090	2064

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–98. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.48×10^{-8}	2.60×10^{-2}	8.93×10^{-7}	1.48×10^{-8}	6.69×10^{-2}	2.95×10^{-6}	1.48×10^{-8}	1.37×10^{-1}	6.45×10^{-6}
Iodine-129	2.23×10^{-11}	6.36×10^{-3}	7.23×10^{-8}	2.23×10^{-11}	7.95×10^{-3}	1.04×10^{-7}	2.23×10^{-11}	1.03×10^{-2}	1.58×10^{-7}
Total	**N/A**	**3.23×10^{-2}**	**9.65×10^{-7}**	**N/A**	**7.48×10^{-2}**	**3.05×10^{-6}**	**N/A**	**1.47×10^{-1}**	**6.61×10^{-6}**
Year of peak impact	3272	3272	3272	3272	3272	3276	3272	3272	3276
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.98×10^{-4}	4.74×10^{-3}	0.00	4.71×10^{-4}	4.65×10^{-3}	2.01×10^{-12}	4.71×10^{-4}	7.00×10^{-3}	9.24×10^{-8}
Nitrate	1.25×10^{-1}	2.24×10^{-3}	0.00	1.34×10^{-1}	1.88×10^{-2}	0.00	1.34×10^{-1}	4.20×10^{-2}	0.00
Total	**N/A**	**6.98×10^{-3}**	**0.00**	**N/A**	**2.35×10^{-2}**	**2.01×10^{-12}**	**N/A**	**4.90×10^{-2}**	**9.24×10^{-8}**
Year of peak impact	3330	3330	N/A	3174	3174	2833	3174	3174	2833

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–99. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.75×10^{-13}	2.14×10^{-6}	9.40×10^{-11}	4.68×10^{-13}	4.87×10^{-6}	2.35×10^{-10}	1.48×10^{-8}	4.49×10^{-4}	2.41×10^{-8}
Iodine-129	6.33×10^{-16}	2.26×10^{-7}	3.19×10^{-12}	6.51×10^{-16}	3.55×10^{-6}	8.30×10^{-11}	2.23×10^{-11}	8.71×10^{-5}	2.04×10^{-9}
Total	**N/A**	**2.37×10^{-6}**	**9.72×10^{-11}**	**N/A**	**8.42×10^{-6}**	**3.18×10^{-10}**	**N/A**	**5.36×10^{-4}**	**2.61×10^{-8}**
Year of peak impact	2954	2954	2954	2925	2925	2954	3272	3272	3276
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.45×10^{-8}	1.43×10^{-7}	5.69×10^{-17}	1.45×10^{-8}	2.34×10^{-7}	2.61×10^{-12}	4.71×10^{-4}	2.07×10^{-3}	9.24×10^{-8}
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	1.34×10^{-1}	4.72×10^{-3}	0.00
Total	**N/A**	**1.43×10^{-7}**	**5.69×10^{-17}**	**N/A**	**2.34×10^{-7}**	**2.61×10^{-12}**	**N/A**	**6.79×10^{-3}**	**9.24×10^{-8}**
Year of peak impact	2268	2268	2268	2268	2268	2268	3174	3174	2833

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–100. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.11×10^{-8}	5.43×10^{-2}	1.87×10^{-6}	3.11×10^{-8}	1.40×10^{-1}	6.15×10^{-6}	3.11×10^{-8}	2.86×10^{-1}	1.34×10^{-5}
Iodine-129	3.68×10^{-11}	1.05×10^{-2}	1.19×10^{-7}	3.68×10^{-11}	1.31×10^{-2}	1.84×10^{-7}	3.68×10^{-11}	1.69×10^{-2}	2.79×10^{-7}
Total	**N/A**	$\mathbf{6.48\times10^{-2}}$	$\mathbf{1.99\times10^{-6}}$	**N/A**	$\mathbf{1.53\times10^{-1}}$	$\mathbf{6.33\times10^{-6}}$	**N/A**	$\mathbf{3.03\times10^{-1}}$	$\mathbf{1.37\times10^{-5}}$
Year of peak impact	3610	3610	3610	3610	3610	3610	3610	3610	3610
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.09×10^{-6}	3.85×10^{-5}	0.00	9.35×10^{-6}	5.56×10^{-5}	0.00	9.35×10^{-6}	1.01×10^{-4}	0.00
Chromium	1.30×10^{-3}	1.24×10^{-2}	0.00	1.25×10^{-3}	1.23×10^{-2}	5.12×10^{-12}	1.25×10^{-3}	1.85×10^{-2}	2.35×10^{-7}
Nitrate	1.67×10^{-1}	2.97×10^{-3}	0.00	1.83×10^{-1}	2.56×10^{-2}	0.00	1.83×10^{-1}	5.71×10^{-2}	0.00
Total	**N/A**	$\mathbf{1.54\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{3.80\times10^{-2}}$	$\mathbf{5.12\times10^{-12}}$	**N/A**	$\mathbf{7.58\times10^{-2}}$	$\mathbf{2.35\times10^{-7}}$
Year of peak impact	3647	3647	N/A	3648	3648	3647	3648	3648	3647

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–101. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.91×10^{-7}	3.35×10^{-1}	1.15×10^{-5}	1.91×10^{-7}	8.63×10^{-1}	3.79×10^{-5}	1.91×10^{-7}	1.76	8.28×10^{-5}
Iodine-129	1.30×10^{-10}	3.71×10^{-2}	4.21×10^{-7}	1.30×10^{-10}	4.63×10^{-2}	6.51×10^{-7}	1.30×10^{-10}	5.98×10^{-2}	9.85×10^{-7}
Total	**N/A**	**3.72×10^{-1}**	**1.19×10^{-5}**	**N/A**	**9.09×10^{-1}**	**3.85×10^{-5}**	**N/A**	**1.82**	**8.38×10^{-5}**
Year of peak impact	3113	3113	3113	3113	3113	3113	3113	3113	3113
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	7.19×10^{-8}	3.42×10^{-7}	0.00	1.08×10^{-7}	6.40×10^{-7}	0.00	1.08×10^{-7}	1.16×10^{-6}	0.00
Chromium	5.27×10^{-3}	5.02×10^{-2}	0.00	4.36×10^{-3}	4.30×10^{-2}	2.07×10^{-11}	4.36×10^{-3}	6.48×10^{-2}	9.49×10^{-7}
Nitrate	3.66×10^{-1}	6.54×10^{-3}	0.00	4.90×10^{-1}	6.88×10^{-2}	0.00	4.90×10^{-1}	1.53×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-2}**	**0.00**	**N/A**	**1.12×10^{-1}**	**2.07×10^{-11}**	**N/A**	**2.18×10^{-1}**	**9.49×10^{-7}**
Year of peak impact	3115	3115	N/A	3045	3045	3115	3648	3045	3115

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–102. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.82×10^{-8}	8.43×10^{-2}	2.91×10^{-6}	4.83×10^{-8}	2.18×10^{-1}	9.61×10^{-6}	4.83×10^{-8}	4.45×10^{-1}	2.10×10^{-5}
Iodine-129	8.02×10^{-11}	2.29×10^{-2}	2.57×10^{-7}	7.92×10^{-11}	2.82×10^{-2}	3.59×10^{-7}	7.92×10^{-11}	3.65×10^{-2}	5.43×10^{-7}
Total	**N/A**	$\mathbf{1.07\times10^{-1}}$	$\mathbf{3.16\times10^{-6}}$	**N/A**	$\mathbf{2.46\times10^{-1}}$	$\mathbf{9.97\times10^{-6}}$	**N/A**	$\mathbf{4.81\times10^{-1}}$	$\mathbf{2.16\times10^{-5}}$
Year of peak impact	3750	3750	3766	3766	3766	3675	3766	3766	3675

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.03×10^{-5}	4.89×10^{-5}	0.00	1.03×10^{-5}	6.10×10^{-5}	0.00	9.81×10^{-6}	1.06×10^{-4}	0.00
Chromium	2.01×10^{-3}	1.92×10^{-2}	0.00	2.01×10^{-3}	1.99×10^{-2}	7.91×10^{-12}	1.84×10^{-3}	2.74×10^{-2}	3.63×10^{-7}
Nitrate	1.66×10^{-1}	2.96×10^{-3}	0.00	1.66×10^{-1}	2.33×10^{-2}	0.00	1.74×10^{-1}	5.45×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.22\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.33\times10^{-2}}$	$\mathbf{7.91\times10^{-12}}$	**N/A**	$\mathbf{8.20\times10^{-2}}$	$\mathbf{3.63\times10^{-7}}$
Year of peak impact	3724	3724	N/A	3724	3724	3724	3617	3617	3724

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–103. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	9.36×10^{-8}	1.64×10^{-1}	5.63×10^{-6}	9.36×10^{-8}	4.22×10^{-1}	1.85×10^{-5}	9.36×10^{-8}	8.62×10^{-1}	4.05×10^{-5}
Iodine-129	1.42×10^{-10}	4.04×10^{-2}	4.59×10^{-7}	1.42×10^{-10}	5.04×10^{-2}	7.09×10^{-7}	1.42×10^{-10}	6.51×10^{-2}	1.07×10^{-6}
Total	**N/A**	$\mathbf{2.04\times10^{-1}}$	$\mathbf{6.09\times10^{-6}}$	**N/A**	$\mathbf{4.72\times10^{-1}}$	$\mathbf{1.92\times10^{-5}}$	**N/A**	$\mathbf{9.27\times10^{-1}}$	$\mathbf{4.16\times10^{-5}}$
Year of peak impact	3469	3469	3469	3469	3469	3469	3469	3469	3469

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.52×10^{-3}	1.45×10^{-2}	0.00	1.45×10^{-3}	1.43×10^{-2}	5.97×10^{-12}	1.45×10^{-3}	2.15×10^{-2}	2.74×10^{-7}
Nitrate	3.22×10^{-1}	5.75×10^{-3}	0.00	3.36×10^{-1}	4.71×10^{-2}	0.00	3.36×10^{-1}	1.05×10^{-1}	0.00
Total	**N/A**	$\mathbf{2.02\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{6.14\times10^{-2}}$	$\mathbf{5.97\times10^{-12}}$	**N/A**	$\mathbf{1.27\times10^{-1}}$	$\mathbf{2.74\times10^{-7}}$
Year of peak impact	3412	3412	N/A	3379	3379	3412	3379	3379	3412

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–104. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	8.13×10^{-8}	1.42×10^{-1}	4.89×10^{-6}	8.13×10^{-8}	3.67×10^{-1}	1.62×10^{-5}	8.13×10^{-8}	7.49×10^{-1}	3.55×10^{-5}
Iodine-129	1.03×10^{-10}	2.94×10^{-2}	3.34×10^{-7}	1.03×10^{-10}	3.67×10^{-2}	4.32×10^{-7}	1.03×10^{-10}	4.75×10^{-2}	6.53×10^{-7}
Total	**N/A**	**1.72×10^{-1}**	**5.23×10^{-6}**	**N/A**	**4.03×10^{-1}**	**1.67×10^{-5}**	**N/A**	**7.96×10^{-1}**	**3.62×10^{-5}**
Year of peak impact	3353	3353	3353	3353	3353	3307	3353	3353	3307
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-3}	1.60×10^{-2}	0.00	1.57×10^{-3}	1.55×10^{-2}	6.61×10^{-12}	1.57×10^{-3}	2.34×10^{-2}	3.03×10^{-7}
Nitrate	1.68×10^{-1}	3.01×10^{-3}	0.00	1.77×10^{-1}	2.48×10^{-2}	0.00	1.77×10^{-1}	5.54×10^{-2}	0.00
Total	**N/A**	**1.90×10^{-2}**	**0.00**	**N/A**	**4.04×10^{-2}**	**6.61×10^{-12}**	**N/A**	**7.87×10^{-2}**	**3.03×10^{-7}**
Year of peak impact	3273	3273	N/A	3293	3293	3273	3293	3293	3273

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–105. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the Core Zone Boundary

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.91×10^{-7}	3.35×10^{-1}	1.15×10^{-5}	1.91×10^{-7}	8.63×10^{-1}	3.79×10^{-5}	1.91×10^{-7}	1.76	8.28×10^{-5}
Iodine-129	1.30×10^{-10}	3.71×10^{-2}	4.21×10^{-7}	1.30×10^{-10}	4.63×10^{-2}	6.51×10^{-7}	1.30×10^{-10}	5.98×10^{-2}	9.85×10^{-7}
Total	**N/A**	**3.72×10^{-1}**	**1.19×10^{-5}**	**N/A**	**9.09×10^{-1}**	**3.85×10^{-5}**	**N/A**	**1.82**	**8.38×10^{-5}**
Year of peak impact	3113	3113	3113	3113	3113	3113	3113	3113	3113
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.22×10^{-7}	1.53×10^{-6}	0.00	2.26×10^{-7}	1.34×10^{-6}	0.00	2.26×10^{-7}	2.43×10^{-6}	0.00
Chromium	5.27×10^{-3}	5.02×10^{-2}	0.00	4.36×10^{-3}	4.30×10^{-2}	2.07×10^{-11}	4.36×10^{-3}	6.48×10^{-2}	9.49×10^{-7}
Nitrate	3.66×10^{-1}	6.54×10^{-3}	0.00	4.90×10^{-1}	6.88×10^{-2}	0.00	4.90×10^{-1}	1.53×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-2}**	**0.00**	**N/A**	**1.12×10^{-1}**	**2.07×10^{-11}**	**N/A**	**2.18×10^{-1}**	**9.49×10^{-7}**
Year of peak impact	3115	3115	N/A	3045	3045	3115	3045	3045	3115

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–106. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the Columbia River Nearshore

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.44×10^{-8}	2.51×10^{-2}	8.78×10^{-7}	1.46×10^{-8}	6.58×10^{-2}	2.89×10^{-6}	1.46×10^{-8}	1.34×10^{-1}	6.32×10^{-6}
Iodine-129	2.26×10^{-11}	6.43×10^{-3}	6.80×10^{-8}	2.10×10^{-11}	7.47×10^{-3}	1.05×10^{-7}	2.10×10^{-11}	9.66×10^{-3}	1.59×10^{-7}
Total	**N/A**	**3.15×10^{-2}**	**9.46×10^{-7}**	**N/A**	**7.33×10^{-2}**	**2.99×10^{-6}**	**N/A**	**1.44×10^{-1}**	**6.48×10^{-6}**
Year of peak impact	4330	4330	4161	4161	4161	4161	4161	4161	4161
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.38×10^{-7}	3.99×10^{-6}	0.00	8.38×10^{-7}	4.98×10^{-6}	0.00	7.07×10^{-7}	7.61×10^{-6}	0.00
Chromium	3.89×10^{-4}	3.70×10^{-3}	0.00	3.89×10^{-4}	3.84×10^{-3}	1.56×10^{-12}	3.82×10^{-4}	5.68×10^{-3}	7.14×10^{-8}
Nitrate	5.28×10^{-2}	9.44×10^{-4}	0.00	5.28×10^{-2}	7.42×10^{-3}	0.00	5.32×10^{-2}	1.67×10^{-2}	0.00
Total	**N/A**	**4.65×10^{-3}**	**0.00**	**N/A**	**1.13×10^{-2}**	**1.56×10^{-12}**	**N/A**	**2.23×10^{-2}**	**7.14×10^{-8}**
Year of peak impact	4267	4267	N/A	4267	4267	4217	4266	4266	4217

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–107. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.36×10^{-13}	1.97×10^{-6}	8.64×10^{-11}	4.22×10^{-13}	4.38×10^{-6}	2.08×10^{-10}	1.46×10^{-8}	4.40×10^{-4}	2.35×10^{-8}
Iodine-129	6.22×10^{-16}	2.22×10^{-7}	3.13×10^{-12}	6.91×10^{-16}	3.76×10^{-6}	9.05×10^{-11}	2.10×10^{-11}	9.02×10^{-5}	2.21×10^{-9}
Total	**N/A**	**2.19×10^{-6}**	**8.95×10^{-11}**	**N/A**	**8.15×10^{-6}**	**2.99×10^{-10}**	**N/A**	**5.31×10^{-4}**	**2.58×10^{-8}**
Year of peak impact	3736	3736	3736	3811	3811	3811	4161	4161	4161
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	8.38×10^{-7}	5.03×10^{-6}	0.00
Chromium	1.09×10^{-8}	1.07×10^{-7}	4.27×10^{-17}	1.09×10^{-8}	1.76×10^{-7}	1.96×10^{-12}	3.89×10^{-4}	1.71×10^{-3}	7.13×10^{-8}
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	5.28×10^{-2}	1.86×10^{-3}	0.00
Total	**N/A**	**1.07×10^{-7}**	**4.27×10^{-17}**	**N/A**	**1.76×10^{-7}**	**1.96×10^{-12}**	**N/A**	**3.58×10^{-3}**	**7.13×10^{-8}**
Year of peak impact	3671	3671	3671	3671	3671	3671	4267	4267	4217

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–108. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.60×10^{-7}	2.79×10^{-1}	9.60×10^{-6}	1.60×10^{-7}	7.19×10^{-1}	3.16×10^{-5}	1.60×10^{-7}	1.47	6.91×10^{-5}
Iodine-129	7.02×10^{-11}	2.00×10^{-2}	2.28×10^{-7}	7.02×10^{-11}	2.50×10^{-2}	3.52×10^{-7}	7.02×10^{-11}	3.23×10^{-2}	5.32×10^{-7}
Total	**N/A**	**2.99×10^{-1}**	**9.83×10^{-6}**	**N/A**	**7.44×10^{-1}**	**3.19×10^{-5}**	**N/A**	**1.50**	**6.96×10^{-5}**
Year of peak impact	3685	3685	3685	3685	3685	3685	3685	3685	3685
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.43×10^{-4}	1.15×10^{-3}	0.00	3.24×10^{-4}	1.93×10^{-3}	0.00	1.76×10^{-4}	1.89×10^{-3}	0.00
Chromium	5.42×10^{-3}	5.16×10^{-2}	0.00	4.67×10^{-3}	4.61×10^{-2}	2.13×10^{-11}	4.33×10^{-3}	6.43×10^{-2}	9.77×10^{-7}
Nitrate	4.17×10^{-1}	7.44×10^{-3}	0.00	4.95×10^{-1}	6.95×10^{-2}	0.00	5.23×10^{-1}	1.64×10^{-1}	0.00
Total	**N/A**	**6.02×10^{-2}**	**0.00**	**N/A**	**1.18×10^{-1}**	**2.13×10^{-11}**	**N/A**	**2.30×10^{-1}**	**9.77×10^{-7}**
Year of peak impact	3451	3451	N/A	3573	3573	3451	3443	3443	3451

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–109. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.12×10^{-7}	1.07	3.69×10^{-5}	6.12×10^{-7}	2.76	1.22×10^{-4}	6.12×10^{-7}	5.64	2.67×10^{-4}
Iodine-129	2.57×10^{-10}	7.31×10^{-2}	8.31×10^{-7}	2.57×10^{-10}	9.13×10^{-2}	6.01×10^{-7}	2.57×10^{-10}	1.18×10^{-1}	9.10×10^{-7}
Total	**N/A**	**1.14**	**3.77×10^{-5}**	**N/A**	**2.85**	**1.23×10^{-4}**	**N/A**	**5.76**	**2.68×10^{-4}**
Year of peak impact	3083	3083	3083	3083	3083	2965	3083	3083	2965

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.77×10^{-6}	8.41×10^{-6}	0.00	6.72×10^{-7}	4.00×10^{-6}	0.00	6.72×10^{-7}	7.23×10^{-6}	0.00
Chromium	1.88×10^{-2}	1.79×10^{-1}	0.00	1.75×10^{-2}	1.72×10^{-1}	7.39×10^{-11}	1.75×10^{-2}	2.59×10^{-1}	3.39×10^{-6}
Nitrate	1.39	2.48×10^{-2}	0.00	1.60	2.25×10^{-1}	0.00	1.60	5.02×10^{-1}	0.00
Total	**N/A**	**2.04×10^{-1}**	**0.00**	**N/A**	**3.97×10^{-1}**	**7.39×10^{-11}**	**N/A**	**7.61×10^{-1}**	**3.39×10^{-6}**
Year of peak impact	2960	2960	N/A	2903	2903	2873	2903	2903	2873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–110. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.52×10^{-7}	7.92×10^{-1}	2.76×10^{-5}	4.59×10^{-7}	2.07	9.08×10^{-5}	4.59×10^{-7}	4.22	1.99×10^{-4}
Iodine-129	2.38×10^{-10}	6.79×10^{-2}	6.12×10^{-7}	1.89×10^{-10}	6.72×10^{-2}	9.46×10^{-7}	1.89×10^{-10}	8.69×10^{-2}	1.43×10^{-6}
Total	**N/A**	**8.59×10^{-1}**	**2.82×10^{-5}**	**N/A**	**2.14**	**9.18×10^{-5}**	**N/A**	**4.31**	**2.00×10^{-4}**
Year of peak impact	3765	3765	3674	3674	3674	3674	3674	3674	3674
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.43×10^{-4}	1.63×10^{-3}	0.00	3.44×10^{-4}	2.05×10^{-3}	0.00	3.44×10^{-4}	3.70×10^{-3}	0.00
Chromium	1.38×10^{-2}	1.31×10^{-1}	0.00	1.29×10^{-2}	1.28×10^{-1}	5.40×10^{-11}	1.29×10^{-2}	1.92×10^{-1}	2.48×10^{-6}
Nitrate	1.00	1.79×10^{-2}	0.00	1.08	1.51×10^{-1}	0.00	1.08	3.37×10^{-1}	0.00
Total	**N/A**	**1.51×10^{-1}**	**0.00**	**N/A**	**2.81×10^{-1}**	**5.40×10^{-11}**	**N/A**	**5.33×10^{-1}**	**2.48×10^{-6}**
Year of peak impact	3620	3620	N/A	3586	3586	3620	3586	3586	3620

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–111. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.48×10^{-7}	6.08×10^{-1}	2.18×10^{-5}	3.62×10^{-7}	1.63	7.16×10^{-5}	3.62×10^{-7}	3.33	1.57×10^{-4}
Iodine-129	2.44×10^{-10}	6.96×10^{-2}	4.70×10^{-7}	1.45×10^{-10}	5.17×10^{-2}	7.27×10^{-7}	1.45×10^{-10}	6.68×10^{-2}	1.10×10^{-6}
Total	**N/A**	**6.78×10^{-1}**	**2.22×10^{-5}**	**N/A**	**1.68**	**7.23×10^{-5}**	**N/A**	**3.40**	**1.58×10^{-4}**
Year of peak impact	3434	3434	3329	3329	3329	3329	3329	3329	3329
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.76×10^{-3}	5.49×10^{-2}	0.00	5.11×10^{-3}	5.04×10^{-2}	2.26×10^{-11}	5.11×10^{-3}	7.59×10^{-2}	1.04×10^{-6}
Nitrate	1.19	2.12×10^{-2}	0.00	1.32	1.85×10^{-1}	0.00	1.32	4.12×10^{-1}	0.00
Total	**N/A**	**7.61×10^{-2}**	**0.00**	**N/A**	**2.35×10^{-1}**	**2.26×10^{-11}**	**N/A**	**4.88×10^{-1}**	**1.04×10^{-6}**
Year of peak impact	3311	3311	N/A	3354	3354	3311	3354	3354	3311

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–112. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.66×10^{-7}	2.90×10^{-1}	1.02×10^{-5}	1.69×10^{-7}	7.64×10^{-1}	3.35×10^{-5}	1.69×10^{-7}	1.56	7.33×10^{-5}
Iodine-129	1.24×10^{-10}	3.53×10^{-2}	2.78×10^{-7}	8.58×10^{-11}	3.05×10^{-2}	4.30×10^{-7}	8.58×10^{-11}	3.95×10^{-2}	6.50×10^{-7}
Total	**N/A**	**3.25×10^{-1}**	**1.05×10^{-5}**	**N/A**	**7.94×10^{-1}**	**3.40×10^{-5}**	**N/A**	**1.60**	**7.40×10^{-5}**
Year of peak impact	3296	3296	3201	3201	3201	3201	3201	3201	3201

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.82×10^{-7}	1.34×10^{-6}	0.00	5.66×10^{-7}	3.36×10^{-6}	0.00	5.66×10^{-7}	6.08×10^{-6}	0.00
Chromium	3.52×10^{-3}	3.35×10^{-2}	0.00	3.48×10^{-3}	3.44×10^{-2}	1.38×10^{-11}	3.48×10^{-3}	5.17×10^{-2}	6.34×10^{-7}
Nitrate	3.56×10^{-1}	6.36×10^{-3}	0.00	3.67×10^{-1}	5.16×10^{-2}	0.00	3.67×10^{-1}	1.15×10^{-1}	0.00
Total	**N/A**	**3.99×10^{-2}**	**0.00**	**N/A**	**8.59×10^{-2}**	**1.38×10^{-11}**	**N/A**	**1.67×10^{-1}**	**6.34×10^{-7}**
Year of peak impact	3194	3194	N/A	3168	3168	3194	3168	3168	3194

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–113. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	6.12×10^{-7}	1.07	3.69×10^{-5}	6.12×10^{-7}	2.76	1.22×10^{-4}	6.12×10^{-7}	5.64	2.67×10^{-4}
Iodine-129	2.57×10^{-10}	7.31×10^{-2}	8.31×10^{-7}	2.57×10^{-10}	9.13×10^{-2}	6.01×10^{-7}	2.57×10^{-10}	1.18×10^{-1}	9.10×10^{-7}
Total	**N/A**	**1.14**	**3.77×10^{-5}**	**N/A**	**2.85**	**1.23×10^{-4}**	**N/A**	**5.76**	**2.68×10^{-4}**
Year of peak impact	3083	3083	3083	3083	3083	2965	3083	3083	2965
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	4.17×10^{-6}	1.98×10^{-5}	0.00	2.62×10^{-6}	1.56×10^{-5}	0.00	2.62×10^{-6}	2.82×10^{-5}	0.00
Chromium	1.88×10^{-2}	1.79×10^{-1}	0.00	1.75×10^{-2}	1.72×10^{-1}	7.39×10^{-11}	1.75×10^{-2}	2.59×10^{-1}	3.39×10^{-6}
Nitrate	1.39	2.48×10^{-2}	0.00	1.60	2.25×10^{-1}	0.00	1.60	5.02×10^{-1}	0.00
Total	**N/A**	**2.04×10^{-1}**	**0.00**	**N/A**	**3.97×10^{-1}**	**7.39×10^{-11}**	**N/A**	**7.61×10^{-1}**	**3.39×10^{-6}**
Year of peak impact	2960	2960	N/A	2903	2903	2873	2903	2903	2873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–114. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.70×10^{-8}	8.23×10^{-2}	2.83×10^{-6}	4.70×10^{-8}	2.12×10^{-1}	9.31×10^{-6}	4.70×10^{-8}	4.33×10^{-1}	2.04×10^{-5}
Iodine-129	4.59×10^{-11}	1.31×10^{-2}	1.49×10^{-7}	4.59×10^{-11}	1.63×10^{-2}	2.30×10^{-7}	4.59×10^{-11}	2.11×10^{-2}	3.48×10^{-7}
Total	**N/A**	**9.54×10^{-2}**	**2.98×10^{-6}**	**N/A**	**2.28×10^{-1}**	**9.54×10^{-6}**	**N/A**	**4.54×10^{-1}**	**2.07×10^{-5}**
Year of peak impact	4230	4230	4230	4230	4230	4230	4230	4230	4230
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.43×10^{-5}	1.63×10^{-4}	0.00	2.51×10^{-5}	1.49×10^{-4}	0.00	2.51×10^{-5}	2.70×10^{-4}	0.00
Chromium	1.04×10^{-3}	9.91×10^{-3}	0.00	1.01×10^{-3}	9.98×10^{-3}	4.18×10^{-12}	1.01×10^{-3}	1.50×10^{-2}	1.92×10^{-7}
Nitrate	1.50×10^{-1}	2.69×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.65×10^{-1}	5.16×10^{-2}	0.00
Total	**N/A**	**1.28×10^{-2}**	**0.00**	**N/A**	**3.33×10^{-2}**	**4.18×10^{-12}**	**N/A**	**6.69×10^{-2}**	**1.92×10^{-7}**
Year of peak impact	3914	3914	N/A	4221	4221	4025	4221	4221	4025

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–115. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the Columbia River Surface Water

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.32×10^{-12}	1.05×10^{-5}	4.60×10^{-10}	2.29×10^{-12}	2.39×10^{-5}	1.13×10^{-9}	4.70×10^{-8}	1.43×10^{-3}	7.64×10^{-8}
Iodine-129	1.75×10^{-15}	6.24×10^{-7}	8.79×10^{-12}	1.88×10^{-15}	1.02×10^{-5}	2.46×10^{-10}	4.59×10^{-11}	2.27×10^{-4}	5.57×10^{-9}
Total	**N/A**	**1.11×10^{-5}**	**4.69×10^{-10}**	**N/A**	**3.41×10^{-5}**	**1.38×10^{-9}**	**N/A**	**1.66×10^{-3}**	**8.20×10^{-8}**
Year of peak impact	3896	3896	3896	3941	3941	3941	4230	4230	4230

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.83×10^{-5}	2.90×10^{-4}	0.00
Chromium	4.72×10^{-8}	4.67×10^{-7}	1.90×10^{-16}	4.72×10^{-8}	7.65×10^{-7}	8.74×10^{-12}	1.01×10^{-3}	4.45×10^{-3}	1.92×10^{-7}
Nitrate	5.76×10^{-6}	8.72×10^{-7}	0.00	5.76×10^{-6}	5.43×10^{-4}	0.00	1.49×10^{-1}	9.83×10^{-3}	0.00
Total	**N/A**	**1.34×10^{-6}**	**1.90×10^{-16}**	**N/A**	**5.44×10^{-4}**	**8.74×10^{-12}**	**N/A**	**1.46×10^{-2}**	**1.92×10^{-7}**
Year of peak impact	3728	3728	3719	3728	3728	3719	3750	3750	4025

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

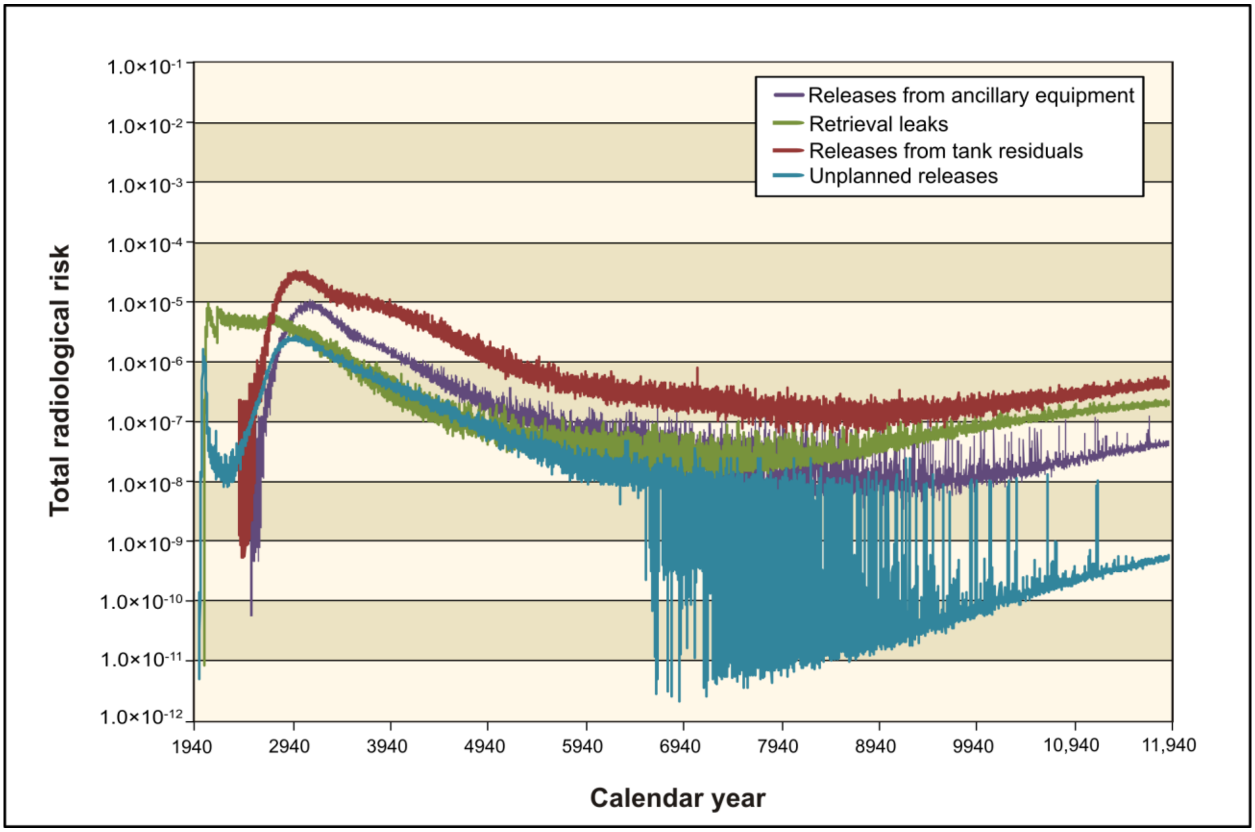


Figure Q–5. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary from Unplanned Releases, Retrieval Leaks, and Releases from Ancillary Equipment and Tank Residuals

Q.3.1.1.4 Tank Closure Alternative 4

Under Tank Closure Alternative 4, tank waste would be retrieved to a volume corresponding to 99.9 percent retrieval. Except for the BX and SX tank farms, residual material in tanks would be stabilized in place and the tank farms and adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. The BX and SX tank farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column.

Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–116 through Q–120; to past leaks after CY 1940, in Tables Q–121 through Q–128; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–129 through Q–136.

Table Q–116. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–117. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	$\mathbf{8.91\times10^{2}}$	$\mathbf{8.46\times10^{-3}}$	**N/A**	$\mathbf{1.04\times10^{3}}$	$\mathbf{1.02\times10^{-2}}$	**N/A**	$\mathbf{1.23\times10^{3}}$	$\mathbf{1.30\times10^{-2}}$
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	$\mathbf{9.18\times10^{1}}$	**0.00**	**N/A**	$\mathbf{2.84\times10^{2}}$	$\mathbf{2.65\times10^{-8}}$	**N/A**	$\mathbf{5.85\times10^{2}}$	$\mathbf{1.21\times10^{-3}}$
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–118. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–119. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–120. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	$\mathbf{3.44\times10^{-4}}$	$\mathbf{1.11\times10^{-8}}$	**N/A**	$\mathbf{9.82\times10^{-4}}$	$\mathbf{3.41\times10^{-8}}$	**N/A**	$\mathbf{9.67\times10^{-2}}$	$\mathbf{2.66\times10^{-6}}$
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	$\mathbf{8.95\times10^{-4}}$	$\mathbf{6.82\times10^{-14}}$	**N/A**	$\mathbf{4.54\times10^{-1}}$	$\mathbf{3.13\times10^{-9}}$	**N/A**	**4.61**	$\mathbf{4.10\times10^{-5}}$
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–121. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the A Barrier Boundary

	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.90×10^{-7}	2.23×10^{-2}	2.11×10^{-7}	1.90×10^{-7}	2.59×10^{-2}	2.55×10^{-7}	1.90×10^{-7}	3.08×10^{-2}	3.23×10^{-7}
Technetium-99	1.40×10^{-6}	2.44	8.40×10^{-5}	1.40×10^{-6}	6.30	2.76×10^{-4}	1.40×10^{-6}	1.29×10^{1}	6.04×10^{-4}
Iodine-129	5.45×10^{-10}	1.55×10^{-1}	1.76×10^{-6}	5.45×10^{-10}	1.94×10^{-1}	2.73×10^{-6}	5.45×10^{-10}	2.51×10^{-1}	4.13×10^{-6}
Total	**N/A**	**2.62**	$\mathbf{8.60\times10^{-5}}$	**N/A**	**6.52**	$\mathbf{2.79\times10^{-4}}$	**N/A**	$\mathbf{1.31\times10^{1}}$	$\mathbf{6.09\times10^{-4}}$
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.25×10^{-2}	5.95×10^{-1}	0.00	6.25×10^{-2}	6.17×10^{-1}	2.45×10^{-10}	6.25×10^{-2}	9.28×10^{-1}	1.13×10^{-5}
Nitrate	1.97	3.51×10^{-2}	0.00	1.97	2.76×10^{-1}	0.00	1.97	6.16×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.30\times10^{-1}}$	**0.00**	**N/A**	$\mathbf{8.93\times10^{-1}}$	$\mathbf{2.45\times10^{-10}}$	**N/A**	**1.54**	$\mathbf{1.13\times10^{-5}}$
Year of peak impact	2103	2103	N/A	2103	2103	2103	2103	2103	2103

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–122. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.78×10^{-9}	3.26×10^{-4}	3.09×10^{-9}	2.78×10^{-9}	3.78×10^{-4}	3.73×10^{-9}	2.78×10^{-9}	4.51×10^{-4}	4.73×10^{-9}
Technetium-99	1.58×10^{-6}	2.76	9.50×10^{-5}	1.58×10^{-6}	7.12	3.12×10^{-4}	1.58×10^{-6}	1.45×10^{1}	6.83×10^{-4}
Iodine-129	2.41×10^{-9}	6.88×10^{-1}	7.82×10^{-6}	2.41×10^{-9}	8.59×10^{-1}	1.21×10^{-5}	2.41×10^{-9}	1.11	1.83×10^{-5}
Total	**N/A**	**3.45**	**1.03×10^{-4}**	**N/A**	**7.98**	**3.25×10^{-4}**	**N/A**	**1.56×10^{1}**	**7.02×10^{-4}**
Year of peak impact	2074	2074	2074	2074	2074	2074	2074	2074	2074
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.63×10^{-2}	5.36×10^{-1}	0.00	5.63×10^{-2}	5.56×10^{-1}	2.21×10^{-10}	5.38×10^{-2}	7.99×10^{-1}	1.01×10^{-5}
Nitrate	2.51	4.49×10^{-2}	0.00	2.51	3.53×10^{-1}	0.00	2.67	8.37×10^{-1}	0.00
Total	**N/A**	**5.81×10^{-1}**	**0.00**	**N/A**	**9.09×10^{-1}**	**2.21×10^{-10}**	**N/A**	**1.64**	**1.01×10^{-5}**
Year of peak impact	2093	2093	N/A	2093	2093	2093	2095	2095	2093

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–123. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.64×10^{-7}	1.91×10^{-2}	1.81×10^{-7}	1.64×10^{-7}	2.22×10^{-2}	2.19×10^{-7}	1.64×10^{-7}	2.65×10^{-2}	2.78×10^{-7}
Technetium-99	2.46×10^{-6}	4.30	1.48×10^{-4}	2.46×10^{-6}	1.11×10^{1}	4.86×10^{-4}	2.46×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.64×10^{-9}	1.32	1.50×10^{-5}	4.64×10^{-9}	1.65	2.33×10^{-5}	4.64×10^{-9}	2.14	3.52×10^{-5}
Total	**N/A**	**5.64**	**1.63×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.10×10^{-4}**	**N/A**	**2.48×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.34	0.00	2.46×10^{-1}	2.43	9.65×10^{-10}	2.46×10^{-1}	3.65	4.43×10^{-5}
Nitrate	7.03	1.25×10^{-1}	0.00	7.03	9.86×10^{-1}	0.00	7.03	2.20	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.41**	**9.65×10^{-10}**	**N/A**	**5.85**	**4.43×10^{-5}**
Year of peak impact	2026	2026	N/A	2026	2026	2026	2026	2026	2026

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–124. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.07×10^{-6}	2.42×10^{-1}	2.30×10^{-6}	2.07×10^{-6}	2.82×10^{-1}	2.78×10^{-6}	2.07×10^{-6}	3.36×10^{-1}	3.52×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.34×10^{-4}	1.05×10^{-5}	4.75×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.70×10^{1}	4.56×10^{-3}
Iodine-129	2.00×10^{-8}	5.70	6.48×10^{-5}	2.00×10^{-8}	7.12	1.00×10^{-4}	2.00×10^{-8}	9.20	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.01×10^{-4}**	**N/A**	**5.49×10^{1}**	**2.19×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.03×10^{-1}	2.88	0.00	3.03×10^{-1}	2.99	1.19×10^{-9}	3.03×10^{-1}	4.50	5.46×10^{-5}
Nitrate	2.41×10^{1}	4.30×10^{-1}	0.00	2.41×10^{1}	3.38	0.00	2.41×10^{1}	7.53	0.00
Total	**N/A**	**3.31**	**0.00**	**N/A**	**6.37**	**1.19×10^{-9}**	**N/A**	**1.20×10^{1}**	**5.46×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–125. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.49×10^{-8}	1.74×10^{-3}	1.65×10^{-8}	1.49×10^{-8}	2.03×10^{-3}	2.00×10^{-8}	1.49×10^{-8}	2.41×10^{-3}	2.53×10^{-8}
Technetium-99	1.29×10^{-7}	2.26×10^{-1}	7.79×10^{-6}	1.29×10^{-7}	5.84×10^{-1}	2.56×10^{-5}	1.29×10^{-7}	1.19	5.60×10^{-5}
Iodine-129	1.55×10^{-10}	4.41×10^{-2}	5.02×10^{-7}	1.55×10^{-10}	5.51×10^{-2}	7.76×10^{-7}	1.55×10^{-10}	7.12×10^{-2}	1.17×10^{-6}
Total	**N/A**	**2.72×10^{-1}**	**8.31×10^{-6}**	**N/A**	**6.41×10^{-1}**	**2.64×10^{-5}**	**N/A**	**1.27**	**5.72×10^{-5}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.16×10^{-3}	5.86×10^{-2}	0.00	6.16×10^{-3}	6.08×10^{-2}	2.42×10^{-11}	5.99×10^{-3}	8.90×10^{-2}	1.11×10^{-6}
Nitrate	4.28×10^{-1}	7.64×10^{-3}	0.00	4.28×10^{-1}	6.01×10^{-2}	0.00	4.38×10^{-1}	1.37×10^{-1}	0.00
Total	**N/A**	**6.63×10^{-2}**	**0.00**	**N/A**	**1.21×10^{-1}**	**2.42×10^{-11}**	**N/A**	**2.26×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2041	2041	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–126. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	9.20×10^{-9}	1.08×10^{-3}	1.02×10^{-8}	9.20×10^{-9}	1.25×10^{-3}	1.23×10^{-8}	9.20×10^{-9}	1.49×10^{-3}	1.56×10^{-8}
Technetium-99	1.58×10^{-6}	2.76	9.50×10^{-5}	1.58×10^{-6}	7.12	3.12×10^{-4}	1.58×10^{-6}	1.45×10^{1}	6.83×10^{-4}
Iodine-129	2.41×10^{-9}	6.88×10^{-1}	7.82×10^{-6}	2.41×10^{-9}	8.59×10^{-1}	1.21×10^{-5}	2.41×10^{-9}	1.11	1.83×10^{-5}
Total	**N/A**	**3.45**	**1.03×10^{-4}**	**N/A**	**7.98**	**3.25×10^{-4}**	**N/A**	**1.56×10^{1}**	**7.02×10^{-4}**
Year of peak impact	2074	2074	2074	2074	2074	2074	2074	2074	2074

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.31×10^{-2}	6.96×10^{-1}	0.00	7.31×10^{-2}	7.22×10^{-1}	2.87×10^{-10}	7.31×10^{-2}	1.09	1.32×10^{-5}
Nitrate	2.62	4.68×10^{-2}	0.00	2.62	3.68×10^{-1}	0.00	2.62	8.21×10^{-1}	0.00
Total	**N/A**	**7.43×10^{-1}**	**0.00**	**N/A**	**1.09**	**2.87×10^{-10}**	**N/A**	**1.91**	**1.32×10^{-5}**
Year of peak impact	2098	2098	N/A	2098	2098	2098	2098	2098	2098

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–127. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.57×10^{-7}	6.25×10^{-1}	2.16×10^{-5}	3.59×10^{-7}	1.62	7.10×10^{-5}	3.59×10^{-7}	3.30	1.55×10^{-4}
Iodine-129	6.21×10^{-10}	1.77×10^{-1}	1.96×10^{-6}	6.04×10^{-10}	2.15×10^{-1}	3.02×10^{-6}	6.04×10^{-10}	2.78×10^{-1}	4.58×10^{-6}
Total	**N/A**	$\mathbf{8.02\times10^{-1}}$	$\mathbf{2.35\times10^{-5}}$	**N/A**	**1.83**	$\mathbf{7.40\times10^{-5}}$	**N/A**	**3.58**	$\mathbf{1.60\times10^{-4}}$
Year of peak impact	2242	2242	2228	2228	2228	2228	2228	2228	2228

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.37×10^{-3}	7.02×10^{-2}	0.00	6.74×10^{-3}	6.66×10^{-2}	2.89×10^{-11}	6.74×10^{-3}	1.00×10^{-1}	1.33×10^{-6}
Nitrate	5.76×10^{-1}	1.03×10^{-2}	0.00	6.45×10^{-1}	9.05×10^{-2}	0.00	6.45×10^{-1}	2.02×10^{-1}	0.00
Total	**N/A**	$\mathbf{8.04\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.57\times10^{-1}}$	$\mathbf{2.89\times10^{-11}}$	**N/A**	$\mathbf{3.02\times10^{-1}}$	$\mathbf{1.33\times10^{-6}}$
Year of peak impact	2253	2253	N/A	2222	2222	2253	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–128. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.45×10^{-12}	3.36×10^{-5}	1.47×10^{-9}	7.42×10^{-12}	7.72×10^{-5}	3.67×10^{-9}	3.59×10^{-7}	1.08×10^{-2}	5.77×10^{-7}
Iodine-129	1.39×10^{-14}	4.96×10^{-6}	6.99×10^{-11}	1.40×10^{-14}	7.65×10^{-5}	1.84×10^{-9}	6.04×10^{-10}	2.23×10^{-3}	5.47×10^{-8}
Total	**N/A**	**3.85×10^{-5}**	**1.54×10^{-9}**	**N/A**	**1.54×10^{-4}**	**5.50×10^{-9}**	**N/A**	**1.30×10^{-2}**	**6.32×10^{-7}**
Year of peak impact	2180	2180	2180	2184	2184	2184	2228	2228	2228
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.76×10^{-7}	2.73×10^{-6}	1.09×10^{-15}	2.60×10^{-7}	4.20×10^{-6}	4.99×10^{-11}	6.74×10^{-3}	2.97×10^{-2}	1.33×10^{-6}
Nitrate	1.50×10^{-5}	2.26×10^{-6}	0.00	1.52×10^{-5}	1.43×10^{-3}	0.00	6.45×10^{-1}	3.23×10^{-2}	0.00
Total	**N/A**	**4.99×10^{-6}**	**1.09×10^{-15}**	**N/A**	**1.44×10^{-3}**	**4.99×10^{-11}**	**N/A**	**6.19×10^{-2}**	**1.33×10^{-6}**
Year of peak impact	2195	2195	2193	2184	2184	2193	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–129. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	9.40×10^{-10}	1.10×10^{-4}	1.04×10^{-9}	9.40×10^{-10}	1.28×10^{-4}	1.26×10^{-9}	9.40×10^{-10}	1.52×10^{-4}	1.60×10^{-9}
Technetium-99	7.90×10^{-7}	1.38	4.75×10^{-5}	7.90×10^{-7}	3.56	1.56×10^{-4}	7.90×10^{-7}	7.27	3.42×10^{-4}
Iodine-129	1.39×10^{-9}	3.95×10^{-1}	4.49×10^{-6}	1.39×10^{-9}	4.93×10^{-1}	6.94×10^{-6}	1.39×10^{-9}	6.38×10^{-1}	1.05×10^{-5}
Total	**N/A**	**1.78**	**5.20×10^{-5}**	**N/A**	**4.06**	**1.63×10^{-4}**	**N/A**	**7.91**	**3.52×10^{-4}**
Year of peak impact	2100	2100	2100	2100	2100	2100	2100	2100	2100
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.11×10^{-2}	6.77×10^{-1}	0.00	6.09×10^{-2}	6.01×10^{-1}	2.79×10^{-10}	6.09×10^{-2}	9.05×10^{-1}	1.28×10^{-5}
Nitrate	1.52×10^{1}	2.71×10^{-1}	0.00	1.76×10^{1}	2.47	0.00	1.76×10^{1}	5.50	0.00
Total	**N/A**	**9.48×10^{-1}**	**0.00**	**N/A**	**3.07**	**2.79×10^{-10}**	**N/A**	**6.41**	**1.28×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–130. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.30×10^{-7}	2.69×10^{-2}	2.55×10^{-7}	2.30×10^{-7}	3.13×10^{-2}	3.08×10^{-7}	2.30×10^{-7}	3.72×10^{-2}	3.91×10^{-7}
Technetium-99	3.50×10^{-6}	6.13	2.11×10^{-4}	3.50×10^{-6}	1.58×10^{1}	6.93×10^{-4}	3.50×10^{-6}	3.22×10^{1}	1.52×10^{-3}
Iodine-129	4.33×10^{-9}	1.23	1.40×10^{-5}	4.33×10^{-9}	1.54	2.17×10^{-5}	4.33×10^{-9}	1.99	3.28×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.38**	$\mathbf{2.25\times10^{-4}}$	**N/A**	$\mathbf{1.74\times10^{1}}$	$\mathbf{7.15\times10^{-4}}$	**N/A**	$\mathbf{3.43\times10^{1}}$	$\mathbf{1.55\times10^{-3}}$
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.73×10^{-1}	1.71	8.44×10^{-10}	1.73×10^{-1}	2.57	3.87×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	$\mathbf{2.57\times10^{1}}$	$\mathbf{8.44\times10^{-10}}$	**N/A**	$\mathbf{5.60\times10^{1}}$	$\mathbf{3.87\times10^{-5}}$
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–131. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.35×10^{-9}	5.09×10^{-4}	4.83×10^{-9}	4.35×10^{-9}	5.92×10^{-4}	5.83×10^{-9}	4.35×10^{-9}	7.05×10^{-4}	7.40×10^{-9}
Technetium-99	1.96×10^{-7}	3.44×10^{-1}	1.18×10^{-5}	1.96×10^{-7}	8.85×10^{-1}	3.89×10^{-5}	1.96×10^{-7}	1.81	8.50×10^{-5}
Iodine-129	3.84×10^{-10}	1.10×10^{-1}	1.25×10^{-6}	3.84×10^{-10}	1.37×10^{-1}	1.93×10^{-6}	3.84×10^{-10}	1.77×10^{-1}	2.91×10^{-6}
Total	**N/A**	**4.54×10^{-1}**	**1.31×10^{-5}**	**N/A**	**1.02**	**4.08×10^{-5}**	**N/A**	**1.99**	**8.79×10^{-5}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.69×10^{-2}	2.56×10^{-1}	0.00	2.62×10^{-2}	2.58×10^{-1}	1.05×10^{-10}	2.62×10^{-2}	3.89×10^{-1}	4.84×10^{-6}
Nitrate	9.06×10^{-1}	1.62×10^{-2}	0.00	9.65×10^{-1}	1.35×10^{-1}	0.00	9.65×10^{-1}	3.02×10^{-1}	0.00
Total	**N/A**	**2.72×10^{-1}**	**0.00**	**N/A**	**3.94×10^{-1}**	**1.05×10^{-10}**	**N/A**	**6.91×10^{-1}**	**4.84×10^{-6}**
Year of peak impact	2059	2059	N/A	2070	2070	2059	2070	2070	2059

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–132. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.59×10^{-6}	1.15×10^{1}	3.97×10^{-4}	6.59×10^{-6}	2.97×10^{1}	1.31×10^{-3}	6.59×10^{-6}	6.07×10^{1}	2.86×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.49	6.32×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	$\mathbf{1.55\times10^{1}}$	$\mathbf{4.41\times10^{-4}}$	**N/A**	$\mathbf{3.46\times10^{1}}$	$\mathbf{1.37\times10^{-3}}$	**N/A**	$\mathbf{6.70\times10^{1}}$	$\mathbf{2.96\times10^{-3}}$
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.53×10^{-1}	3.36	0.00	3.53×10^{-1}	3.49	1.39×10^{-9}	3.53×10^{-1}	5.25	6.36×10^{-5}
Nitrate	6.20×10^{1}	1.11	0.00	6.20×10^{1}	8.70	0.00	6.20×10^{1}	1.94×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.47**	**0.00**	**N/A**	$\mathbf{1.22\times10^{1}}$	$\mathbf{1.39\times10^{-9}}$	**N/A**	$\mathbf{2.46\times10^{1}}$	$\mathbf{6.36\times10^{-5}}$
Year of peak impact	2051	2051	N/A	2051	2051	2045	2051	2051	2045

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–133. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.09×10^{-8}	1.28×10^{-3}	1.21×10^{-8}	1.09×10^{-8}	1.49×10^{-3}	1.46×10^{-8}	1.09×10^{-8}	1.77×10^{-3}	1.86×10^{-8}
Technetium-99	1.47×10^{-7}	2.57×10^{-1}	8.83×10^{-6}	1.47×10^{-7}	6.61×10^{-1}	2.90×10^{-5}	1.47×10^{-7}	1.35	6.35×10^{-5}
Iodine-129	1.96×10^{-10}	5.60×10^{-2}	6.36×10^{-7}	1.96×10^{-10}	6.99×10^{-2}	9.84×10^{-7}	1.96×10^{-10}	9.03×10^{-2}	1.49×10^{-6}
Total	**N/A**	**3.14×10^{-1}**	**9.47×10^{-6}**	**N/A**	**7.33×10^{-1}**	**3.00×10^{-5}**	**N/A**	**1.44**	**6.50×10^{-5}**
Year of peak impact	2058	2058	2058	2058	2058	2058	2058	2058	2058
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.76×10^{-3}	5.48×10^{-2}	0.00	4.90×10^{-3}	4.84×10^{-2}	2.30×10^{-11}	4.90×10^{-3}	7.28×10^{-2}	1.06×10^{-6}
Nitrate	7.01×10^{-1}	1.25×10^{-2}	0.00	9.09×10^{-1}	1.28×10^{-1}	0.00	9.09×10^{-1}	2.85×10^{-1}	0.00
Total	**N/A**	**6.73×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**2.30×10^{-11}**	**N/A**	**3.57×10^{-1}**	**1.06×10^{-6}**
Year of peak impact	2056	2056	N/A	2071	2071	2050	2071	2071	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–134. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	5.27×10^{-7}	4.75×10^{-7}	6.46×10^{-2}	6.37×10^{-7}	4.75×10^{-7}	7.70×10^{-2}	8.08×10^{-7}
Technetium-99	3.50×10^{-6}	6.13	2.11×10^{-4}	3.50×10^{-6}	1.58×10^{1}	6.93×10^{-4}	3.50×10^{-6}	3.22×10^{1}	1.52×10^{-3}
Iodine-129	4.33×10^{-9}	1.23	1.40×10^{-5}	4.33×10^{-9}	1.54	2.17×10^{-5}	4.33×10^{-9}	1.99	3.28×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.41**	**2.25×10^{-4}**	**N/A**	**1.74×10^{1}**	**7.15×10^{-4}**	**N/A**	**3.43×10^{1}**	**1.55×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.15×10^{-1}	2.05	0.00	1.73×10^{-1}	1.71	8.44×10^{-10}	1.73×10^{-1}	2.57	3.87×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.44×10^{-10}**	**N/A**	**5.60×10^{1}**	**3.87×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–135. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.90×10^{-11}	2.22×10^{-6}	2.11×10^{-11}	1.90×10^{-11}	2.58×10^{-6}	1.29×10^{-11}	1.90×10^{-11}	3.08×10^{-6}	1.64×10^{-11}
Technetium-99	3.92×10^{-7}	6.85×10^{-1}	2.36×10^{-5}	3.92×10^{-7}	1.77	7.76×10^{-5}	3.92×10^{-7}	3.61	1.70×10^{-4}
Iodine-129	6.88×10^{-10}	1.96×10^{-1}	2.23×10^{-6}	6.88×10^{-10}	2.45×10^{-1}	3.39×10^{-6}	6.88×10^{-10}	3.17×10^{-1}	5.13×10^{-6}
Total	**N/A**	**8.82×10^{-1}**	**2.58×10^{-5}**	**N/A**	**2.01**	**8.10×10^{-5}**	**N/A**	**3.92**	**1.75×10^{-4}**
Year of peak impact	2242	2242	2242	2242	2242	2254	2242	2242	2254

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.09×10^{-2}	6.75×10^{-1}	0.00	7.09×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.09×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–136. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	9.71×10^{-12}	4.38×10^{-5}	1.92×10^{-9}	9.71×10^{-12}	1.01×10^{-4}	4.79×10^{-9}	3.92×10^{-7}	1.18×10^{-2}	6.31×10^{-7}
Iodine-129	1.66×10^{-14}	5.94×10^{-6}	8.37×10^{-11}	1.66×10^{-14}	9.07×10^{-5}	2.18×10^{-9}	6.88×10^{-10}	2.53×10^{-3}	6.22×10^{-8}
Total	**N/A**	**4.97×10^{-5}**	**2.01×10^{-9}**	**N/A**	**1.92×10^{-4}**	**6.97×10^{-9}**	**N/A**	**1.43×10^{-2}**	**6.93×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2242	2242	2242
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.79×10^{-7}	9.67×10^{-6}	3.84×10^{-15}	9.79×10^{-7}	1.58×10^{-5}	1.76×10^{-10}	7.09×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.17×10^{-4}	4.79×10^{-5}	0.00	3.17×10^{-4}	2.98×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.76×10^{-5}**	**3.84×10^{-15}**	**N/A**	**2.99×10^{-2}**	**1.76×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Similar to Alternatives 2A, 2B, 3A, 3B, and 3C, the risk and hazard drivers are tritium, technetium-99, iodine-129, uranium-238, chromium, nitrate, and total uranium. The dose standard and Hazard Index guidelines would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C for releases from cribs and trenches (ditches). The dose standard would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C for releases from past leaks with slightly less impacts at the B Barrier, S Barrier, and Core Zone Boundary as a result of clean closure at the two tank farms located within the B and S Barriers. Impacts would be slightly less than under Alternatives 2B, 3A, 3B, 3C, and 6C as a result of the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), except for the S Barrier, where no exceedances were identified. Overall, the population dose is estimated as 2.49×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–6 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2070 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. For the period of time between CYs 3100 and 5500, other tank farm sources, primarily tank residuals, make a major contribution to peak radiological risk. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by tritium, technetium-99, and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

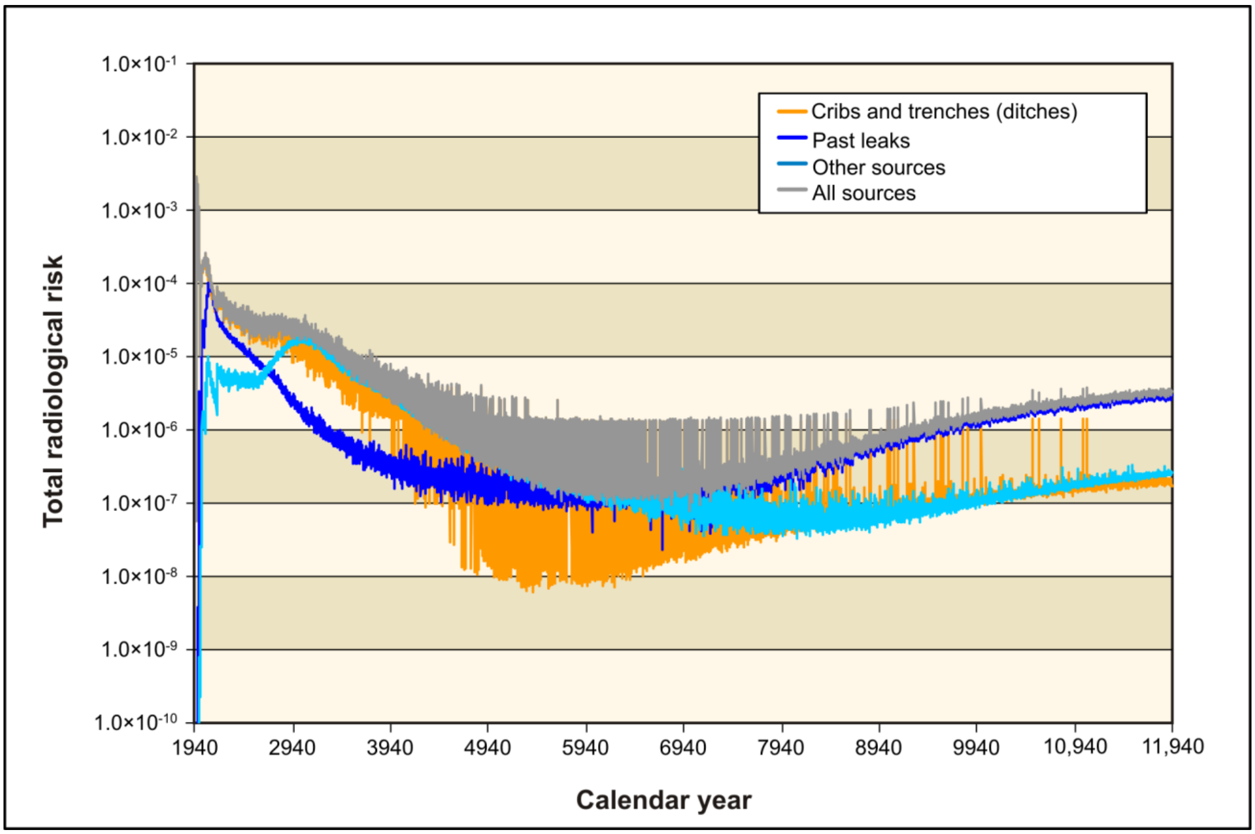


Figure Q–6. Tank Closure Alternative 4 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.5 Tank Closure Alternative 5

Under Tank Closure Alternative 5, tank waste would be retrieved to a volume corresponding to 90 percent retrieval, residual material in tanks would be stabilized in place, and the tank farms and adjacent cribs and trenches (ditches) would be covered with a Hanford barrier. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–137 through Q–141; to past leaks after CY 1940, in Tables Q–142 through Q–149; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–150 through Q–157.

The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, 3C, and 4 for releases from cribs and trenches (ditches). The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C, but would be slightly higher than under those alternatives. Population dose is estimated as 4.24×10^{-1} person-rem per year for the year of maximum impact.

Table Q–137. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–138. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	$\mathbf{8.91\times10^{2}}$	$\mathbf{8.46\times10^{-3}}$	**N/A**	$\mathbf{1.04\times10^{3}}$	$\mathbf{1.02\times10^{-2}}$	**N/A**	$\mathbf{1.23\times10^{3}}$	$\mathbf{1.30\times10^{-2}}$
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	$\mathbf{9.18\times10^{1}}$	**0.00**	**N/A**	$\mathbf{2.84\times10^{2}}$	$\mathbf{2.65\times10^{-8}}$	**N/A**	$\mathbf{5.85\times10^{2}}$	$\mathbf{1.21\times10^{-3}}$
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–139. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–140. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–141. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–142. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.90×10^{-7}	2.23×10^{-2}	2.11×10^{-7}	1.90×10^{-7}	2.59×10^{-2}	2.55×10^{-7}	1.90×10^{-7}	3.08×10^{-2}	3.23×10^{-7}
Technetium-99	1.36×10^{-6}	2.38	8.19×10^{-5}	1.36×10^{-6}	6.14	2.69×10^{-4}	1.36×10^{-6}	1.25×10^{1}	5.89×10^{-4}
Iodine-129	5.37×10^{-10}	1.53×10^{-1}	1.74×10^{-6}	5.37×10^{-10}	1.91×10^{-1}	2.69×10^{-6}	5.37×10^{-10}	2.47×10^{-1}	4.07×10^{-6}
Total	**N/A**	**2.56**	$\mathbf{8.39\times10^{-5}}$	**N/A**	**6.36**	$\mathbf{2.72\times10^{-4}}$	**N/A**	$\mathbf{1.28\times10^{1}}$	$\mathbf{5.94\times10^{-4}}$
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.69×10^{-2}	6.37×10^{-1}	0.00	6.69×10^{-2}	6.61×10^{-1}	2.63×10^{-10}	6.69×10^{-2}	9.94×10^{-1}	1.21×10^{-5}
Nitrate	1.98	3.53×10^{-2}	0.00	1.98	2.77×10^{-1}	0.00	1.98	6.18×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.73\times10^{-1}}$	**0.00**	**N/A**	$\mathbf{9.38\times10^{-1}}$	$\mathbf{2.63\times10^{-10}}$	**N/A**	**1.61**	$\mathbf{1.21\times10^{-5}}$
Year of peak impact	2105	2105	N/A	2105	2105	2105	2105	2105	2105

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–143. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.48×10^{-9}	1.73×10^{-4}	1.64×10^{-9}	1.48×10^{-9}	2.01×10^{-4}	1.98×10^{-9}	1.48×10^{-9}	2.39×10^{-4}	2.51×10^{-9}
Technetium-99	1.53×10^{-6}	2.68	9.22×10^{-5}	1.53×10^{-6}	6.91	3.03×10^{-4}	1.53×10^{-6}	1.41×10^{1}	6.63×10^{-4}
Iodine-129	2.79×10^{-9}	7.96×10^{-1}	9.05×10^{-6}	2.79×10^{-9}	9.94×10^{-1}	1.40×10^{-5}	2.79×10^{-9}	1.28	2.12×10^{-5}
Total	**N/A**	**3.48**	**1.01×10^{-4}**	**N/A**	**7.90**	**3.17×10^{-4}**	**N/A**	**1.54×10^{1}**	**6.85×10^{-4}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.51×10^{-2}	6.20×10^{-1}	0.00	6.51×10^{-2}	6.43×10^{-1}	2.56×10^{-10}	6.51×10^{-2}	9.67×10^{-1}	1.17×10^{-5}
Nitrate	2.51	4.48×10^{-2}	0.00	2.51	3.52×10^{-1}	0.00	2.51	7.86×10^{-1}	0.00
Total	**N/A**	**6.65×10^{-1}**	**0.00**	**N/A**	**9.95×10^{-1}**	**2.56×10^{-10}**	**N/A**	**1.75**	**1.17×10^{-5}**
Year of peak impact	2107	2107	N/A	2107	2107	2107	2107	2107	2107

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–144. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.58×10^{-7}	1.85×10^{-2}	1.75×10^{-7}	1.58×10^{-7}	2.15×10^{-2}	2.12×10^{-7}	1.58×10^{-7}	2.56×10^{-2}	2.69×10^{-7}
Technetium-99	2.45×10^{-6}	4.28	1.47×10^{-4}	2.45×10^{-6}	1.10×10^{1}	4.84×10^{-4}	2.45×10^{-6}	2.25×10^{1}	1.06×10^{-3}
Iodine-129	4.66×10^{-9}	1.33	1.51×10^{-5}	4.66×10^{-9}	1.66	2.33×10^{-5}	4.66×10^{-9}	2.14	3.53×10^{-5}
Total	**N/A**	**5.63**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.08×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.09×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.39×10^{-1}	2.28	0.00	2.39×10^{-1}	2.36	9.39×10^{-10}	2.39×10^{-1}	3.55	4.30×10^{-5}
Nitrate	7.05	1.26×10^{-1}	0.00	7.05	9.90×10^{-1}	0.00	7.05	2.21	0.00
Total	**N/A**	**2.40**	**0.00**	**N/A**	**3.35**	**9.39×10^{-10}**	**N/A**	**5.76**	**4.30×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–145. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.91×10^{-6}	2.24×10^{-1}	2.34×10^{-6}	2.11×10^{-6}	2.87×10^{-1}	2.83×10^{-6}	2.11×10^{-6}	3.42×10^{-1}	3.59×10^{-6}
Technetium-99	1.04×10^{-5}	1.83×10^{1}	6.30×10^{-4}	1.05×10^{-5}	4.72×10^{1}	2.07×10^{-3}	1.05×10^{-5}	9.64×10^{1}	4.53×10^{-3}
Iodine-129	2.03×10^{-8}	5.79	6.45×10^{-5}	1.99×10^{-8}	7.09	9.98×10^{-5}	1.99×10^{-8}	9.16	1.51×10^{-4}
Total	**N/A**	$\mathbf{2.43\times10^{1}}$	$\mathbf{6.97\times10^{-4}}$	**N/A**	$\mathbf{5.46\times10^{1}}$	$\mathbf{2.18\times10^{-3}}$	**N/A**	$\mathbf{1.06\times10^{2}}$	$\mathbf{4.69\times10^{-3}}$
Year of peak impact	2024	2024	2022	2022	2022	2022	2022	2022	2022
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.01×10^{-1}	2.87	0.00	3.01×10^{-1}	2.98	1.18×10^{-9}	3.01×10^{-1}	4.48	5.43×10^{-5}
Nitrate	2.38×10^{1}	4.25×10^{-1}	0.00	2.38×10^{1}	3.34	0.00	2.38×10^{1}	7.45	0.00
Total	**N/A**	**3.30**	**0.00**	**N/A**	**6.32**	$\mathbf{1.18\times10^{-9}}$	**N/A**	$\mathbf{1.19\times10^{1}}$	$\mathbf{5.43\times10^{-5}}$
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–146. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.58×10^{-8}	1.85×10^{-3}	1.75×10^{-8}	1.58×10^{-8}	2.15×10^{-3}	2.11×10^{-8}	1.58×10^{-8}	2.56×10^{-3}	2.68×10^{-8}
Technetium-99	1.27×10^{-7}	2.22×10^{-1}	7.63×10^{-6}	1.27×10^{-7}	5.72×10^{-1}	2.51×10^{-5}	1.27×10^{-7}	1.17	5.49×10^{-5}
Iodine-129	1.58×10^{-10}	4.50×10^{-2}	5.12×10^{-7}	1.58×10^{-10}	5.62×10^{-2}	7.91×10^{-7}	1.58×10^{-10}	7.26×10^{-2}	1.20×10^{-6}
Total	**N/A**	**2.69×10^{-1}**	**8.16×10^{-6}**	**N/A**	**6.30×10^{-1}**	**2.59×10^{-5}**	**N/A**	**1.24**	**5.61×10^{-5}**
Year of peak impact	2049	2049	2049	2049	2049	2049	2049	2049	2049

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.17×10^{-3}	5.88×10^{-2}	0.00	6.17×10^{-3}	6.10×10^{-2}	2.42×10^{-11}	6.00×10^{-3}	8.91×10^{-2}	1.11×10^{-6}
Nitrate	4.33×10^{-1}	7.73×10^{-3}	0.00	4.33×10^{-1}	6.08×10^{-2}	0.00	4.45×10^{-1}	1.39×10^{-1}	0.00
Total	**N/A**	**6.65×10^{-2}**	**0.00**	**N/A**	**1.22×10^{-1}**	**2.42×10^{-11}**	**N/A**	**2.28×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2038	2038	N/A	2038	2038	2038	2040	2040	2038

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–147. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.81×10^{-9}	2.12×10^{-4}	2.01×10^{-9}	1.81×10^{-9}	2.46×10^{-4}	2.43×10^{-9}	1.81×10^{-9}	2.93×10^{-4}	3.08×10^{-9}
Technetium-99	1.53×10^{-6}	2.68	9.22×10^{-5}	1.53×10^{-6}	6.91	3.03×10^{-4}	1.53×10^{-6}	1.41×10^{1}	6.63×10^{-4}
Iodine-129	2.79×10^{-9}	7.96×10^{-1}	9.05×10^{-6}	2.79×10^{-9}	9.94×10^{-1}	1.40×10^{-5}	2.79×10^{-9}	1.28	2.12×10^{-5}
Total	**N/A**	**3.48**	**1.01×10^{-4}**	**N/A**	**7.90**	**3.17×10^{-4}**	**N/A**	**1.54×10^{1}**	**6.85×10^{-4}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.01×10^{-2}	7.63×10^{-1}	0.00	7.72×10^{-2}	7.62×10^{-1}	3.14×10^{-10}	7.72×10^{-2}	1.15	1.44×10^{-5}
Nitrate	2.47	4.42×10^{-2}	0.00	2.69	3.77×10^{-1}	0.00	2.69	8.41×10^{-1}	0.00
Total	**N/A**	**8.07×10^{-1}**	**0.00**	**N/A**	**1.14**	**3.14×10^{-10}**	**N/A**	**1.99**	**1.44×10^{-5}**
Year of peak impact	2102	2102	N/A	2098	2098	2102	2098	2098	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–148. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.46×10^{-7}	6.06×10^{-1}	2.08×10^{-5}	3.46×10^{-7}	1.56	6.85×10^{-5}	3.46×10^{-7}	3.19	1.50×10^{-4}
Iodine-129	6.79×10^{-10}	1.94×10^{-1}	2.20×10^{-6}	6.79×10^{-10}	2.42×10^{-1}	3.40×10^{-6}	6.79×10^{-10}	3.12×10^{-1}	5.15×10^{-6}
Total	**N/A**	**7.99×10^{-1}**	**2.30×10^{-5}**	**N/A**	**1.80**	**7.19×10^{-5}**	**N/A**	**3.50**	**1.55×10^{-4}**
Year of peak impact	2265	2265	2265	2265	2265	2265	2265	2265	2265
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.61×10^{-3}	8.20×10^{-2}	0.00	8.61×10^{-3}	8.51×10^{-2}	3.38×10^{-11}	8.23×10^{-3}	1.22×10^{-1}	1.55×10^{-6}
Nitrate	6.05×10^{-1}	1.08×10^{-2}	0.00	6.05×10^{-1}	8.49×10^{-2}	0.00	6.28×10^{-1}	1.97×10^{-1}	0.00
Total	**N/A**	**9.28×10^{-2}**	**0.00**	**N/A**	**1.70×10^{-1}**	**3.38×10^{-11}**	**N/A**	**3.19×10^{-1}**	**1.55×10^{-6}**
Year of peak impact	2283	2283	N/A	2283	2283	2283	2285	2285	2283

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–149. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	7.54×10^{-12}	3.40×10^{-5}	1.49×10^{-9}	7.50×10^{-12}	7.80×10^{-5}	3.71×10^{-9}	3.46×10^{-7}	1.04×10^{-2}	5.57×10^{-7}
Iodine-129	1.41×10^{-14}	5.02×10^{-6}	7.08×10^{-11}	1.45×10^{-14}	7.91×10^{-5}	1.90×10^{-9}	6.79×10^{-10}	2.39×10^{-3}	5.86×10^{-8}
Total	**N/A**	$\mathbf{3.90\times10^{-5}}$	$\mathbf{1.56\times10^{-9}}$	**N/A**	$\mathbf{1.57\times10^{-4}}$	$\mathbf{5.61\times10^{-9}}$	**N/A**	$\mathbf{1.28\times10^{-2}}$	$\mathbf{6.15\times10^{-7}}$
Year of peak impact	2180	2180	2180	2185	2185	2185	2265	2265	2265

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.95×10^{-7}	2.91×10^{-6}	1.16×10^{-15}	2.86×10^{-7}	4.63×10^{-6}	5.31×10^{-11}	8.61×10^{-3}	3.79×10^{-2}	1.55×10^{-6}
Nitrate	1.53×10^{-5}	2.31×10^{-6}	0.00	1.55×10^{-5}	1.46×10^{-3}	0.00	6.05×10^{-1}	2.87×10^{-2}	0.00
Total	**N/A**	$\mathbf{5.22\times10^{-6}}$	$\mathbf{1.16\times10^{-15}}$	**N/A**	$\mathbf{1.47\times10^{-3}}$	$\mathbf{5.31\times10^{-11}}$	**N/A**	$\mathbf{6.66\times10^{-2}}$	$\mathbf{1.55\times10^{-6}}$
Year of peak impact	2199	2199	2199	2192	2192	2199	2283	2283	2283

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–150. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.11×10^{-6}	1.95	6.70×10^{-5}	1.11×10^{-6}	5.02	2.20×10^{-4}	1.11×10^{-6}	1.03×10^{1}	4.82×10^{-4}
Iodine-129	1.81×10^{-10}	5.15×10^{-2}	5.85×10^{-7}	1.81×10^{-10}	6.43×10^{-2}	9.05×10^{-7}	1.81×10^{-10}	8.31×10^{-2}	1.37×10^{-6}
Uranium-238	4.00×10^{-13}	4.96×10^{-5}	5.60×10^{-10}	4.00×10^{-13}	5.16×10^{-5}	6.04×10^{-10}	4.00×10^{-13}	5.56×10^{-5}	6.89×10^{-10}
Total	**N/A**	**2.00**	**6.76×10^{-5}**	**N/A**	**5.08**	**2.21×10^{-4}**	**N/A**	**1.03×10^{1}**	**4.83×10^{-4}**
Year of peak impact	4155	4155	4155	4155	4155	4155	4155	4155	4155
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.88×10^{-2}	7.50×10^{-1}	0.00	6.75×10^{-2}	6.67×10^{-1}	3.09×10^{-10}	6.75×10^{-2}	1.00	1.42×10^{-5}
Nitrate	1.55×10^{1}	2.77×10^{-1}	0.00	1.78×10^{1}	2.49	0.00	1.78×10^{1}	5.56	0.00
Total	**N/A**	**1.03**	**0.00**	**N/A**	**3.16**	**3.09×10^{-10}**	**N/A**	**6.56**	**1.42×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–151. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.31×10^{-7}	2.70×10^{-2}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Technetium-99	3.58×10^{-6}	6.26	2.34×10^{-4}	3.88×10^{-6}	1.75×10^{1}	7.69×10^{-4}	3.88×10^{-6}	3.58×10^{1}	1.68×10^{-3}
Iodine-129	4.41×10^{-9}	1.26	3.87×10^{-6}	1.20×10^{-9}	4.25×10^{-1}	5.99×10^{-6}	1.20×10^{-9}	5.50×10^{-1}	9.06×10^{-6}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	9.82×10^{-10}	7.01×10^{-13}	9.04×10^{-5}	1.06×10^{-9}	7.01×10^{-13}	9.75×10^{-5}	1.21×10^{-9}
Total	**N/A**	**7.54**	**2.38×10^{-4}**	**N/A**	**1.79×10^{1}**	**7.75×10^{-4}**	**N/A**	**3.63×10^{1}**	**1.69×10^{-3}**
Year of peak impact	2056	2056	3616	3616	3616	3616	3616	3616	3616
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.72×10^{-1}	1.70	8.42×10^{-10}	1.72×10^{-1}	2.55	3.86×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	**2.57×10^{1}**	**8.42×10^{-10}**	**N/A**	**5.62×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–152. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.44×10^{-6}	6.01	2.07×10^{-4}	3.44×10^{-6}	1.55×10^{1}	6.81×10^{-4}	3.44×10^{-6}	3.17×10^{1}	1.49×10^{-3}
Iodine-129	4.76×10^{-10}	1.36×10^{-1}	1.38×10^{-6}	4.76×10^{-10}	1.69×10^{-1}	2.14×10^{-6}	4.27×10^{-10}	1.96×10^{-1}	3.23×10^{-6}
Uranium-238	1.18×10^{-13}	1.46×10^{-5}	8.18×10^{-11}	1.18×10^{-13}	1.52×10^{-5}	8.82×10^{-11}	5.84×10^{-14}	8.12×10^{-6}	1.00×10^{-10}
Total	**N/A**	**6.15**	**2.08×10^{-4}**	**N/A**	**1.57×10^{1}**	**6.83×10^{-4}**	**N/A**	**3.19×10^{1}**	**1.49×10^{-3}**
Year of peak impact	4321	4321	4314	4321	4321	4314	4314	4314	4314

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	3.01×10^{-3}	1.79×10^{-2}	0.00	3.01×10^{-3}	3.24×10^{-2}	0.00
Chromium	1.58×10^{-1}	1.51	0.00	1.26×10^{-1}	1.24	6.22×10^{-10}	1.26×10^{-1}	1.87	2.85×10^{-5}
Nitrate	4.70	8.39×10^{-2}	0.00	1.01×10^{1}	1.41	0.00	1.01×10^{1}	3.15	0.00
Total	**N/A**	**1.59**	**0.00**	**N/A**	**2.67**	**6.22×10^{-10}**	**N/A**	**5.05**	**2.85×10^{-5}**
Year of peak impact	2050	2050	N/A	4088	4088	2050	4088	4088	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–153. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.63×10^{-6}	1.16×10^{1}	3.99×10^{-4}	6.63×10^{-6}	2.99×10^{1}	1.31×10^{-3}	6.63×10^{-6}	6.11×10^{1}	2.87×10^{-3}
Iodine-129	1.28×10^{-8}	3.63	4.13×10^{-5}	1.28×10^{-8}	4.54	6.39×10^{-5}	1.28×10^{-8}	5.87	9.66×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.56×10^{1}**	**4.44×10^{-4}**	**N/A**	**3.48×10^{1}**	**1.38×10^{-3}**	**N/A**	**6.74×10^{1}**	**2.97×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.54×10^{-1}	3.38	0.00	3.54×10^{-1}	3.50	1.39×10^{-9}	3.54×10^{-1}	5.27	6.38×10^{-5}
Nitrate	6.18×10^{1}	1.10	0.00	6.18×10^{1}	8.68	0.00	6.18×10^{1}	1.93×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.48**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.38×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–154. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.42×10^{-6}	2.48	8.52×10^{-5}	1.42×10^{-6}	6.39	2.80×10^{-4}	1.42×10^{-6}	1.30×10^{1}	6.13×10^{-4}
Iodine-129	3.67×10^{-10}	1.05×10^{-1}	1.19×10^{-6}	3.67×10^{-10}	1.31×10^{-1}	1.84×10^{-6}	3.67×10^{-10}	1.69×10^{-1}	2.78×10^{-6}
Uranium-238	3.63×10^{-14}	4.51×10^{-6}	5.09×10^{-11}	3.63×10^{-14}	4.69×10^{-6}	5.49×10^{-11}	3.63×10^{-14}	5.05×10^{-6}	6.25×10^{-11}
Total	**N/A**	**2.58**	**8.64×10^{-5}**	**N/A**	**6.52**	**2.82×10^{-4}**	**N/A**	**1.32×10^{1}**	**6.16×10^{-4}**
Year of peak impact	3949	3949	3949	3949	3949	3949	3949	3949	3949

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	2.84×10^{-6}	1.69×10^{-5}	0.00	0.00	0.00	0.00
Chromium	3.03×10^{-2}	2.89×10^{-1}	0.00	2.95×10^{-2}	2.92×10^{-1}	1.19×10^{-10}	2.76×10^{-2}	4.10×10^{-1}	5.46×10^{-6}
Nitrate	3.00	5.35×10^{-2}	0.00	3.34	4.69×10^{-1}	0.00	3.44	1.08	0.00
Total	**N/A**	**3.42×10^{-1}**	**0.00**	**N/A**	**7.60×10^{-1}**	**1.19×10^{-10}**	**N/A**	**1.49**	**5.46×10^{-6}**
Year of peak impact	3565	3565	N/A	3598	3598	3565	3568	3568	3565

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–155. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Technetium-99	3.58×10^{-6}	6.26	2.34×10^{-4}	3.88×10^{-6}	1.75×10^{1}	7.69×10^{-4}	3.88×10^{-6}	3.58×10^{1}	1.68×10^{-3}
Iodine-129	4.41×10^{-9}	1.26	3.87×10^{-6}	1.20×10^{-9}	4.25×10^{-1}	5.99×10^{-6}	1.20×10^{-9}	5.50×10^{-1}	9.06×10^{-6}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	9.82×10^{-10}	7.01×10^{-13}	9.04×10^{-5}	1.06×10^{-9}	7.01×10^{-13}	9.75×10^{-5}	1.21×10^{-9}
Total	**N/A**	**7.57**	$\mathbf{2.38\times10^{-4}}$	**N/A**	$\mathbf{1.79\times10^{1}}$	$\mathbf{7.75\times10^{-4}}$	**N/A**	$\mathbf{3.63\times10^{1}}$	$\mathbf{1.69\times10^{-3}}$
Year of peak impact	2056	2056	3616	3616	3616	3616	3616	3616	3616
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.72×10^{-1}	1.70	8.42×10^{-10}	1.72×10^{-1}	2.55	3.86×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	$\mathbf{2.57\times10^{1}}$	$\mathbf{8.42\times10^{-10}}$	**N/A**	$\mathbf{5.62\times10^{1}}$	$\mathbf{3.86\times10^{-5}}$
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–156. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.78×10^{-7}	8.37×10^{-1}	2.88×10^{-5}	4.78×10^{-7}	2.16	9.47×10^{-5}	4.78×10^{-7}	4.41	2.07×10^{-4}
Iodine-129	2.01×10^{-10}	5.74×10^{-2}	6.52×10^{-7}	2.01×10^{-10}	7.17×10^{-2}	1.01×10^{-6}	2.01×10^{-10}	9.26×10^{-2}	1.53×10^{-6}
Uranium-238	2.15×10^{-13}	2.66×10^{-5}	3.00×10^{-10}	2.15×10^{-13}	2.77×10^{-5}	3.24×10^{-10}	2.15×10^{-13}	2.98×10^{-5}	3.69×10^{-10}
Total	**N/A**	**8.94×10^{-1}**	**2.94×10^{-5}**	**N/A**	**2.23**	**9.57×10^{-5}**	**N/A**	**4.50**	**2.09×10^{-4}**
Year of peak impact	4809	4809	4809	4809	4809	4809	4809	4809	4809

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.08×10^{-2}	6.75×10^{-1}	0.00	7.08×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.08×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–157. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.85×10^{-11}	8.32×10^{-5}	3.65×10^{-9}	1.85×10^{-11}	1.92×10^{-4}	9.12×10^{-9}	4.78×10^{-7}	1.45×10^{-2}	7.76×10^{-7}
Iodine-129	4.36×10^{-15}	1.56×10^{-6}	2.20×10^{-11}	4.36×10^{-15}	2.38×10^{-5}	5.72×10^{-10}	2.01×10^{-10}	8.04×10^{-4}	1.97×10^{-8}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	2.15×10^{-13}	2.66×10^{-6}	5.81×10^{-11}
Total	**N/A**	**8.48×10^{-5}**	**3.68×10^{-9}**	**N/A**	**2.16×10^{-4}**	**9.69×10^{-9}**	**N/A**	**1.53×10^{-2}**	**7.95×10^{-7}**
Year of peak impact	4440	4440	4440	4440	4440	4440	4809	4809	4809
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.81×10^{-7}	9.69×10^{-6}	3.85×10^{-15}	9.81×10^{-7}	1.59×10^{-5}	1.77×10^{-10}	7.08×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.17×10^{-4}	4.80×10^{-5}	0.00	3.17×10^{-4}	2.99×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.77×10^{-5}**	**3.85×10^{-15}**	**N/A**	**2.99×10^{-2}**	**1.77×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figure Q–7 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Between CYs 3000 and 9600, peak radiological risk is due to other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

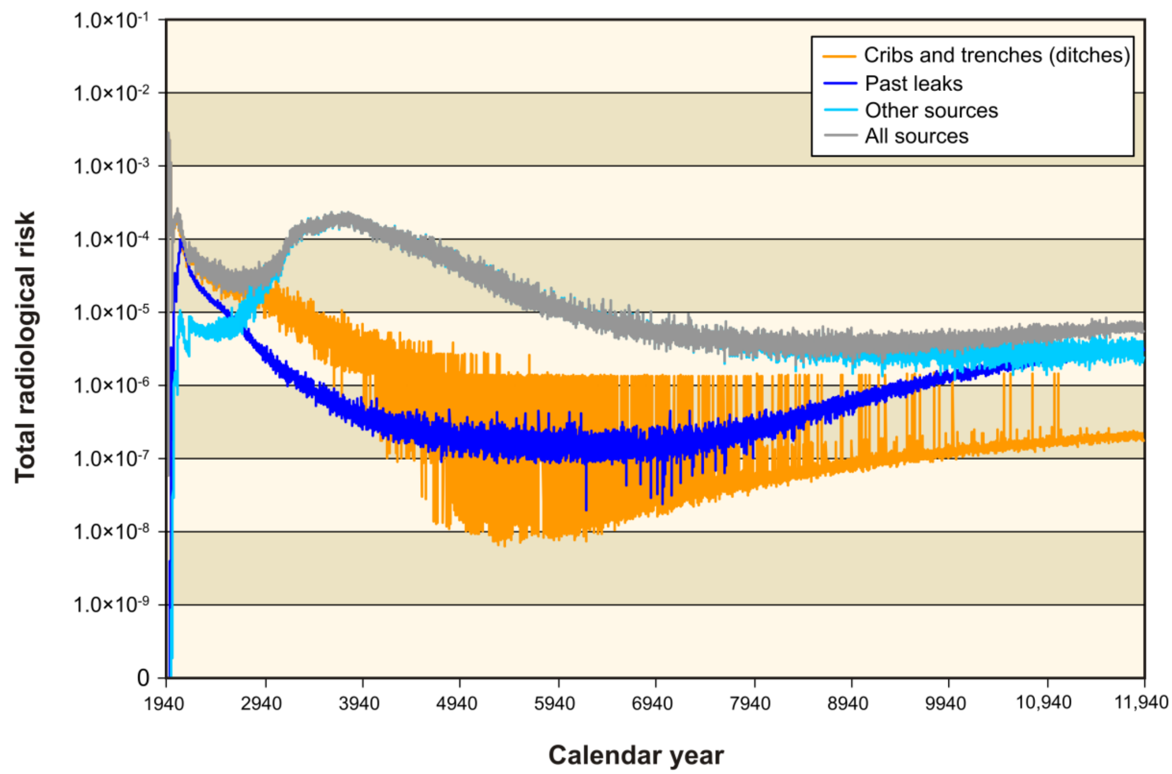


Figure Q–7. Tank Closure Alternative 5 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.6 Tank Closure Alternative 6A, Base and Option Cases

Under Tank Closure Alternative 6A, Base Case, tank waste would be retrieved to a volume corresponding to 99.9 percent retrieval, all tanks farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. The adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–158 through Q–162; to past leaks after CY 1940, in Tables Q–163 through Q–170; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–171 through Q–178.

Table Q–158. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	$\mathbf{1.50\times10^{2}}$	$\mathbf{2.91\times10^{-3}}$	**N/A**	$\mathbf{2.58\times10^{2}}$	$\mathbf{7.78\times10^{-3}}$	**N/A**	$\mathbf{4.39\times10^{2}}$	$\mathbf{1.60\times10^{-2}}$
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	$\mathbf{8.96\times10^{1}}$	**0.00**	**N/A**	$\mathbf{3.25\times10^{2}}$	$\mathbf{2.41\times10^{-8}}$	**N/A**	$\mathbf{7.04\times10^{2}}$	$\mathbf{1.11\times10^{-3}}$
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–159. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–160. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	$\mathbf{1.50\times10^{2}}$	$\mathbf{2.91\times10^{-3}}$	**N/A**	$\mathbf{2.58\times10^{2}}$	$\mathbf{7.78\times10^{-3}}$	**N/A**	$\mathbf{4.39\times10^{2}}$	$\mathbf{1.60\times10^{-2}}$
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	$\mathbf{8.96\times10^{1}}$	**0.00**	**N/A**	$\mathbf{3.25\times10^{2}}$	$\mathbf{2.41\times10^{-8}}$	**N/A**	$\mathbf{7.04\times10^{2}}$	$\mathbf{1.11\times10^{-3}}$
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–161. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–162. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–163. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.89×10^{-7}	2.22×10^{-2}	2.10×10^{-7}	1.89×10^{-7}	2.58×10^{-2}	2.54×10^{-7}	1.89×10^{-7}	3.07×10^{-2}	3.22×10^{-7}
Technetium-99	1.34×10^{-6}	2.35	8.07×10^{-5}	1.34×10^{-6}	6.05	2.66×10^{-4}	1.34×10^{-6}	1.24×10^{1}	5.81×10^{-4}
Iodine-129	5.38×10^{-10}	1.53×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**2.52**	**8.27×10^{-5}**	**N/A**	**6.27**	**2.68×10^{-4}**	**N/A**	**1.26×10^{1}**	**5.85×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.01×10^{-2}	6.67×10^{-1}	0.00	6.98×10^{-2}	6.89×10^{-1}	2.75×10^{-10}	6.98×10^{-2}	1.04	1.26×10^{-5}
Nitrate	2.10	3.75×10^{-2}	0.00	2.15	3.02×10^{-1}	0.00	2.15	6.74×10^{-1}	0.00
Total	**N/A**	**7.05×10^{-1}**	**0.00**	**N/A**	**9.91×10^{-1}**	**2.75×10^{-10}**	**N/A**	**1.71**	**1.26×10^{-5}**
Year of peak impact	2102	2102	N/A	2110	2110	2102	2110	2110	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–164. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.70×10^{-9}	3.16×10^{-4}	3.00×10^{-9}	2.70×10^{-9}	3.67×10^{-4}	3.62×10^{-9}	2.70×10^{-9}	4.37×10^{-4}	4.59×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.51×10^{-2}	6.20×10^{-1}	0.00	6.51×10^{-2}	6.43×10^{-1}	2.56×10^{-10}	6.51×10^{-2}	9.67×10^{-1}	1.17×10^{-5}
Nitrate	3.81	6.79×10^{-2}	0.00	3.81	5.34×10^{-1}	0.00	3.81	1.19	0.00
Total	**N/A**	**6.88×10^{-1}**	**0.00**	**N/A**	**1.18**	**2.56×10^{-10}**	**N/A**	**2.16**	**1.17×10^{-5}**
Year of peak impact	2090	2090	N/A	2090	2090	2090	2090	2090	2090

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–165. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.61×10^{-7}	1.88×10^{-2}	1.79×10^{-7}	1.61×10^{-7}	2.19×10^{-2}	2.16×10^{-7}	1.61×10^{-7}	2.61×10^{-2}	2.74×10^{-7}
Technetium-99	2.51×10^{-6}	4.39	1.51×10^{-4}	2.51×10^{-6}	1.13×10^{1}	4.97×10^{-4}	2.51×10^{-6}	2.31×10^{1}	1.09×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.67	2.34×10^{-5}	4.68×10^{-9}	2.15	3.55×10^{-5}
Total	**N/A**	**5.75**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.21×10^{-4}**	**N/A**	**2.53×10^{1}**	**1.12×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.21	1.29×10^{-1}	0.00	7.21	1.01	0.00	7.21	2.26	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.44**	**9.67×10^{-10}**	**N/A**	**5.92**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–166. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.06×10^{-6}	2.41×10^{-1}	2.29×10^{-6}	2.06×10^{-6}	2.80×10^{-1}	2.76×10^{-6}	2.06×10^{-6}	3.34×10^{-1}	3.50×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.38×10^{-4}	1.06×10^{-5}	4.78×10^{1}	2.10×10^{-3}	1.06×10^{-5}	9.75×10^{1}	4.59×10^{-3}
Iodine-129	2.03×10^{-8}	5.77	6.56×10^{-5}	2.03×10^{-8}	7.21	1.01×10^{-4}	2.03×10^{-8}	9.32	1.53×10^{-4}
Total	**N/A**	**2.45×10^{1}**	**7.05×10^{-4}**	**N/A**	**5.52×10^{1}**	**2.20×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.74×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.00×10^{-1}	2.86	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.46	5.40×10^{-5}
Nitrate	2.37×10^{1}	4.24×10^{-1}	0.00	2.37×10^{1}	3.33	0.00	2.37×10^{1}	7.43	0.00
Total	**N/A**	**3.28**	**0.00**	**N/A**	**6.29**	**1.18×10^{-9}**	**N/A**	**1.19×10^{1}**	**5.40×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–167. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	$\mathbf{1.44\times10^{-7}}$	$\mathbf{2.89\times10^{-1}}$	$\mathbf{8.84\times10^{-6}}$	$\mathbf{1.44\times10^{-7}}$	$\mathbf{6.81\times10^{-1}}$	$\mathbf{2.81\times10^{-5}}$	$\mathbf{1.44\times10^{-7}}$	**1.35**	$\mathbf{6.09\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.16×10^{-3}	5.87×10^{-2}	0.00	6.10×10^{-3}	6.03×10^{-2}	2.42×10^{-11}	6.10×10^{-3}	9.07×10^{-2}	1.11×10^{-6}
Nitrate	4.34×10^{-1}	7.75×10^{-3}	0.00	4.42×10^{-1}	6.20×10^{-2}	0.00	4.42×10^{-1}	1.38×10^{-1}	0.00
Total	$\mathbf{4.40\times10^{-1}}$	$\mathbf{6.64\times10^{-2}}$	**0.00**	$\mathbf{4.48\times10^{-1}}$	$\mathbf{1.22\times10^{-1}}$	$\mathbf{2.42\times10^{-11}}$	$\mathbf{4.48\times10^{-1}}$	$\mathbf{2.29\times10^{-1}}$	$\mathbf{1.11\times10^{-6}}$
Year of peak impact	2040	2040	N/A	2041	2041	2040	2041	2041	2040

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–168. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	**Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)**	**Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)**	**Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk**	**Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)**	**Resident Farmer: Dose at Year of Peak Dose (millirem per year)**	**Resident Farmer: Radiological Risk at Year of Peak Radiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)**	**American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)**	**American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	3.63×10^{-9}	4.24×10^{-4}	4.02×10^{-9}	3.63×10^{-9}	4.93×10^{-4}	4.86×10^{-9}	3.63×10^{-9}	5.87×10^{-4}	6.16×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087

Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.65×10^{-2}	8.24×10^{-1}	0.00	8.65×10^{-2}	8.54×10^{-1}	3.40×10^{-10}	8.65×10^{-2}	1.29	1.56×10^{-5}
Nitrate	3.65	6.52×10^{-2}	0.00	3.65	5.13×10^{-1}	0.00	3.65	1.14	0.00
Total	**N/A**	**8.89×10^{-1}**	**0.00**	**N/A**	**1.37**	**3.40×10^{-10}**	**N/A**	**2.43**	**1.56×10^{-5}**
Year of peak impact	2098	2098	N/A	2098	2098	2098	2098	2098	2098

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–169. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.54×10^{-7}	6.19×10^{-1}	2.13×10^{-5}	3.54×10^{-7}	1.60	7.00×10^{-5}	3.54×10^{-7}	3.26	1.53×10^{-4}
Iodine-129	6.86×10^{-10}	1.96×10^{-1}	2.22×10^{-6}	6.86×10^{-10}	2.44×10^{-1}	3.44×10^{-6}	6.86×10^{-10}	3.16×10^{-1}	5.20×10^{-6}
Total	**N/A**	**8.15×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.84**	**7.35×10^{-5}**	**N/A**	**3.57**	**1.58×10^{-4}**
Year of peak impact	2251	2251	2251	2251	2251	2251	2251	2251	2251
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.14×10^{-3}	8.04×10^{-2}	3.23×10^{-11}	8.14×10^{-3}	1.21×10^{-1}	1.48×10^{-6}
Nitrate	6.75×10^{-1}	1.21×10^{-2}	0.00	6.84×10^{-1}	9.61×10^{-2}	0.00	6.84×10^{-1}	2.14×10^{-1}	0.00
Total	**N/A**	**9.05×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.35×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2285	2285	N/A	2284	2284	2285	2284	2284	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–170. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	7.90×10^{-12}	3.57×10^{-5}	1.57×10^{-9}	7.90×10^{-12}	8.22×10^{-5}	3.90×10^{-9}	3.54×10^{-7}	1.07×10^{-2}	5.70×10^{-7}
Iodine-129	1.48×10^{-14}	5.27×10^{-6}	7.42×10^{-11}	1.48×10^{-14}	8.04×10^{-5}	1.93×10^{-9}	6.86×10^{-10}	2.49×10^{-3}	6.12×10^{-8}
Total	**N/A**	$\mathbf{4.09\times10^{-5}}$	$\mathbf{1.64\times10^{-9}}$	**N/A**	$\mathbf{1.63\times10^{-4}}$	$\mathbf{5.84\times10^{-9}}$	**N/A**	$\mathbf{1.32\times10^{-2}}$	$\mathbf{6.31\times10^{-7}}$
Year of peak impact	2184	2184	2184	2184	2184	2184	2251	2251	2251
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.02×10^{-7}	2.98×10^{-6}	1.19×10^{-15}	3.02×10^{-7}	4.88×10^{-6}	5.47×10^{-11}	7.99×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.66×10^{-5}	2.51×10^{-6}	0.00	1.66×10^{-5}	1.56×10^{-3}	0.00	6.30×10^{-1}	3.54×10^{-2}	0.00
Total	**N/A**	$\mathbf{5.49\times10^{-6}}$	$\mathbf{1.19\times10^{-15}}$	**N/A**	$\mathbf{1.57\times10^{-3}}$	$\mathbf{5.47\times10^{-11}}$	**N/A**	$\mathbf{7.06\times10^{-2}}$	$\mathbf{1.48\times10^{-6}}$
Year of peak impact	2201	2201	2200	2201	2201	2200	2208	2208	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–171. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.89×10^{-10}	9.23×10^{-5}	8.76×10^{-10}	7.89×10^{-10}	1.07×10^{-4}	1.06×10^{-9}	7.89×10^{-10}	1.28×10^{-4}	1.34×10^{-9}
Technetium-99	9.63×10^{-7}	1.69	5.80×10^{-5}	9.63×10^{-7}	4.34	1.91×10^{-4}	9.63×10^{-7}	8.87	4.17×10^{-4}
Iodine-129	1.65×10^{-9}	4.69×10^{-1}	5.34×10^{-6}	1.65×10^{-9}	5.86×10^{-1}	8.25×10^{-6}	1.65×10^{-9}	7.58×10^{-1}	1.25×10^{-5}
Total	**N/A**	**2.16**	**6.33×10^{-5}**	**N/A**	**4.93**	**1.99×10^{-4}**	**N/A**	**9.63**	**4.30×10^{-4}**
Year of peak impact	2103	2103	2103	2103	2103	2103	2103	2103	2103

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.32×10^{-2}	7.93×10^{-1}	0.00	6.97×10^{-2}	6.88×10^{-1}	3.27×10^{-10}	6.97×10^{-2}	1.04	1.50×10^{-5}
Nitrate	1.48×10^{1}	2.63×10^{-1}	0.00	1.68×10^{1}	2.36	0.00	1.68×10^{1}	5.26	0.00
Total	**N/A**	**1.06**	**0.00**	**N/A**	**3.05**	**3.27×10^{-10}**	**N/A**	**6.30**	**1.50×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–172. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.23×10^{-7}	2.61×10^{-2}	2.48×10^{-7}	2.23×10^{-7}	3.04×10^{-2}	2.99×10^{-7}	2.23×10^{-7}	3.62×10^{-2}	3.80×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.10×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.29×10^{-9}	1.22	1.39×10^{-5}	4.29×10^{-9}	1.53	2.15×10^{-5}	4.29×10^{-9}	1.97	3.25×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.34**	**2.24×10^{-4}**	**N/A**	**1.73×10^{1}**	**7.11×10^{-4}**	**N/A**	**3.41×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.14×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.40×10^{-10}	1.74×10^{-1}	2.58	3.85×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.40×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.85×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–173. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.43×10^{-8}	2.84×10^{-3}	2.70×10^{-8}	2.43×10^{-8}	3.31×10^{-3}	3.26×10^{-8}	2.43×10^{-8}	3.94×10^{-3}	4.13×10^{-8}
Technetium-99	1.48×10^{-6}	2.58	8.88×10^{-5}	1.48×10^{-6}	6.65	2.92×10^{-4}	1.48×10^{-6}	1.36×10^{1}	6.39×10^{-4}
Iodine-129	2.72×10^{-9}	7.75×10^{-1}	8.81×10^{-6}	2.72×10^{-9}	9.68×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.36**	**9.76×10^{-5}**	**N/A**	**7.62**	**3.06×10^{-4}**	**N/A**	**1.48×10^{1}**	**6.59×10^{-4}**
Year of peak impact	2052	2052	2052	2052	2052	2052	2052	2052	2052
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.56×10^{-1}	1.48	0.00	1.56×10^{-1}	1.54	6.11×10^{-10}	1.56×10^{-1}	2.31	2.80×10^{-5}
Nitrate	4.61	8.22×10^{-2}	0.00	4.61	6.47×10^{-1}	0.00	4.61	1.44	0.00
Total	**N/A**	**1.56**	**0.00**	**N/A**	**2.18**	**6.11×10^{-10}**	**N/A**	**3.75**	**2.80×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–174. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.53×10^{-6}	1.14×10^{1}	3.93×10^{-4}	6.53×10^{-6}	2.94×10^{1}	1.29×10^{-3}	6.53×10^{-6}	6.01×10^{1}	2.83×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.50	6.33×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.54×10^{1}**	**4.37×10^{-4}**	**N/A**	**3.43×10^{1}**	**1.36×10^{-3}**	**N/A**	**6.64×10^{1}**	**2.93×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.54×10^{-1}	3.37	0.00	3.54×10^{-1}	3.50	1.39×10^{-9}	3.54×10^{-1}	5.26	6.38×10^{-5}
Nitrate	6.18×10^{1}	1.10	0.00	6.18×10^{1}	8.67	0.00	6.18×10^{1}	1.93×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.48**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.38×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2045	2051	2051	2045

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–175. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	$\mathbf{1.44\times10^{-7}}$	$\mathbf{2.89\times10^{-1}}$	$\mathbf{8.84\times10^{-6}}$	$\mathbf{1.44\times10^{-7}}$	$\mathbf{6.81\times10^{-1}}$	$\mathbf{2.81\times10^{-5}}$	$\mathbf{1.44\times10^{-7}}$	**1.35**	$\mathbf{6.09\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.63×10^{-3}	5.36×10^{-2}	0.00	5.63×10^{-3}	5.56×10^{-2}	2.21×10^{-11}	5.63×10^{-3}	8.36×10^{-2}	1.01×10^{-6}
Nitrate	4.13×10^{-1}	7.37×10^{-3}	0.00	4.13×10^{-1}	5.80×10^{-2}	0.00	4.13×10^{-1}	1.29×10^{-1}	0.00
Total	$\mathbf{4.19\times10^{-1}}$	$\mathbf{6.09\times10^{-2}}$	**0.00**	$\mathbf{4.19\times10^{-1}}$	$\mathbf{1.14\times10^{-1}}$	$\mathbf{2.21\times10^{-11}}$	$\mathbf{4.19\times10^{-1}}$	$\mathbf{2.13\times10^{-1}}$	$\mathbf{1.01\times10^{-6}}$
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–176. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	5.27×10^{-7}	4.75×10^{-7}	6.46×10^{-2}	6.36×10^{-7}	4.75×10^{-7}	7.69×10^{-2}	8.07×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.10×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.29×10^{-9}	1.22	1.39×10^{-5}	4.29×10^{-9}	1.53	2.15×10^{-5}	4.29×10^{-9}	1.97	3.25×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.37**	**2.24×10^{-4}**	**N/A**	**1.73×10^{1}**	**7.12×10^{-4}**	**N/A**	**3.41×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.14×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.40×10^{-10}	1.74×10^{-1}	2.58	3.85×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.40×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.85×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–177. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.09×10^{-11}	1.28×10^{-6}	1.21×10^{-11}	1.09×10^{-11}	1.49×10^{-6}	1.46×10^{-11}	1.09×10^{-11}	1.77×10^{-6}	1.86×10^{-11}
Technetium-99	3.82×10^{-7}	6.69×10^{-1}	2.30×10^{-5}	3.82×10^{-7}	1.72	7.57×10^{-5}	3.82×10^{-7}	3.52	1.65×10^{-4}
Iodine-129	7.27×10^{-10}	2.07×10^{-1}	2.35×10^{-6}	7.27×10^{-10}	2.59×10^{-1}	3.64×10^{-6}	7.27×10^{-10}	3.34×10^{-1}	5.51×10^{-6}
Uranium-238	3.72×10^{-14}	4.61×10^{-6}	5.21×10^{-11}	3.72×10^{-14}	4.80×10^{-6}	5.61×10^{-11}	3.72×10^{-14}	5.17×10^{-6}	6.39×10^{-11}
Total	**N/A**	**8.76×10^{-1}**	**2.54×10^{-5}**	**N/A**	**1.98**	**7.93×10^{-5}**	**N/A**	**3.85**	**1.71×10^{-4}**
Year of peak impact	2251	2251	2251	2251	2251	2251	2251	2251	2251
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.09×10^{-2}	6.75×10^{-1}	0.00	7.09×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.09×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–178. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	0.00	0.00	0.00	0.00	0.00	0.00	1.09×10^{-11}	6.93×10^{-8}	1.28×10^{-12}
Technetium-99	9.69×10^{-12}	4.37×10^{-5}	1.92×10^{-9}	9.69×10^{-12}	1.01×10^{-4}	4.79×10^{-9}	3.82×10^{-7}	1.15×10^{-2}	6.16×10^{-7}
Iodine-129	1.69×10^{-14}	6.03×10^{-6}	8.50×10^{-11}	1.69×10^{-14}	9.21×10^{-5}	2.21×10^{-9}	7.27×10^{-10}	2.69×10^{-3}	6.60×10^{-8}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	3.72×10^{-14}	4.61×10^{-7}	1.01×10^{-11}
Total	**N/A**	$\mathbf{4.97\times10^{-5}}$	$\mathbf{2.00\times10^{-9}}$	**N/A**	$\mathbf{1.93\times10^{-4}}$	$\mathbf{7.00\times10^{-9}}$	**N/A**	$\mathbf{1.42\times10^{-2}}$	$\mathbf{6.82\times10^{-7}}$
Year of peak impact	2155	2155	2155	2155	2155	2155	2251	2251	2251
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.81×10^{-7}	9.69×10^{-6}	3.85×10^{-15}	9.81×10^{-7}	1.59×10^{-5}	1.77×10^{-10}	7.09×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.13×10^{-4}	4.74×10^{-5}	0.00	3.13×10^{-4}	2.95×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	$\mathbf{5.71\times10^{-5}}$	$\mathbf{3.85\times10^{-15}}$	**N/A**	$\mathbf{2.95\times10^{-2}}$	$\mathbf{1.77\times10^{-10}}$	**N/A**	**1.03**	$\mathbf{1.28\times10^{-5}}$
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, 3C, 4, and 5 for releases from cribs and trenches (ditches). The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2B, 3A, 3B, 3C, and 4 for releases from past leaks. Impacts would be slightly higher than under Alternatives 2B, 3A, 3B, 3C, and 6C for onsite locations as a result of the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases). However, after CY 2940, the impacts drop significantly as a result of tank farm removal and clean closure activities. Population dose is estimated as 2.49×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–8 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination due to past leaks and other sources has exited the unconfined aquifer, and Figure Q–8 is interpreted as reporting no risk due to these sources.

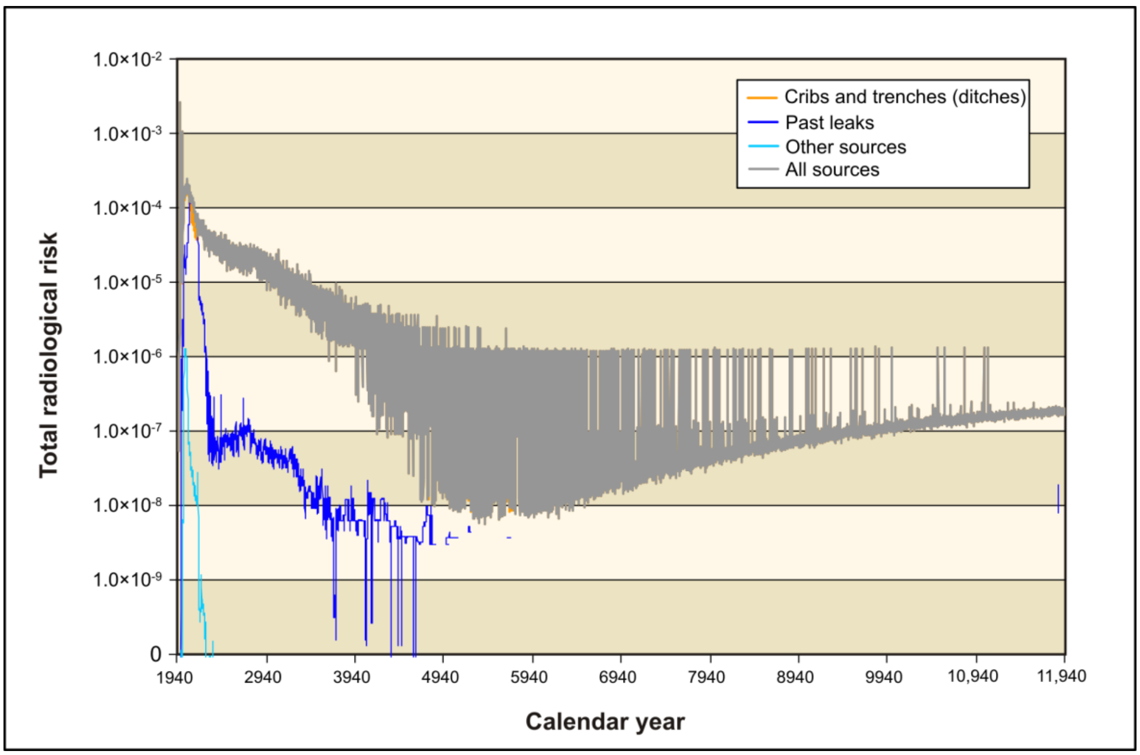


Figure Q–8. Tank Closure Alternative 6A, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Under Tank Closure Alternative 6A, Option Case, tank waste would be retrieved to a volume corresponding to 99.9 percent retrieval, all tanks farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. In addition, the adjacent cribs and trenches (ditches) would be clean-closed. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–179 through Q–183; to past leaks after CY 1940, in Tables Q–184 through Q–191; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–192 through Q–199.

Table Q–179. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.75×10^{-4}	7.89×10^{1}	7.49×10^{-4}	6.75×10^{-4}	9.17×10^{1}	9.04×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.25×10^{-5}	5.68×10^{1}	1.95×10^{-3}	3.25×10^{-5}	1.46×10^{2}	6.43×10^{-3}	3.25×10^{-5}	2.99×10^{2}	1.41×10^{-2}
Iodine-129	4.30×10^{-8}	1.22×10^{1}	1.39×10^{-4}	4.30×10^{-8}	1.53×10^{1}	2.15×10^{-4}	4.30×10^{-8}	1.98×10^{1}	3.26×10^{-4}
Total	**N/A**	**1.48×10^{2}**	**2.84×10^{-3}**	**N/A**	**2.53×10^{2}**	**7.55×10^{-3}**	**N/A**	**4.28×10^{2}**	**1.55×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.14	5.84×10^{1}	0.00	2.85	2.82×10^{1}	2.41×10^{-8}	2.85	4.24×10^{1}	1.10×10^{-3}
Nitrate	1.72×10^{3}	3.07×10^{1}	0.00	2.05×10^{3}	2.87×10^{2}	0.00	2.05×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.92×10^{1}**	**0.00**	**N/A**	**3.15×10^{2}**	**2.41×10^{-8}**	**N/A**	**6.83×10^{2}**	**1.10×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–180. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.62×10^{-3}	8.92×10^{2}	8.46×10^{-3}	7.62×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.62×10^{-3}	1.24×10^{3}	1.30×10^{-2}
Technetium-99	1.20×10^{-7}	2.11×10^{-1}	7.25×10^{-6}	1.20×10^{-7}	5.43×10^{-1}	2.38×10^{-5}	1.20×10^{-7}	1.11	5.21×10^{-5}
Iodine-129	1.11×10^{-9}	3.17×10^{-1}	3.61×10^{-6}	1.11×10^{-9}	3.96×10^{-1}	5.58×10^{-6}	1.11×10^{-9}	5.12×10^{-1}	8.44×10^{-6}
Total	**N/A**	**8.93×10^{2}**	**8.47×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.24×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.33	6.02×10^{1}	0.00	6.33	6.25×10^{1}	2.48×10^{-8}	6.33	9.40×10^{1}	1.14×10^{-3}
Nitrate	1.55×10^{3}	2.76×10^{1}	0.00	1.55×10^{3}	2.17×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**8.79×10^{1}**	**0.00**	**N/A**	**2.80×10^{2}**	**2.48×10^{-8}**	**N/A**	**5.79×10^{2}**	**1.14×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–181. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.75×10^{-4}	7.89×10^{1}	7.49×10^{-4}	6.75×10^{-4}	9.17×10^{1}	9.04×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.25×10^{-5}	5.68×10^{1}	1.95×10^{-3}	3.25×10^{-5}	1.46×10^{2}	6.43×10^{-3}	3.25×10^{-5}	2.99×10^{2}	1.41×10^{-2}
Iodine-129	4.30×10^{-8}	1.22×10^{1}	1.39×10^{-4}	4.30×10^{-8}	1.53×10^{1}	2.15×10^{-4}	4.30×10^{-8}	1.98×10^{1}	3.26×10^{-4}
Total	**N/A**	**1.48×10^{2}**	**2.84×10^{-3}**	**N/A**	**2.53×10^{2}**	**7.55×10^{-3}**	**N/A**	**4.28×10^{2}**	**1.55×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.14	5.84×10^{1}	0.00	2.85	2.82×10^{1}	2.41×10^{-8}	2.85	4.24×10^{1}	1.10×10^{-3}
Nitrate	1.72×10^{3}	3.07×10^{1}	0.00	2.05×10^{3}	2.87×10^{2}	0.00	2.05×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.92×10^{1}**	**0.00**	**N/A**	**3.15×10^{2}**	**2.41×10^{-8}**	**N/A**	**6.83×10^{2}**	**1.10×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–182. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.08×10^{-5}	1.26	1.19×10^{-5}	1.08×10^{-5}	1.46	1.44×10^{-5}	1.08×10^{-5}	1.74	1.83×10^{-5}
Technetium-99	8.67×10^{-7}	1.52	5.22×10^{-5}	8.67×10^{-7}	3.91	1.72×10^{-4}	8.67×10^{-7}	7.98	3.75×10^{-4}
Iodine-129	1.13×10^{-9}	3.21×10^{-1}	3.65×10^{-6}	1.13×10^{-9}	4.01×10^{-1}	5.65×10^{-6}	1.13×10^{-9}	5.18×10^{-1}	8.54×10^{-6}
Total	**N/A**	**3.10**	**6.78×10^{-5}**	**N/A**	**5.77**	**1.92×10^{-4}**	**N/A**	**1.02×10^{1}**	**4.02×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.99×10^{-1}	1.89	0.00	1.38×10^{-1}	1.37	7.80×10^{-10}	1.38×10^{-1}	2.06	3.58×10^{-5}
Nitrate	4.23×10^{1}	7.56×10^{-1}	0.00	6.94×10^{1}	9.74	0.00	6.94×10^{1}	2.17×10^{1}	0.00
Total	**N/A**	**2.65**	**0.00**	**N/A**	**1.11×10^{1}**	**7.80×10^{-10}**	**N/A**	**2.38×10^{1}**	**3.58×10^{-5}**
Year of peak impact	2017	2017	N/A	1964	1964	2017	1964	1964	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–183. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.23×10^{-10}	9.83×10^{-5}	9.69×10^{-10}	7.23×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.08×10^{-5}	6.84×10^{-2}	1.26×10^{-6}
Technetium-99	4.97×10^{-11}	2.24×10^{-4}	9.83×10^{-9}	4.97×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.67×10^{-7}	2.61×10^{-2}	1.40×10^{-6}
Iodine-129	6.32×10^{-14}	2.26×10^{-5}	3.18×10^{-10}	6.32×10^{-14}	3.45×10^{-4}	8.28×10^{-9}	1.13×10^{-9}	4.08×10^{-3}	1.00×10^{-7}
Total	**N/A**	$\mathbf{3.45\times10^{-4}}$	$\mathbf{1.11\times10^{-8}}$	**N/A**	$\mathbf{9.81\times10^{-4}}$	$\mathbf{3.41\times10^{-8}}$	**N/A**	$\mathbf{9.85\times10^{-2}}$	$\mathbf{2.75\times10^{-6}}$
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.70×10^{-5}	1.68×10^{-4}	7.03×10^{-14}	1.70×10^{-5}	2.75×10^{-4}	3.22×10^{-9}	3.31×10^{-2}	1.46×10^{-1}	3.57×10^{-5}
Nitrate	4.81×10^{-3}	7.29×10^{-4}	0.00	4.81×10^{-3}	4.54×10^{-1}	0.00	1.42×10^{1}	4.50	0.00
Total	**N/A**	$\mathbf{8.96\times10^{-4}}$	$\mathbf{7.03\times10^{-14}}$	**N/A**	$\mathbf{4.54\times10^{-1}}$	$\mathbf{3.22\times10^{-9}}$	**N/A**	**4.64**	$\mathbf{3.57\times10^{-5}}$
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–184. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.89×10^{-7}	2.22×10^{-2}	2.10×10^{-7}	1.89×10^{-7}	2.58×10^{-2}	2.54×10^{-7}	1.89×10^{-7}	3.07×10^{-2}	3.22×10^{-7}
Technetium-99	1.34×10^{-6}	2.35	8.07×10^{-5}	1.34×10^{-6}	6.05	2.66×10^{-4}	1.34×10^{-6}	1.24×10^{1}	5.81×10^{-4}
Iodine-129	5.38×10^{-10}	1.53×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**2.52**	**8.27×10^{-5}**	**N/A**	**6.27**	**2.68×10^{-4}**	**N/A**	**1.26×10^{1}**	**5.85×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.01×10^{-2}	6.67×10^{-1}	0.00	6.98×10^{-2}	6.89×10^{-1}	2.75×10^{-10}	6.98×10^{-2}	1.04	1.26×10^{-5}
Nitrate	2.10	3.75×10^{-2}	0.00	2.15	3.02×10^{-1}	0.00	2.15	6.74×10^{-1}	0.00
Total	**N/A**	**7.05×10^{-1}**	**0.00**	**N/A**	**9.91×10^{-1}**	**2.75×10^{-10}**	**N/A**	**1.71**	**1.26×10^{-5}**
Year of peak impact	2102	2102	N/A	2110	2110	2102	2110	2110	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–185. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.70×10^{-9}	3.16×10^{-4}	3.00×10^{-9}	2.70×10^{-9}	3.67×10^{-4}	3.62×10^{-9}	2.70×10^{-9}	4.37×10^{-4}	4.59×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	$\mathbf{1.58\times10^{-4}}$	**N/A**	$\mathbf{1.23\times10^{1}}$	$\mathbf{4.94\times10^{-4}}$	**N/A**	$\mathbf{2.40\times10^{1}}$	$\mathbf{1.07\times10^{-3}}$
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.51×10^{-2}	6.20×10^{-1}	0.00	6.51×10^{-2}	6.43×10^{-1}	2.56×10^{-10}	6.51×10^{-2}	9.67×10^{-1}	1.17×10^{-5}
Nitrate	3.81	6.79×10^{-2}	0.00	3.81	5.34×10^{-1}	0.00	3.81	1.19	0.00
Total	**N/A**	$\mathbf{6.88\times10^{-1}}$	**0.00**	**N/A**	**1.18**	$\mathbf{2.56\times10^{-10}}$	**N/A**	**2.16**	$\mathbf{1.17\times10^{-5}}$
Year of peak impact	2090	2090	N/A	2090	2090	2090	2090	2090	2090

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–186. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.61×10^{-7}	1.88×10^{-2}	1.79×10^{-7}	1.61×10^{-7}	2.19×10^{-2}	2.16×10^{-7}	1.61×10^{-7}	2.61×10^{-2}	2.74×10^{-7}
Technetium-99	2.51×10^{-6}	4.39	1.51×10^{-4}	2.51×10^{-6}	1.13×10^{1}	4.97×10^{-4}	2.51×10^{-6}	2.31×10^{1}	1.09×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.67	2.34×10^{-5}	4.68×10^{-9}	2.15	3.55×10^{-5}
Total	**N/A**	**5.75**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.21×10^{-4}**	**N/A**	**2.53×10^{1}**	**1.12×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.21	1.29×10^{-1}	0.00	7.21	1.01	0.00	7.21	2.26	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.44**	**9.67×10^{-10}**	**N/A**	**5.92**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–187. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.06×10^{-6}	2.41×10^{-1}	2.29×10^{-6}	2.06×10^{-6}	2.80×10^{-1}	2.76×10^{-6}	2.06×10^{-6}	3.34×10^{-1}	3.50×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.38×10^{-4}	1.06×10^{-5}	4.78×10^{1}	2.10×10^{-3}	1.06×10^{-5}	9.75×10^{1}	4.59×10^{-3}
Iodine-129	2.03×10^{-8}	5.77	6.56×10^{-5}	2.03×10^{-8}	7.21	1.01×10^{-4}	2.03×10^{-8}	9.32	1.53×10^{-4}
Total	**N/A**	**2.45×10^{1}**	**7.05×10^{-4}**	**N/A**	**5.52×10^{1}**	**2.20×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.74×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.00×10^{-1}	2.86	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.46	5.40×10^{-5}
Nitrate	2.37×10^{1}	4.24×10^{-1}	0.00	2.37×10^{1}	3.33	0.00	2.37×10^{1}	7.43	0.00
Total	**N/A**	**3.28**	**0.00**	**N/A**	**6.29**	**1.18×10^{-9}**	**N/A**	**1.19×10^{1}**	**5.40×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–188. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	$\mathbf{1.44\times10^{-7}}$	$\mathbf{2.89\times10^{-1}}$	$\mathbf{8.84\times10^{-6}}$	$\mathbf{1.44\times10^{-7}}$	$\mathbf{6.81\times10^{-1}}$	$\mathbf{2.81\times10^{-5}}$	$\mathbf{1.44\times10^{-7}}$	**1.35**	$\mathbf{6.09\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.16×10^{-3}	5.87×10^{-2}	0.00	6.10×10^{-3}	6.03×10^{-2}	2.42×10^{-11}	6.10×10^{-3}	9.07×10^{-2}	1.11×10^{-6}
Nitrate	4.34×10^{-1}	7.75×10^{-3}	0.00	4.42×10^{-1}	6.20×10^{-2}	0.00	4.42×10^{-1}	1.38×10^{-1}	0.00
Total	$\mathbf{4.40\times10^{-1}}$	$\mathbf{6.64\times10^{-2}}$	**0.00**	$\mathbf{4.48\times10^{-1}}$	$\mathbf{1.22\times10^{-1}}$	$\mathbf{2.42\times10^{-11}}$	$\mathbf{4.48\times10^{-1}}$	$\mathbf{2.29\times10^{-1}}$	$\mathbf{1.11\times10^{-6}}$
Year of peak impact	2040	2040	N/A	2041	2041	2040	2041	2041	2040

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–189. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	3.63×10^{-9}	4.24×10^{-4}	4.02×10^{-9}	3.63×10^{-9}	4.93×10^{-4}	4.86×10^{-9}	3.63×10^{-9}	5.87×10^{-4}	6.16×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.65×10^{-2}	8.24×10^{-1}	0.00	8.65×10^{-2}	8.54×10^{-1}	3.40×10^{-10}	8.65×10^{-2}	1.29	1.56×10^{-5}
Nitrate	3.65	6.52×10^{-2}	0.00	3.65	5.13×10^{-1}	0.00	3.65	1.14	0.00
Total	**N/A**	**8.89×10^{-1}**	**0.00**	**N/A**	**1.37**	**3.40×10^{-10}**	**N/A**	**2.43**	**1.56×10^{-5}**
Year of peak impact	2098	2098	N/A	2098	2098	2098	2098	2098	2098

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–190. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.54×10^{-7}	6.19×10^{-1}	2.13×10^{-5}	3.54×10^{-7}	1.60	7.00×10^{-5}	3.54×10^{-7}	3.26	1.53×10^{-4}
Iodine-129	6.86×10^{-10}	1.96×10^{-1}	2.22×10^{-6}	6.86×10^{-10}	2.44×10^{-1}	3.44×10^{-6}	6.86×10^{-10}	3.16×10^{-1}	5.20×10^{-6}
Total	**N/A**	**8.15×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.84**	**7.35×10^{-5}**	**N/A**	**3.57**	**1.58×10^{-4}**
Year of peak impact	2251	2251	2251	2251	2251	2251	2251	2251	2251
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.14×10^{-3}	8.04×10^{-2}	3.23×10^{-11}	8.14×10^{-3}	1.21×10^{-1}	1.48×10^{-6}
Nitrate	6.75×10^{-1}	1.21×10^{-2}	0.00	6.84×10^{-1}	9.61×10^{-2}	0.00	6.84×10^{-1}	2.14×10^{-1}	0.00
Total	**N/A**	**9.05×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.35×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2285	2285	N/A	2284	2284	2285	2284	2284	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–191. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.90×10^{-12}	3.57×10^{-5}	1.57×10^{-9}	7.90×10^{-12}	8.22×10^{-5}	3.90×10^{-9}	3.54×10^{-7}	1.07×10^{-2}	5.70×10^{-7}
Iodine-129	1.48×10^{-14}	5.27×10^{-6}	7.42×10^{-11}	1.48×10^{-14}	8.04×10^{-5}	1.93×10^{-9}	6.86×10^{-10}	2.49×10^{-3}	6.12×10^{-8}
Total	**N/A**	**4.09×10^{-5}**	**1.64×10^{-9}**	**N/A**	**1.63×10^{-4}**	**5.84×10^{-9}**	**N/A**	**1.32×10^{-2}**	**6.31×10^{-7}**
Year of peak impact	2184	2184	2184	2184	2184	2184	2251	2251	2251
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.02×10^{-7}	2.98×10^{-6}	1.19×10^{-15}	3.02×10^{-7}	4.88×10^{-6}	5.47×10^{-11}	7.99×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.66×10^{-5}	2.51×10^{-6}	0.00	1.66×10^{-5}	1.56×10^{-3}	0.00	6.30×10^{-1}	3.54×10^{-2}	0.00
Total	**N/A**	**5.49×10^{-6}**	**1.19×10^{-15}**	**N/A**	**1.57×10^{-3}**	**5.47×10^{-11}**	**N/A**	**7.06×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2201	2201	2200	2201	2201	2200	2208	2208	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–192. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.89×10^{-10}	9.23×10^{-5}	8.76×10^{-10}	7.89×10^{-10}	1.07×10^{-4}	1.06×10^{-9}	7.89×10^{-10}	1.28×10^{-4}	1.34×10^{-9}
Technetium-99	9.63×10^{-7}	1.69	5.80×10^{-5}	9.63×10^{-7}	4.34	1.91×10^{-4}	9.63×10^{-7}	8.87	4.17×10^{-4}
Iodine-129	1.65×10^{-9}	4.69×10^{-1}	5.34×10^{-6}	1.65×10^{-9}	5.86×10^{-1}	8.25×10^{-6}	1.65×10^{-9}	7.58×10^{-1}	1.25×10^{-5}
Total	**N/A**	**2.16**	**6.33×10^{-5}**	**N/A**	**4.93**	**1.99×10^{-4}**	**N/A**	**9.63**	**4.30×10^{-4}**
Year of peak impact	2103	2103	2103	2103	2103	2103	2103	2103	2103

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.98×10^{-2}	7.60×10^{-1}	0.00	7.98×10^{-2}	7.88×10^{-1}	3.13×10^{-10}	7.98×10^{-2}	1.19	1.44×10^{-5}
Nitrate	1.74×10^{1}	3.11×10^{-1}	0.00	1.74×10^{1}	2.45	0.00	1.74×10^{1}	5.46	0.00
Total	**N/A**	**1.07**	**0.00**	**N/A**	**3.24**	**3.13×10^{-10}**	**N/A**	**6.64**	**1.44×10^{-5}**
Year of peak impact	2164	2164	N/A	2164	2164	2164	2164	2164	2164

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–193. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.41×10^{-7}	1.65×10^{-2}	1.56×10^{-7}	1.41×10^{-7}	1.91×10^{-2}	1.89×10^{-7}	1.41×10^{-7}	2.28×10^{-2}	2.39×10^{-7}
Technetium-99	3.65×10^{-6}	6.38	2.20×10^{-4}	3.65×10^{-6}	1.65×10^{1}	7.22×10^{-4}	3.65×10^{-6}	3.36×10^{1}	1.58×10^{-3}
Iodine-129	4.34×10^{-9}	1.24	1.40×10^{-5}	4.34×10^{-9}	1.54	2.17×10^{-5}	4.34×10^{-9}	1.99	3.29×10^{-5}
Uranium-238	7.48×10^{-13}	9.28×10^{-5}	1.05×10^{-9}	7.48×10^{-13}	9.65×10^{-5}	1.13×10^{-9}	7.48×10^{-13}	1.04×10^{-4}	1.29×10^{-9}
Total	**N/A**	**7.64**	$\mathbf{2.34\times10^{-4}}$	**N/A**	$\mathbf{1.80\times10^{1}}$	$\mathbf{7.44\times10^{-4}}$	**N/A**	$\mathbf{3.56\times10^{1}}$	$\mathbf{1.61\times10^{-3}}$
Year of peak impact	2066	2066	2066	2066	2066	2066	2066	2066	2066
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.95×10^{-1}	1.86	0.00	1.95×10^{-1}	1.92	8.18×10^{-10}	1.95×10^{-1}	2.89	3.75×10^{-5}
Nitrate	1.88×10^{2}	3.36	0.00	1.88×10^{2}	2.65×10^{1}	0.00	1.88×10^{2}	5.90×10^{1}	0.00
Total uranium	1.24×10^{-6}	1.18×10^{-5}	0.00	1.24×10^{-6}	1.21×10^{-5}	0.00	1.24×10^{-6}	1.26×10^{-5}	0.00
Total	**N/A**	**5.22**	**0.00**	**N/A**	$\mathbf{2.84\times10^{1}}$	$\mathbf{8.18\times10^{-10}}$	**N/A**	$\mathbf{6.19\times10^{1}}$	$\mathbf{3.75\times10^{-5}}$
Year of peak impact	2051	2051	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–194. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.43×10^{-8}	2.84×10^{-3}	2.70×10^{-8}	2.43×10^{-8}	3.31×10^{-3}	3.26×10^{-8}	2.43×10^{-8}	3.94×10^{-3}	4.13×10^{-8}
Technetium-99	1.48×10^{-6}	2.58	8.88×10^{-5}	1.48×10^{-6}	6.65	2.92×10^{-4}	1.48×10^{-6}	1.36×10^{1}	6.39×10^{-4}
Iodine-129	2.72×10^{-9}	7.75×10^{-1}	8.81×10^{-6}	2.72×10^{-9}	9.68×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.36**	**9.76×10^{-5}**	**N/A**	**7.62**	**3.06×10^{-4}**	**N/A**	**1.48×10^{1}**	**6.59×10^{-4}**
Year of peak impact	2052	2052	2052	2052	2052	2052	2052	2052	2052
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.56×10^{-1}	1.48	0.00	1.56×10^{-1}	1.54	6.11×10^{-10}	1.56×10^{-1}	2.31	2.80×10^{-5}
Nitrate	4.61	8.22×10^{-2}	0.00	4.61	6.47×10^{-1}	0.00	4.61	1.44	0.00
Total	**N/A**	**1.56**	**0.00**	**N/A**	**2.18**	**6.11×10^{-10}**	**N/A**	**3.75**	**2.80×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–195. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.25×10^{-6}	2.63×10^{-1}	2.50×10^{-6}	2.25×10^{-6}	3.06×10^{-1}	3.01×10^{-6}	2.25×10^{-6}	3.64×10^{-1}	3.82×10^{-6}
Technetium-99	6.53×10^{-6}	1.14×10^{1}	3.93×10^{-4}	6.53×10^{-6}	2.94×10^{1}	1.29×10^{-3}	6.53×10^{-6}	6.01×10^{1}	2.83×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.50	6.33×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.47×10^{-11}	1.82×10^{-3}	2.06×10^{-8}	1.47×10^{-11}	1.90×10^{-3}	2.22×10^{-8}	1.47×10^{-11}	2.04×10^{-3}	2.53×10^{-8}
Total	**N/A**	**1.53×10^{1}**	**4.36×10^{-4}**	**N/A**	**3.42×10^{1}**	**1.36×10^{-3}**	**N/A**	**6.63×10^{1}**	**2.93×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.39×10^{-1}	3.23	0.00	3.39×10^{-1}	3.35	1.33×10^{-9}	3.39×10^{-1}	5.04	6.11×10^{-5}
Nitrate	6.30×10^{1}	1.12	0.00	6.30×10^{1}	8.84	0.00	6.30×10^{1}	1.97×10^{1}	0.00
Total uranium	2.23×10^{-5}	2.13×10^{-4}	0.00	2.23×10^{-5}	2.17×10^{-4}	0.00	2.23×10^{-5}	2.26×10^{-4}	0.00
Total	**N/A**	**4.35**	**0.00**	**N/A**	**1.22×10^{1}**	**1.33×10^{-9}**	**N/A**	**2.47×10^{1}**	**6.11×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–196. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	$\mathbf{1.44\times10^{-7}}$	$\mathbf{2.89\times10^{-1}}$	$\mathbf{8.84\times10^{-6}}$	$\mathbf{1.44\times10^{-7}}$	$\mathbf{6.81\times10^{-1}}$	$\mathbf{2.81\times10^{-5}}$	$\mathbf{1.44\times10^{-7}}$	**1.35**	$\mathbf{6.09\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.63×10^{-3}	5.36×10^{-2}	0.00	5.63×10^{-3}	5.56×10^{-2}	2.21×10^{-11}	5.63×10^{-3}	8.36×10^{-2}	1.01×10^{-6}
Nitrate	4.13×10^{-1}	7.37×10^{-3}	0.00	4.13×10^{-1}	5.80×10^{-2}	0.00	4.13×10^{-1}	1.29×10^{-1}	0.00
Total	$\mathbf{4.19\times10^{-1}}$	$\mathbf{6.09\times10^{-2}}$	**0.00**	$\mathbf{4.19\times10^{-1}}$	$\mathbf{1.14\times10^{-1}}$	$\mathbf{2.21\times10^{-11}}$	$\mathbf{4.19\times10^{-1}}$	$\mathbf{2.13\times10^{-1}}$	$\mathbf{1.01\times10^{-6}}$
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–197. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.95×10^{-7}	2.28×10^{-2}	2.16×10^{-7}	1.95×10^{-7}	2.65×10^{-2}	2.61×10^{-7}	1.95×10^{-7}	3.15×10^{-2}	3.31×10^{-7}
Technetium-99	3.65×10^{-6}	6.38	2.20×10^{-4}	3.65×10^{-6}	1.65×10^{1}	7.22×10^{-4}	3.65×10^{-6}	3.36×10^{1}	1.58×10^{-3}
Iodine-129	4.34×10^{-9}	1.24	1.40×10^{-5}	4.34×10^{-9}	1.54	2.17×10^{-5}	4.34×10^{-9}	1.99	3.29×10^{-5}
Uranium-238	7.48×10^{-13}	9.28×10^{-5}	1.05×10^{-9}	7.48×10^{-13}	9.65×10^{-5}	1.13×10^{-9}	7.48×10^{-13}	1.04×10^{-4}	1.29×10^{-9}
Total	**N/A**	**7.64**	$\mathbf{2.34\times10^{-4}}$	**N/A**	$\mathbf{1.80\times10^{1}}$	$\mathbf{7.44\times10^{-4}}$	**N/A**	$\mathbf{3.56\times10^{1}}$	$\mathbf{1.61\times10^{-3}}$
Year of peak impact	2066	2066	2066	2066	2066	2066	2066	2066	2066
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.95×10^{-1}	1.86	0.00	1.95×10^{-1}	1.92	8.18×10^{-10}	1.95×10^{-1}	2.89	3.75×10^{-5}
Nitrate	1.88×10^{2}	3.36	0.00	1.88×10^{2}	2.65×10^{1}	0.00	1.88×10^{2}	5.90×10^{1}	0.00
Total uranium	1.24×10^{-6}	1.18×10^{-5}	0.00	1.24×10^{-6}	1.21×10^{-5}	0.00	1.24×10^{-6}	1.26×10^{-5}	0.00
Total	**N/A**	**5.22**	**0.00**	**N/A**	$\mathbf{2.84\times10^{1}}$	$\mathbf{8.18\times10^{-10}}$	**N/A**	$\mathbf{6.19\times10^{1}}$	$\mathbf{3.75\times10^{-5}}$
Year of peak impact	2051	2051	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–198. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.00×10^{-11}	1.17×10^{-6}	2.24×10^{-11}	2.02×10^{-11}	2.74×10^{-6}	2.70×10^{-11}	2.02×10^{-11}	3.27×10^{-6}	3.43×10^{-11}
Technetium-99	3.92×10^{-7}	6.86×10^{-1}	2.38×10^{-5}	3.96×10^{-7}	1.78	7.83×10^{-5}	3.96×10^{-7}	3.64	1.71×10^{-4}
Iodine-129	7.47×10^{-10}	2.13×10^{-1}	2.32×10^{-6}	7.15×10^{-10}	2.54×10^{-1}	3.58×10^{-6}	7.15×10^{-10}	3.29×10^{-1}	5.42×10^{-6}
Uranium-238	7.99×10^{-15}	9.91×10^{-7}	1.15×10^{-11}	8.23×10^{-15}	1.06×10^{-6}	1.24×10^{-11}	8.23×10^{-15}	1.14×10^{-6}	1.42×10^{-11}
Total	**N/A**	**8.99×10^{-1}**	**2.61×10^{-5}**	**N/A**	**2.04**	**8.19×10^{-5}**	**N/A**	**3.97**	**1.77×10^{-4}**
Year of peak impact	2251	2251	2239	2239	2239	2239	2239	2239	2239

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.43×10^{-2}	6.13×10^{-1}	0.00	6.43×10^{-2}	6.35×10^{-1}	2.53×10^{-10}	6.43×10^{-2}	9.56×10^{-1}	1.16×10^{-5}
Nitrate	1.68×10^{1}	2.99×10^{-1}	0.00	1.68×10^{1}	2.35	0.00	1.68×10^{1}	5.25	0.00
Total uranium	2.26×10^{-8}	2.16×10^{-7}	0.00	2.26×10^{-8}	2.20×10^{-7}	0.00	2.26×10^{-8}	2.29×10^{-7}	0.00
Total	**N/A**	**9.12×10^{-1}**	**0.00**	**N/A**	**2.99**	**2.53×10^{-10}**	**N/A**	**6.21**	**1.16×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–199. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.01×10^{-11}	4.57×10^{-5}	2.00×10^{-9}	1.01×10^{-11}	1.05×10^{-4}	5.00×10^{-9}	3.96×10^{-7}	1.19×10^{-2}	6.38×10^{-7}
Iodine-129	1.75×10^{-14}	6.25×10^{-6}	8.80×10^{-11}	1.75×10^{-14}	9.54×10^{-5}	2.29×10^{-9}	7.15×10^{-10}	2.73×10^{-3}	6.69×10^{-8}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	8.23×10^{-15}	1.02×10^{-7}	2.23×10^{-12}
Total	**N/A**	**5.19×10^{-5}**	**2.09×10^{-9}**	**N/A**	**2.01×10^{-4}**	**7.29×10^{-9}**	**N/A**	**1.47×10^{-2}**	**7.05×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2239	2239	2239
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.02×10^{-6}	1.01×10^{-5}	4.00×10^{-15}	1.02×10^{-6}	1.65×10^{-5}	1.83×10^{-10}	6.43×10^{-2}	2.83×10^{-1}	1.16×10^{-5}
Nitrate	3.46×10^{-4}	5.24×10^{-5}	0.00	3.46×10^{-4}	3.26×10^{-2}	0.00	1.68×10^{1}	7.34×10^{-1}	0.00
Total uranium	0.00	0.00	0.00	0.00	0.00	0.00	2.26×10^{-8}	1.00×10^{-8}	0.00
Total	**N/A**	**6.25×10^{-5}**	**4.00×10^{-15}**	**N/A**	**3.26×10^{-2}**	**1.83×10^{-10}**	**N/A**	**1.02**	**1.16×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, 3C, 4, 5, and 6A, Base Case, for releases from cribs and trenches (ditches). Similar to Alternative 6A, Base Case, the dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C, but would be slightly higher than under those alternatives. Impacts would be slightly higher than under Alternatives 2B, 3A, 3B, 3C, and 6C for onsite locations as a result of the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases). However, after CY 2940, the impacts drop significantly as a result of tank farm removal. Population dose is estimated as 2.60×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–9 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2070 and is dominated by technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination has exited the unconfined aquifer, and Figure Q–9 is interpreted as reporting no risk due to these sources.

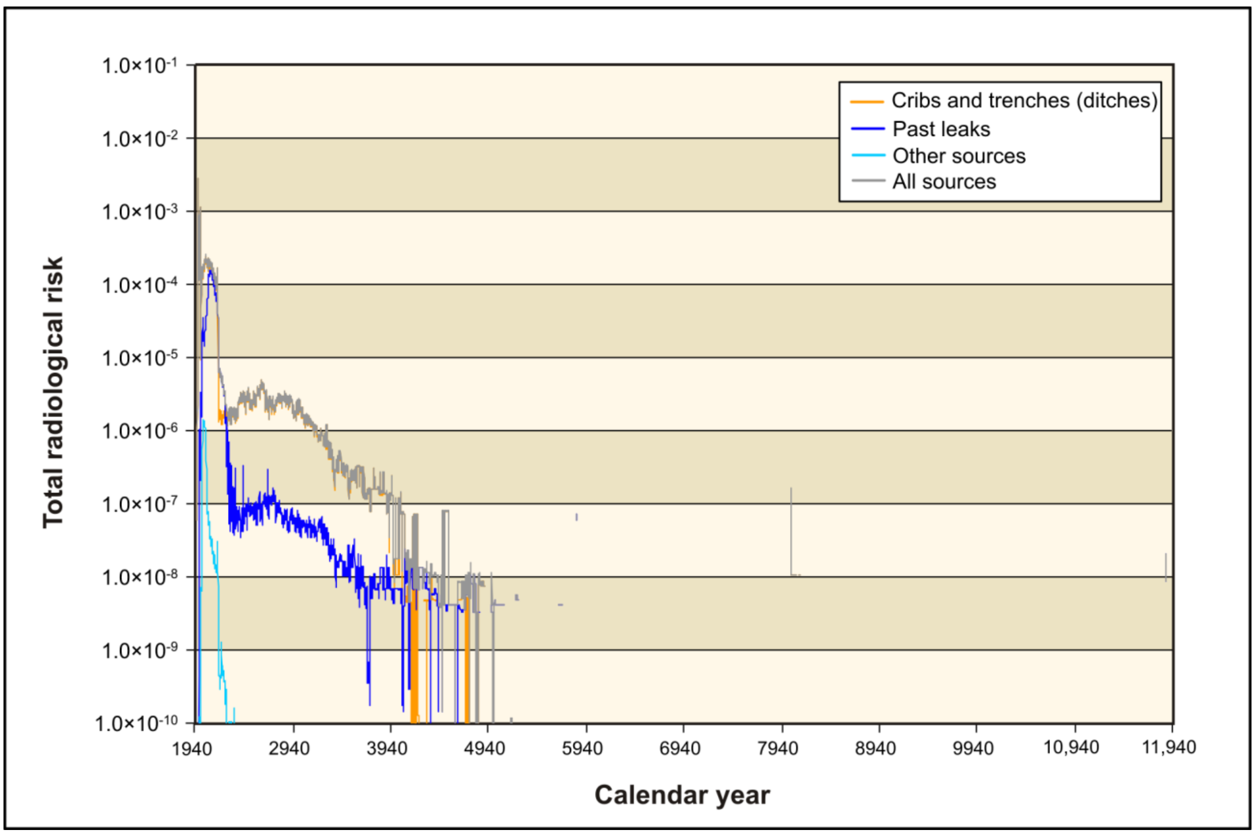


Figure Q–9. Tank Closure Alternative 6A, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.7 Tank Closure Alternative 6B, Base and Option Cases

Tank Closure Alternative 6B, Base and Option Cases, resembles Tank Closure Alternative 6A, Base and Option Cases, except that waste retrieval and processing would proceed at a faster rate and closure would occur at an earlier date. All tank farms would be clean-closed under Tank Closure Alternative 6B. Under the Base Case, the adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier, while under the Option Case, the adjacent cribs and trenches (ditches) would be clean-closed.

Potential human health impacts of Alternative 6B, Base Case, related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–200 through Q–204; to past leaks after CY 1940, in Tables Q–205 through Q–212; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–213 through Q–220. Impacts would be similar to those of Alternative 6A, and standards would be exceeded, as under Alternative 6A. Population dose is estimated as 2.43×10^{-1} person-rem per year for the year of maximum impact.

Table Q–200. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–201. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–202. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	$\mathbf{1.50\times10^{2}}$	$\mathbf{2.91\times10^{-3}}$	**N/A**	$\mathbf{2.58\times10^{2}}$	$\mathbf{7.78\times10^{-3}}$	**N/A**	$\mathbf{4.39\times10^{2}}$	$\mathbf{1.60\times10^{-2}}$
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	$\mathbf{8.96\times10^{1}}$	**0.00**	**N/A**	$\mathbf{3.25\times10^{2}}$	$\mathbf{2.41\times10^{-8}}$	**N/A**	$\mathbf{7.04\times10^{2}}$	$\mathbf{1.11\times10^{-3}}$
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–203. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–204. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	$\mathbf{3.44\times10^{-4}}$	$\mathbf{1.11\times10^{-8}}$	**N/A**	$\mathbf{9.82\times10^{-4}}$	$\mathbf{3.41\times10^{-8}}$	**N/A**	$\mathbf{9.67\times10^{-2}}$	$\mathbf{2.66\times10^{-6}}$
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	$\mathbf{8.95\times10^{-4}}$	$\mathbf{6.82\times10^{-14}}$	**N/A**	$\mathbf{4.54\times10^{-1}}$	$\mathbf{3.13\times10^{-9}}$	**N/A**	**4.61**	$\mathbf{4.10\times10^{-5}}$
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–205. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.91×10^{-7}	2.23×10^{-2}	2.12×10^{-7}	1.91×10^{-7}	2.60×10^{-2}	2.56×10^{-7}	1.91×10^{-7}	3.09×10^{-2}	3.25×10^{-7}
Technetium-99	1.36×10^{-6}	2.39	8.21×10^{-5}	1.36×10^{-6}	6.15	2.70×10^{-4}	1.36×10^{-6}	1.26×10^{1}	5.90×10^{-4}
Iodine-129	5.42×10^{-10}	1.54×10^{-1}	1.76×10^{-6}	5.42×10^{-10}	1.93×10^{-1}	2.71×10^{-6}	5.42×10^{-10}	2.49×10^{-1}	4.11×10^{-6}
Total	**N/A**	**2.56**	**8.40×10^{-5}**	**N/A**	**6.37**	**2.73×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.95×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.94×10^{-2}	6.60×10^{-1}	0.00	6.94×10^{-2}	6.85×10^{-1}	2.72×10^{-10}	6.94×10^{-2}	1.03	1.25×10^{-5}
Nitrate	1.97	3.52×10^{-2}	0.00	1.97	2.77×10^{-1}	0.00	1.97	6.18×10^{-1}	0.00
Total	**N/A**	**6.96×10^{-1}**	**0.00**	**N/A**	**9.62×10^{-1}**	**2.72×10^{-10}**	**N/A**	**1.65**	**1.25×10^{-5}**
Year of peak impact	2097	2097	N/A	2097	2097	2097	2097	2097	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–206. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.07×10^{-9}	2.42×10^{-4}	2.30×10^{-9}	2.07×10^{-9}	2.82×10^{-4}	2.78×10^{-9}	2.07×10^{-9}	3.36×10^{-4}	3.52×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.18×10^{-2}	5.89×10^{-1}	0.00	6.18×10^{-2}	6.10×10^{-1}	2.43×10^{-10}	5.95×10^{-2}	8.83×10^{-1}	1.11×10^{-5}
Nitrate	3.54	6.32×10^{-2}	0.00	3.54	4.97×10^{-1}	0.00	3.68	1.15	0.00
Total	**N/A**	**6.52×10^{-1}**	**0.00**	**N/A**	**1.11**	**2.43×10^{-10}**	**N/A**	**2.04**	**1.11×10^{-5}**
Year of peak impact	2092	2092	N/A	2092	2092	2092	2090	2090	2092

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–207. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.62×10^{-7}	1.89×10^{-2}	1.79×10^{-7}	1.62×10^{-7}	2.20×10^{-2}	2.17×10^{-7}	1.62×10^{-7}	2.62×10^{-2}	2.75×10^{-7}
Technetium-99	2.45×10^{-6}	4.29	1.47×10^{-4}	2.45×10^{-6}	1.10×10^{1}	4.85×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.66	2.34×10^{-5}	4.68×10^{-9}	2.15	3.54×10^{-5}
Total	**N/A**	**5.64**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.00	1.25×10^{-1}	0.00	7.00	9.82×10^{-1}	0.00	7.00	2.19	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.41**	**9.67×10^{-10}**	**N/A**	**5.85**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–208. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.14×10^{-6}	2.50×10^{-1}	2.37×10^{-6}	2.14×10^{-6}	2.91×10^{-1}	2.87×10^{-6}	2.14×10^{-6}	3.47×10^{-1}	3.64×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.33×10^{-4}	1.05×10^{-5}	4.74×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.68×10^{1}	4.55×10^{-3}
Iodine-129	2.01×10^{-8}	5.72	6.50×10^{-5}	2.01×10^{-8}	7.14	1.01×10^{-4}	2.01×10^{-8}	9.23	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.00×10^{-4}**	**N/A**	**5.48×10^{1}**	**2.18×10^{-3}**	**N/A**	**1.06×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2022	2022	2022	2022	2022	2022	2022	2022	2022

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.00×10^{-1}	2.85	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.45	5.41×10^{-5}
Nitrate	2.45×10^{1}	4.37×10^{-1}	0.00	2.45×10^{1}	3.43	0.00	2.45×10^{1}	7.66	0.00
Total	**N/A**	**3.29**	**0.00**	**N/A**	**6.39**	**1.18×10^{-9}**	**N/A**	**1.21×10^{1}**	**5.41×10^{-5}**
Year of peak impact	2024	2024	N/A	2024	2024	2022	2024	2024	2022

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–209. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	$\mathbf{1.43\times10^{-7}}$	$\mathbf{2.86\times10^{-1}}$	$\mathbf{8.76\times10^{-6}}$	$\mathbf{1.43\times10^{-7}}$	$\mathbf{6.75\times10^{-1}}$	$\mathbf{2.79\times10^{-5}}$	$\mathbf{1.43\times10^{-7}}$	**1.33**	$\mathbf{6.04\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.07×10^{-3}	5.78×10^{-2}	0.00	6.07×10^{-3}	5.99×10^{-2}	2.38×10^{-11}	6.07×10^{-3}	9.02×10^{-2}	1.09×10^{-6}
Nitrate	4.37×10^{-1}	7.81×10^{-3}	0.00	4.37×10^{-1}	6.14×10^{-2}	0.00	4.37×10^{-1}	1.37×10^{-1}	0.00
Total	$\mathbf{4.43\times10^{-1}}$	$\mathbf{6.56\times10^{-2}}$	**0.00**	$\mathbf{4.43\times10^{-1}}$	$\mathbf{1.21\times10^{-1}}$	$\mathbf{2.38\times10^{-11}}$	$\mathbf{4.43\times10^{-1}}$	$\mathbf{2.27\times10^{-1}}$	$\mathbf{1.09\times10^{-6}}$
Year of peak impact	2041	2041	N/A	2041	2041	2038	2041	2041	2038

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–210. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.11×10^{-9}	2.47×10^{-4}	2.34×10^{-9}	2.11×10^{-9}	2.87×10^{-4}	2.82×10^{-9}	2.11×10^{-9}	3.41×10^{-4}	3.58×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	$\mathbf{1.67\times10^{-4}}$	**N/A**	$\mathbf{1.30\times10^{1}}$	$\mathbf{5.24\times10^{-4}}$	**N/A**	$\mathbf{2.54\times10^{1}}$	$\mathbf{1.13\times10^{-3}}$
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.14×10^{-2}	7.75×10^{-1}	0.00	7.21×10^{-2}	7.12×10^{-1}	3.20×10^{-10}	7.21×10^{-2}	1.07	1.47×10^{-5}
Nitrate	2.73	4.87×10^{-2}	0.00	3.62	5.08×10^{-1}	0.00	3.62	1.13	0.00
Total	**N/A**	$\mathbf{8.24\times10^{-1}}$	**0.00**	**N/A**	**1.22**	$\mathbf{3.20\times10^{-10}}$	**N/A**	**2.20**	$\mathbf{1.47\times10^{-5}}$
Year of peak impact	2101	2101	N/A	2093	2093	2101	2093	2093	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–211. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.21×10^{-7}	5.62×10^{-1}	1.96×10^{-5}	3.26×10^{-7}	1.47	6.48×10^{-5}	3.26×10^{-7}	3.00	1.42×10^{-4}
Iodine-129	6.54×10^{-10}	1.86×10^{-1}	1.99×10^{-6}	6.16×10^{-10}	2.19×10^{-1}	2.93×10^{-6}	6.16×10^{-10}	2.83×10^{-1}	4.43×10^{-6}
Total	**N/A**	$\mathbf{7.48\times10^{-1}}$	$\mathbf{2.16\times10^{-5}}$	**N/A**	**1.69**	$\mathbf{6.77\times10^{-5}}$	**N/A**	**3.28**	$\mathbf{1.46\times10^{-4}}$
Year of peak impact	2218	2218	2232	2232	2232	2227	2232	2232	2227
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.24×10^{-3}	8.13×10^{-2}	3.23×10^{-11}	7.82×10^{-3}	1.16×10^{-1}	1.48×10^{-6}
Nitrate	5.71×10^{-1}	1.02×10^{-2}	0.00	5.71×10^{-1}	8.02×10^{-2}	0.00	5.99×10^{-1}	1.88×10^{-1}	0.00
Total	**N/A**	$\mathbf{8.86\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.62\times10^{-1}}$	$\mathbf{3.23\times10^{-11}}$	**N/A**	$\mathbf{3.04\times10^{-1}}$	$\mathbf{1.48\times10^{-6}}$
Year of peak impact	2246	2246	N/A	2246	2246	2246	2269	2269	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–212. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.82×10^{-12}	3.53×10^{-5}	1.55×10^{-9}	7.79×10^{-12}	8.10×10^{-5}	3.86×10^{-9}	3.21×10^{-7}	9.69×10^{-3}	5.27×10^{-7}
Iodine-129	1.43×10^{-14}	5.09×10^{-6}	7.17×10^{-11}	1.43×10^{-14}	7.82×10^{-5}	1.87×10^{-9}	6.54×10^{-10}	2.45×10^{-3}	5.48×10^{-8}
Total	**N/A**	**4.03×10^{-5}**	**1.62×10^{-9}**	**N/A**	**1.59×10^{-4}**	**5.73×10^{-9}**	**N/A**	**1.21×10^{-2}**	**5.82×10^{-7}**
Year of peak impact	2180	2180	2180	2185	2185	2180	2218	2218	2227

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.96×10^{-7}	2.93×10^{-6}	1.17×10^{-15}	2.92×10^{-7}	4.73×10^{-6}	5.38×10^{-11}	7.97×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.58×10^{-5}	2.39×10^{-6}	0.00	1.59×10^{-5}	1.50×10^{-3}	0.00	5.76×10^{-1}	3.16×10^{-2}	0.00
Total	**N/A**	**5.32×10^{-6}**	**1.17×10^{-15}**	**N/A**	**1.50×10^{-3}**	**5.38×10^{-11}**	**N/A**	**6.66×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2197	2197	2204	2192	2192	2204	2226	2226	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–213. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.29×10^{-9}	1.51×10^{-4}	1.43×10^{-9}	1.29×10^{-9}	1.75×10^{-4}	1.73×10^{-9}	1.29×10^{-9}	2.09×10^{-4}	2.19×10^{-9}
Technetium-99	8.75×10^{-7}	1.53	5.27×10^{-5}	8.75×10^{-7}	3.95	1.73×10^{-4}	8.75×10^{-7}	8.06	3.79×10^{-4}
Iodine-129	1.60×10^{-9}	4.57×10^{-1}	5.19×10^{-6}	1.60×10^{-9}	5.71×10^{-1}	8.03×10^{-6}	1.60×10^{-9}	7.37×10^{-1}	1.22×10^{-5}
Total	**N/A**	**1.99**	**5.79×10^{-5}**	**N/A**	**4.52**	**1.81×10^{-4}**	**N/A**	**8.80**	**3.91×10^{-4}**
Year of peak impact	2093	2093	2093	2093	2093	2093	2093	2093	2093
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.35×10^{-2}	7.00×10^{-1}	0.00	6.02×10^{-2}	5.95×10^{-1}	3.02×10^{-10}	6.02×10^{-2}	8.95×10^{-1}	1.38×10^{-5}
Nitrate	1.42×10^{1}	2.54×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.53×10^{-1}**	**0.00**	**N/A**	**2.92**	**3.02×10^{-10}**	**N/A**	**6.08**	**1.38×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2097	2172	2172	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–214. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.23×10^{-7}	2.61×10^{-2}	2.47×10^{-7}	2.23×10^{-7}	3.03×10^{-2}	2.99×10^{-7}	2.23×10^{-7}	3.61×10^{-2}	3.79×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.09×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.24×10^{-9}	1.21	1.37×10^{-5}	4.24×10^{-9}	1.51	2.12×10^{-5}	4.24×10^{-9}	1.95	3.21×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.32**	**2.23×10^{-4}**	**N/A**	**1.72×10^{1}**	**7.11×10^{-4}**	**N/A**	**3.40×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.43×10^{-10}	1.74×10^{-1}	2.59	3.86×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.43×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–215. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.00×10^{-8}	3.51×10^{-3}	3.33×10^{-8}	3.00×10^{-8}	4.08×10^{-3}	4.02×10^{-8}	3.00×10^{-8}	4.86×10^{-3}	5.10×10^{-8}
Technetium-99	1.49×10^{-6}	2.60	8.94×10^{-5}	1.49×10^{-6}	6.70	2.94×10^{-4}	1.49×10^{-6}	1.37×10^{1}	6.43×10^{-4}
Iodine-129	2.85×10^{-9}	8.13×10^{-1}	9.24×10^{-6}	2.85×10^{-9}	1.02	1.43×10^{-5}	2.85×10^{-9}	1.31	2.16×10^{-5}
Total	**N/A**	**3.42**	**9.87×10^{-5}**	**N/A**	**7.72**	**3.08×10^{-4}**	**N/A**	**1.50×10^{1}**	**6.65×10^{-4}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.58×10^{-1}	1.50	0.00	1.58×10^{-1}	1.56	6.19×10^{-10}	1.58×10^{-1}	2.34	2.84×10^{-5}
Nitrate	4.59	8.19×10^{-2}	0.00	4.59	6.44×10^{-1}	0.00	4.59	1.44	0.00
Total	**N/A**	**1.58**	**0.00**	**N/A**	**2.20**	**6.19×10^{-10}**	**N/A**	**3.78**	**2.84×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–216. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	3.76×10^{-6}
Technetium-99	6.44×10^{-6}	1.13×10^{1}	3.88×10^{-4}	6.44×10^{-6}	2.91×10^{1}	1.28×10^{-3}	6.44×10^{-6}	5.93×10^{1}	2.79×10^{-3}
Iodine-129	1.27×10^{-8}	3.61	4.10×10^{-5}	1.27×10^{-8}	4.51	6.34×10^{-5}	1.27×10^{-8}	5.82	9.51×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.56×10^{-8}
Total	**N/A**	**1.52×10^{1}**	**4.32×10^{-4}**	**N/A**	**3.40×10^{1}**	**1.34×10^{-3}**	**N/A**	**6.56×10^{1}**	**2.89×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2051
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.53×10^{-1}	3.36	0.00	3.53×10^{-1}	3.49	1.39×10^{-9}	3.53×10^{-1}	5.25	6.36×10^{-5}
Nitrate	6.17×10^{1}	1.10	0.00	6.17×10^{1}	8.66	0.00	6.17×10^{1}	1.93×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.47**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.36×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–217. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	$\mathbf{1.43\times10^{-7}}$	$\mathbf{2.86\times10^{-1}}$	$\mathbf{8.76\times10^{-6}}$	$\mathbf{1.43\times10^{-7}}$	$\mathbf{6.75\times10^{-1}}$	$\mathbf{2.79\times10^{-5}}$	$\mathbf{1.43\times10^{-7}}$	**1.33**	$\mathbf{6.04\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.73×10^{-3}	5.46×10^{-2}	0.00	5.68×10^{-3}	5.61×10^{-2}	2.25×10^{-11}	5.68×10^{-3}	8.44×10^{-2}	1.03×10^{-6}
Nitrate	4.02×10^{-1}	7.18×10^{-3}	0.00	4.07×10^{-1}	5.71×10^{-2}	0.00	4.07×10^{-1}	1.27×10^{-1}	0.00
Total	$\mathbf{4.08\times10^{-1}}$	$\mathbf{6.18\times10^{-2}}$	**0.00**	$\mathbf{4.12\times10^{-1}}$	$\mathbf{1.13\times10^{-1}}$	$\mathbf{2.25\times10^{-11}}$	$\mathbf{4.12\times10^{-1}}$	$\mathbf{2.12\times10^{-1}}$	$\mathbf{1.03\times10^{-6}}$
Year of peak impact	2050	2050	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–218. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.76×10^{-7}	5.56×10^{-2}	5.28×10^{-7}	4.76×10^{-7}	6.47×10^{-2}	6.37×10^{-7}	4.76×10^{-7}	7.70×10^{-2}	8.09×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.09×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.24×10^{-9}	1.21	1.37×10^{-5}	4.24×10^{-9}	1.51	2.12×10^{-5}	4.24×10^{-9}	1.95	3.21×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.35**	**2.24×10^{-4}**	**N/A**	**1.73×10^{1}**	**7.11×10^{-4}**	**N/A**	**3.41×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.43×10^{-10}	1.74×10^{-1}	2.59	3.86×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.43×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–219. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.99×10^{-11}	8.18×10^{-6}	6.72×10^{-11}	6.06×10^{-11}	8.24×10^{-6}	8.12×10^{-11}	6.06×10^{-11}	9.81×10^{-6}	1.03×10^{-10}
Technetium-99	3.53×10^{-7}	6.17×10^{-1}	2.16×10^{-5}	3.58×10^{-7}	1.62	7.09×10^{-5}	3.58×10^{-7}	3.30	1.55×10^{-4}
Iodine-129	7.19×10^{-10}	2.05×10^{-1}	2.18×10^{-6}	6.73×10^{-10}	2.40×10^{-1}	3.37×10^{-6}	6.73×10^{-10}	3.10×10^{-1}	5.10×10^{-6}
Total	**N/A**	**8.22×10^{-1}**	**2.38×10^{-5}**	**N/A**	**1.86**	**7.43×10^{-5}**	**N/A**	**3.61**	**1.60×10^{-4}**
Year of peak impact	2218	2218	2221	2221	2221	2221	2221	2221	2221
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.10×10^{-2}	6.76×10^{-1}	0.00	7.10×10^{-2}	7.01×10^{-1}	2.79×10^{-10}	7.10×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.72×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.79×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–220. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	9.50×10^{-12}	4.29×10^{-5}	1.88×10^{-9}	9.50×10^{-12}	9.88×10^{-5}	4.69×10^{-9}	3.58×10^{-7}	1.08×10^{-2}	5.78×10^{-7}
Iodine-129	1.59×10^{-14}	5.69×10^{-6}	8.02×10^{-11}	1.59×10^{-14}	8.69×10^{-5}	2.09×10^{-9}	6.73×10^{-10}	2.62×10^{-3}	6.43×10^{-8}
Total	**N/A**	**4.85×10^{-5}**	**1.96×10^{-9}**	**N/A**	**1.86×10^{-4}**	**6.78×10^{-9}**	**N/A**	**1.34×10^{-2}**	**6.43×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2221	2221	2221
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.72×10^{-7}	9.60×10^{-6}	3.82×10^{-15}	9.72×10^{-7}	1.57×10^{-5}	1.75×10^{-10}	7.10×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.13×10^{-4}	4.74×10^{-5}	0.00	3.13×10^{-4}	2.95×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.70×10^{-5}**	**3.82×10^{-15}**	**N/A**	**2.95×10^{-2}**	**1.75×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figure Q–10 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by technetium-99 and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination due to cribs and trenches (ditches) and past leaks has exited the unconfined aquifer, and Figure Q–10 is interpreted as reporting no risk due to these sources.

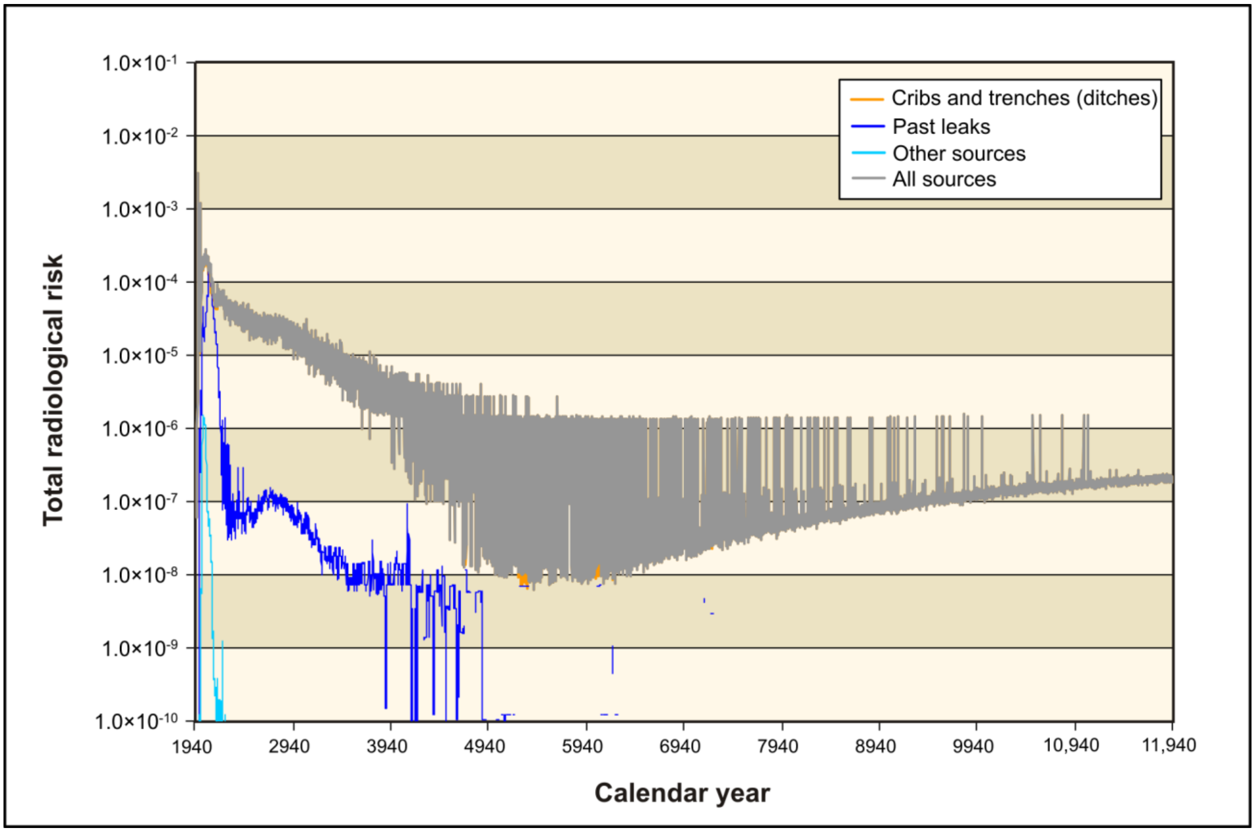


Figure Q–10. Tank Closure Alternative 6B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Potential human health impacts of Alternative 6B, Option Case, related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–221 through Q–225; to past leaks after CY 1940, in Tables Q–226 through Q–233; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–234 through Q–241. Impacts would be slightly less than those under Alternative 6B, Base Case, and standards would be exceeded, as under Alternative 6B, Base Case. Population dose is estimated as 2.44×10^{-1} person-rem per year for the year of maximum impact.

Table Q–221. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.70×10^{-4}	7.83×10^{1}	7.43×10^{-4}	6.70×10^{-4}	9.11×10^{1}	8.97×10^{-4}	6.70×10^{-4}	1.08×10^{2}	1.14×10^{-3}
Technetium-99	3.42×10^{-5}	5.98×10^{1}	2.06×10^{-3}	3.42×10^{-5}	1.54×10^{2}	6.76×10^{-3}	3.42×10^{-5}	3.15×10^{2}	1.48×10^{-2}
Iodine-129	4.47×10^{-8}	1.27×10^{1}	1.45×10^{-4}	4.47×10^{-8}	1.59×10^{1}	2.24×10^{-4}	4.47×10^{-8}	2.06×10^{1}	3.39×10^{-4}
Total	**N/A**	$\mathbf{1.51\times10^{2}}$	$\mathbf{2.94\times10^{-3}}$	**N/A**	$\mathbf{2.61\times10^{2}}$	$\mathbf{7.88\times10^{-3}}$	**N/A**	$\mathbf{4.44\times10^{2}}$	$\mathbf{1.63\times10^{-2}}$
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.24	5.94×10^{1}	0.00	2.83	2.80×10^{1}	2.45×10^{-8}	2.83	4.21×10^{1}	1.12×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.06×10^{3}	2.89×10^{2}	0.00	2.06×10^{3}	6.45×10^{2}	0.00
Total	**N/A**	$\mathbf{8.99\times10^{1}}$	**0.00**	**N/A**	$\mathbf{3.17\times10^{2}}$	$\mathbf{2.45\times10^{-8}}$	**N/A**	$\mathbf{6.87\times10^{2}}$	$\mathbf{1.12\times10^{-3}}$
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–222. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.90×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.03×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.17×10^{-7}	2.05×10^{-1}	7.04×10^{-6}	1.17×10^{-7}	5.28×10^{-1}	2.32×10^{-5}	1.17×10^{-7}	1.08	5.07×10^{-5}
Iodine-129	1.06×10^{-9}	3.01×10^{-1}	3.42×10^{-6}	1.06×10^{-9}	3.76×10^{-1}	5.29×10^{-6}	1.06×10^{-9}	4.86×10^{-1}	8.00×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.32	6.02×10^{1}	0.00	6.32	6.24×10^{1}	2.48×10^{-8}	6.32	9.39×10^{1}	1.14×10^{-3}
Nitrate	1.56×10^{3}	2.78×10^{1}	0.00	1.56×10^{3}	2.19×10^{2}	0.00	1.56×10^{3}	4.87×10^{2}	0.00
Total	**N/A**	**8.80×10^{1}**	**0.00**	**N/A**	**2.81×10^{2}**	**2.48×10^{-8}**	**N/A**	**5.81×10^{2}**	**1.14×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–223. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.70×10^{-4}	7.83×10^{1}	7.43×10^{-4}	6.70×10^{-4}	9.11×10^{1}	8.97×10^{-4}	6.70×10^{-4}	1.08×10^{2}	1.14×10^{-3}
Technetium-99	3.42×10^{-5}	5.98×10^{1}	2.06×10^{-3}	3.42×10^{-5}	1.54×10^{2}	6.76×10^{-3}	3.42×10^{-5}	3.15×10^{2}	1.48×10^{-2}
Iodine-129	4.47×10^{-8}	1.27×10^{1}	1.45×10^{-4}	4.47×10^{-8}	1.59×10^{1}	2.24×10^{-4}	4.47×10^{-8}	2.06×10^{1}	3.39×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.94×10^{-3}**	**N/A**	**2.61×10^{2}**	**7.88×10^{-3}**	**N/A**	**4.44×10^{2}**	**1.63×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.24	5.94×10^{1}	0.00	2.83	2.80×10^{1}	2.45×10^{-8}	2.83	4.21×10^{1}	1.12×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.06×10^{3}	2.89×10^{2}	0.00	2.06×10^{3}	6.45×10^{2}	0.00
Total	**N/A**	**8.99×10^{1}**	**0.00**	**N/A**	**3.17×10^{2}**	**2.45×10^{-8}**	**N/A**	**6.87×10^{2}**	**1.12×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–224. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.09×10^{-5}	1.27	1.21×10^{-5}	1.09×10^{-5}	1.48	1.46×10^{-5}	1.09×10^{-5}	1.76	1.85×10^{-5}
Technetium-99	8.91×10^{-7}	1.56	5.36×10^{-5}	8.91×10^{-7}	4.02	1.76×10^{-4}	8.91×10^{-7}	8.21	3.86×10^{-4}
Iodine-129	1.11×10^{-9}	3.16×10^{-1}	3.59×10^{-6}	1.11×10^{-9}	3.94×10^{-1}	5.55×10^{-6}	1.11×10^{-9}	5.10×10^{-1}	8.40×10^{-6}
Total	**N/A**	**3.15**	**6.93×10^{-5}**	**N/A**	**5.89**	**1.97×10^{-4}**	**N/A**	**1.05×10^{1}**	**4.13×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.94×10^{-1}	1.84	0.00	1.34×10^{-1}	1.32	7.60×10^{-10}	1.34×10^{-1}	1.99	3.48×10^{-5}
Nitrate	4.16×10^{1}	7.42×10^{-1}	0.00	7.00×10^{1}	9.83	0.00	7.00×10^{1}	2.19×10^{1}	0.00
Total	**N/A**	**2.58**	**0.00**	**N/A**	**1.12×10^{1}**	**7.60×10^{-10}**	**N/A**	**2.39×10^{1}**	**3.48×10^{-5}**
Year of peak impact	2014	2014	N/A	1964	1964	2014	1964	1964	2014

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–225. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.25×10^{-10}	9.86×10^{-5}	9.72×10^{-10}	7.25×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.09×10^{-5}	6.90×10^{-2}	1.27×10^{-6}
Technetium-99	4.95×10^{-11}	2.23×10^{-4}	9.81×10^{-9}	4.95×10^{-11}	5.15×10^{-4}	2.45×10^{-8}	8.91×10^{-7}	2.68×10^{-2}	1.43×10^{-6}
Iodine-129	6.37×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.37×10^{-14}	3.47×10^{-4}	8.34×10^{-9}	1.11×10^{-9}	4.03×10^{-3}	9.89×10^{-8}
Total	**N/A**	$\mathbf{3.45\times10^{-4}}$	$\mathbf{1.11\times10^{-8}}$	**N/A**	$\mathbf{9.83\times10^{-4}}$	$\mathbf{3.41\times10^{-8}}$	**N/A**	$\mathbf{9.99\times10^{-2}}$	$\mathbf{2.80\times10^{-6}}$
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.71×10^{-5}	1.68×10^{-4}	7.04×10^{-14}	1.71×10^{-5}	2.76×10^{-4}	3.23×10^{-9}	3.31×10^{-2}	1.46×10^{-1}	3.48×10^{-5}
Nitrate	4.80×10^{-3}	7.27×10^{-4}	0.00	4.80×10^{-3}	4.53×10^{-1}	0.00	1.43×10^{1}	4.50	0.00
Total	**N/A**	$\mathbf{8.96\times10^{-4}}$	$\mathbf{7.04\times10^{-14}}$	**N/A**	$\mathbf{4.53\times10^{-1}}$	$\mathbf{3.23\times10^{-9}}$	**N/A**	**4.64**	$\mathbf{3.48\times10^{-5}}$
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2014

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–226. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.91×10^{-7}	2.23×10^{-2}	2.12×10^{-7}	1.91×10^{-7}	2.60×10^{-2}	2.56×10^{-7}	1.91×10^{-7}	3.09×10^{-2}	3.25×10^{-7}
Technetium-99	1.36×10^{-6}	2.39	8.21×10^{-5}	1.36×10^{-6}	6.15	2.70×10^{-4}	1.36×10^{-6}	1.26×10^{1}	5.90×10^{-4}
Iodine-129	5.42×10^{-10}	1.54×10^{-1}	1.76×10^{-6}	5.42×10^{-10}	1.93×10^{-1}	2.71×10^{-6}	5.42×10^{-10}	2.49×10^{-1}	4.11×10^{-6}
Total	**N/A**	**2.56**	**8.40×10^{-5}**	**N/A**	**6.37**	**2.73×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.95×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.94×10^{-2}	6.60×10^{-1}	0.00	6.94×10^{-2}	6.85×10^{-1}	2.72×10^{-10}	6.94×10^{-2}	1.03	1.25×10^{-5}
Nitrate	1.97	3.52×10^{-2}	0.00	1.97	2.77×10^{-1}	0.00	1.97	6.18×10^{-1}	0.00
Total	**N/A**	**6.96×10^{-1}**	**0.00**	**N/A**	**9.62×10^{-1}**	**2.72×10^{-10}**	**N/A**	**1.65**	**1.25×10^{-5}**
Year of peak impact	2097	2097	N/A	2097	2097	2097	2097	2097	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–227. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.07×10^{-9}	2.42×10^{-4}	2.30×10^{-9}	2.07×10^{-9}	2.82×10^{-4}	2.78×10^{-9}	2.07×10^{-9}	3.36×10^{-4}	3.52×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.18×10^{-2}	5.89×10^{-1}	0.00	6.18×10^{-2}	6.10×10^{-1}	2.43×10^{-10}	5.95×10^{-2}	8.83×10^{-1}	1.11×10^{-5}
Nitrate	3.54	6.32×10^{-2}	0.00	3.54	4.97×10^{-1}	0.00	3.68	1.15	0.00
Total	**N/A**	**6.52×10^{-1}**	**0.00**	**N/A**	**1.11**	**2.43×10^{-10}**	**N/A**	**2.04**	**1.11×10^{-5}**
Year of peak impact	2092	2092	N/A	2092	2092	2092	2090	2090	2092

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–228. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.62×10^{-7}	1.89×10^{-2}	1.79×10^{-7}	1.62×10^{-7}	2.20×10^{-2}	2.17×10^{-7}	1.62×10^{-7}	2.62×10^{-2}	2.75×10^{-7}
Technetium-99	2.45×10^{-6}	4.29	1.47×10^{-4}	2.45×10^{-6}	1.10×10^{1}	4.85×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.66	2.34×10^{-5}	4.68×10^{-9}	2.15	3.54×10^{-5}
Total	**N/A**	**5.64**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.00	1.25×10^{-1}	0.00	7.00	9.82×10^{-1}	0.00	7.00	2.19	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.41**	**9.67×10^{-10}**	**N/A**	**5.85**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–229. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.14×10^{-6}	2.50×10^{-1}	2.37×10^{-6}	2.14×10^{-6}	2.91×10^{-1}	2.87×10^{-6}	2.14×10^{-6}	3.47×10^{-1}	3.64×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.33×10^{-4}	1.05×10^{-5}	4.74×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.68×10^{1}	4.55×10^{-3}
Iodine-129	2.01×10^{-8}	5.72	6.50×10^{-5}	2.01×10^{-8}	7.14	1.01×10^{-4}	2.01×10^{-8}	9.23	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.00×10^{-4}**	**N/A**	**5.48×10^{1}**	**2.18×10^{-3}**	**N/A**	**1.06×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2022	2022	2022	2022	2022	2022	2022	2022	2022

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.00×10^{-1}	2.85	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.45	5.41×10^{-5}
Nitrate	2.45×10^{1}	4.37×10^{-1}	0.00	2.45×10^{1}	3.43	0.00	2.45×10^{1}	7.66	0.00
Total	**N/A**	**3.29**	**0.00**	**N/A**	**6.39**	**1.18×10^{-9}**	**N/A**	**1.21×10^{1}**	**5.41×10^{-5}**
Year of peak impact	2024	2024	N/A	2024	2024	2022	2024	2024	2022

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–230. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	$\mathbf{1.43\times10^{-7}}$	$\mathbf{2.86\times10^{-1}}$	$\mathbf{8.76\times10^{-6}}$	$\mathbf{1.43\times10^{-7}}$	$\mathbf{6.75\times10^{-1}}$	$\mathbf{2.79\times10^{-5}}$	$\mathbf{1.43\times10^{-7}}$	**1.33**	$\mathbf{6.04\times10^{-5}}$
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.07×10^{-3}	5.78×10^{-2}	0.00	6.07×10^{-3}	5.99×10^{-2}	2.38×10^{-11}	6.07×10^{-3}	9.02×10^{-2}	1.09×10^{-6}
Nitrate	4.37×10^{-1}	7.81×10^{-3}	0.00	4.37×10^{-1}	6.14×10^{-2}	0.00	4.37×10^{-1}	1.37×10^{-1}	0.00
Total	$\mathbf{4.43\times10^{-1}}$	$\mathbf{6.56\times10^{-2}}$	**0.00**	$\mathbf{4.43\times10^{-1}}$	$\mathbf{1.21\times10^{-1}}$	$\mathbf{2.38\times10^{-11}}$	$\mathbf{4.43\times10^{-1}}$	$\mathbf{2.27\times10^{-1}}$	$\mathbf{1.09\times10^{-6}}$
Year of peak impact	2041	2041	N/A	2041	2041	2038	2041	2041	2038

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–231. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.11×10^{-9}	2.47×10^{-4}	2.34×10^{-9}	2.11×10^{-9}	2.87×10^{-4}	2.82×10^{-9}	2.11×10^{-9}	3.41×10^{-4}	3.58×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	8.14×10^{-2}	7.75×10^{-1}	0.00	7.21×10^{-2}	7.12×10^{-1}	3.20×10^{-10}	7.21×10^{-2}	1.07	1.47×10^{-5}
Nitrate	2.73	4.87×10^{-2}	0.00	3.62	5.08×10^{-1}	0.00	3.62	1.13	0.00
Total	**N/A**	**8.24×10^{-1}**	**0.00**	**N/A**	**1.22**	**3.20×10^{-10}**	**N/A**	**2.20**	**1.47×10^{-5}**
Year of peak impact	2101	2101	N/A	2093	2093	2101	2093	2093	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–232. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.21×10^{-7}	5.62×10^{-1}	1.96×10^{-5}	3.26×10^{-7}	1.47	6.48×10^{-5}	3.26×10^{-7}	3.00	1.42×10^{-4}
Iodine-129	6.54×10^{-10}	1.86×10^{-1}	1.99×10^{-6}	6.16×10^{-10}	2.19×10^{-1}	2.93×10^{-6}	6.16×10^{-10}	2.83×10^{-1}	4.43×10^{-6}
Total	**N/A**	**7.48×10^{-1}**	**2.16×10^{-5}**	**N/A**	**1.69**	**6.77×10^{-5}**	**N/A**	**3.28**	**1.46×10^{-4}**
Year of peak impact	2218	2218	2232	2232	2232	2227	2232	2232	2227

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.24×10^{-3}	8.13×10^{-2}	3.23×10^{-11}	7.82×10^{-3}	1.16×10^{-1}	1.48×10^{-6}
Nitrate	5.71×10^{-1}	1.02×10^{-2}	0.00	5.71×10^{-1}	8.02×10^{-2}	0.00	5.99×10^{-1}	1.88×10^{-1}	0.00
Total	**N/A**	**8.86×10^{-2}**	**0.00**	**N/A**	**1.62×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.04×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2246	2246	N/A	2246	2246	2246	2269	2246	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–233. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.82×10^{-12}	3.53×10^{-5}	1.55×10^{-9}	7.79×10^{-12}	8.10×10^{-5}	3.86×10^{-9}	3.21×10^{-7}	9.69×10^{-3}	5.27×10^{-7}
Iodine-129	1.43×10^{-14}	5.09×10^{-6}	7.17×10^{-11}	1.43×10^{-14}	7.82×10^{-5}	1.87×10^{-9}	6.54×10^{-10}	2.45×10^{-3}	5.48×10^{-8}
Total	**N/A**	**4.03×10^{-5}**	**1.62×10^{-9}**	**N/A**	**1.59×10^{-4}**	**5.73×10^{-9}**	**N/A**	**1.21×10^{-2}**	**5.82×10^{-7}**
Year of peak impact	2180	2180	2180	2185	2185	2180	2218	2218	2227

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.96×10^{-7}	2.93×10^{-6}	1.17×10^{-15}	2.92×10^{-7}	4.73×10^{-6}	5.38×10^{-11}	7.97×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.58×10^{-5}	2.39×10^{-6}	0.00	1.59×10^{-5}	1.50×10^{-3}	0.00	5.76×10^{-1}	3.16×10^{-2}	0.00
Total	**N/A**	**5.32×10^{-6}**	**1.17×10^{-15}**	**N/A**	**1.50×10^{-3}**	**5.38×10^{-11}**	**N/A**	**6.66×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2197	2197	2204	2192	2192	2204	2226	2226	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–234. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.30×10^{-9}	1.53×10^{-4}	1.45×10^{-9}	1.30×10^{-9}	1.77×10^{-4}	1.75×10^{-9}	1.30×10^{-9}	2.11×10^{-4}	2.22×10^{-9}
Technetium-99	8.75×10^{-7}	1.53	5.27×10^{-5}	8.75×10^{-7}	3.95	1.73×10^{-4}	8.75×10^{-7}	8.06	3.79×10^{-4}
Iodine-129	1.60×10^{-9}	4.57×10^{-1}	5.19×10^{-6}	1.60×10^{-9}	5.71×10^{-1}	8.03×10^{-6}	1.60×10^{-9}	7.37×10^{-1}	1.22×10^{-5}
Total	**N/A**	**1.99**	**5.79×10^{-5}**	**N/A**	**4.52**	**1.81×10^{-4}**	**N/A**	**8.80**	**3.91×10^{-4}**
Year of peak impact	2093	2093	2093	2093	2093	2093	2093	2093	2093

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.46×10^{-2}	7.10×10^{-1}	0.00	1.34×10^{-2}	1.33×10^{-1}	2.93×10^{-10}	1.34×10^{-2}	2.00×10^{-1}	1.34×10^{-5}
Nitrate	6.49	1.16×10^{-1}	0.00	1.23×10^{1}	1.72	0.00	1.23×10^{1}	3.84	0.00
Total	**N/A**	**8.26×10^{-1}**	**0.00**	**N/A**	**1.85**	**2.93×10^{-10}**	**N/A**	**4.04**	**1.34×10^{-5}**
Year of peak impact	2097	2097	N/A	2247	2247	2097	2247	2247	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–235. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.72×10^{-7}	5.52×10^{-2}	5.24×10^{-7}	4.72×10^{-7}	6.42×10^{-2}	6.32×10^{-7}	4.72×10^{-7}	7.65×10^{-2}	8.02×10^{-7}
Technetium-99	3.76×10^{-6}	6.58	2.26×10^{-4}	3.76×10^{-6}	1.70×10^{1}	7.44×10^{-4}	3.76×10^{-6}	3.46×10^{1}	1.63×10^{-3}
Iodine-129	4.50×10^{-9}	1.28	1.46×10^{-5}	4.50×10^{-9}	1.60	2.26×10^{-5}	4.50×10^{-9}	2.07	3.41×10^{-5}
Uranium-238	7.66×10^{-13}	9.50×10^{-5}	1.07×10^{-9}	7.66×10^{-13}	9.89×10^{-5}	1.16×10^{-9}	7.66×10^{-13}	1.07×10^{-4}	1.32×10^{-9}
Total	**N/A**	**7.92**	**2.41×10^{-4}**	**N/A**	**1.86×10^{1}**	**7.67×10^{-4}**	**N/A**	**3.68×10^{1}**	**1.66×10^{-3}**
Year of peak impact	2065	2065	2065	2065	2065	2065	2065	2065	2065
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.80×10^{-1}	1.71	0.00	1.67×10^{-1}	1.65	7.70×10^{-10}	1.67×10^{-1}	2.49	3.53×10^{-5}
Nitrate	1.97×10^{2}	3.52	0.00	2.00×10^{2}	2.81×10^{1}	0.00	2.00×10^{2}	6.26×10^{1}	0.00
Total uranium	1.45×10^{-6}	1.38×10^{-5}	0.00	1.40×10^{-6}	1.36×10^{-5}	0.00	1.40×10^{-6}	1.42×10^{-5}	0.00
Total	**N/A**	**5.23**	**0.00**	**N/A**	**2.97×10^{1}**	**7.70×10^{-10}**	**N/A**	**6.51×10^{1}**	**3.53×10^{-5}**
Year of peak impact	2083	2083	N/A	2077	2077	2087	2077	2077	2087

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–236. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	3.00×10^{-8}	3.51×10^{-3}	3.33×10^{-8}	3.00×10^{-8}	4.08×10^{-3}	4.02×10^{-8}	3.00×10^{-8}	4.86×10^{-3}	5.10×10^{-8}
Technetium-99	1.49×10^{-6}	2.60	8.94×10^{-5}	1.49×10^{-6}	6.70	2.94×10^{-4}	1.49×10^{-6}	1.37×10^{1}	6.43×10^{-4}
Iodine-129	2.85×10^{-9}	8.13×10^{-1}	9.24×10^{-6}	2.85×10^{-9}	1.02	1.43×10^{-5}	2.85×10^{-9}	1.31	2.16×10^{-5}
Total	**N/A**	**3.42**	**9.87×10^{-5}**	**N/A**	**7.72**	**3.08×10^{-4}**	**N/A**	**1.50×10^{1}**	**6.65×10^{-4}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.58×10^{-1}	1.50	0.00	1.58×10^{-1}	1.56	6.19×10^{-10}	1.58×10^{-1}	2.34	2.84×10^{-5}
Nitrate	4.59	8.19×10^{-2}	0.00	4.59	6.44×10^{-1}	0.00	4.59	1.44	0.00
Total	**N/A**	**1.58**	**0.00**	**N/A**	**2.20**	**6.19×10^{-10}**	**N/A**	**3.78**	**2.84×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–237. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.88×10^{-6}	2.19×10^{-1}	2.08×10^{-6}	1.88×10^{-6}	2.55×10^{-1}	2.51×10^{-6}	1.88×10^{-6}	3.04×10^{-1}	3.19×10^{-6}
Technetium-99	6.45×10^{-6}	1.13×10^{1}	3.88×10^{-4}	6.45×10^{-6}	2.91×10^{1}	1.28×10^{-3}	6.45×10^{-6}	5.94×10^{1}	2.79×10^{-3}
Iodine-129	1.26×10^{-8}	3.58	4.07×10^{-5}	1.26×10^{-8}	4.47	6.29×10^{-5}	1.26×10^{-8}	5.77	9.51×10^{-5}
Uranium-238	1.49×10^{-11}	1.85×10^{-3}	2.08×10^{-8}	1.49×10^{-11}	1.92×10^{-3}	2.25×10^{-8}	1.49×10^{-11}	2.07×10^{-3}	2.56×10^{-8}
Total	**N/A**	**1.51×10^{1}**	**4.31×10^{-4}**	**N/A**	**3.38×10^{1}**	**1.34×10^{-3}**	**N/A**	**6.55×10^{1}**	**2.89×10^{-3}**
Year of peak impact	2051	2051	2051	2051	2051	2051	2051	2051	2051
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.37×10^{-1}	3.21	0.00	3.25×10^{-1}	3.21	1.32×10^{-9}	3.25×10^{-1}	4.83	6.07×10^{-5}
Nitrate	6.18×10^{1}	1.10	0.00	6.40×10^{1}	8.98	0.00	6.40×10^{1}	2.00×10^{1}	0.00
Total uranium	2.24×10^{-5}	2.14×10^{-4}	0.00	2.24×10^{-5}	2.17×10^{-4}	0.00	2.24×10^{-5}	2.27×10^{-4}	0.00
Total	**N/A**	**4.31**	**0.00**	**N/A**	**1.22×10^{1}**	**1.32×10^{-9}**	**N/A**	**2.49×10^{1}**	**6.07×10^{-5}**
Year of peak impact	2050	2050	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–238. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	**1.43×10^{-7}**	**2.86×10^{-1}**	**8.76×10^{-6}**	**1.43×10^{-7}**	**6.75×10^{-1}**	**2.79×10^{-5}**	**1.43×10^{-7}**	**1.33**	**6.04×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.73×10^{-3}	5.46×10^{-2}	0.00	5.68×10^{-3}	5.61×10^{-2}	2.25×10^{-11}	5.68×10^{-3}	8.44×10^{-2}	1.03×10^{-6}
Nitrate	4.02×10^{-1}	7.18×10^{-3}	0.00	4.07×10^{-1}	5.71×10^{-2}	0.00	4.07×10^{-1}	1.27×10^{-1}	0.00
Total	**4.08×10^{-1}**	**6.18×10^{-2}**	**0.00**	**4.12×10^{-1}**	**1.13×10^{-1}**	**2.25×10^{-11}**	**4.12×10^{-1}**	**2.12×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2050	2050	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–239. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	4.72×10^{-7}	5.52×10^{-2}	5.24×10^{-7}	4.72×10^{-7}	6.42×10^{-2}	6.32×10^{-7}	4.72×10^{-7}	7.65×10^{-2}	8.02×10^{-7}
Technetium-99	3.76×10^{-6}	6.58	2.26×10^{-4}	3.76×10^{-6}	1.70×10^{1}	7.44×10^{-4}	3.76×10^{-6}	3.46×10^{1}	1.63×10^{-3}
Iodine-129	4.50×10^{-9}	1.28	1.46×10^{-5}	4.50×10^{-9}	1.60	2.26×10^{-5}	4.50×10^{-9}	2.07	3.41×10^{-5}
Uranium-238	7.66×10^{-13}	9.50×10^{-5}	1.07×10^{-9}	7.66×10^{-13}	9.89×10^{-5}	1.16×10^{-9}	7.66×10^{-13}	1.07×10^{-4}	1.32×10^{-9}
Total	**N/A**	**7.92**	**2.41×10^{-4}**	**N/A**	**1.86×10^{1}**	**7.67×10^{-4}**	**N/A**	**3.68×10^{1}**	**1.66×10^{-3}**
Year of peak impact	2065	2065	2065	2065	2065	2065	2065	2065	2065
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.80×10^{-1}	1.71	0.00	1.67×10^{-1}	1.65	7.70×10^{-10}	1.67×10^{-1}	2.49	3.53×10^{-5}
Nitrate	1.97×10^{2}	3.52	0.00	2.00×10^{2}	2.81×10^{1}	0.00	2.00×10^{2}	6.26×10^{1}	0.00
Total uranium	1.45×10^{-6}	1.38×10^{-5}	0.00	1.40×10^{-6}	1.36×10^{-5}	0.00	1.40×10^{-6}	1.42×10^{-5}	0.00
Total	**N/A**	**5.23**	**0.00**	**N/A**	**2.97×10^{1}**	**7.70×10^{-10}**	**N/A**	**6.51×10^{1}**	**3.53×10^{-5}**
Year of peak impact	2083	2083	N/A	2077	2077	2087	2077	2077	2087

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–240. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	9.48×10^{-11}	1.11×10^{-5}	9.79×10^{-12}	8.82×10^{-12}	1.20×10^{-6}	1.18×10^{-11}	8.82×10^{-12}	1.43×10^{-6}	1.50×10^{-11}
Technetium-99	3.45×10^{-7}	6.03×10^{-1}	2.11×10^{-5}	3.50×10^{-7}	1.58	6.94×10^{-5}	3.50×10^{-7}	3.23	1.52×10^{-4}
Iodine-129	7.17×10^{-10}	2.04×10^{-1}	2.20×10^{-6}	6.78×10^{-10}	2.41×10^{-1}	3.40×10^{-6}	6.78×10^{-10}	3.12×10^{-1}	5.14×10^{-6}
Uranium-238	1.25×10^{-14}	1.55×10^{-6}	1.27×10^{-11}	9.08×10^{-15}	1.17×10^{-6}	1.37×10^{-11}	9.08×10^{-15}	1.26×10^{-6}	1.56×10^{-11}
Total	**N/A**	**8.07×10^{-1}**	**2.33×10^{-5}**	**N/A**	**1.82**	**7.28×10^{-5}**	**N/A**	**3.54**	**1.57×10^{-4}**
Year of peak impact	2218	2218	2256	2256	2256	2256	2256	2256	2256
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.95×10^{-2}	5.67×10^{-1}	0.00	5.61×10^{-2}	5.54×10^{-1}	2.34×10^{-10}	5.61×10^{-2}	8.34×10^{-1}	1.07×10^{-5}
Nitrate	1.47×10^{1}	2.62×10^{-1}	0.00	1.50×10^{1}	2.10	0.00	1.50×10^{1}	4.69	0.00
Total uranium	1.98×10^{-8}	1.89×10^{-7}	0.00	2.29×10^{-8}	2.22×10^{-7}	0.00	2.29×10^{-8}	2.32×10^{-7}	0.00
Total	**N/A**	**8.30×10^{-1}**	**0.00**	**N/A**	**2.66**	**2.34×10^{-10}**	**N/A**	**5.53**	**1.07×10^{-5}**
Year of peak impact	2074	2074	N/A	2076	2076	2074	2076	2076	2074

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–241. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	9.54×10^{-12}	4.30×10^{-5}	1.89×10^{-9}	9.54×10^{-12}	9.93×10^{-5}	4.71×10^{-9}	3.45×10^{-7}	1.04×10^{-2}	5.62×10^{-7}
Iodine-129	1.60×10^{-14}	5.70×10^{-6}	8.03×10^{-11}	1.60×10^{-14}	8.70×10^{-5}	2.09×10^{-9}	7.17×10^{-10}	2.72×10^{-3}	6.32×10^{-8}
Total	**N/A**	**4.87×10^{-5}**	**1.97×10^{-9}**	**N/A**	**1.86×10^{-4}**	**6.81×10^{-9}**	**N/A**	**1.31×10^{-2}**	**6.26×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2218	2218	2232
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.95×10^{-7}	8.84×10^{-6}	3.53×10^{-15}	8.95×10^{-7}	1.45×10^{-5}	1.62×10^{-10}	5.95×10^{-2}	2.62×10^{-1}	1.07×10^{-5}
Nitrate	2.98×10^{-4}	4.51×10^{-5}	0.00	2.98×10^{-4}	2.81×10^{-2}	0.00	1.47×10^{1}	6.59×10^{-1}	0.00
Total	**N/A**	**5.40×10^{-5}**	**3.53×10^{-15}**	**N/A**	**2.81×10^{-2}**	**1.62×10^{-10}**	**N/A**	**9.21×10^{-1}**	**1.07×10^{-5}**
Year of peak impact	2155	2155	2193	2155	2155	2193	2074	2074	2074

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figure Q–11 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2055 and is dominated by technetium-99 and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination has exited the unconfined aquifer, and Figure Q–11 is interpreted as reporting no risk due to these sources.

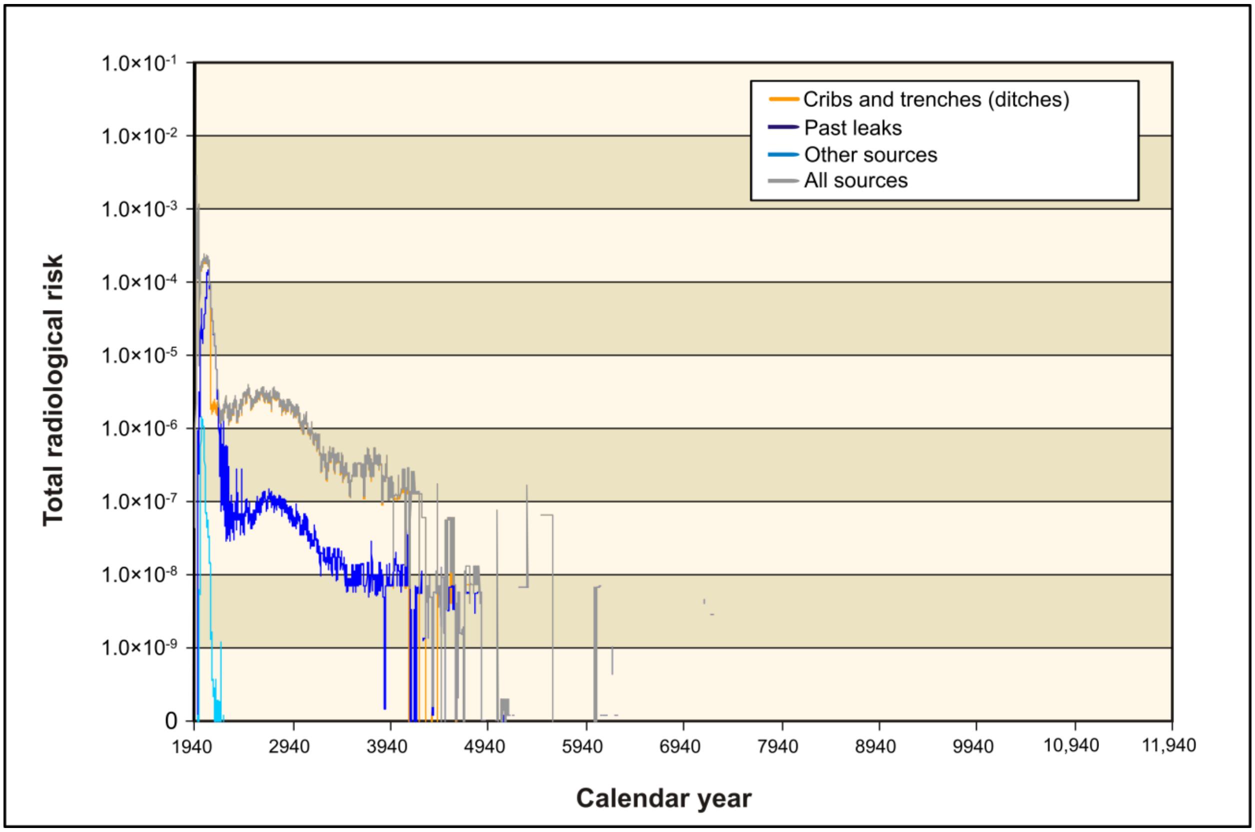


Figure Q–11. Tank Closure Alternative 6B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.8 Tank Closure Intruder Scenario

Intruders are individuals who enter a tank farm area and engage in activity that could cause direct contact with residual contamination in the stabilized or closed tanks. Two types of receptors and two types of scenarios were considered. The receptor types were the American Indian resident farmer and the resident farmer, and the scenario types were home construction and well drilling. Because the majority of the waste at the tank farms is at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Screening analysis also determined that impacts of intrusion were dominated by contact with short-lived radionuclides, strontium-90 and cesium-137. Consequently, impacts of intrusion at the tank farms are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. Because complete removal of tanks is proposed under Tank Closure Alternatives 6A, Base and Option Cases, and 6B, Base and Option Cases, no tank farm intruder impacts would occur under these alternatives. In addition, complete removal of tanks is proposed for the BX and SX tank farms under Alternative 4 and intruder impacts would be avoided. Estimates of impact under this intrusion scenario for the eighteen tank farms and Tank Closure Alternatives 1 through 5 and 6C are summarized in Table Q–242 for American Indian resident farmer intruders. For all tank farms and alternatives, resident farmer impacts are dominated by exposure to strontium-90 and cesium-137. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker involved in well drilling would be the same for resident farmer and American Indian receptors. Estimates of impact on the drilling worker are presented in Table Q–243. For all tank farms and alternatives, drilling worker doses are dominated by external exposure to cesium-137 and inhalation exposure to plutonium-239 and americium-241. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose. Because doses are dominated by radionuclides with short half-lives, the year of peak dose occurs immediately after loss of institutional control. Due to high concentrations of strontium-90 and cesium-137, the DOE intruder dose guideline of 500 millirem (DOE Guide 435.1-1) is exceeded for single-shell tank farms under Alternative 1 and 5 and for double-shell tank farms under all alternatives.

Table Q–242. Doses to an American Indian Engaged in Residential Agriculture Following Well Drilling at the Tank Farms

Tank Farm	Dose (rem per year)					
	Tank Closure Alternative					
	1	2	3	4	5	6C
A	48.4	0.484	0.484	0.048	4.84	0.484
AX	36.8	0.368	0.368	0.0368	3.68	0.368
B	6.84	0.068	0.068	0.0068	0.68	0.068
BX	5.71	0.0571	0.0571	N/A[a]	0.571	0.0571
BY	27.8	0.278	0.278	0.0278	2.78	0.278
C	25.0	0.250	0.250	0.0250	2.50	0.250
S	33.2	0.332	0.332	0.0332	3.32	0.332
SX	30.7	0.307	0.307	N/A[a]	3.07	0.307
T	2.38	0.0238	0.0238	0.0024	0.238	0.0238
TX	19.5	0.195	0.195	0.0195	1.95	0.195
TY	2.23	0.0223	0.0223	0.0022	0.223	0.0223
U	26.8	0.268	0.268	0.0268	2.68	0.268
AN	166	1.66	1.66	0.166	16.6	1.66
AP	90.3	0.903	0.903	0.0903	9.03	0.903
AW	74.1	0.741	0.741	0.0741	7.41	0.741
AY	82.6	0.826	0.826	0.0826	8.26	0.826
AZ	738	7.38	7.38	0.738	73.8	7.38
SY	117	1.17	1.17	0.117	11.7	1.17

[a] BX and SX tank farms would be clean-closed under Tank Closure Alternative 4.

Key: N/A=not applicable.

Table Q–243. Doses to a Well-Drilling Worker at the Tank Farms

Tank Farm	Dose (rem)					
	Tank Closure Alternative					
	1	2	3	4	5	6C
A	1.38×10^{-1}	1.38×10^{-3}	1.38×10^{-3}	1.38×10^{-4}	1.38×10^{-2}	1.38×10^{-3}
AX	8.78×10^{-2}	8.78×10^{-4}	8.78×10^{-4}	8.78×10^{-5}	8.73×10^{-3}	8.78×10^{-4}
B	1.93×10^{-2}	1.93×10^{-4}	1.93×10^{-4}	1.93×10^{-5}	1.93×10^{-3}	1.93×10^{-4}
BX	2.30×10^{-2}	2.30×10^{-4}	2.30×10^{-4}	N/A[a]	2.30×10^{-3}	2.30×10^{-4}
BY	6.20×10^{-2}	6.20×10^{-4}	6.20×10^{-4}	6.20×10^{-5}	6.20×10^{-3}	6.20×10^{-4}
C	1.95×10^{-1}	1.95×10^{-3}	1.95×10^{-3}	1.95×10^{-4}	1.95×10^{-2}	1.95×10^{-3}
S	9.10×10^{-2}	9.10×10^{-4}	9.10×10^{-4}	9.10×10^{-5}	9.10×10^{-3}	9.10×10^{-4}
SX	8.85×10^{-2}	8.85×10^{-4}	8.85×10^{-4}	N/A[a]	8.85×10^{-3}	8.85×10^{-4}
T	1.22×10^{-2}	1.22×10^{-4}	1.22×10^{-4}	1.22×10^{-5}	1.22×10^{-3}	1.22×10^{-4}
TX	1.33×10^{-1}	1.33×10^{-3}	1.33×10^{-3}	1.33×10^{-4}	1.33×10^{-2}	1.33×10^{-3}
TY	6.99×10^{-3}	6.99×10^{-5}	6.99×10^{-5}	6.99×10^{-6}	6.99×10^{-4}	6.99×10^{-5}
U	7.94×10^{-2}	7.94×10^{-4}	7.94×10^{-4}	7.94×10^{-5}	7.94×10^{-3}	7.94×10^{-4}
AN	3.75×10^{-1}	3.75×10^{-3}	3.75×10^{-3}	3.75×10^{-4}	3.75×10^{-2}	3.75×10^{-3}
AP	1.90×10^{-1}	1.90×10^{-3}	1.90×10^{-3}	1.90×10^{-4}	1.90×10^{-2}	1.90×10^{-3}
AW	1.91×10^{-1}	1.91×10^{-3}	1.91×10^{-3}	1.91×10^{-4}	1.91×10^{-2}	1.91×10^{-3}
AY	4.71×10^{-1}	4.71×10^{-3}	4.71×10^{-3}	4.71×10^{-4}	4.71×10^{-2}	4.71×10^{-3}
AZ	2.43	2.43×10^{-2}	2.43×10^{-2}	2.43×10^{-3}	2.43×10^{-1}	2.43×10^{-2}
SY	6.87×10^{-1}	6.87×10^{-3}	6.87×10^{-3}	6.87×10^{-4}	6.87×10^{-2}	6.87×10^{-3}

[a] BX and SX tank farms would be clean-closed under Tank Closure Alternative 4.

Key: N/A=not applicable.

Q.3.2 Long-Term Human Health Impacts of FFTF Decommissioning Alternatives

Impacts on human health over the long time period following decommissioning of FFTF would be due primarily to the materials left in place following no action, entombment, or removal. These releases would involve both radioactive and chemical constituents. The results of this human health impacts analysis for onsite, offsite, and intruder receptors are summarized in the following sections.

Q.3.2.1 Impacts on Onsite and Offsite Receptors of Expected Conditions Under FFTF Decommissioning Alternatives

Implementation of activities defined for the FFTF Decommissioning alternatives could lead to releases of radioactive and chemical constituents to the environment over long periods of time. In the case of FFTF Decommissioning Alternative 1, these releases would not be controlled by final decommissioning activities. In the case of FFTF Decommissioning Alternative 2, these releases would be controlled by removal of all aboveground structures and minimal removal of below-grade structures, equipment, and materials. An RCRA-compliant barrier would be constructed over the Reactor Containment Building and any other remaining below-grade structures (including the reactor vessel). In the case of FFTF Decommissioning Alternative 3, these releases would be further controlled by removal of all aboveground structures, as well as contaminated below-grade structures (including the reactor vessel), equipment and materials.

Potential human health impacts of the release of radioactive constituents are estimated as dose and as lifetime risk of incidence of cancer. Potential human health effects due to release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to the highest intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of the group of chemicals contributing to impacts through the exposure pathways evaluated in a particular scenario. Further information on the nature of human health effects in response to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. Impacts due to exposure to these constituents are presented in this appendix.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year for 10,000 years for each receptor at three locations (i.e., FFTF barrier, Columbia River nearshore, and Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observation that peak risk and peak noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. The significance of dose impacts is evaluated by comparison against the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. The level of protection provided for the drinking water pathway is evaluated by comparison against the MCLs of the "National Primary Drinking Water Regulations" (40 CFR 141) and other benchmarks presented in Appendix O. In addition, only those radioactive and chemical constituents that resulted in a lifetime risk or Hazard Index greater than 1×10^{-10} for all impacts analysis locations for a given source are included in the human health impact tables presented in this section to reduce the size of the tables. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location.

The results of the analysis for drinking-water well user are summarized in Tables Q–244 and Q–245 for radioactive and chemical constituents, respectively. Impacts due to ingestion of drinking water under FFTF Decommissioning Alternatives 1 and 2 would not be higher than the 100-millirem-per-year dose standard at the FFTF barrier. Under both FFTF Decommissioning Alternatives 1 and 2, doses estimated for drinking water ingestion are less than 10 millirem per year at the Columbia River nearshore location. The peak radiological impacts would be due to technetium-99, and chemical impacts would be due to uranium. As a result of removal of all contaminated material under FFTF Decommissioning Alternative 3, there would be no impacts on groundwater and no impacts on human health.

Table Q–244. Summary of Radiological Human Health Impacts on Drinking-Water Well User

Location	Alternative 1		Alternative 2	
	Radiation Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Radiation Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Fast Flux Test Facility barrier	7.19×10^{-1} (2790)	2.47×10^{-5} (2790)	7.02×10^{-1} (3137)	2.42×10^{-5} (3137)
Columbia River nearshore	5.57×10^{-2} (2978)	1.91×10^{-6} (2978)	5.86×10^{-2} (3307)	2.02×10^{-6} (3307)

Note: Calendar year of peak impact presented in parentheses.

Table Q–245. Summary of Chemical Human Health Impacts on Drinking-Water Well User

	Alternative 1		Alternative 2	
	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Fast Flux Test Facility barrier	1.91×10^{-1} (11,842)	Not applicable	Not applicable	Not applicable
Columbia River nearshore	7.99×10^{-3} (11,788)	Not applicable	Not applicable	Not applicable

Note: Calendar year of peak impact presented in parentheses.

Q.3.2.1.1 FFTF Decommissioning Alternative 1: No Action

Under FFTF Decommissioning Alternative 1, only those actions consistent with previous DOE actions under the National Environmental Policy Act would be completed. Final decommissioning of FFTF would not occur. For analysis purposes, the remaining waste would be available for release to the environment after an institutional control period of 100 years. Potential human health impacts of this alternative are summarized in Tables Q–246 through Q–248. The key constituent contributors to radiological risk would be tritium and technetium-99. Dose standards would not be exceeded at any location, and the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 1.16×10^{-2} person-rem per year for the year of maximum impact.

Table Q–246. FFTF Decommissioning Alternative 1 Human Health Impacts at the Fast Flux Test Facility Barrier

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.11×10^{-7}	7.19×10^{-1}	2.47×10^{-5}	4.11×10^{-7}	1.85	8.14×10^{-5}	4.11×10^{-7}	3.79	1.78×10^{-4}
Total	**N/A**	**7.19×10^{-1}**	**2.47×10^{-5}**	**N/A**	**1.85**	**8.14×10^{-5}**	**N/A**	**3.79**	**1.78×10^{-4}**
Year of peak impact	2790	2790	2790	2790	2790	2790	2790	2790	2790
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Total uranium	2.01×10^{-2}	1.91×10^{-1}	0.00	2.01×10^{-2}	1.95×10^{-1}	0.00	2.01×10^{-2}	2.03×10^{-1}	0.00
Total	**N/A**	**1.91×10^{-1}**	**0.00**	**N/A**	**1.95×10^{-1}**	**3.87×10^{-16}**	**N/A**	**2.03×10^{-1}**	**1.77×10^{-11}**
Year of peak impact	11,842	11,842	N/A	11,842	11,842	2735	11,842	11,842	2735

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–247. FFTF Decommissioning Alternative 1 Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.18×10^{-8}	5.57×10^{-2}	1.91×10^{-6}	3.18×10^{-8}	1.43×10^{-1}	6.30×10^{-6}	3.18×10^{-8}	2.93×10^{-1}	1.38×10^{-5}
Total	**N/A**	**5.57×10^{-2}**	**1.91×10^{-6}**	**N/A**	**1.43×10^{-1}**	**6.30×10^{-6}**	**N/A**	**2.93×10^{-1}**	**1.38×10^{-5}**
Year of peak impact	2978	2978	2978	2978	2978	2978	2978	2978	2978
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Total uranium	8.39×10^{-4}	7.99×10^{-3}	0.00	8.39×10^{-4}	8.14×10^{-3}	0.00	8.39×10^{-4}	8.50×10^{-3}	0.00
Total	**N/A**	**7.99×10^{-3}**	**0.00**	**N/A**	**8.14×10^{-3}**	**0.00**	**N/A**	**8.50×10^{-3}**	**0.00**
Year of peak impact	11,788	11,788	N/A	11,788	11,788	N/A	11,788	11,788	N/A

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–248. FFTF Decommissioning Alternative 1 Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	5.12×10^{-13}	2.31×10^{-6}	1.01×10^{-10}	5.12×10^{-13}	5.33×10^{-6}	2.53×10^{-10}	3.18×10^{-8}	9.58×10^{-4}	5.12×10^{-8}
Total	**N/A**	$\mathbf{2.31\times10^{-6}}$	$\mathbf{1.01\times10^{-10}}$	**N/A**	$\mathbf{5.33\times10^{-6}}$	$\mathbf{2.53\times10^{-10}}$	**N/A**	$\mathbf{9.58\times10^{-4}}$	$\mathbf{5.12\times10^{-8}}$
Year of peak impact	2930	2930	2930	2930	2930	2930	2978	2978	2978
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Total uranium	2.15×10^{-8}	2.09×10^{-7}	0.00	2.15×10^{-8}	2.90×10^{-7}	0.00	8.39×10^{-4}	3.72×10^{-4}	0.00
Total	**N/A**	$\mathbf{2.09\times10^{-7}}$	**0.00**	**N/A**	$\mathbf{2.90\times10^{-7}}$	**0.00**	**N/A**	$\mathbf{3.72\times10^{-4}}$	**0.00**
Year of peak impact	11,936	11,936	N/A	11,936	11,936	N/A	11,788	11,788	N/A

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Figure Q–12 depicts the cumulative radiological lifetime risk of incidence of cancer at the FFTF barrier for the drinking-water well user over time. The peak radiological risk occurs around CY 2800 at the FFTF barrier and is dominated by technetium-99. Technetium-99 is a relatively mobile radionuclide that moves at the same velocity as groundwater.

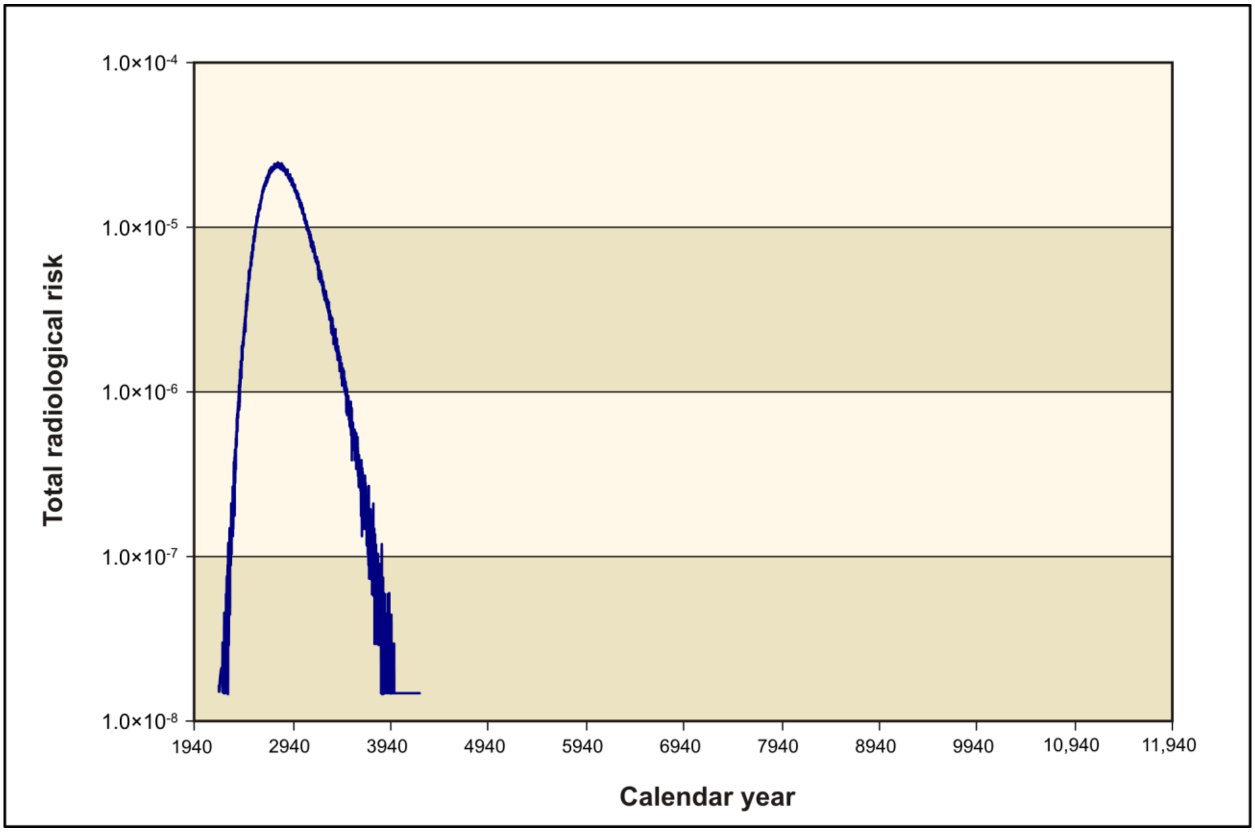


Figure Q–12. FFTF Decommissioning Alternative 1 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Fast Flux Test Facility Barrier

Q.3.2.1.2 FFTF Decommissioning Alternative 2: Entombment

Under FFTF Decommissioning Alternative 2, all aboveground structures and minimal below-grade structures, equipment, and materials would be removed. An RCRA-compliant barrier would be constructed over the Reactor Containment Building and any other remaining below-grade structures (including the reactor vessel). Potential human health impacts of this alternative are summarized in Tables Q–249 through Q–251. The key constituent contributor to radiological risk would be technetium-99. The chemical risk and hazard drivers would be essentially negligible. For radionuclides, the dose standard would not be exceeded at any location. In addition, the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 1.15×10^{-2} person-rem per year for the year of maximum impact.

Table Q–249. FFTF Decommissioning Alternative 2 Human Health Impacts at the Fast Flux Test Facility Barrier

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.01×10^{-7}	7.02×10^{-1}	2.42×10^{-5}	4.01×10^{-7}	1.81	7.94×10^{-5}	4.01×10^{-7}	3.70	1.74×10^{-4}
Total	**N/A**	**7.02×10^{-1}**	**2.42×10^{-5}**	**N/A**	**1.81**	**7.94×10^{-5}**	**N/A**	**3.70**	**1.74×10^{-4}**
Year of peak impact	3137	3137	3137	3137	3137	3137	3137	3137	3137

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–250. FFTF Decommissioning Alternative 2 Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.35×10^{-8}	5.86×10^{-2}	2.02×10^{-6}	3.35×10^{-8}	1.51×10^{-1}	6.63×10^{-6}	3.35×10^{-8}	3.09×10^{-1}	1.45×10^{-5}
Total	**N/A**	**5.86×10^{-2}**	**2.02×10^{-6}**	**N/A**	**1.51×10^{-1}**	**6.63×10^{-6}**	**N/A**	**3.09×10^{-1}**	**1.45×10^{-5}**
Year of peak impact	3307	3307	3307	3307	3307	3307	3307	3307	3307

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–251. FFTF Decommissioning Alternative 2 Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.10×10^{-13}	2.30×10^{-6}	1.01×10^{-10}	5.10×10^{-13}	5.30×10^{-6}	2.52×10^{-10}	3.35×10^{-8}	1.01×10^{-3}	5.39×10^{-8}
Total	**N/A**	**2.30×10^{-6}**	**1.01×10^{-10}**	**N/A**	**5.30×10^{-6}**	**2.52×10^{-10}**	**N/A**	**1.01×10^{-3}**	**5.39×10^{-8}**
Year of peak impact	3233	3233	3233	3233	3233	3233	3307	3307	3307

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Figure Q–13 depicts the cumulative radiological lifetime risk of incidence of cancer at the FFTF barrier for the drinking-water well user over time. The peak radiological risk occurs around CY 3100 at the FFTF barrier and is dominated by technetium-99. Technetium-99 is a relatively mobile radionuclide that moves at the same velocity as groundwater.

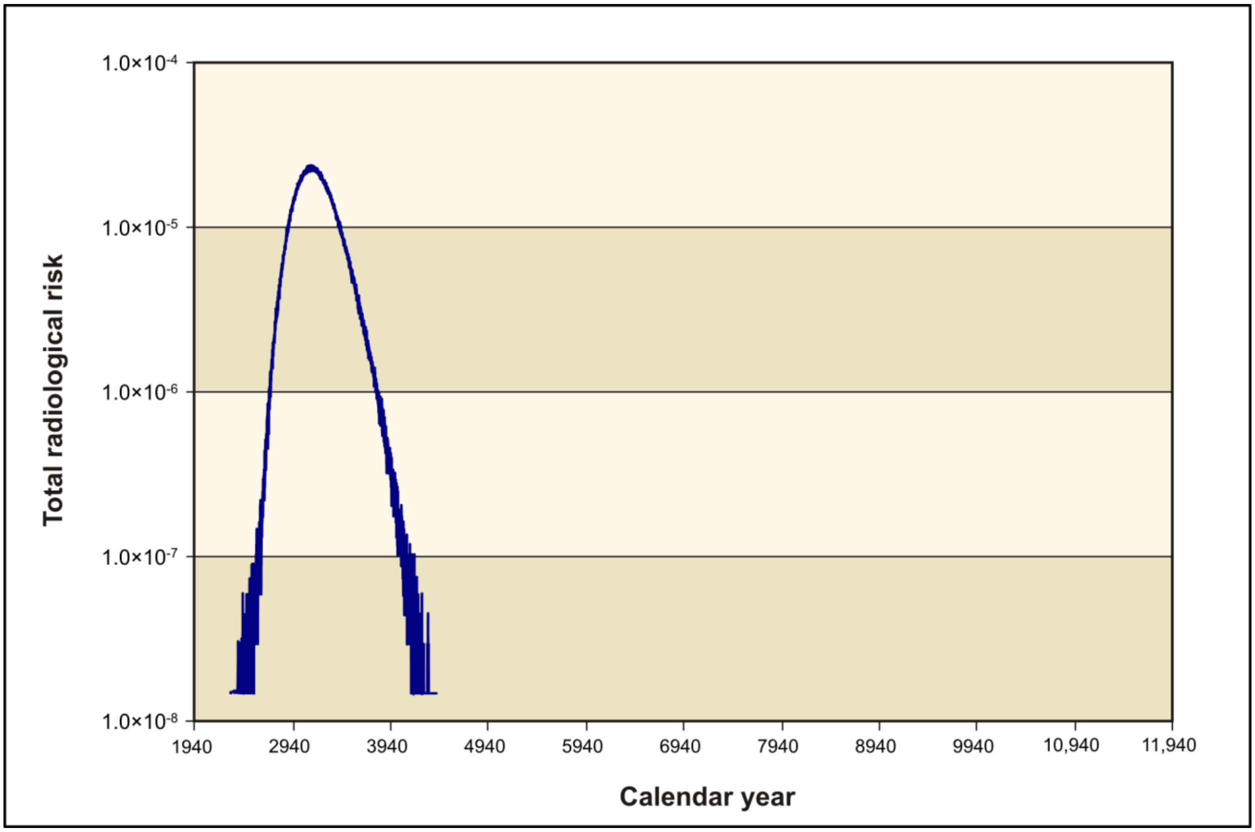


Figure Q–13. FFTF Decommissioning Alternative 2 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Fast Flux Test Facility Barrier

Q.3.2.1.3 FFTF Decommissioning Alternative 3: Removal

Under FFTF Decommissioning Alternative 3, all aboveground structures, as well as contaminated below-grade structures, equipment, and materials, would be removed. As a result of removal of nearly all contaminated material, only small impacts are projected for groundwater and human health. At the FFTF barrier, dose for the drinking-water well user, resident farmer, and American Indian resident farmer are estimated as 1.6×10^{-7}, 4.2×10^{-7}, and 8.6×10^{-7} millirem per year, respectively.

Q.3.2.1.4 FFTF Decommissioning Intruder Scenario

Intruders are individuals who enter the FFTF area and engage in activity that could cause direct contact with residual contamination in the abandoned or stabilized structures. As in the case of Tank Closure alternatives, two types of receptors and two types of scenarios were considered. The receptor types were the American Indian resident farmer and the resident farmer, and the scenario types were home construction and well drilling. Because the majority of radionuclides at the FFTF area are in hardware at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker involved in well drilling would be the same for the resident farmer and American Indian resident farmer. For FFTF, estimates of inventory indicate that the greatest hazard is due to quantities of the long-lived radionuclides carbon-14 and technetium-99 and isotopes of uranium remaining at the site. Relatively small amounts of short-lived radionuclides are estimated to remain at the site. Consequently, impacts of intrusion at the FFTF area are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. The impacts under this intrusion scenario for the three FFTF Decommissioning alternatives are summarized in Table Q–252 for the drilling worker and American Indian resident farmer intruders. Resident farmer impacts are dominated by exposure to carbon-14, while for the worker carbon-14, technetium-99, and uranium isotopes contribute to dose through the direct external and inhalation pathways. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose. Because radionuclides appearing due to decay and ingrowth did not have major contributions to these, the year of peak dose occurs immediately after loss of institutional control. The DOE intruder dose guideline of 500 millirem is not exceeded for any alternative.

Table Q–252. Doses to a Well-Drilling Worker and an American Indian Engaged in Residential Agriculture Following Well Drilling at the FFTF Area

Receptor	Dose (rem per year)		
	FFTF Decommissioning Alternative		
	1	2	3
Worker	4.5×10^{-6}	4.5×10^{-6}	2.7×10^{-14}
Resident farmer	1.1×10^{-3}	1.1×10^{-3}	1.4×10^{-8}

Key: FFTF=Fast Flux Test Facility.

Q.3.3 Long-Term Human Health Impacts of Waste Management Alternatives

Impacts on human health over the long time period following stabilization and closure of the waste management disposal facilities would be due primarily to naturally occurring release mechanisms, such as dissolution, diffusion, and radioactive groundwater flow and the degradation of waste forms over time. These releases would involve both radioactive and chemical constituents. Because a large number of constituents, sources, and scenarios have been considered, screening analysis was used to identify a reduced number of controlling scenarios. The results of this human health impacts analysis for onsite, offsite, and intruder receptors are summarized in the following sections.

Q.3.3.1 Impacts on Onsite and Offsite Receptors of Expected Conditions Under Waste Management Alternatives

Implementation of activities defined for the Waste Management alternatives could lead to releases of radioactive and chemical constituents to the environment over long periods of time. In the case of Waste Management Alternative 1, these releases would come from Low-Level Radioactive Waste Burial Ground (LLBG) 218-W-5, trenches 31 and 34. In the case of Waste Management Alternative 2, these releases would come from IDF-East and the RPPDF. In the case of Waste Management Alternative 3, these releases would come from IDF-East, IDF-West, and the RPPDF. Potential human health impacts due to release of radionuclides are estimated as dose and as lifetime risk of incidence of cancer. Potential human health effects due to release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to the highest intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of the group of chemicals contributing to impacts through the exposure pathways evaluated in a particular scenario. Further information on the nature of human health effects in response to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. As previously discussed in Section Q.1, the screening analysis identified 14 radioactive and 27 chemical constituents as contributing the greatest risk of adverse impacts. Impacts due to exposure to these constituents are presented in this appendix.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year for 10,000 years for each receptor at six locations (i.e., IDF-East, IDF-West, RPPDF, Core Zone Boundary, Columbia River nearshore, and Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observations that peak risks and noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. The significance of dose impacts is evaluated by comparison against the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. The level of protection provided for the drinking water pathway is evaluated by comparison against the MCLs of the "National Primary Drinking Water Regulations" (40 CFR 141) and other benchmarks presented in Appendix O. In addition, only those radioactive and chemical constituents that resulted in a lifetime risk or Hazard Index greater than 1×10^{-10} for all impacts analysis locations for a given source are included in the human health impact tables presented in this section to reduce the size of the tables. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location.

The results of the analysis for drinking-water well users are summarized in Tables Q–253 through Q–259 for radioactive and chemical constituents. Under all the Waste Management alternatives and disposal groups, doses would not be greater than the 100-millirem-per-year standard at any location. Under all Waste Management alternatives except Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, and Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, doses estimated for drinking water ingestion are less than 10 millirem per year at the Columbia River nearshore location.

Peak radiological impacts would be due to technetium-99 and iodine-129, and chemical impacts would be due to boron and boron compounds, chromium, fluoride, and nitrate. For peak impacts occurring after CY 5000, radiological impacts would be due to uranium isotopes, and chemical impacts would be due to total uranium.

Table Q–253. Waste Management Alternative 1 Summary of Human Health Impacts on Drinking-Water Well User

Location	Radiation Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Trenches 31 and 34	1.39×10^{-2} (3434)	4.36×10^{-7} (3443)	1.00×10^{-2} (3490)	N/A
Core Zone Boundary	9.90×10^{-4} (3462)	3.21×10^{-8} (3462)	6.87×10^{-4} (3519)	N/A
Columbia River nearshore	2.42×10^{-3} (3980)	7.67×10^{-8} (3980)	1.66×10^{-3} (3993)	N/A

Note: Calendar year of peak impact presented in parentheses.

Key: N/A= not applicable.

Table Q–254. Waste Management Alternative 2 Summary of Radiation Dose at Year of Peak Dose for Drinking-Water Well User (millirem per year)

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	2.70 (7826)	3.06 (8002)	5.31 (10,774)	2.88 (7826)	6.89 (10,921)	3.01 (7826)	2.70 (7826)	5.08 (7644)	5.03 (8117)	5.07 (7644)	5.19 (7678)	5.22 (7832)
RPPDF	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	2.37×10^{-1} (3785)	N/A	8.94×10^{-2} (3818)	N/A	3.26×10^{-1} (3769)	4.70×10^{-1} (3812)	3.14×10^{-1} (4013)	4.75×10^{-1} (4018)
Core Zone Boundary	1.01 (7439)	1.43 (7848)	1.94 (8334)	1.18 (8237)	2.49 (9662)	1.34 (8302)	1.01 (7439)	1.16 (7328)	1.16 (7328)	1.17 (7328)	1.21 (7891)	1.17 (7723)
Columbia River nearshore	7.56×10^{-1} (7847)	1.17 (8014)	1.60 (10,429)	9.66×10^{-1} (8174)	2.07 (10,639)	1.07 (8014)	7.46×10^{-1} (7847)	7.43×10^{-1} (7754)	7.66×10^{-1} (7754)	7.70×10^{-1} (7754)	7.52×10^{-1} (8233)	7.65×10^{-1} (8233)

Note: Calendar year of peak impact presented in parentheses.

Key: IDF-East=200-East Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–255. Waste Management Alternative 2 Summary of Radiological Risk at Year of Peak Radiological Risk for Drinking-Water Well User

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	8.14×10^{-5} (7826)	9.68×10^{-5} (7629)	1.81×10^{-4} (10,774)	8.72×10^{-5} (7826)	2.34×10^{-4} (10,921)	9.20×10^{-5} (7826)	8.14×10^{-5} (7826)	1.50×10^{-4} (7644)	1.49×10^{-4} (8117)	1.50×10^{-4} (7644)	1.57×10^{-4} (7678)	1.56×10^{-4} (7678)
RPPDF	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	7.01×10^{-6} (3785)	N/A	2.69×10^{-6} (3818)	N/A	9.96×10^{-6} (3769)	1.42×10^{-5} (3812)	9.51×10^{-6} (4013)	1.49×10^{-5} (4018)
Core Zone Boundary	3.14×10^{-5} (7709)	4.64×10^{-5} (7848)	6.44×10^{-5} (8334)	3.80×10^{-5} (8237)	8.45×10^{-5} (9662)	4.33×10^{-5} (8302)	3.14×10^{-5} (7709)	3.56×10^{-5} (7328)	3.57×10^{-5} (7328)	3.57×10^{-5} (7328)	3.70×10^{-5} (7891)	3.66×10^{-5} (7723)
Columbia River nearshore	2.38×10^{-5} (7847)	3.78×10^{-5} (8014)	5.46×10^{-5} (10,429)	3.04×10^{-5} (8130)	7.07×10^{-5} (10,639)	3.47×10^{-5} (8014)	2.38×10^{-5} (8130)	2.35×10^{-5} (7754)	2.39×10^{-5} (7754)	2.40×10^{-5} (7754)	2.34×10^{-5} (8233)	2.37×10^{-5} (8233)

Note: Calendar year of peak impact presented in parentheses.

Key: IDF-East=200-East Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–256. Waste Management Alternative 2 Summary of Hazard Index at Year of Peak Hazard Index for Drinking-Water Well User

Location	Disposal Group 1, Subgroup 1-A	1-B	1-C	1-D	1-E	1-F	1-G	Disposal Group 2, Subgroup 2-A	2-B, Base Case	2-B, Option Case	Disposal Group 3 Base Case	Option Case
IDF-East	2.29×10^{-1} (7962)	1.89×10^{-1} (8052)	3.40 (8608)	3.05×10^{-1} (8207)	2.08 (9008)	3.03 (8882)	2.29×10^{-1} (7962)	1.77×10^{-1} (7960)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)
RPPDF	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	6.92×10^{-2} (3666)	N/A	2.84×10^{-2} (3792)	N/A	3.78×10^{-2} (3710)	4.41×10^{-1} (3680)	3.92×10^{-2} (3929)	4.39×10^{-1} (3916)
Core Zone Boundary	5.76×10^{-2} (8248)	5.16×10^{-2} (8095)	1.11 (8680)	9.26×10^{-2} (8317)	6.26×10^{-1} (8873)	8.21×10^{-1} (8588)	5.78×10^{-2} (8248)	5.65×10^{-2} (8123)	6.05×10^{-2} (7860)	3.56×10^{-1} (3688)	6.05×10^{-2} (7860)	3.75×10^{-1} (3865)
Columbia River nearshore	3.80×10^{-2} (7927)	4.05×10^{-2} (7940)	8.56×10^{-1} (8594)	6.38×10^{-2} (8284)	4.68×10^{-1} (8827)	6.12×10^{-1} (8535)	3.81×10^{-2} (8798)	3.58×10^{-2} (8406)	3.95×10^{-2} (7994)	2.34×10^{-1} (4560)	3.96×10^{-2} (7994)	2.58×10^{-1} (4487)

Note: Calendar year of peak impact presented in parentheses.

Key: IDF-East=200-East Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–257. Waste Management Alternative 3 Summary of Radiation Dose at Year of Peak Dose (millirem per year) for Drinking-Water Well User

Location	Disposal Group 1, Subgroup 1-A	1-B	1-C	1-D	1-E	1-F	1-G	Disposal Group 2, Subgroup 2-A	2-B, Base Case	2-B, Option Case	Disposal Group 3 Base Case	Option Case
IDF-East	5.64×10^{-1} (9827)	2.59 (7629)	5.27 (10,774)	2.28 (11,434)	6.84 (10,921)	2.53 (8878)	5.50×10^{-1} (11,385)	4.98×10^{-1} (10,979)	5.27×10^{-1} (10,636)	5.08×10^{-1} (9990)	5.27×10^{-1} (10,636)	5.08×10^{-1} (9990)
IDF-West	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)
RPPDF	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	2.37×10^{-1} (3785)	N/A	8.94×10^{-2} (3818)	N/A	3.26×10^{-1} (3769)	4.70×10^{-1} (3812)	3.14×10^{-1} (4013)	4.75×10^{-1} (4018)
Core Zone Boundary	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)
Columbia River nearshore	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.53 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)

Note: Calendar year of peak impact presented in parentheses.

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–258. Waste Management Alternative 3
Summary of Radiological Risk at Year of Peak Radiological Risk for Drinking-Water Well User

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	1.44×10^{-5} (10,129)	8.70×10^{-5} (7629)	1.80×10^{-4} (10,774)	7.26×10^{-5} (11,434)	2.32×10^{-4} (10,921)	8.45×10^{-5} (8878)	1.46×10^{-5} (11,385)	1.32×10^{-5} (11,050)	1.36×10^{-5} (10,188)	1.35×10^{-5} (9705)	1.36×10^{-5} (10,188)	1.35×10^{-5} (9705)
IDF-West	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)
RPPDF	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	7.01×10^{-6} (3785)	N/A	2.69×10^{-6} (3818)	N/A	9.96×10^{-6} (3769)	1.42×10^{-5} (3812)	9.51×10^{-6} (4013)	1.49×10^{-5} (4018)
Core Zone Boundary	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)
Columbia River nearshore	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)

Note: Calendar year of peak impact presented in parentheses.
Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–259. Waste Management Alternative 3
Summary of Hazard Index at Year of Peak Hazard Index for Drinking-Water Well User

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	2.29×10^{-1} (7962)	1.89×10^{-1} (8052)	3.39 (8608)	3.04×10^{-1} (8207)	2.08 (9008)	3.03 (8882)	2.29×10^{-1} (7962)	1.77×10^{-1} (7960)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)
IDF-West	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)
RPPDF	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	6.92×10^{-2} (3666)	N/A	2.84×10^{-2} (3792)	N/A	3.78×10^{-2} (3710)	4.41×10^{-1} (3680)	3.92×10^{-2} (3929)	4.39×10^{-1} (3916)
Core Zone Boundary	5.76×10^{-2} (8248)	5.15×10^{-2} (8095)	1.11 (8680)	9.23×10^{-2} (8317)	6.26×10^{-1} (8873)	8.20×10^{-1} (8588)	5.77×10^{-2} (8248)	5.64×10^{-2} (8123)	6.02×10^{-2} (7860)	3.56×10^{-1} (3688)	6.02×10^{-2} (7860)	3.75×10^{-1} (3865)
Columbia River nearshore	3.77×10^{-2} (7927)	4.04×10^{-2} (7940)	8.56×10^{-1} (8594)	6.35×10^{-2} (8284)	4.68×10^{-1} (8827)	6.11×10^{-1} (8535)	3.78×10^{-2} (7927)	3.57×10^{-2} (8406)	3.95×10^{-2} (7994)	2.36×10^{-1} (4560)	3.95×10^{-2} (7994)	2.60×10^{-1} (4487)

Note: Calendar year of peak impact presented in parentheses.
Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Q.3.3.1.1 Waste Management Alternative 1: No Action

Under Waste Management Alternative 1, only those wastes currently generated on site at Hanford from non–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions would continue to be disposed of in LLBG 218-W-5, trenches 31 and 34. Although the short-term impacts do not address the impacts associated with closure activities for this site, for the purpose of analyzing long-term impacts, it was assumed that these trenches would be closed using an RCRA-compliant barrier consistent with the closure plans for these burial grounds. As a result, the non-CERCLA waste disposed of in these trenches from 2008 to 2035 would become available for release to the environment. Potential human health impacts of this alternative at the disposal area boundary, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–260 through Q–263, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. In addition, the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 2.23×10^{-4} person-rem per year for the year of maximum impact.

Table Q–260. Waste Management Alternative 1
Human Health Impacts at Low-Level Radioactive Waste Burial Ground 218-W-5, Trenches 31 and 34

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.86×10^{-9}	1.20×10^{-2}	4.16×10^{-7}	6.92×10^{-9}	3.12×10^{-2}	1.37×10^{-6}	6.92×10^{-9}	6.37×10^{-2}	3.00×10^{-6}
Iodine-129	6.49×10^{-12}	1.85×10^{-3}	1.99×10^{-8}	6.14×10^{-12}	2.19×10^{-3}	3.08×10^{-8}	6.14×10^{-12}	2.83×10^{-3}	4.66×10^{-8}
Total	**N/A**	**1.39×10^{-2}**	**4.36×10^{-7}**	**N/A**	**3.34×10^{-2}**	**1.40×10^{-6}**	**N/A**	**6.65×10^{-2}**	**3.04×10^{-6}**
Year of peak impact	3434	3434	3443	3443	3443	3443	3443	3443	3443

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	1.84×10^{-5}	2.63×10^{-6}	0.00	1.84×10^{-5}	2.73×10^{-6}	0.00	1.84×10^{-5}	2.97×10^{-6}	0.00
Chromium	9.44×10^{-4}	8.99×10^{-3}	0.00	9.44×10^{-4}	9.32×10^{-3}	3.71×10^{-12}	9.44×10^{-4}	1.40×10^{-2}	1.70×10^{-7}
Fluoride	1.55×10^{-3}	7.40×10^{-4}	0.00	1.55×10^{-3}	2.08×10^{-3}	0.00	1.55×10^{-3}	4.36×10^{-3}	0.00
Nitrate	1.77×10^{-2}	3.16×10^{-4}	0.00	1.77×10^{-2}	2.48×10^{-3}	0.00	1.77×10^{-2}	5.54×10^{-3}	0.00
Total	**N/A**	**1.00×10^{-2}**	**0.00**	**N/A**	**1.39×10^{-2}**	**3.71×10^{-12}**	**N/A**	**2.39×10^{-2}**	**1.70×10^{-7}**
Year of peak impact	3490	3490	N/A	3490	3490	3490	3490	3490	3490

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–261. Waste Management Alternative 1 Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.17×10^{-10}	9.04×10^{-4}	3.11×10^{-8}	5.17×10^{-10}	2.33×10^{-3}	1.02×10^{-7}	5.17×10^{-10}	4.76×10^{-3}	2.24×10^{-7}
Iodine-129	3.02×10^{-13}	8.61×10^{-5}	9.79×10^{-10}	3.02×10^{-13}	1.08×10^{-4}	1.51×10^{-9}	3.02×10^{-13}	1.39×10^{-4}	2.29×10^{-9}
Total	**N/A**	**9.90×10^{-4}**	**3.21×10^{-8}**	**N/A**	**2.44×10^{-3}**	**1.04×10^{-7}**	**N/A**	**4.90×10^{-3}**	**2.26×10^{-7}**
Year of peak impact	3462	3462	3462	3462	3462	3462	3462	3462	3462

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	1.14×10^{-6}	1.63×10^{-7}	0.00	1.14×10^{-6}	1.69×10^{-7}	0.00	1.14×10^{-6}	1.84×10^{-7}	0.00
Chromium	6.64×10^{-5}	6.32×10^{-4}	0.00	6.31×10^{-5}	6.23×10^{-4}	2.61×10^{-13}	6.31×10^{-5}	9.38×10^{-4}	1.19×10^{-8}
Fluoride	7.52×10^{-5}	3.58×10^{-5}	0.00	9.87×10^{-5}	1.32×10^{-4}	0.00	9.87×10^{-5}	2.77×10^{-4}	0.00
Nitrate	1.09×10^{-3}	1.94×10^{-5}	0.00	1.11×10^{-3}	1.56×10^{-4}	0.00	1.11×10^{-3}	3.48×10^{-4}	0.00
Total	**N/A**	**6.87×10^{-4}**	**0.00**	**N/A**	**9.12×10^{-4}**	**2.61×10^{-13}**	**N/A**	**1.56×10^{-3}**	**1.19×10^{-8}**
Year of peak impact	3519	3519	N/A	3551	3551	3519	3551	3551	3519

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–262. Waste Management Alternative 1 Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.22×10^{-9}	2.14×10^{-3}	7.36×10^{-8}	1.22×10^{-9}	5.51×10^{-3}	2.42×10^{-7}	1.22×10^{-9}	1.13×10^{-2}	5.29×10^{-7}
Iodine-129	9.78×10^{-13}	2.79×10^{-4}	3.17×10^{-9}	9.78×10^{-13}	3.48×10^{-4}	4.90×10^{-9}	9.78×10^{-13}	4.50×10^{-4}	7.41×10^{-9}
Total	**N/A**	$\mathbf{2.42\times10^{-3}}$	$\mathbf{7.67\times10^{-8}}$	**N/A**	$\mathbf{5.86\times10^{-3}}$	$\mathbf{2.47\times10^{-7}}$	**N/A**	$\mathbf{1.17\times10^{-2}}$	$\mathbf{5.37\times10^{-7}}$
Year of peak impact	3980	3980	3980	3980	3980	3980	3980	3980	3980
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.82×10^{-6}	4.03×10^{-7}	0.00	2.82×10^{-6}	4.19×10^{-7}	0.00	2.82×10^{-6}	4.56×10^{-7}	0.00
Chromium	1.58×10^{-4}	1.50×10^{-3}	0.00	1.58×10^{-4}	1.56×10^{-3}	6.20×10^{-13}	1.58×10^{-4}	2.34×10^{-3}	2.84×10^{-8}
Fluoride	2.33×10^{-4}	1.11×10^{-4}	0.00	2.33×10^{-4}	3.12×10^{-4}	0.00	2.33×10^{-4}	6.54×10^{-4}	0.00
Nitrate	2.64×10^{-3}	4.72×10^{-5}	0.00	2.64×10^{-3}	3.71×10^{-4}	0.00	2.64×10^{-3}	8.28×10^{-4}	0.00
Total	**N/A**	$\mathbf{1.66\times10^{-3}}$	**0.00**	**N/A**	$\mathbf{2.24\times10^{-3}}$	$\mathbf{6.20\times10^{-13}}$	**N/A**	$\mathbf{3.83\times10^{-3}}$	$\mathbf{2.84\times10^{-8}}$
Year of peak impact	3993	3993	N/A	3993	3993	3993	3993	3993	3993

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–263. Waste Management Alternative 1 Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	0.00	0.00	0.00	0.00	0.00	0.00	1.22×10^{-9}	3.65×10^{-5}	1.96×10^{-9}
Iodine-129	0.00	0.00	0.00	0.00	0.00	0.00	9.78×10^{-13}	2.90×10^{-6}	7.12×10^{-11}
Total	**N/A**	**0.00**	**0.00**	**N/A**	**0.00**	**0.00**	**N/A**	**3.94×10^{-5}**	**2.03×10^{-9}**
Year of peak impact	N/A	N/A	N/A	N/A	N/A	N/A	3980	3980	3980

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	0.00	0.00	0.00	0.00	0.00	0.00	2.82×10^{-6}	3.07×10^{-8}	0.00
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.58×10^{-4}	6.94×10^{-4}	2.84×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.33×10^{-4}	3.40×10^{-5}	0.00
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	2.64×10^{-3}	9.30×10^{-5}	0.00
Total	**N/A**	**0.00**	**0.00**	**N/A**	**0.00**	**0.00**	**N/A**	**8.21×10^{-4}**	**2.84×10^{-8}**
Year of peak impact	N/A	N/A	N/A	N/A	N/A	N/A	3993	3993	3993

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figure Q–14 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time. The peak radiological risk occurs around CY 3470 and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in LLBG 218-W-5, trenches 31 and 34. These are relatively mobile radionuclides that move at the same velocity as groundwater.

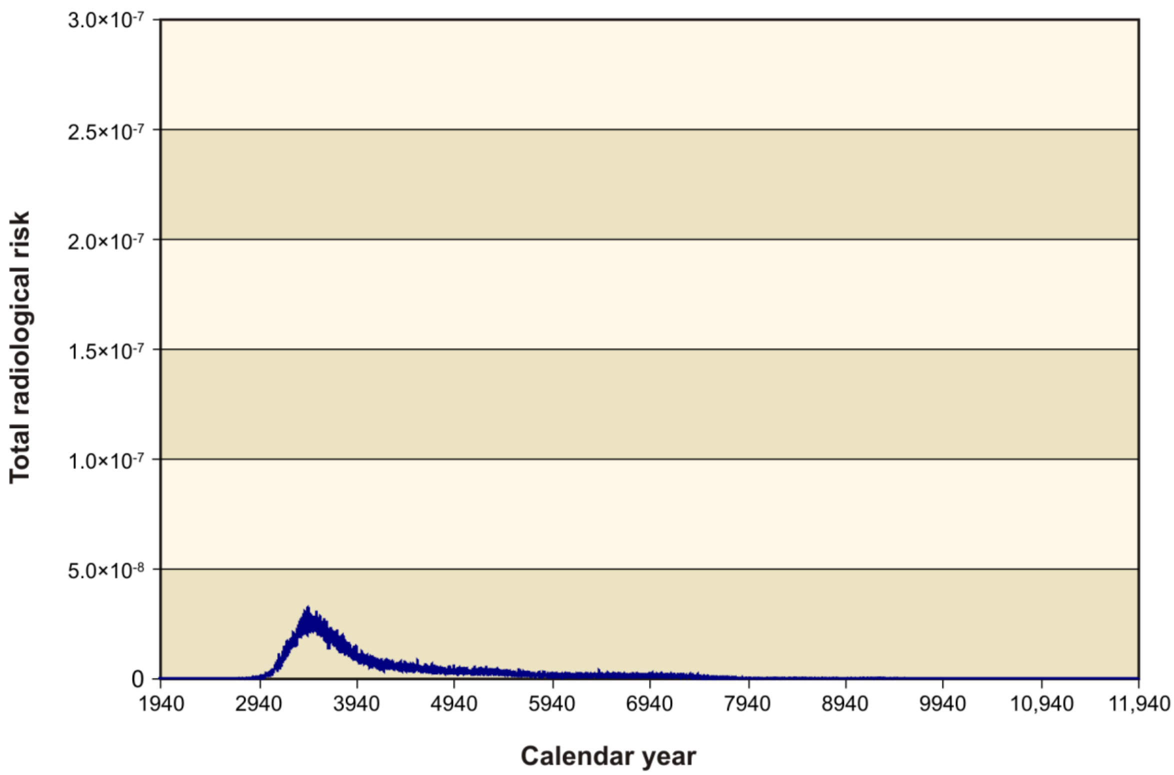


Figure Q–14. Waste Management Alternative 1 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only

Under Waste Management Alternative 2, waste from tank treatment operations, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-East. Waste from tank farm cleanup activities would be disposed of in the RPPDF. As a result, the waste disposed of in these two facilities would become available for release to the environment. Because different waste types would result from the Tank Closure action alternatives, three disposal groups were considered to account for the different IDF-East sizes and operational time periods. In addition, within these three disposal groups, subgroups were identified to allow consideration of the different waste types resulting from the Tank Closure alternatives. Potential human health impacts of these subgroups under this alternative are discussed in the following sections.

Q.3.3.1.2.1 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A

Disposal Group 1, Subgroup 1-A, addresses the waste resulting from Tank Closure Alternative 2B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Immobilized low-activity waste (ILAW) glass
- LAW melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 2B.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–264 through Q–268, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 1.68×10^{-1} person-rem per year for the year of maximum impact.

Table Q–264. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.26×10^{-6}	2.20	7.58×10^{-5}	1.26×10^{-6}	5.68	2.49×10^{-4}	1.26×10^{-6}	1.16×10^{1}	5.45×10^{-4}
Iodine-129	1.74×10^{-9}	4.95×10^{-1}	5.63×10^{-6}	1.74×10^{-9}	6.19×10^{-1}	8.71×10^{-6}	1.74×10^{-9}	7.99×10^{-1}	1.32×10^{-5}
Total	**N/A**	**2.70**	$\mathbf{8.14\times10^{-5}}$	**N/A**	**6.30**	$\mathbf{2.58\times10^{-4}}$	**N/A**	$\mathbf{1.24\times10^{1}}$	$\mathbf{5.58\times10^{-4}}$
Year of peak impact	7826	7826	7826	7826	7826	7826	7826	7826	7826
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.94×10^{-6}	4.20×10^{-7}	0.00	2.94×10^{-6}	4.37×10^{-7}	0.00	2.94×10^{-6}	4.76×10^{-7}	0.00
Chromium	1.32×10^{-3}	1.25×10^{-2}	0.00	1.32×10^{-3}	1.30×10^{-2}	8.22×10^{-12}	1.32×10^{-3}	1.96×10^{-2}	3.77×10^{-7}
Fluoride	2.07×10^{-4}	9.87×10^{-5}	0.00	2.07×10^{-4}	2.77×10^{-4}	0.00	2.07×10^{-4}	5.82×10^{-4}	0.00
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	$\mathbf{2.29\times10^{-1}}$	**0.00**	**N/A**	**1.71**	$\mathbf{8.22\times10^{-12}}$	**N/A**	**3.81**	$\mathbf{3.77\times10^{-7}}$
Year of peak impact	7962	7962	N/A	7962	7962	8438	7962	7962	8438

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–265. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–266. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.93×10^{-7}	8.63×10^{-1}	2.99×10^{-5}	4.93×10^{-7}	2.22	9.84×10^{-5}	4.97×10^{-7}	4.58	2.15×10^{-4}
Iodine-129	5.20×10^{-10}	1.48×10^{-1}	1.48×10^{-6}	5.20×10^{-10}	1.85×10^{-1}	2.29×10^{-6}	4.58×10^{-10}	2.11×10^{-1}	3.47×10^{-6}
Total	**N/A**	**1.01**	**3.14×10^{-5}**	**N/A**	**2.41**	**1.01×10^{-4}**	**N/A**	**4.79**	**2.19×10^{-4}**
Year of peak impact	7439	7439	7709	7439	7439	7709	7709	7709	7709

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	7.27×10^{-7}	1.04×10^{-7}	0.00	7.27×10^{-7}	1.08×10^{-7}	0.00	7.27×10^{-7}	1.18×10^{-7}	0.00
Chromium	4.01×10^{-4}	3.82×10^{-3}	0.00	4.01×10^{-4}	3.96×10^{-3}	2.94×10^{-12}	4.01×10^{-4}	5.96×10^{-3}	1.35×10^{-7}
Fluoride	4.95×10^{-5}	2.36×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.76×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–267. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.77×10^{-7}	6.60×10^{-1}	2.27×10^{-5}	3.77×10^{-7}	1.70	7.46×10^{-5}	3.77×10^{-7}	3.47	1.63×10^{-4}
Iodine-129	3.37×10^{-10}	9.60×10^{-2}	1.09×10^{-6}	3.37×10^{-10}	1.20×10^{-1}	1.69×10^{-6}	3.37×10^{-10}	1.55×10^{-1}	2.55×10^{-6}
Total	**N/A**	**7.56×10^{-1}**	**2.38×10^{-5}**	**N/A**	**1.82**	**7.63×10^{-5}**	**N/A**	**3.63**	**1.66×10^{-4}**
Year of peak impact	7847	7847	7847	7847	7847	7847	7847	7847	7847
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.72×10^{-4}	1.63×10^{-3}	0.00	1.72×10^{-4}	1.69×10^{-3}	1.67×10^{-12}	1.72×10^{-4}	2.55×10^{-3}	7.64×10^{-8}
Fluoride	2.97×10^{-5}	1.41×10^{-5}	0.00	2.97×10^{-5}	3.97×10^{-5}	0.00	2.97×10^{-5}	8.33×10^{-5}	0.00
Nitrate	2.03	3.63×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	**3.80×10^{-2}**	**0.00**	**N/A**	**2.87×10^{-1}**	**1.67×10^{-12}**	**N/A**	**6.39×10^{-1}**	**7.64×10^{-8}**
Year of peak impact	7927	7927	N/A	7927	7927	8236	7927	7927	8236

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–268. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.63×10^{-12}	2.99×10^{-5}	1.31×10^{-9}	6.50×10^{-12}	6.76×10^{-5}	3.28×10^{-9}	3.77×10^{-7}	1.14×10^{-2}	6.07×10^{-7}
Iodine-129	1.02×10^{-14}	3.63×10^{-6}	5.11×10^{-11}	1.06×10^{-14}	5.78×10^{-5}	1.33×10^{-9}	3.37×10^{-10}	1.45×10^{-3}	3.56×10^{-8}
Total	**N/A**	**3.35×10^{-5}**	**1.36×10^{-9}**	**N/A**	**1.25×10^{-4}**	**4.61×10^{-9}**	**N/A**	**1.28×10^{-2}**	**6.43×10^{-7}**
Year of peak impact	7861	7861	7861	7935	7935	7861	7847	7847	7847
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**7.64×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	8236

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–15 and Q–16 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 7700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

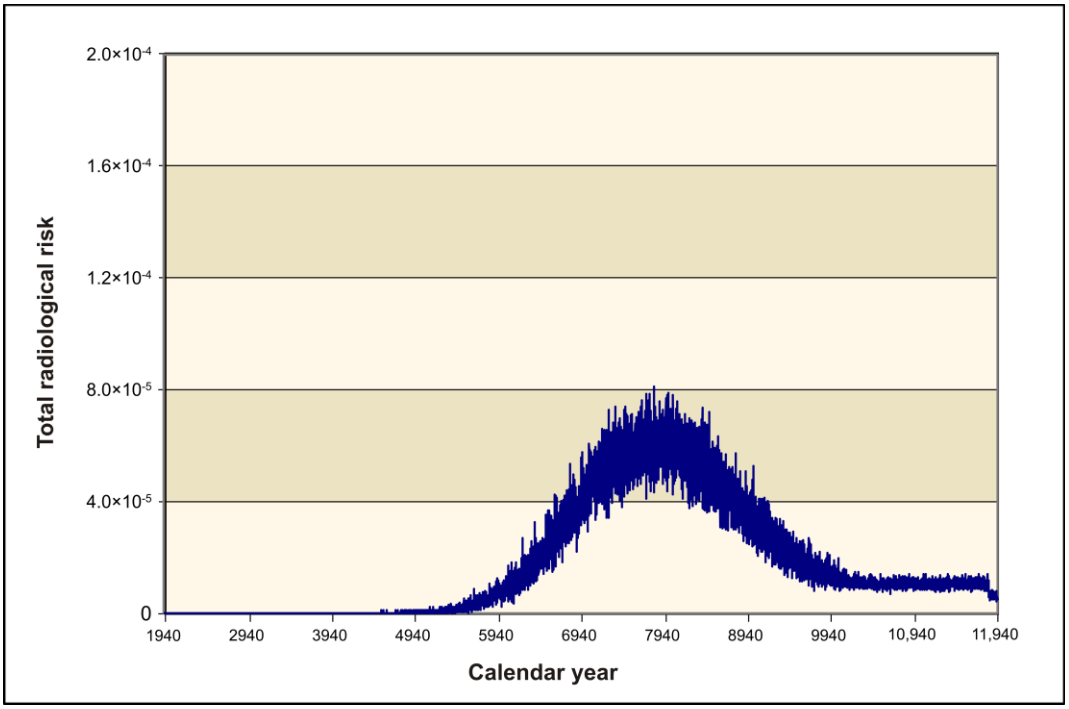


Figure Q–15. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

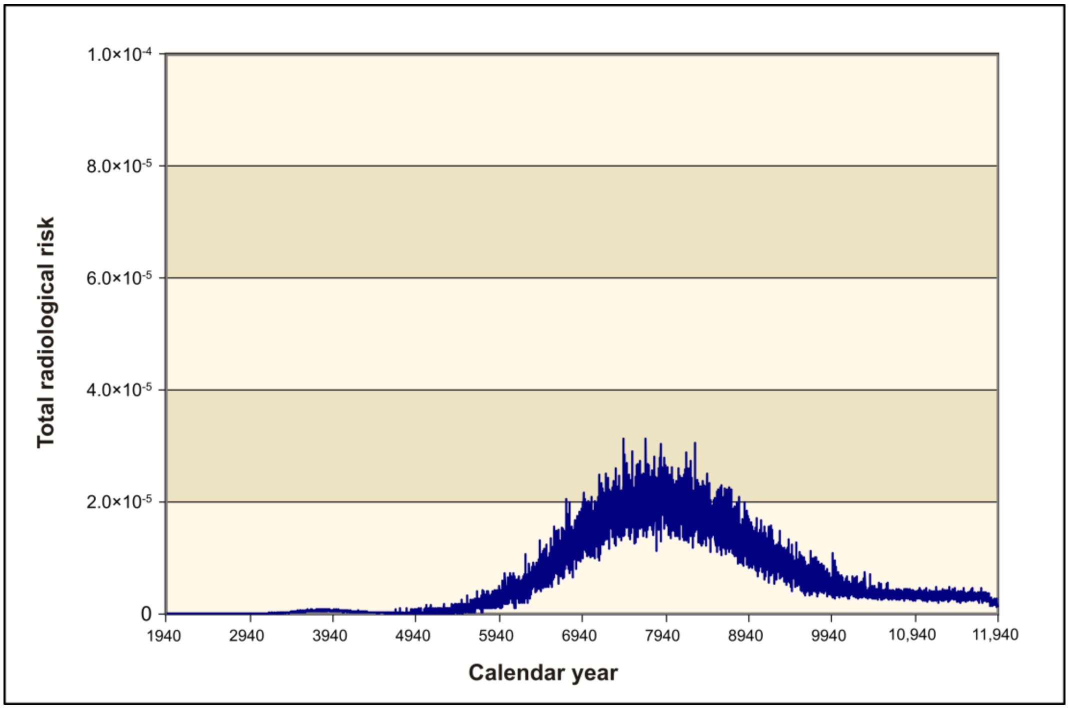


Figure Q–16. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.2 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B

Disposal Group 1, Subgroup 1-B, addresses the waste resulting from Tank Closure Alternative 3A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3A.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–269 through Q–273, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded for the resident farmer and American Indian resident farmer at the IDF-East barrier due primarily to release of nitrate. Population dose is estimated as 2.78×10^{-1} person-rem per year for the year of maximum impact.

Table Q–269. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.49×10^{-6}	2.61	9.28×10^{-5}	1.54×10^{-6}	6.95	3.05×10^{-4}	1.54×10^{-6}	1.42×10^{1}	6.68×10^{-4}
Iodine-129	1.58×10^{-9}	4.50×10^{-1}	3.99×10^{-6}	1.23×10^{-9}	4.38×10^{-1}	6.16×10^{-6}	1.23×10^{-9}	5.66×10^{-1}	9.32×10^{-6}
Total	**N/A**	**3.06**	**9.68×10^{-5}**	**N/A**	**7.39**	**3.11×10^{-4}**	**N/A**	**1.48×10^{1}**	**6.77×10^{-4}**
Year of peak impact	8002	8002	7629	7629	7629	7629	7629	7629	7629

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	2.47×10^{-6}	3.52×10^{-7}	0.00	2.47×10^{-6}	3.66×10^{-7}	0.00	2.47×10^{-6}	3.99×10^{-7}	0.00
Chromium	5.87×10^{-4}	5.59×10^{-3}	0.00	5.87×10^{-4}	5.80×10^{-3}	3.72×10^{-12}	5.87×10^{-4}	8.72×10^{-3}	1.71×10^{-7}
Fluoride	1.46×10^{-4}	6.94×10^{-5}	0.00	1.46×10^{-4}	1.95×10^{-4}	0.00	1.46×10^{-4}	4.09×10^{-4}	0.00
Nitrate	1.03×10^{1}	1.83×10^{-1}	0.00	1.03×10^{1}	1.44	0.00	1.03×10^{1}	3.22	0.00
Total	**N/A**	**1.89×10^{-1}**	**0.00**	**N/A**	**1.45**	**3.72×10^{-12}**	**N/A**	**3.22**	**1.71×10^{-7}**
Year of peak impact	8052	8052	N/A	8052	8052	8691	8052	8052	8691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–270. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	$\mathbf{8.94\times10^{-2}}$	$\mathbf{2.69\times10^{-6}}$	**N/A**	$\mathbf{2.08\times10^{-1}}$	$\mathbf{8.54\times10^{-6}}$	**N/A**	$\mathbf{4.10\times10^{-1}}$	$\mathbf{1.85\times10^{-5}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.84\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.96\times10^{-2}}$	$\mathbf{1.05\times10^{-11}}$	**N/A**	$\mathbf{9.17\times10^{-2}}$	$\mathbf{4.81\times10^{-7}}$
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–271. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.48×10^{-7}	1.31	4.50×10^{-5}	7.48×10^{-7}	3.37	1.48×10^{-4}	7.48×10^{-7}	6.89	3.24×10^{-4}
Iodine-129	4.30×10^{-10}	1.22×10^{-1}	1.39×10^{-6}	4.30×10^{-10}	1.53×10^{-1}	2.15×10^{-6}	4.30×10^{-10}	1.98×10^{-1}	3.26×10^{-6}
Total	**N/A**	**1.43**	**4.64×10^{-5}**	**N/A**	**3.53**	**1.50×10^{-4}**	**N/A**	**7.09**	**3.27×10^{-4}**
Year of peak impact	7848	7848	7848	7848	7848	7848	7848	7848	7848
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	7.60×10^{-7}	1.09×10^{-7}	0.00	7.60×10^{-7}	1.13×10^{-7}	0.00	7.60×10^{-7}	1.23×10^{-7}	0.00
Chromium	1.82×10^{-4}	1.73×10^{-3}	0.00	1.82×10^{-4}	1.79×10^{-3}	2.94×10^{-12}	1.82×10^{-4}	2.70×10^{-3}	1.35×10^{-7}
Fluoride	3.96×10^{-5}	1.88×10^{-5}	0.00	3.96×10^{-5}	5.30×10^{-5}	0.00	3.96×10^{-5}	1.11×10^{-4}	0.00
Nitrate	2.79	4.99×10^{-2}	0.00	2.79	3.92×10^{-1}	0.00	2.79	8.75×10^{-1}	0.00
Total	**N/A**	**5.16×10^{-2}**	**0.00**	**N/A**	**3.94×10^{-1}**	**2.94×10^{-12}**	**N/A**	**8.78×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8095	8095	N/A	8095	8095	3846	8095	8095	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–272. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.08×10^{-7}	1.06	3.66×10^{-5}	6.08×10^{-7}	2.74	1.20×10^{-4}	6.08×10^{-7}	5.60	2.63×10^{-4}
Iodine-129	3.61×10^{-10}	1.03×10^{-1}	1.17×10^{-6}	3.61×10^{-10}	1.28×10^{-1}	1.81×10^{-6}	3.61×10^{-10}	1.66×10^{-1}	2.73×10^{-6}
Total	**N/A**	**1.17**	**3.78×10^{-5}**	**N/A**	**2.87**	**1.22×10^{-4}**	**N/A**	**5.77**	**2.66×10^{-4}**
Year of peak impact	8014	8014	8014	8014	8014	8014	8014	8014	8014
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.21×10^{-4}	1.15×10^{-3}	0.00	1.21×10^{-4}	1.19×10^{-3}	1.11×10^{-12}	1.21×10^{-4}	1.80×10^{-3}	5.07×10^{-8}
Fluoride	3.46×10^{-5}	1.65×10^{-5}	0.00	3.46×10^{-5}	4.63×10^{-5}	0.00	3.46×10^{-5}	9.72×10^{-5}	0.00
Nitrate	2.21	3.94×10^{-2}	0.00	2.21	3.10×10^{-1}	0.00	2.21	6.90×10^{-1}	0.00
Total	**N/A**	**4.05×10^{-2}**	**0.00**	**N/A**	**3.11×10^{-1}**	**1.11×10^{-12}**	**N/A**	**6.92×10^{-1}**	**5.07×10^{-8}**
Year of peak impact	7940	7940	N/A	7940	7940	4250	7940	7940	4250

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–273. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.16×10^{-11}	5.22×10^{-5}	2.29×10^{-9}	1.12×10^{-11}	1.17×10^{-4}	5.71×10^{-9}	6.08×10^{-7}	1.83×10^{-2}	9.80×10^{-7}
Iodine-129	9.50×10^{-15}	3.39×10^{-6}	4.78×10^{-11}	1.06×10^{-14}	5.78×10^{-5}	1.24×10^{-9}	3.61×10^{-10}	1.53×10^{-3}	3.75×10^{-8}
Total	**N/A**	**5.55×10^{-5}**	**2.34×10^{-9}**	**N/A**	**1.75×10^{-4}**	**6.96×10^{-9}**	**N/A**	**1.99×10^{-2}**	**1.02×10^{-6}**
Year of peak impact	7806	7806	7806	8104	8104	7806	8014	8014	8014
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.21×10^{-4}	5.32×10^{-4}	5.07×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	3.46×10^{-5}	5.06×10^{-6}	0.00
Nitrate	3.38×10^{-5}	5.11×10^{-6}	0.00	3.38×10^{-5}	3.18×10^{-3}	0.00	2.21	1.00×10^{-1}	0.00
Total	**N/A**	**5.11×10^{-6}**	**0.00**	**N/A**	**3.18×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**5.07×10^{-8}**
Year of peak impact	8025	8025	N/A	8025	8025	N/A	7940	7940	4250

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–17 and Q–18 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8000 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

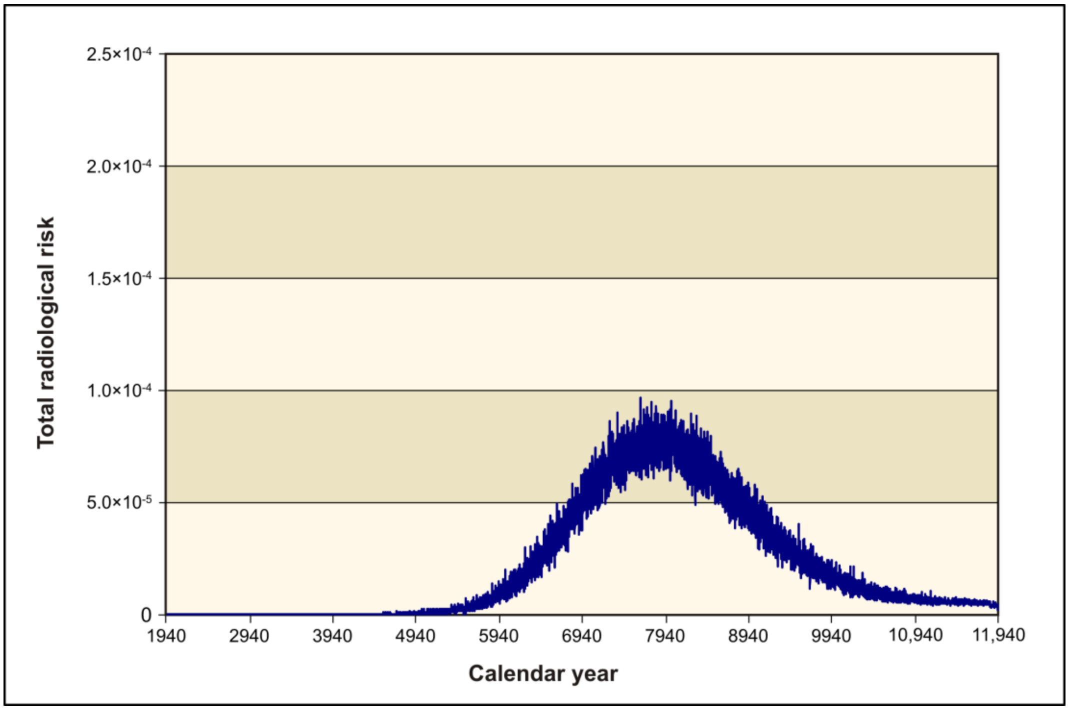


Figure Q–17. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

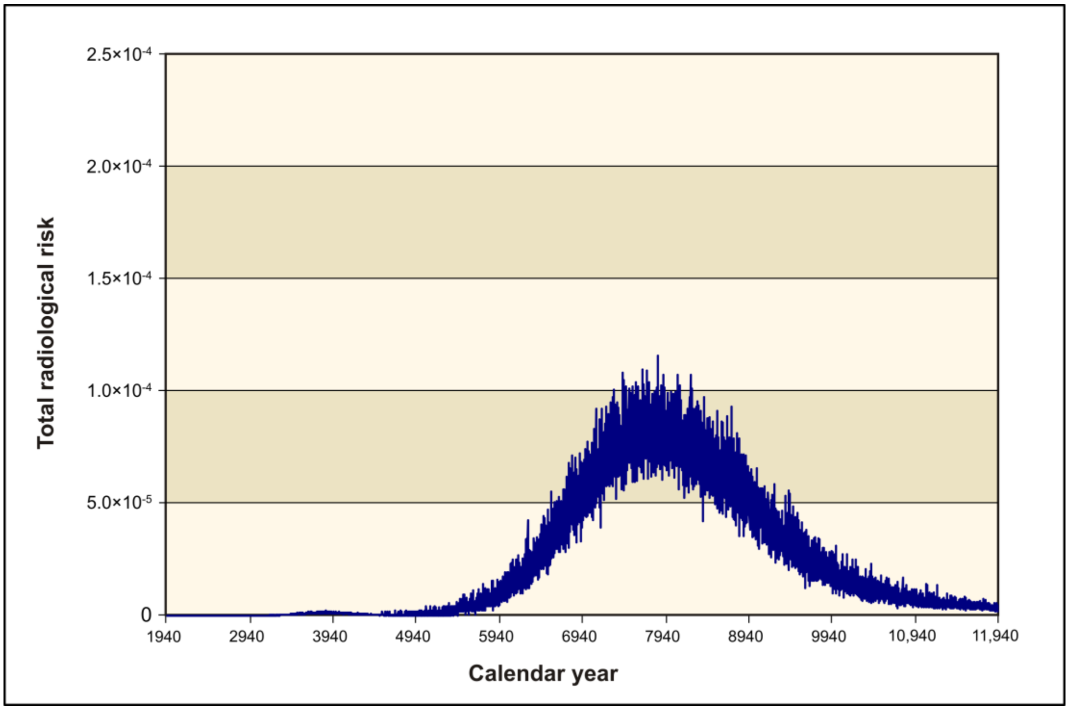


Figure Q–18. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.3 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C

Disposal Group 1, Subgroup 1-C, addresses the waste resulting from Tank Closure Alternative 3B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Cast stone waste
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3B.

Potential human health impacts are summarized in Tables Q–274 through Q–278, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. However, the Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user, the resident farmer, and the American Indian resident farmer and at the Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.29×10^{-1} person-rem per year for the year of maximum impact.

Table Q–274. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.99×10^{-6}	5.24	1.80×10^{-4}	2.99×10^{-6}	1.35×10^{1}	5.92×10^{-4}	2.99×10^{-6}	2.76×10^{1}	1.30×10^{-3}
Iodine-129	2.47×10^{-10}	7.05×10^{-2}	8.02×10^{-7}	2.47×10^{-10}	8.81×10^{-2}	1.24×10^{-6}	2.47×10^{-10}	1.14×10^{-1}	1.88×10^{-6}
Total	**N/A**	**5.31**	**1.81×10^{-4}**	**N/A**	**1.36×10^{1}**	**5.94×10^{-4}**	**N/A**	**2.77×10^{1}**	**1.30×10^{-3}**
Year of peak impact	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.15×10^{-2}	5.45×10^{-2}	0.00	1.63×10^{-2}	9.69×10^{-2}	0.00	1.63×10^{-2}	1.75×10^{-1}	0.00
Boron and compounds	2.68×10^{-6}	3.83×10^{-7}	0.00	1.95×10^{-6}	2.89×10^{-7}	0.00	1.95×10^{-6}	3.15×10^{-7}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.34×10^{-1}	2.31	1.16×10^{-9}	2.34×10^{-1}	3.47	5.32×10^{-5}
Fluoride	1.30×10^{-4}	6.17×10^{-5}	0.00	1.43×10^{-4}	1.91×10^{-4}	0.00	1.43×10^{-4}	4.00×10^{-4}	0.00
Nitrate	2.96×10^{1}	5.28×10^{-1}	0.00	4.26×10^{1}	5.98	0.00	4.26×10^{1}	1.33×10^{1}	0.00
Total	**N/A**	**3.40**	**0.00**	**N/A**	**8.39**	**1.16×10^{-9}**	**N/A**	**1.70×10^{1}**	**5.32×10^{-5}**
Year of peak impact	8608	8608	N/A	8888	8888	8608	8888	8888	8608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–275. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	$\mathbf{8.94\times10^{-2}}$	$\mathbf{2.69\times10^{-6}}$	**N/A**	$\mathbf{2.08\times10^{-1}}$	$\mathbf{8.54\times10^{-6}}$	**N/A**	$\mathbf{4.10\times10^{-1}}$	$\mathbf{1.85\times10^{-5}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.84\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.96\times10^{-2}}$	$\mathbf{1.05\times10^{-11}}$	**N/A**	$\mathbf{9.17\times10^{-2}}$	$\mathbf{4.81\times10^{-7}}$
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–276. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.05×10^{-6}	1.84	6.33×10^{-5}	1.05×10^{-6}	4.74	2.08×10^{-4}	1.05×10^{-6}	9.68	4.55×10^{-4}
Iodine-129	3.45×10^{-10}	9.84×10^{-2}	1.12×10^{-6}	3.45×10^{-10}	1.23×10^{-1}	1.73×10^{-6}	3.45×10^{-10}	1.59×10^{-1}	2.62×10^{-6}
Total	**N/A**	**1.94**	**6.44×10^{-5}**	**N/A**	**4.86**	**2.10×10^{-4}**	**N/A**	**9.84**	**4.58×10^{-4}**
Year of peak impact	8334	8334	8334	8334	8334	8334	8334	8334	8334
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.24×10^{-3}	1.54×10^{-2}	0.00	3.60×10^{-3}	2.14×10^{-2}	0.00	3.60×10^{-3}	3.88×10^{-2}	0.00
Chromium	1.02×10^{-1}	9.69×10^{-1}	0.00	7.55×10^{-2}	7.46×10^{-1}	3.99×10^{-10}	7.55×10^{-2}	1.12	1.83×10^{-5}
Fluoride	5.69×10^{-5}	2.71×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	7.02	1.25×10^{-1}	0.00	1.61×10^{1}	2.26	0.00	1.61×10^{1}	5.04	0.00
Total	**N/A**	**1.11**	**0.00**	**N/A**	**3.03**	**3.99×10^{-10}**	**N/A**	**6.20**	**1.83×10^{-5}**
Year of peak impact	8680	8680	N/A	8973	8973	8680	8973	8973	8680

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–277. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	9.04×10^{-7}	1.58	5.44×10^{-5}	9.04×10^{-7}	4.08	1.79×10^{-4}	9.04×10^{-7}	8.33	3.91×10^{-4}
Iodine-129	4.92×10^{-11}	1.40×10^{-2}	1.60×10^{-7}	4.92×10^{-11}	1.75×10^{-2}	2.47×10^{-7}	4.92×10^{-11}	2.26×10^{-2}	3.73×10^{-7}
Total	**N/A**	**1.60**	$\mathbf{5.46\times10^{-5}}$	**N/A**	**4.09**	$\mathbf{1.79\times10^{-4}}$	**N/A**	**8.35**	$\mathbf{3.92\times10^{-4}}$
Year of peak impact	10,429	10,429	10,429	10,429	10,429	10,429	10,429	10,429	10,429
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.34×10^{-3}	1.12×10^{-2}	0.00	2.16×10^{-3}	1.29×10^{-2}	0.00	2.16×10^{-3}	2.33×10^{-2}	0.00
Chromium	7.85×10^{-2}	7.47×10^{-1}	0.00	6.40×10^{-2}	6.32×10^{-1}	3.08×10^{-10}	6.40×10^{-2}	9.51×10^{-1}	1.41×10^{-5}
Fluoride	3.96×10^{-5}	1.88×10^{-5}	0.00	1.98×10^{-5}	2.65×10^{-5}	0.00	1.98×10^{-5}	5.56×10^{-5}	0.00
Nitrate	5.45	9.74×10^{-2}	0.00	1.09×10^{1}	1.52	0.00	1.09×10^{1}	3.40	0.00
Total	**N/A**	$\mathbf{8.56\times10^{-1}}$	**0.00**	**N/A**	**2.17**	$\mathbf{3.08\times10^{-10}}$	**N/A**	**4.37**	$\mathbf{1.41\times10^{-5}}$
Year of peak impact	8594	8594	N/A	8469	8469	8594	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–278. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.41×10^{-11}	6.36×10^{-5}	2.79×10^{-9}	1.38×10^{-11}	1.43×10^{-4}	6.81×10^{-9}	9.04×10^{-7}	2.72×10^{-2}	1.45×10^{-6}
Iodine-129	5.83×10^{-15}	2.08×10^{-6}	2.93×10^{-11}	8.32×10^{-15}	4.54×10^{-5}	1.09×10^{-9}	4.92×10^{-11}	2.64×10^{-4}	6.47×10^{-9}
Total	**N/A**	**6.57×10^{-5}**	**2.82×10^{-9}**	**N/A**	**1.89×10^{-4}**	**7.90×10^{-9}**	**N/A**	**2.75×10^{-2}**	**1.46×10^{-6}**
Year of peak impact	9164	9164	9164	8574	8574	8574	10,429	10,429	10,429
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.92×10^{-8}	3.52×10^{-7}	0.00	5.89×10^{-8}	6.34×10^{-7}	0.00	2.16×10^{-3}	1.30×10^{-2}	0.00
Chromium	1.06×10^{-6}	1.05×10^{-5}	4.59×10^{-15}	1.04×10^{-6}	1.68×10^{-5}	2.11×10^{-10}	6.40×10^{-2}	2.81×10^{-1}	1.41×10^{-5}
Nitrate	1.89×10^{-4}	2.87×10^{-5}	0.00	1.91×10^{-4}	1.80×10^{-2}	0.00	1.09×10^{1}	5.23×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-5}**	**4.59×10^{-15}**	**N/A**	**1.80×10^{-2}**	**2.11×10^{-10}**	**N/A**	**8.18×10^{-1}**	**1.41×10^{-5}**
Year of peak impact	8702	8702	9094	8672	8672	9094	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–19 and Q–20 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8300 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

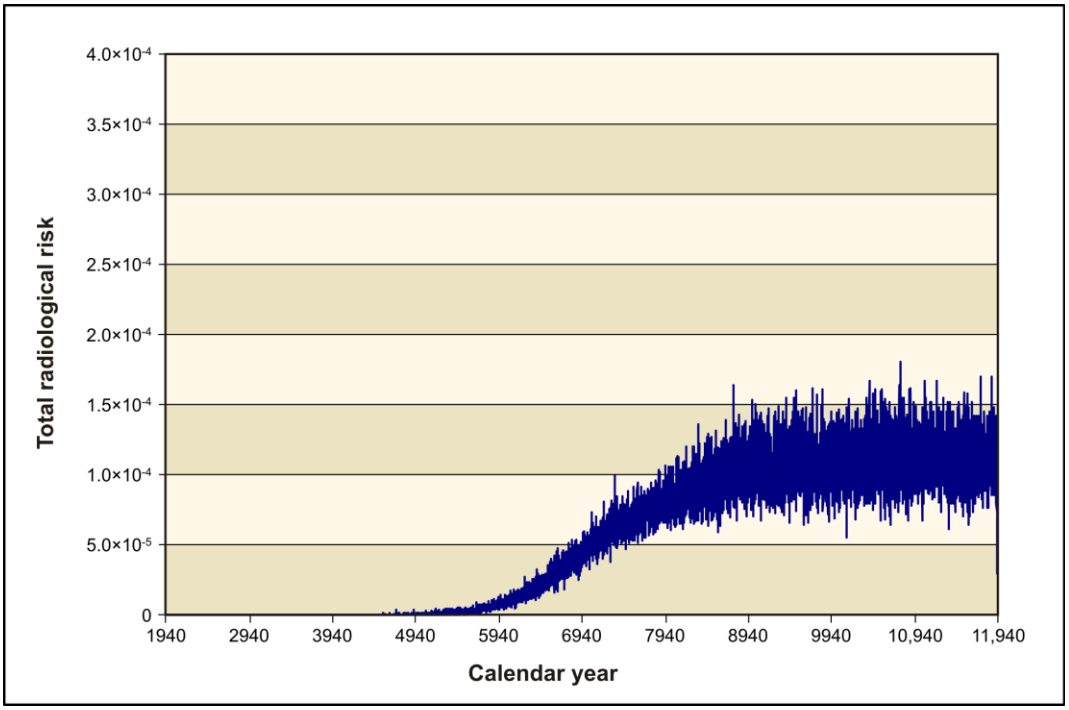


Figure Q–19. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

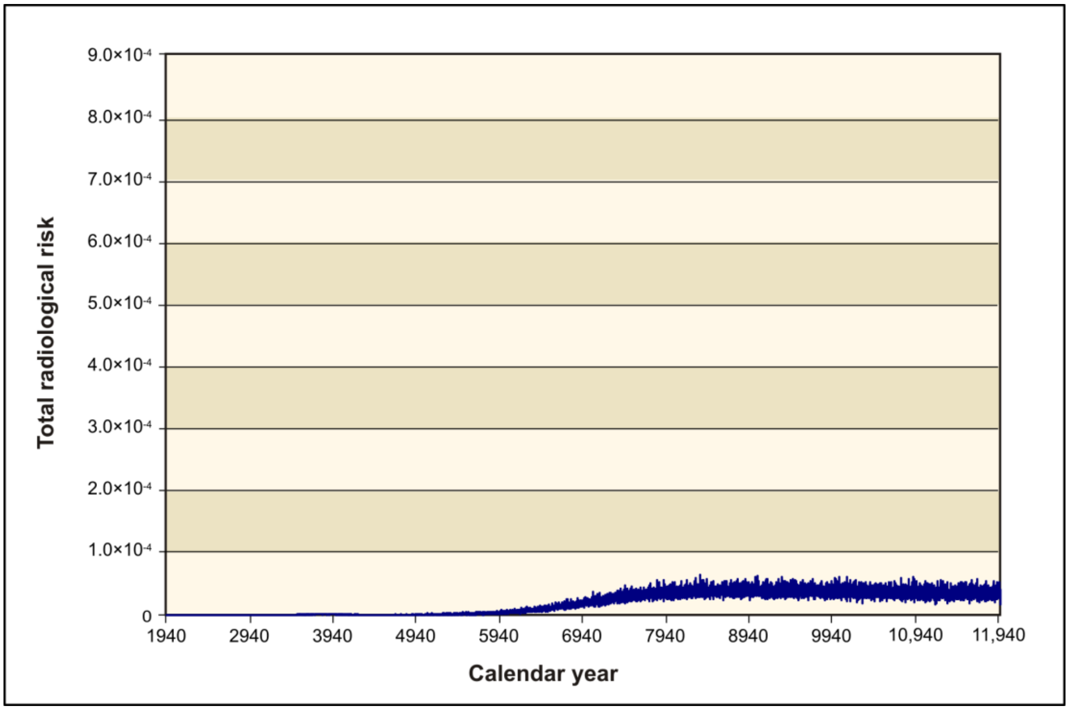


Figure Q–20. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.4 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D

Disposal Group 1, Subgroup 1-D, addresses the waste resulting from Tank Closure Alternative 3C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Steam reforming waste
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3C.

Potential human health impacts are summarized in Tables Q–279 through Q–283, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the resident farmer and the American Indian resident farmer and at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 2.11×10^{-1} person-rem per year for the year of maximum impact.

Table Q–279. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.35×10^{-6}	2.37	8.15×10^{-5}	1.35×10^{-6}	6.10	2.76×10^{-4}	1.39×10^{-6}	1.28×10^{1}	6.04×10^{-4}
Iodine-129	1.79×10^{-9}	5.10×10^{-1}	5.79×10^{-6}	1.79×10^{-9}	6.37×10^{-1}	5.02×10^{-6}	1.00×10^{-9}	4.60×10^{-1}	7.59×10^{-6}
Total	**N/A**	**2.88**	$\mathbf{8.72\times10^{-5}}$	**N/A**	**6.74**	$\mathbf{2.81\times10^{-4}}$	**N/A**	$\mathbf{1.33\times10^{1}}$	$\mathbf{6.11\times10^{-4}}$
Year of peak impact	7826	7826	7826	7826	7826	8054	8054	8054	8054
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	1.82×10^{-6}	2.60×10^{-7}	0.00	1.82×10^{-6}	2.70×10^{-7}	0.00	1.82×10^{-6}	2.94×10^{-7}	0.00
Chromium	1.05×10^{-2}	1.00×10^{-1}	0.00	1.05×10^{-2}	1.04×10^{-1}	7.57×10^{-11}	1.05×10^{-2}	1.56×10^{-1}	3.47×10^{-6}
Fluoride	2.07×10^{-4}	9.87×10^{-5}	0.00	2.07×10^{-4}	2.77×10^{-4}	0.00	2.07×10^{-4}	5.82×10^{-4}	0.00
Nitrate	1.15×10^{1}	2.04×10^{-1}	0.00	1.15×10^{1}	1.61	0.00	1.15×10^{1}	3.58	0.00
Total	**N/A**	$\mathbf{3.05\times10^{-1}}$	**0.00**	**N/A**	**1.71**	$\mathbf{7.57\times10^{-11}}$	**N/A**	**3.74**	$\mathbf{3.47\times10^{-6}}$
Year of peak impact	8207	8207	N/A	8207	8207	11,378	8207	8207	11,378

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–280. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–281. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.10×10^{-7}	1.07	3.67×10^{-5}	6.10×10^{-7}	2.75	1.21×10^{-4}	6.10×10^{-7}	5.62	2.64×10^{-4}
Iodine-129	4.13×10^{-10}	1.18×10^{-1}	1.34×10^{-6}	4.13×10^{-10}	1.47×10^{-1}	2.07×10^{-6}	4.13×10^{-10}	1.90×10^{-1}	3.13×10^{-6}
Total	**N/A**	**1.18**	**3.80×10^{-5}**	**N/A**	**2.90**	**1.23×10^{-4}**	**N/A**	**5.81**	**2.67×10^{-4}**
Year of peak impact	8237	8237	8237	8237	8237	8237	8237	8237	8237
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	7.93×10^{-7}	1.13×10^{-7}	0.00	7.27×10^{-7}	1.08×10^{-7}	0.00	7.27×10^{-7}	1.18×10^{-7}	0.00
Chromium	4.28×10^{-3}	4.08×10^{-2}	0.00	2.44×10^{-3}	2.41×10^{-2}	2.38×10^{-11}	2.44×10^{-3}	3.63×10^{-2}	1.09×10^{-6}
Fluoride	5.94×10^{-5}	2.83×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	2.90	5.18×10^{-2}	0.00	3.15	4.42×10^{-1}	0.00	3.15	9.86×10^{-1}	0.00
Total	**N/A**	**9.26×10^{-2}**	**0.00**	**N/A**	**4.66×10^{-1}**	**2.38×10^{-11}**	**N/A**	**1.02**	**1.09×10^{-6}**
Year of peak impact	8317	8317	N/A	8121	8121	10,691	8121	8121	10,691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–282. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.74×10^{-7}	8.30×10^{-1}	2.93×10^{-5}	4.86×10^{-7}	2.19	9.63×10^{-5}	4.86×10^{-7}	4.48	2.11×10^{-4}
Iodine-129	4.76×10^{-10}	1.36×10^{-1}	1.08×10^{-6}	3.32×10^{-10}	1.18×10^{-1}	1.66×10^{-6}	3.32×10^{-10}	1.53×10^{-1}	2.52×10^{-6}
Total	**N/A**	**9.66×10^{-1}**	**3.04×10^{-5}**	**N/A**	**2.31**	**9.80×10^{-5}**	**N/A**	**4.63**	**2.13×10^{-4}**
Year of peak impact	8174	8174	8130	8130	8130	8130	8130	8130	8130
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.59×10^{-3}	3.42×10^{-2}	0.00	1.97×10^{-3}	1.95×10^{-2}	1.83×10^{-11}	1.97×10^{-3}	2.93×10^{-2}	8.39×10^{-7}
Fluoride	5.44×10^{-5}	2.59×10^{-5}	0.00	3.46×10^{-5}	4.63×10^{-5}	0.00	3.46×10^{-5}	9.72×10^{-5}	0.00
Nitrate	1.66	2.96×10^{-2}	0.00	2.40	3.38×10^{-1}	0.00	2.40	7.53×10^{-1}	0.00
Total	**N/A**	**6.38×10^{-2}**	**0.00**	**N/A**	**3.57×10^{-1}**	**1.83×10^{-11}**	**N/A**	**7.82×10^{-1}**	**8.39×10^{-7}**
Year of peak impact	8284	8284	N/A	7899	7899	11,049	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–283. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	8.54×10^{-12}	3.85×10^{-5}	1.69×10^{-9}	8.40×10^{-12}	8.73×10^{-5}	4.15×10^{-9}	4.74×10^{-7}	1.43×10^{-2}	7.83×10^{-7}
Iodine-129	1.04×10^{-14}	3.71×10^{-6}	5.22×10^{-11}	1.13×10^{-14}	6.15×10^{-5}	1.48×10^{-9}	4.76×10^{-10}	1.87×10^{-3}	3.61×10^{-8}
Total	**N/A**	**4.22×10^{-5}**	**1.74×10^{-9}**	**N/A**	**1.49×10^{-4}**	**5.63×10^{-9}**	**N/A**	**1.62×10^{-2}**	**8.19×10^{-7}**
Year of peak impact	8489	8489	8489	8279	8279	8279	8174	8174	8130
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.10×10^{-8}	4.05×10^{-7}	2.90×10^{-16}	3.55×10^{-8}	5.75×10^{-7}	1.33×10^{-11}	1.97×10^{-3}	8.68×10^{-3}	8.38×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	3.46×10^{-5}	5.06×10^{-6}	0.00
Nitrate	3.88×10^{-5}	5.87×10^{-6}	0.00	3.90×10^{-5}	3.68×10^{-3}	0.00	2.40	1.11×10^{-1}	0.00
Total	**N/A**	**6.27×10^{-6}**	**2.90×10^{-16}**	**N/A**	**3.68×10^{-3}**	**1.33×10^{-11}**	**N/A**	**1.20×10^{-1}**	**8.38×10^{-7}**
Year of peak impact	8293	8293	11,332	8166	8166	11,332	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–21 and Q–22 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8200 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

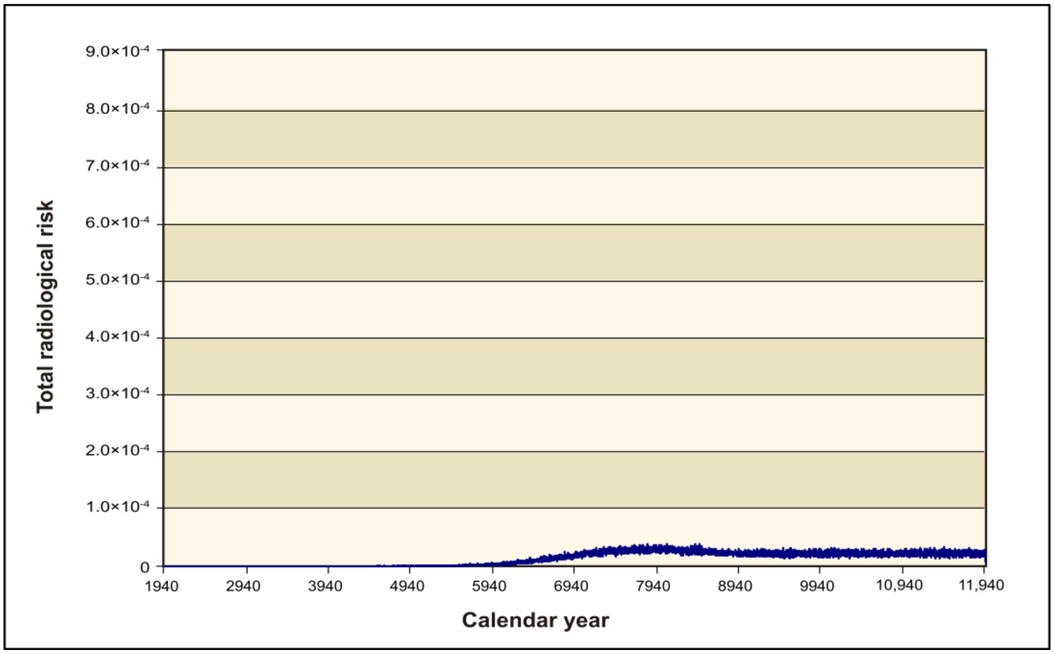


Figure Q–21. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

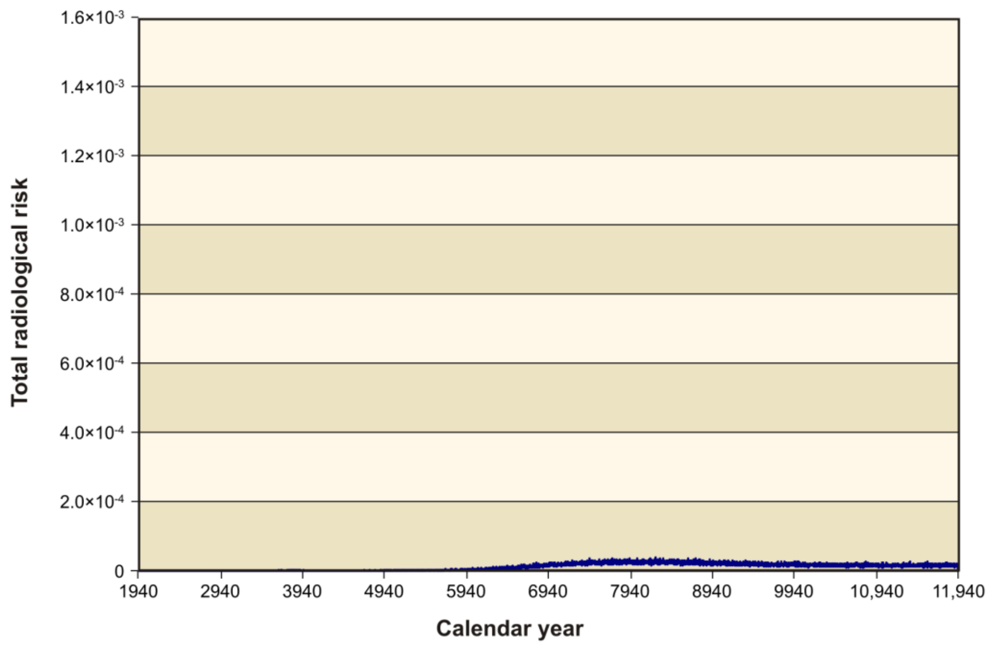


Figure Q–22. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.5 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E

Disposal Group 1, Subgroup 1-E, addresses the waste resulting from Tank Closure Alternative 4, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 4.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–284 through Q–288, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, the resident farmer, and the American Indian resident farmer, and would be exceeded at the Core Zone Boundary and Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.99×10^{-1} person-rem per year for the year of maximum impact.

Table Q–284. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.86×10^{-6}	6.76	2.32×10^{-4}	3.86×10^{-6}	1.74×10^{1}	7.64×10^{-4}	3.86×10^{-6}	3.56×10^{1}	1.67×10^{-3}
Iodine-129	4.59×10^{-10}	1.31×10^{-1}	1.49×10^{-6}	4.59×10^{-10}	1.63×10^{-1}	2.30×10^{-6}	4.59×10^{-10}	2.11×10^{-1}	3.48×10^{-6}
Total	**N/A**	**6.89**	**2.34×10^{-4}**	**N/A**	**1.76×10^{1}**	**7.67×10^{-4}**	**N/A**	**3.58×10^{1}**	**1.67×10^{-3}**
Year of peak impact	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	9.03×10^{-3}	4.30×10^{-2}	0.00	7.76×10^{-3}	4.62×10^{-2}	0.00	7.76×10^{-3}	8.35×10^{-2}	0.00
Boron and compounds	1.86×10^{-6}	2.66×10^{-7}	0.00	2.34×10^{-6}	3.47×10^{-7}	0.00	2.34×10^{-6}	3.78×10^{-7}	0.00
Chromium	1.75×10^{-1}	1.67	0.00	1.42×10^{-1}	1.40	6.88×10^{-10}	1.42×10^{-1}	2.10	3.16×10^{-5}
Fluoride	1.04×10^{-4}	4.93×10^{-5}	0.00	1.52×10^{-4}	2.04×10^{-4}	0.00	1.52×10^{-4}	4.27×10^{-4}	0.00
Nitrate	2.05×10^{1}	3.67×10^{-1}	0.00	2.63×10^{1}	3.70	0.00	2.63×10^{1}	8.24	0.00
Total	**N/A**	**2.08**	**0.00**	**N/A**	**5.14**	**6.88×10^{-10}**	**N/A**	**1.04×10^{1}**	**3.16×10^{-5}**
Year of peak impact	9008	9008	N/A	8599	8599	9008	8599	8599	9008

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–285. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.07×10^{-7}	1.87×10^{-1}	6.45×10^{-6}	1.07×10^{-7}	4.83×10^{-1}	2.12×10^{-5}	1.07×10^{-7}	9.86×10^{-1}	4.64×10^{-5}
Iodine-129	1.74×10^{-10}	4.95×10^{-2}	5.62×10^{-7}	1.74×10^{-10}	6.18×10^{-2}	8.70×10^{-7}	1.74×10^{-10}	7.99×10^{-2}	1.32×10^{-6}
Total	**N/A**	$\mathbf{2.37\times10^{-1}}$	$\mathbf{7.01\times10^{-6}}$	**N/A**	$\mathbf{5.45\times10^{-1}}$	$\mathbf{2.21\times10^{-5}}$	**N/A**	**1.07**	$\mathbf{4.77\times10^{-5}}$
Year of peak impact	3785	3785	3785	3785	3785	3785	3785	3785	3785
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.84×10^{-3}	6.51×10^{-2}	0.00	6.47×10^{-3}	6.39×10^{-2}	2.69×10^{-11}	6.47×10^{-3}	9.61×10^{-2}	1.23×10^{-6}
Nitrate	2.25×10^{-1}	4.01×10^{-3}	0.00	2.63×10^{-1}	3.69×10^{-2}	0.00	2.63×10^{-1}	8.23×10^{-2}	0.00
Total	**N/A**	$\mathbf{6.92\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.01\times10^{-1}}$	$\mathbf{2.69\times10^{-11}}$	**N/A**	$\mathbf{1.78\times10^{-1}}$	$\mathbf{1.23\times10^{-6}}$
Year of peak impact	3666	3666	N/A	3682	3682	3666	3682	3682	3666

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–286. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.39×10^{-6}	2.44	8.39×10^{-5}	1.39×10^{-6}	6.28	2.76×10^{-4}	1.39×10^{-6}	1.28×10^{1}	6.03×10^{-4}
Iodine-129	1.83×10^{-10}	5.21×10^{-2}	5.92×10^{-7}	1.83×10^{-10}	6.51×10^{-2}	9.16×10^{-7}	1.83×10^{-10}	8.41×10^{-2}	1.39×10^{-6}
Total	**N/A**	**2.49**	**8.45×10^{-5}**	**N/A**	**6.35**	**2.77×10^{-4}**	**N/A**	**1.29×10^{1}**	**6.05×10^{-4}**
Year of peak impact	9662	9662	9662	9662	9662	9662	9662	9662	9662
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.60×10^{-3}	7.61×10^{-3}	0.00	2.30×10^{-3}	1.37×10^{-2}	0.00	2.00×10^{-3}	2.15×10^{-2}	0.00
Chromium	5.25×10^{-2}	5.00×10^{-1}	0.00	4.46×10^{-2}	4.40×10^{-1}	2.06×10^{-10}	3.35×10^{-2}	4.97×10^{-1}	9.46×10^{-6}
Fluoride	5.44×10^{-5}	2.59×10^{-5}	0.00	6.18×10^{-5}	8.27×10^{-5}	0.00	5.94×10^{-5}	1.67×10^{-4}	0.00
Nitrate	6.66	1.19×10^{-1}	0.00	8.37	1.18	0.00	8.96	2.80	0.00
Total	**N/A**	**6.26×10^{-1}**	**0.00**	**N/A**	**1.63**	**2.06×10^{-10}**	**N/A**	**3.32**	**9.46×10^{-6}**
Year of peak impact	8873	8873	N/A	8787	8787	8873	8189	8189	8873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–287. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.17×10^{-6}	2.05	7.04×10^{-5}	1.17×10^{-6}	5.27	2.31×10^{-4}	1.17×10^{-6}	1.08×10^{1}	5.06×10^{-4}
Iodine-129	9.94×10^{-11}	2.83×10^{-2}	3.22×10^{-7}	9.94×10^{-11}	3.54×10^{-2}	4.98×10^{-7}	9.94×10^{-11}	4.57×10^{-2}	7.53×10^{-7}
Total	**N/A**	**2.07**	**7.07×10^{-5}**	**N/A**	**5.31**	**2.32×10^{-4}**	**N/A**	**1.08×10^{1}**	**5.07×10^{-4}**
Year of peak impact	10,639	10,639	10,639	10,639	10,639	10,639	10,639	10,639	10,639

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.30×10^{-3}	6.18×10^{-3}	0.00	1.60×10^{-3}	9.51×10^{-3}	0.00	1.60×10^{-3}	1.72×10^{-2}	0.00
Chromium	3.98×10^{-2}	3.79×10^{-1}	0.00	1.91×10^{-2}	1.89×10^{-1}	1.56×10^{-10}	1.91×10^{-2}	2.84×10^{-1}	7.17×10^{-6}
Fluoride	2.97×10^{-5}	1.41×10^{-5}	0.00	1.98×10^{-5}	2.65×10^{-5}	0.00	1.98×10^{-5}	5.56×10^{-5}	0.00
Nitrate	4.62	8.25×10^{-2}	0.00	6.82	9.57×10^{-1}	0.00	6.82	2.13	0.00
Total	**N/A**	**4.68×10^{-1}**	**0.00**	**N/A**	**1.16**	**1.56×10^{-10}**	**N/A**	**2.44**	**7.17×10^{-6}**
Year of peak impact	8827	8827	N/A	9059	9059	8827	9059	9059	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–288. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.70×10^{-11}	7.65×10^{-5}	3.40×10^{-9}	1.70×10^{-11}	1.76×10^{-4}	8.38×10^{-9}	1.17×10^{-6}	3.51×10^{-2}	1.88×10^{-6}
Iodine-129	9.44×10^{-15}	3.37×10^{-6}	3.07×10^{-11}	9.44×10^{-15}	5.15×10^{-5}	1.24×10^{-9}	9.94×10^{-11}	4.18×10^{-4}	1.03×10^{-8}
Total	**N/A**	**7.98×10^{-5}**	**3.43×10^{-9}**	**N/A**	**2.28×10^{-4}**	**9.61×10^{-9}**	**N/A**	**3.55×10^{-2}**	**1.89×10^{-6}**
Year of peak impact	8389	8389	9205	8389	8389	8389	10,639	10,639	10,639

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.12×10^{-8}	1.86×10^{-7}	0.00	3.12×10^{-8}	3.36×10^{-7}	0.00	1.30×10^{-3}	7.79×10^{-3}	0.00
Chromium	5.50×10^{-7}	5.44×10^{-6}	2.59×10^{-15}	5.50×10^{-7}	8.91×10^{-6}	1.19×10^{-10}	3.98×10^{-2}	1.75×10^{-1}	7.17×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.97×10^{-5}	4.33×10^{-6}	0.00
Nitrate	1.16×10^{-4}	1.76×10^{-5}	0.00	1.16×10^{-4}	1.09×10^{-2}	0.00	4.62	2.46×10^{-1}	0.00
Total	**N/A**	**2.32×10^{-5}**	**2.59×10^{-15}**	**N/A**	**1.09×10^{-2}**	**1.19×10^{-10}**	**N/A**	**4.29×10^{-1}**	**7.17×10^{-6}**
Year of peak impact	8855	8855	8960	8855	8855	8960	8827	8827	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–23 and Q–24 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 9700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

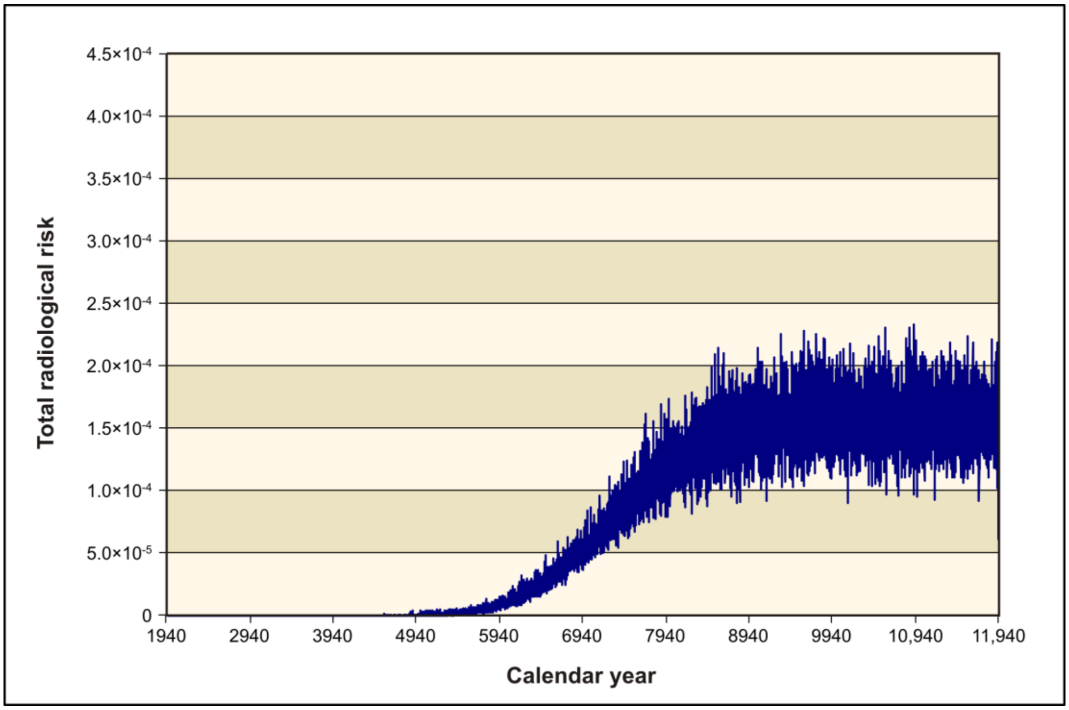


Figure Q–23. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

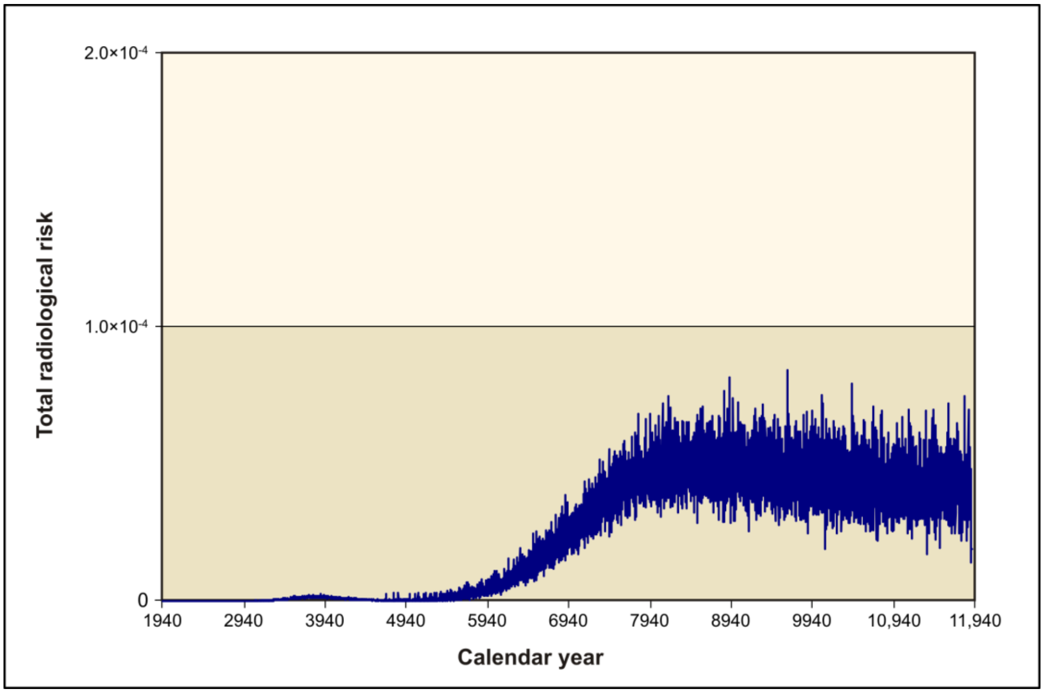


Figure Q–24. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.6 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F

Disposal Group 1, Subgroup 1-F, addresses the waste resulting from Tank Closure Alternative 5, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Sulfate grout
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 5 because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–289 through Q–292, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, the resident farmer, and the American Indian resident farmer; at the Core Zone Boundary for the resident farmer and American Indian resident farmer; and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated as 2.59×10^{-1} person-rem per year for the year of maximum impact.

Table Q–289. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.43×10^{-6}	2.51	8.63×10^{-5}	1.43×10^{-6}	6.47	2.87×10^{-4}	1.43×10^{-6}	1.32×10^{1}	6.27×10^{-4}
Iodine-129	1.74×10^{-9}	4.96×10^{-1}	5.63×10^{-6}	1.74×10^{-9}	6.19×10^{-1}	6.70×10^{-6}	1.74×10^{-9}	8.00×10^{-1}	1.01×10^{-5}
Total	**N/A**	**3.01**	**9.20×10^{-5}**	**N/A**	**7.09**	**2.93×10^{-4}**	**N/A**	**1.40×10^{1}**	**6.37×10^{-4}**
Year of peak impact	7826	7826	7826	7826	7826	7985	7826	7826	7985

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.15×10^{-3}	1.02×10^{-2}	0.00	2.34×10^{-3}	1.39×10^{-2}	0.00	2.34×10^{-3}	2.51×10^{-2}	0.00
Boron and compounds	1.49×10^{-6}	2.13×10^{-7}	0.00	2.21×10^{-6}	3.28×10^{-7}	0.00	2.21×10^{-6}	3.57×10^{-7}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.50×10^{-1}	2.47	1.16×10^{-9}	2.50×10^{-1}	3.72	5.31×10^{-5}
Fluoride	1.36×10^{-4}	6.48×10^{-5}	0.00	1.43×10^{-4}	1.91×10^{-4}	0.00	1.43×10^{-4}	4.00×10^{-4}	0.00
Nitrate	1.16×10^{1}	2.07×10^{-1}	0.00	1.78×10^{1}	2.49	0.00	1.78×10^{1}	5.56	0.00
Total	**N/A**	**3.03**	**0.00**	**N/A**	**4.98**	**1.16×10^{-9}**	**N/A**	**9.31**	**5.31×10^{-5}**
Year of peak impact	8882	8882	N/A	8636	8636	8882	8636	8636	8882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–290. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	6.96×10^{-7}	1.22	4.19×10^{-5}	6.96×10^{-7}	3.14	1.38×10^{-4}	6.96×10^{-7}	6.41	3.01×10^{-4}
Iodine-129	4.41×10^{-10}	1.26×10^{-1}	1.43×10^{-6}	4.41×10^{-10}	1.57×10^{-1}	2.21×10^{-6}	4.41×10^{-10}	2.03×10^{-1}	3.34×10^{-6}
Total	**N/A**	**1.34**	$\mathbf{4.33\times10^{-5}}$	**N/A**	**3.30**	$\mathbf{1.40\times10^{-4}}$	**N/A**	**6.61**	$\mathbf{3.05\times10^{-4}}$
Year of peak impact	8302	8302	8302	8302	8302	8302	8302	8302	8302
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	9.92×10^{-4}	4.72×10^{-3}	0.00	3.97×10^{-4}	2.36×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	7.78×10^{-2}	7.41×10^{-1}	0.00	5.78×10^{-2}	5.71×10^{-1}	3.06×10^{-10}	5.78×10^{-2}	8.59×10^{-1}	1.40×10^{-5}
Fluoride	6.18×10^{-5}	2.94×10^{-5}	0.00	5.44×10^{-5}	7.28×10^{-5}	0.00	5.44×10^{-5}	1.53×10^{-4}	0.00
Nitrate	4.19	7.48×10^{-2}	0.00	6.25	8.77×10^{-1}	0.00	6.25	1.96	0.00
Total	**N/A**	$\mathbf{8.21\times10^{-1}}$	**0.00**	**N/A**	**1.45**	$\mathbf{3.06\times10^{-10}}$	**N/A**	**2.82**	$\mathbf{1.40\times10^{-5}}$
Year of peak impact	8588	8588	N/A	7810	7810	9057	7810	7810	9057

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–291. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.59×10^{-7}	9.77×10^{-1}	3.36×10^{-5}	5.59×10^{-7}	2.52	1.11×10^{-4}	5.59×10^{-7}	5.14	2.42×10^{-4}
Iodine-129	3.30×10^{-10}	9.40×10^{-2}	1.07×10^{-6}	3.30×10^{-10}	1.17×10^{-1}	1.65×10^{-6}	3.30×10^{-10}	1.52×10^{-1}	2.50×10^{-6}
Total	**N/A**	**1.07**	**3.47×10^{-5}**	**N/A**	**2.64**	**1.12×10^{-4}**	**N/A**	**5.30**	**2.44×10^{-4}**
Year of peak impact	8014	8014	8014	8014	8014	8014	8014	8014	8014
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.62×10^{-4}	2.68×10^{-3}	0.00	5.62×10^{-4}	3.35×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	5.87×10^{-2}	5.59×10^{-1}	0.00	5.87×10^{-2}	5.80×10^{-1}	2.34×10^{-10}	4.39×10^{-2}	6.53×10^{-1}	1.07×10^{-5}
Fluoride	2.23×10^{-5}	1.06×10^{-5}	0.00	2.23×10^{-5}	2.98×10^{-5}	0.00	3.96×10^{-5}	1.11×10^{-4}	0.00
Nitrate	2.80	4.99×10^{-2}	0.00	2.80	3.93×10^{-1}	0.00	3.66	1.15	0.00
Total	**N/A**	**6.12×10^{-1}**	**0.00**	**N/A**	**9.76×10^{-1}**	**2.34×10^{-10}**	**N/A**	**1.80**	**1.07×10^{-5}**
Year of peak impact	8535	8535	N/A	8535	8535	8241	8522	8522	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–292. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.07×10^{-11}	4.81×10^{-5}	2.11×10^{-9}	1.07×10^{-11}	1.11×10^{-4}	5.27×10^{-9}	5.59×10^{-7}	1.68×10^{-2}	9.00×10^{-7}
Iodine-129	1.02×10^{-14}	3.65×10^{-6}	5.15×10^{-11}	1.02×10^{-14}	5.58×10^{-5}	1.34×10^{-9}	3.30×10^{-10}	1.44×10^{-3}	3.53×10^{-8}
Total	**N/A**	**5.18×10^{-5}**	**2.16×10^{-9}**	**N/A**	**1.67×10^{-4}**	**6.61×10^{-9}**	**N/A**	**1.83×10^{-2}**	**9.35×10^{-7}**
Year of peak impact	7935	7935	7935	7935	7935	7935	8014	8014	8014
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.06×10^{-8}	6.29×10^{-8}	0.00	1.04×10^{-8}	1.12×10^{-7}	0.00	5.62×10^{-4}	3.37×10^{-3}	0.00
Chromium	9.74×10^{-7}	9.62×10^{-6}	4.03×10^{-15}	8.18×10^{-7}	1.32×10^{-5}	1.85×10^{-10}	5.87×10^{-2}	2.58×10^{-1}	1.07×10^{-5}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.23×10^{-5}	3.25×10^{-6}	0.00
Nitrate	7.30×10^{-5}	1.11×10^{-5}	0.00	7.90×10^{-5}	7.44×10^{-3}	0.00	2.80	1.55×10^{-1}	0.00
Total	**N/A**	**2.07×10^{-5}**	**4.03×10^{-15}**	**N/A**	**7.46×10^{-3}**	**1.85×10^{-10}**	**N/A**	**4.17×10^{-1}**	**1.07×10^{-5}**
Year of peak impact	8457	8457	8987	8385	8385	8987	8535	8535	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–25 and Q–26 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8000 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

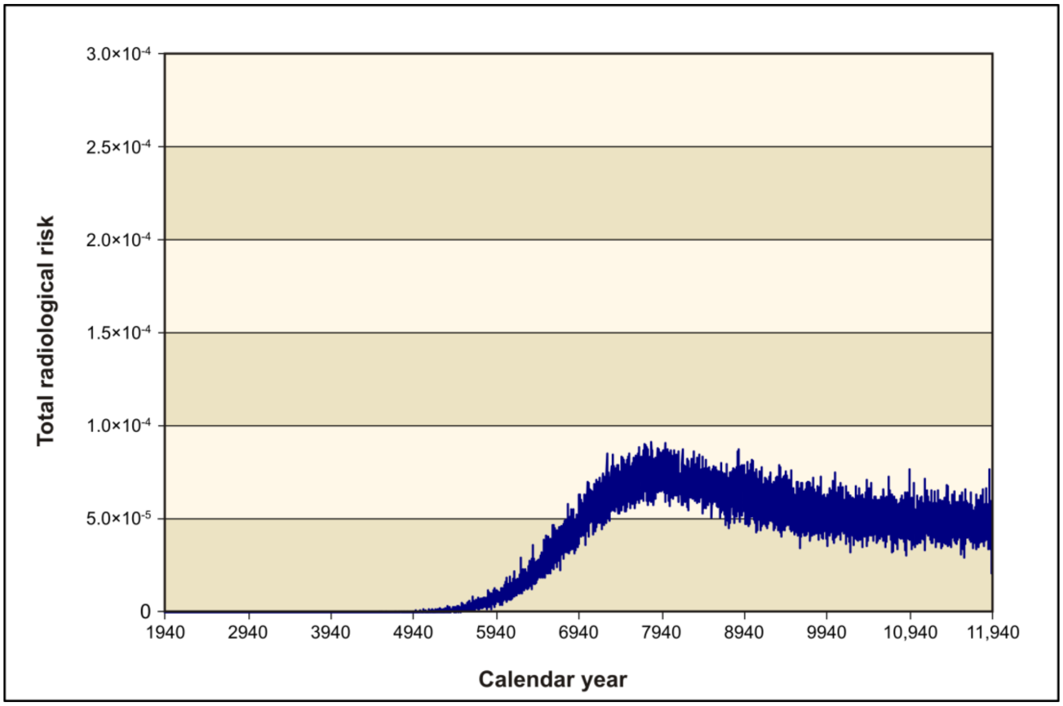


Figure Q–25. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

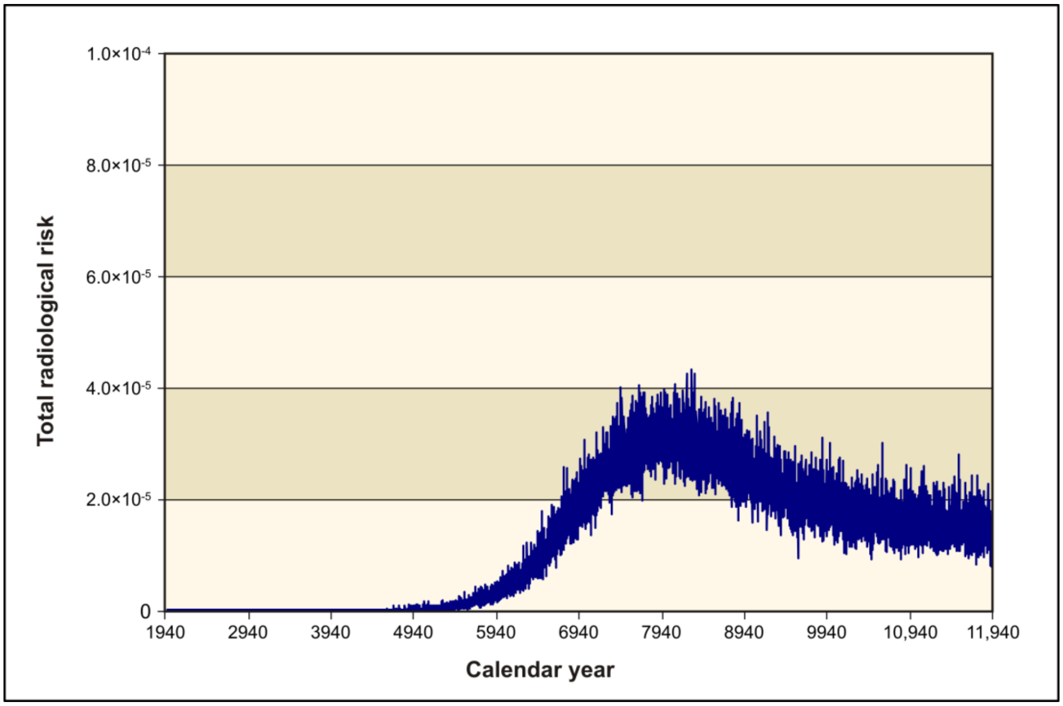


Figure Q–26. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.7 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G

Disposal Group 1, Subgroup 1-G, addresses the waste resulting from Tank Closure Alternative 6C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities for Tank Closure Alternative 6C.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–293 through Q–297, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 1.67×10^{-1} person-rem per year for the year of maximum impact.

Table Q–293. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.26×10^{-6}	2.20	7.58×10^{-5}	1.26×10^{-6}	5.68	2.49×10^{-4}	1.26×10^{-6}	1.16×10^{1}	5.45×10^{-4}
Iodine-129	1.74×10^{-9}	4.95×10^{-1}	5.63×10^{-6}	1.74×10^{-9}	6.19×10^{-1}	8.71×10^{-6}	1.74×10^{-9}	7.99×10^{-1}	1.32×10^{-5}
Total	**N/A**	**2.70**	$\mathbf{8.14\times10^{-5}}$	**N/A**	**6.30**	$\mathbf{2.58\times10^{-4}}$	**N/A**	$\mathbf{1.24\times10^{1}}$	$\mathbf{5.58\times10^{-4}}$
Year of peak impact	7826	7826	7826	7826	7826	7826	7826	7826	7826

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.94×10^{-6}	4.20×10^{-7}	0.00	2.94×10^{-6}	4.37×10^{-7}	0.00	2.94×10^{-6}	4.76×10^{-7}	0.00
Chromium	1.31×10^{-3}	1.24×10^{-2}	0.00	1.31×10^{-3}	1.29×10^{-2}	8.05×10^{-12}	1.31×10^{-3}	1.94×10^{-2}	3.69×10^{-7}
Fluoride	2.07×10^{-4}	9.87×10^{-5}	0.00	2.07×10^{-4}	2.77×10^{-4}	0.00	2.07×10^{-4}	5.82×10^{-4}	0.00
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	$\mathbf{2.29\times10^{-1}}$	**0.00**	**N/A**	**1.71**	$\mathbf{8.05\times10^{-12}}$	**N/A**	**3.81**	$\mathbf{3.69\times10^{-7}}$
Year of peak impact	7962	7962	N/A	7962	7962	8555	7962	7962	8555

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–294. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	$\mathbf{8.94\times10^{-2}}$	$\mathbf{2.69\times10^{-6}}$	**N/A**	$\mathbf{2.08\times10^{-1}}$	$\mathbf{8.54\times10^{-6}}$	**N/A**	$\mathbf{4.10\times10^{-1}}$	$\mathbf{1.85\times10^{-5}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.84\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.96\times10^{-2}}$	$\mathbf{1.05\times10^{-11}}$	**N/A**	$\mathbf{9.17\times10^{-2}}$	$\mathbf{4.81\times10^{-7}}$
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–295. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.93×10^{-7}	8.63×10^{-1}	2.99×10^{-5}	4.93×10^{-7}	2.22	9.84×10^{-5}	4.97×10^{-7}	4.58	2.15×10^{-4}
Iodine-129	5.21×10^{-10}	1.48×10^{-1}	1.49×10^{-6}	5.21×10^{-10}	1.85×10^{-1}	2.30×10^{-6}	4.59×10^{-10}	2.11×10^{-1}	3.48×10^{-6}
Total	**N/A**	**1.01**	**3.14×10^{-5}**	**N/A**	**2.41**	**1.01×10^{-4}**	**N/A**	**4.79**	**2.19×10^{-4}**
Year of peak impact	7439	7439	7709	7439	7439	7709	7709	7709	7709
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	7.27×10^{-7}	1.04×10^{-7}	0.00	7.27×10^{-7}	1.08×10^{-7}	0.00	7.27×10^{-7}	1.18×10^{-7}	0.00
Chromium	4.17×10^{-4}	3.97×10^{-3}	0.00	4.17×10^{-4}	4.12×10^{-3}	2.94×10^{-12}	4.17×10^{-4}	6.20×10^{-3}	1.35×10^{-7}
Fluoride	4.95×10^{-5}	2.36×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.78×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–296. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.71×10^{-7}	6.50×10^{-1}	2.28×10^{-5}	3.79×10^{-7}	1.71	7.51×10^{-5}	3.79×10^{-7}	3.49	1.64×10^{-4}
Iodine-129	3.38×10^{-10}	9.64×10^{-2}	9.34×10^{-7}	2.88×10^{-10}	1.03×10^{-1}	1.44×10^{-6}	2.88×10^{-10}	1.33×10^{-1}	2.18×10^{-6}
Total	**N/A**	$\mathbf{7.46\times10^{-1}}$	$\mathbf{2.38\times10^{-5}}$	**N/A**	**1.81**	$\mathbf{7.65\times10^{-5}}$	**N/A**	**3.63**	$\mathbf{1.66\times10^{-4}}$
Year of peak impact	7847	7847	8130	8130	8130	8130	8130	8130	8130

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.35×10^{-4}	3.19×10^{-3}	0.00	1.72×10^{-4}	1.70×10^{-3}	1.63×10^{-12}	1.72×10^{-4}	2.55×10^{-3}	7.46×10^{-8}
Fluoride	2.97×10^{-5}	1.41×10^{-5}	0.00	2.97×10^{-5}	3.97×10^{-5}	0.00	2.97×10^{-5}	8.33×10^{-5}	0.00
Nitrate	1.95	3.49×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	$\mathbf{3.81\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{2.87\times10^{-1}}$	$\mathbf{1.63\times10^{-12}}$	**N/A**	$\mathbf{6.39\times10^{-1}}$	$\mathbf{7.46\times10^{-8}}$
Year of peak impact	8798	8798	N/A	7927	7927	8735	7927	7927	8735

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–297. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.60×10^{-12}	2.97×10^{-5}	1.31×10^{-9}	6.50×10^{-12}	6.76×10^{-5}	3.21×10^{-9}	3.79×10^{-7}	1.14×10^{-2}	6.10×10^{-7}
Iodine-129	1.01×10^{-14}	3.62×10^{-6}	5.10×10^{-11}	1.06×10^{-14}	5.77×10^{-5}	1.39×10^{-9}	2.88×10^{-10}	1.31×10^{-3}	3.21×10^{-8}
Total	**N/A**	**3.34×10^{-5}**	**1.36×10^{-9}**	**N/A**	**1.25×10^{-4}**	**4.60×10^{-9}**	**N/A**	**1.27×10^{-2}**	**6.43×10^{-7}**
Year of peak impact	7861	7861	7861	7935	7935	7935	8130	8130	8130

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.72×10^{-4}	7.55×10^{-4}	7.46×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.97×10^{-5}	4.33×10^{-6}	0.00
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**7.46×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	8735

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–27 and Q–28 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 7700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

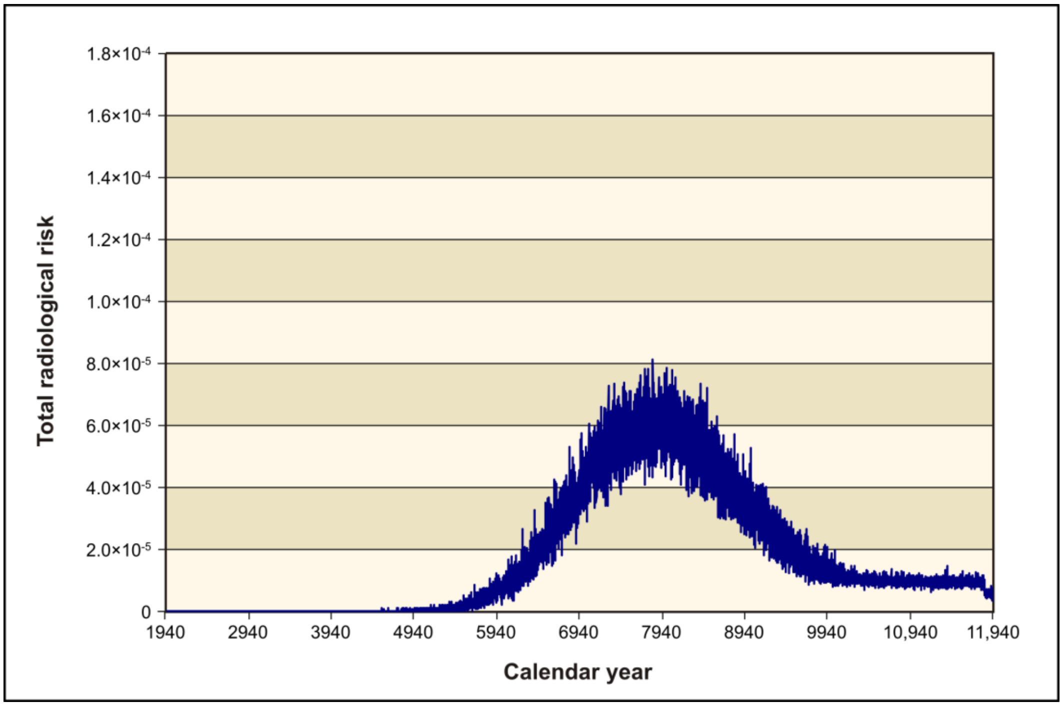


Figure Q–27. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

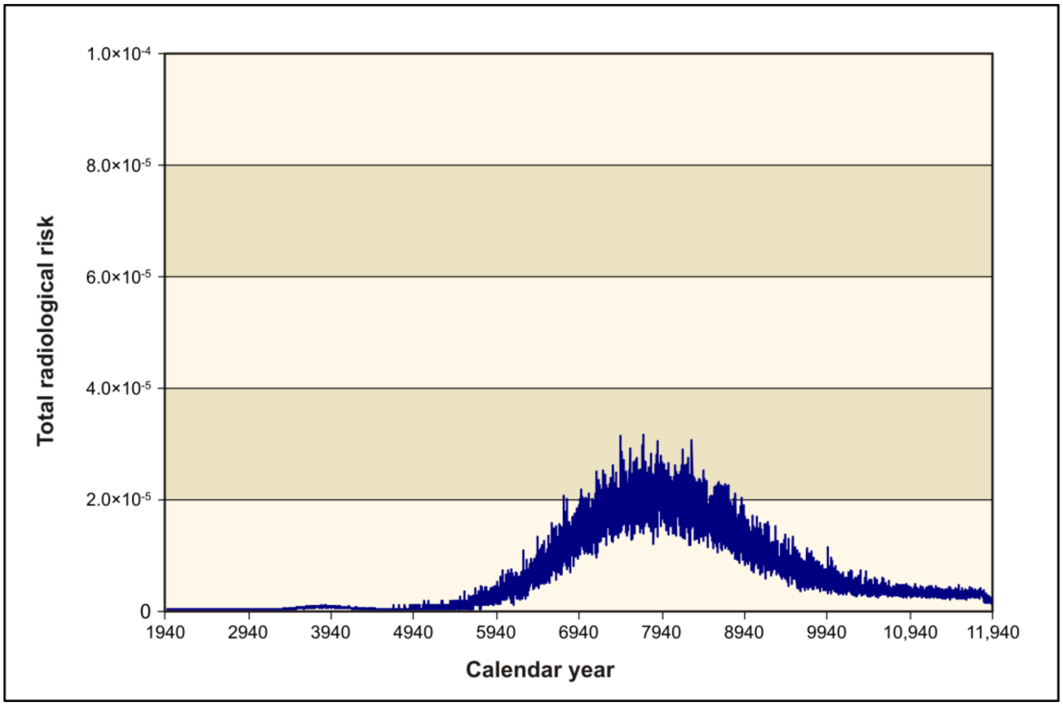


Figure Q–28. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.8 Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A

Disposal Group 2, Subgroup 2-A, addresses the waste resulting from Tank Closure Alternative 2A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 2A because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–298 through Q–301, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 1.68×10^{-1} person-rem per year for the year of maximum impact.

Table Q–298. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	2.29×10^{-6}	4.01	1.38×10^{-4}	2.29×10^{-6}	1.03×10^{1}	4.58×10^{-4}	2.29×10^{-6}	2.11×10^{1}	1.00×10^{-3}
Iodine-129	3.75×10^{-9}	1.07	1.22×10^{-5}	3.75×10^{-9}	1.34	1.45×10^{-5}	3.75×10^{-9}	1.73	2.20×10^{-5}
Total	**N/A**	**5.08**	**1.50×10^{-4}**	**N/A**	**1.17×10^{1}**	**4.72×10^{-4}**	**N/A**	**2.28×10^{1}**	**1.02×10^{-3}**
Year of peak impact	7644	7644	7644	7644	7644	7764	7644	7644	7764
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.08×10^{-6}	2.97×10^{-7}	0.00	2.08×10^{-6}	3.09×10^{-7}	0.00	2.08×10^{-6}	3.36×10^{-7}	0.00
Chromium	1.11×10^{-3}	1.06×10^{-2}	0.00	1.11×10^{-3}	1.10×10^{-2}	7.23×10^{-12}	1.11×10^{-3}	1.65×10^{-2}	3.32×10^{-7}
Fluoride	1.52×10^{-4}	7.22×10^{-5}	0.00	1.52×10^{-4}	2.03×10^{-4}	0.00	1.52×10^{-4}	4.26×10^{-4}	0.00
Nitrate	9.30	1.66×10^{-1}	0.00	9.30	1.31	0.00	9.30	2.91	0.00
Total	**N/A**	**1.77×10^{-1}**	**0.00**	**N/A**	**1.32**	**7.23×10^{-12}**	**N/A**	**2.93**	**3.32×10^{-7}**
Year of peak impact	7960	7960	N/A	7960	7960	8791	7960	7960	8791

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–299. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	5.56×10^{-7}	9.73×10^{-1}	3.35×10^{-5}	5.56×10^{-7}	2.51	1.10×10^{-4}	5.56×10^{-7}	5.12	2.41×10^{-4}
Iodine-129	6.61×10^{-10}	1.88×10^{-1}	2.14×10^{-6}	6.61×10^{-10}	2.35×10^{-1}	3.31×10^{-6}	6.61×10^{-10}	3.04×10^{-1}	5.01×10^{-6}
Total	**N/A**	**1.16**	**3.56×10^{-5}**	**N/A**	**2.74**	**1.13×10^{-4}**	**N/A**	**5.43**	**2.46×10^{-4}**
Year of peak impact	7328	7328	7328	7328	7328	7328	7328	7328	7328
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.60×10^{-4}	4.38×10^{-3}	0.00	4.48×10^{-4}	4.43×10^{-3}	2.92×10^{-12}	4.48×10^{-4}	6.66×10^{-3}	1.34×10^{-7}
Fluoride	5.37×10^{-5}	2.55×10^{-5}	0.00	4.15×10^{-5}	5.55×10^{-5}	0.00	4.15×10^{-5}	1.16×10^{-4}	0.00
Nitrate	2.92	5.21×10^{-2}	0.00	2.92	4.10×10^{-1}	0.00	2.92	9.14×10^{-1}	0.00
Total	**N/A**	**5.65×10^{-2}**	**0.00**	**N/A**	**4.14×10^{-1}**	**2.92×10^{-12}**	**N/A**	**9.21×10^{-1}**	**1.34×10^{-7}**
Year of peak impact	8123	8123	N/A	8291	8291	8053	8291	8291	8053

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–300. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.73×10^{-7}	6.52×10^{-1}	2.24×10^{-5}	3.73×10^{-7}	1.68	7.38×10^{-5}	3.73×10^{-7}	3.43	1.61×10^{-4}
Iodine-129	3.18×10^{-10}	9.07×10^{-2}	1.03×10^{-6}	3.18×10^{-10}	1.13×10^{-1}	1.59×10^{-6}	3.18×10^{-10}	1.46×10^{-1}	2.41×10^{-6}
Total	**N/A**	**7.43×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.79**	**7.54×10^{-5}**	**N/A**	**3.58**	**1.64×10^{-4}**
Year of peak impact	7754	7754	7754	7754	7754	7754	7754	7754	7754
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.65×10^{-4}	2.52×10^{-3}	0.00	2.65×10^{-4}	2.62×10^{-3}	1.77×10^{-12}	2.65×10^{-4}	3.94×10^{-3}	8.11×10^{-8}
Fluoride	2.68×10^{-5}	1.28×10^{-5}	0.00	2.68×10^{-5}	3.59×10^{-5}	0.00	2.68×10^{-5}	7.53×10^{-5}	0.00
Nitrate	1.86	3.33×10^{-2}	0.00	1.86	2.62×10^{-1}	0.00	1.86	5.84×10^{-1}	0.00
Total	**N/A**	**3.58×10^{-2}**	**0.00**	**N/A**	**2.64×10^{-1}**	**1.77×10^{-12}**	**N/A**	**5.88×10^{-1}**	**8.11×10^{-8}**
Year of peak impact	8406	8406	N/A	8406	8406	7640	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–301. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	6.63×10^{-12}	2.99×10^{-5}	1.31×10^{-9}	6.63×10^{-12}	6.89×10^{-5}	3.27×10^{-9}	3.73×10^{-7}	1.12×10^{-2}	6.00×10^{-7}
Iodine-129	9.97×10^{-15}	3.56×10^{-6}	5.01×10^{-11}	9.97×10^{-15}	5.43×10^{-5}	1.31×10^{-9}	3.18×10^{-10}	1.38×10^{-3}	3.38×10^{-8}
Total	**N/A**	$\mathbf{3.35\times10^{-5}}$	$\mathbf{1.36\times10^{-9}}$	**N/A**	$\mathbf{1.23\times10^{-4}}$	$\mathbf{4.58\times10^{-9}}$	**N/A**	$\mathbf{1.26\times10^{-2}}$	$\mathbf{6.34\times10^{-7}}$
Year of peak impact	7990	7990	7990	7990	7990	7990	7754	7754	7754
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	2.65×10^{-4}	1.17×10^{-3}	8.10×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.68×10^{-5}	3.92×10^{-6}	0.00
Nitrate	3.55×10^{-5}	5.37×10^{-6}	0.00	3.55×10^{-5}	3.34×10^{-3}	0.00	1.86	9.02×10^{-2}	0.00
Total	**N/A**	$\mathbf{5.37\times10^{-6}}$	**0.00**	**N/A**	$\mathbf{3.34\times10^{-3}}$	**0.00**	**N/A**	$\mathbf{9.14\times10^{-2}}$	$\mathbf{8.10\times10^{-8}}$
Year of peak impact	8238	8238	N/A	8238	8238	N/A	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–29 and Q–30 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 7300 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

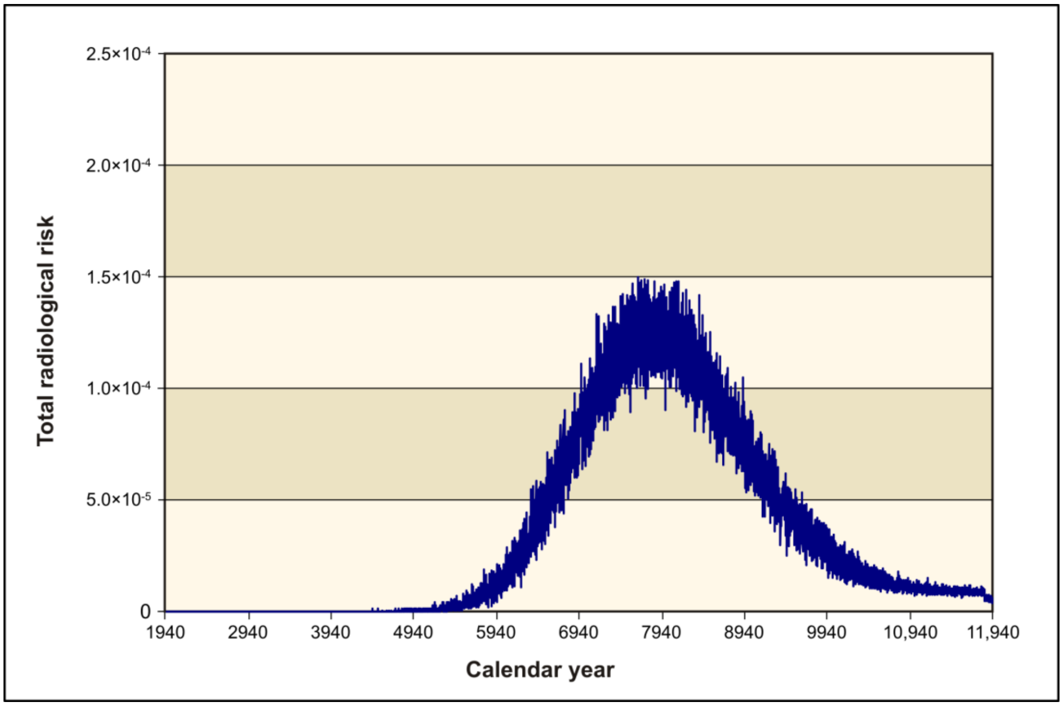


Figure Q–29. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

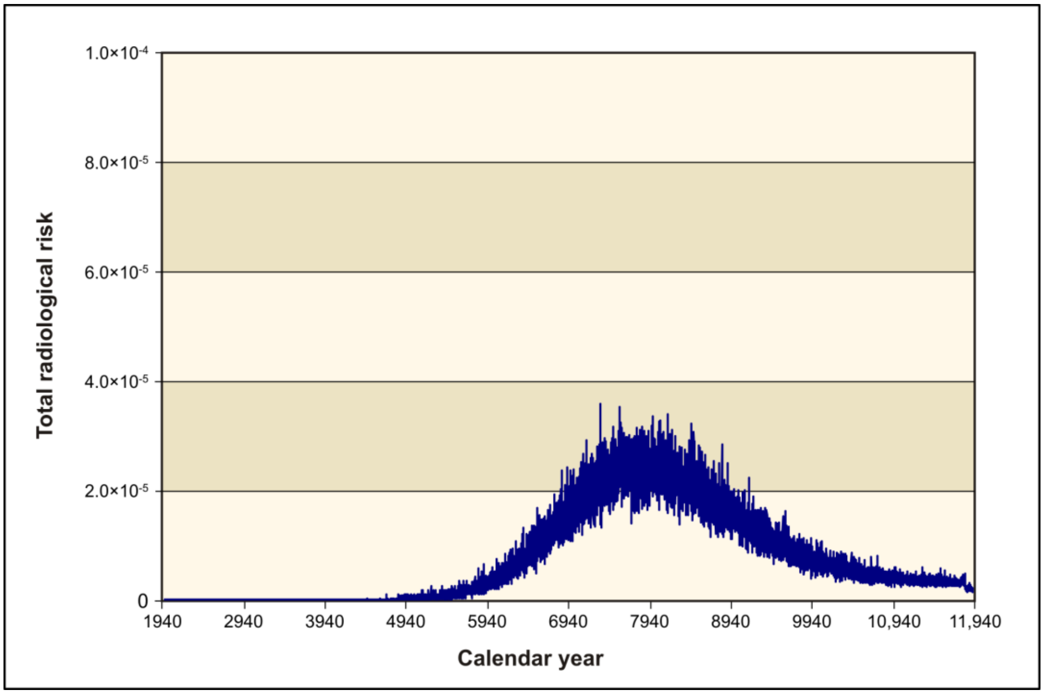


Figure Q–30. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.9 Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B

Disposal Group 2, Subgroup 2-B, addresses the waste resulting from Tank Closure Alternative 6B (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Preprocessing Facility (PPF) glass
- PPF melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6B, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–302 through Q–311, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, nitrate, and total uranium. For radionuclides, the dose standard would not be exceeded at any location. Under both the Base and Option Cases, the Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due to release of nitrate. In addition, under the Option Case, the Hazard Index guideline would be exceeded at the RPPDF barrier and the Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated for Subgroup 2-B, Base and Option Cases, as 1.65×10^{-1} person-rem per year for the year of maximum impact.

Table Q–302. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.29×10^{-6}	4.01	1.38×10^{-4}	2.29×10^{-6}	1.03×10^{1}	4.55×10^{-4}	2.29×10^{-6}	2.11×10^{1}	9.95×10^{-4}
Iodine-129	3.61×10^{-9}	1.03	1.17×10^{-5}	3.61×10^{-9}	1.28	1.67×10^{-5}	3.61×10^{-9}	1.66	2.52×10^{-5}
Total	**N/A**	**5.03**	$\mathbf{1.49\times10^{-4}}$	**N/A**	$\mathbf{1.16\times10^{1}}$	$\mathbf{4.72\times10^{-4}}$	**N/A**	$\mathbf{2.27\times10^{1}}$	$\mathbf{1.02\times10^{-3}}$
Year of peak impact	8117	8117	8117	8117	8117	7843	8117	8117	7843

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	2.47×10^{-6}	3.52×10^{-7}	0.00	2.47×10^{-6}	3.66×10^{-7}	0.00	2.47×10^{-6}	3.99×10^{-7}	0.00
Chromium	1.13×10^{-3}	1.08×10^{-2}	0.00	1.13×10^{-3}	1.12×10^{-2}	7.73×10^{-12}	1.13×10^{-3}	1.68×10^{-2}	3.55×10^{-7}
Fluoride	1.85×10^{-4}	8.79×10^{-5}	0.00	1.85×10^{-4}	2.47×10^{-4}	0.00	1.85×10^{-4}	5.18×10^{-4}	0.00
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	$\mathbf{1.82\times10^{-1}}$	**0.00**	**N/A**	**1.36**	$\mathbf{7.73\times10^{-12}}$	**N/A**	**3.02**	$\mathbf{3.55\times10^{-7}}$
Year of peak impact	7983	7983	N/A	7983	7983	8251	7983	7983	8251

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–303. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.55×10^{-7}	2.71×10^{-1}	9.34×10^{-6}	1.55×10^{-7}	7.00×10^{-1}	3.07×10^{-5}	1.55×10^{-7}	1.43	6.72×10^{-5}
Iodine-129	1.92×10^{-10}	5.48×10^{-2}	6.23×10^{-7}	1.92×10^{-10}	6.84×10^{-2}	9.63×10^{-7}	1.92×10^{-10}	8.84×10^{-2}	1.46×10^{-6}
Total	**N/A**	**3.26×10^{-1}**	**9.96×10^{-6}**	**N/A**	**7.68×10^{-1}**	**3.17×10^{-5}**	**N/A**	**1.52**	**6.86×10^{-5}**
Year of peak impact	3769	3769	3769	3769	3769	3769	3769	3769	3769
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.04×10^{-6}	4.93×10^{-6}	0.00	9.29×10^{-7}	5.53×10^{-6}	0.00	7.28×10^{-7}	7.83×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.00×10^{-3}	2.97×10^{-2}	1.43×10^{-11}	2.65×10^{-3}	3.94×10^{-2}	6.58×10^{-7}
Nitrate	1.67×10^{-1}	2.98×10^{-3}	0.00	2.52×10^{-1}	3.54×10^{-2}	0.00	2.77×10^{-1}	8.66×10^{-2}	0.00
Total	**N/A**	**3.78×10^{-2}**	**0.00**	**N/A**	**6.51×10^{-2}**	**1.43×10^{-11}**	**N/A**	**1.26×10^{-1}**	**6.58×10^{-7}**
Year of peak impact	3710	3710	N/A	3724	3724	3710	3789	3789	3710

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–304. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.57×10^{-7}	9.75×10^{-1}	3.35×10^{-5}	5.57×10^{-7}	2.51	1.10×10^{-4}	5.57×10^{-7}	5.13	2.41×10^{-4}
Iodine-129	6.65×10^{-10}	1.89×10^{-1}	2.15×10^{-6}	6.65×10^{-10}	2.37×10^{-1}	3.33×10^{-6}	6.65×10^{-10}	3.06×10^{-1}	5.04×10^{-6}
Total	**N/A**	**1.16**	**3.57×10^{-5}**	**N/A**	**2.75**	**1.14×10^{-4}**	**N/A**	**5.44**	**2.46×10^{-4}**
Year of peak impact	7328	7328	7328	7328	7328	7328	7328	7328	7328

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.87×10^{-4}	4.64×10^{-3}	0.00	4.87×10^{-4}	4.81×10^{-3}	1.34×10^{-11}	4.87×10^{-4}	7.24×10^{-3}	6.13×10^{-7}
Fluoride	3.66×10^{-5}	1.74×10^{-5}	0.00	3.66×10^{-5}	4.89×10^{-5}	0.00	3.66×10^{-5}	1.03×10^{-4}	0.00
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.05×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.34×10^{-11}**	**N/A**	**9.87×10^{-1}**	**6.13×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3977	7860	7860	3977

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–305. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.77×10^{-7}	6.59×10^{-1}	2.27×10^{-5}	3.77×10^{-7}	1.70	7.46×10^{-5}	3.77×10^{-7}	3.47	1.63×10^{-4}
Iodine-129	3.75×10^{-10}	1.07×10^{-1}	1.22×10^{-6}	3.75×10^{-10}	1.34×10^{-1}	1.88×10^{-6}	3.75×10^{-10}	1.73×10^{-1}	2.84×10^{-6}
Total	**N/A**	**7.66×10^{-1}**	**2.39×10^{-5}**	**N/A**	**1.83**	**7.65×10^{-5}**	**N/A**	**3.64**	**1.66×10^{-4}**
Year of peak impact	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.33×10^{-8}	6.35×10^{-8}	0.00	1.33×10^{-8}	7.93×10^{-8}	0.00	1.33×10^{-8}	1.43×10^{-7}	0.00
Chromium	1.34×10^{-4}	1.28×10^{-3}	0.00	1.34×10^{-4}	1.32×10^{-3}	8.03×10^{-12}	1.34×10^{-4}	1.99×10^{-3}	3.68×10^{-7}
Fluoride	1.71×10^{-5}	8.13×10^{-6}	0.00	1.71×10^{-5}	2.28×10^{-5}	0.00	1.71×10^{-5}	4.79×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**8.03×10^{-12}**	**N/A**	**6.72×10^{-1}**	**3.68×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4632	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–306. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	6.52×10^{-12}	2.94×10^{-5}	1.29×10^{-9}	6.29×10^{-12}	6.55×10^{-5}	3.20×10^{-9}	3.77×10^{-7}	1.13×10^{-2}	6.07×10^{-7}
Iodine-129	9.64×10^{-15}	3.44×10^{-6}	4.85×10^{-11}	1.06×10^{-14}	5.75×10^{-5}	1.32×10^{-9}	3.75×10^{-10}	1.55×10^{-3}	3.79×10^{-8}
Total	**N/A**	$\mathbf{3.29\times10^{-5}}$	$\mathbf{1.34\times10^{-9}}$	**N/A**	$\mathbf{1.23\times10^{-4}}$	$\mathbf{4.52\times10^{-9}}$	**N/A**	$\mathbf{1.29\times10^{-2}}$	$\mathbf{6.45\times10^{-7}}$
Year of peak impact	7990	7990	7990	7964	7964	7960	7754	7754	7754
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	1.33×10^{-8}	8.00×10^{-8}	0.00
Chromium	0.00	0.00	1.64×10^{-16}	0.00	0.00	7.52×10^{-12}	1.34×10^{-4}	5.90×10^{-4}	3.68×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	1.71×10^{-5}	2.49×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	$\mathbf{5.38\times10^{-6}}$	$\mathbf{1.64\times10^{-16}}$	**N/A**	$\mathbf{3.35\times10^{-3}}$	$\mathbf{7.52\times10^{-12}}$	**N/A**	$\mathbf{1.01\times10^{-1}}$	$\mathbf{3.68\times10^{-7}}$
Year of peak impact	8188	8188	4046	8188	8188	4046	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–307. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	2.28×10^{-6}	3.99	1.37×10^{-4}	2.28×10^{-6}	1.03×10^{1}	4.52×10^{-4}	2.28×10^{-6}	2.10×10^{1}	9.88×10^{-4}
Iodine-129	3.78×10^{-9}	1.08	1.22×10^{-5}	3.78×10^{-9}	1.34	1.89×10^{-5}	3.78×10^{-9}	1.74	2.86×10^{-5}
Total	**N/A**	**5.07**	$\mathbf{1.50\times10^{-4}}$	**N/A**	$\mathbf{1.16\times10^{1}}$	$\mathbf{4.71\times10^{-4}}$	**N/A**	$\mathbf{2.28\times10^{1}}$	$\mathbf{1.02\times10^{-3}}$
Year of peak impact	7644	7644	7644	7644	7644	7644	7644	7644	7644
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.25×10^{-6}	3.21×10^{-7}	0.00	2.25×10^{-6}	3.34×10^{-7}	0.00	2.25×10^{-6}	3.63×10^{-7}	0.00
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.83×10^{-12}	1.75×10^{-3}	2.61×10^{-2}	4.05×10^{-7}
Fluoride	1.85×10^{-4}	8.79×10^{-5}	0.00	1.85×10^{-4}	2.47×10^{-4}	0.00	1.85×10^{-4}	5.18×10^{-4}	0.00
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	$\mathbf{2.78\times10^{-1}}$	**0.00**	**N/A**	**2.07**	$\mathbf{8.83\times10^{-12}}$	**N/A**	**4.60**	$\mathbf{4.05\times10^{-7}}$
Year of peak impact	7954	7954	N/A	7954	7954	8501	7954	7954	8501

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–308. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.20×10^{-7}	3.85×10^{-1}	1.32×10^{-5}	2.20×10^{-7}	9.92×10^{-1}	4.35×10^{-5}	2.20×10^{-7}	2.03	9.52×10^{-5}
Iodine-129	2.99×10^{-10}	8.53×10^{-2}	9.70×10^{-7}	2.99×10^{-10}	1.07×10^{-1}	1.50×10^{-6}	2.99×10^{-10}	1.38×10^{-1}	2.27×10^{-6}
Total	**N/A**	**4.70×10^{-1}**	**1.42×10^{-5}**	**N/A**	**1.10**	**4.50×10^{-5}**	**N/A**	**2.16**	**9.75×10^{-5}**
Year of peak impact	3812	3812	3812	3812	3812	3812	3812	3812	3812
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.24×10^{-7}	3.92×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.29×10^{-2}	3.13×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.33×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	6.11×10^{-6}
Nitrate	7.17	1.28×10^{-1}	0.00	9.86	1.38	0.00	9.86	3.09	0.00
Total	**N/A**	**4.41×10^{-1}**	**0.00**	**N/A**	**1.61**	**1.33×10^{-10}**	**N/A**	**3.43**	**6.11×10^{-6}**
Year of peak impact	3680	3680	N/A	3733	3733	3807	3733	3733	3807

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–309. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.57×10^{-7}	9.75×10^{-1}	3.35×10^{-5}	5.57×10^{-7}	2.51	1.10×10^{-4}	5.57×10^{-7}	5.13	2.41×10^{-4}
Iodine-129	6.75×10^{-10}	1.92×10^{-1}	2.19×10^{-6}	6.75×10^{-10}	2.40×10^{-1}	3.38×10^{-6}	6.75×10^{-10}	3.11×10^{-1}	5.12×10^{-6}
Total	**N/A**	**1.17**	**3.57×10^{-5}**	**N/A**	**2.75**	**1.14×10^{-4}**	**N/A**	**5.44**	**2.46×10^{-4}**
Year of peak impact	7328	7328	7328	7328	7328	7328	7328	7328	7328
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.39×10^{-7}	2.57×10^{-6}	0.00	6.91×10^{-7}	4.11×10^{-6}	0.00	6.91×10^{-7}	7.44×10^{-6}	0.00
Chromium	2.84×10^{-2}	2.70×10^{-1}	0.00	2.08×10^{-2}	2.06×10^{-1}	1.12×10^{-10}	2.08×10^{-2}	3.09×10^{-1}	5.15×10^{-6}
Nitrate	4.79	8.56×10^{-2}	0.00	7.22	1.01	0.00	7.22	2.26	0.00
Total	**N/A**	**3.56×10^{-1}**	**0.00**	**N/A**	**1.22**	**1.12×10^{-10}**	**N/A**	**2.57**	**5.15×10^{-6}**
Year of peak impact	3688	3688	N/A	3858	3858	3901	3858	3858	3901

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–310. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.79×10^{-7}	6.63×10^{-1}	2.28×10^{-5}	3.79×10^{-7}	1.71	7.50×10^{-5}	3.79×10^{-7}	3.49	1.64×10^{-4}
Iodine-129	3.77×10^{-10}	1.07×10^{-1}	1.22×10^{-6}	3.77×10^{-10}	1.34×10^{-1}	1.89×10^{-6}	3.77×10^{-10}	1.73×10^{-1}	2.86×10^{-6}
Total	**N/A**	**7.70×10^{-1}**	**2.40×10^{-5}**	**N/A**	**1.84**	**7.69×10^{-5}**	**N/A**	**3.66**	**1.67×10^{-4}**
Year of peak impact	7754	7754	7754	7754	7754	7754	7754	7754	7754
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.60×10^{-7}	2.67×10^{-6}	0.00	4.93×10^{-7}	2.93×10^{-6}	0.00	4.93×10^{-7}	5.31×10^{-6}	0.00
Chromium	1.84×10^{-2}	1.75×10^{-1}	0.00	1.47×10^{-2}	1.45×10^{-1}	7.49×10^{-11}	1.47×10^{-2}	2.19×10^{-1}	3.43×10^{-6}
Nitrate	3.30	5.89×10^{-2}	0.00	4.15	5.83×10^{-1}	0.00	4.15	1.30	0.00
Total	**N/A**	**2.34×10^{-1}**	**0.00**	**N/A**	**7.28×10^{-1}**	**7.49×10^{-11}**	**N/A**	**1.52**	**3.43×10^{-6}**
Year of peak impact	4560	4560	N/A	4465	4465	4558	4465	4465	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–311. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.59×10^{-12}	2.97×10^{-5}	1.30×10^{-9}	6.09×10^{-12}	6.33×10^{-5}	3.25×10^{-9}	3.79×10^{-7}	1.14×10^{-2}	6.10×10^{-7}
Iodine-129	9.79×10^{-15}	3.50×10^{-6}	4.93×10^{-11}	1.11×10^{-14}	6.04×10^{-5}	1.28×10^{-9}	3.77×10^{-10}	1.55×10^{-3}	3.80×10^{-8}
Total	**N/A**	**3.32×10^{-5}**	**1.35×10^{-9}**	**N/A**	**1.24×10^{-4}**	**4.54×10^{-9}**	**N/A**	**1.30×10^{-2}**	**6.48×10^{-7}**
Year of peak impact	7990	7990	7990	7896	7896	7990	7754	7754	7754
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.00×10^{-7}	2.40×10^{-6}	0.00
Chromium	3.67×10^{-7}	3.62×10^{-6}	1.54×10^{-15}	3.67×10^{-7}	5.94×10^{-6}	7.06×10^{-11}	1.20×10^{-2}	5.30×10^{-2}	3.43×10^{-6}
Nitrate	1.10×10^{-4}	1.67×10^{-5}	0.00	1.10×10^{-4}	1.04×10^{-2}	0.00	3.96	2.29×10^{-1}	0.00
Total	**N/A**	**2.03×10^{-5}**	**1.54×10^{-15}**	**N/A**	**1.04×10^{-2}**	**7.06×10^{-11}**	**N/A**	**2.82×10^{-1}**	**3.43×10^{-6}**
Year of peak impact	4079	4079	4055	4079	4079	4055	4055	4055	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–31 through Q–34 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user over time. Under both the Base and Option Cases, the peak radiological risk occurs around CY 7300 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

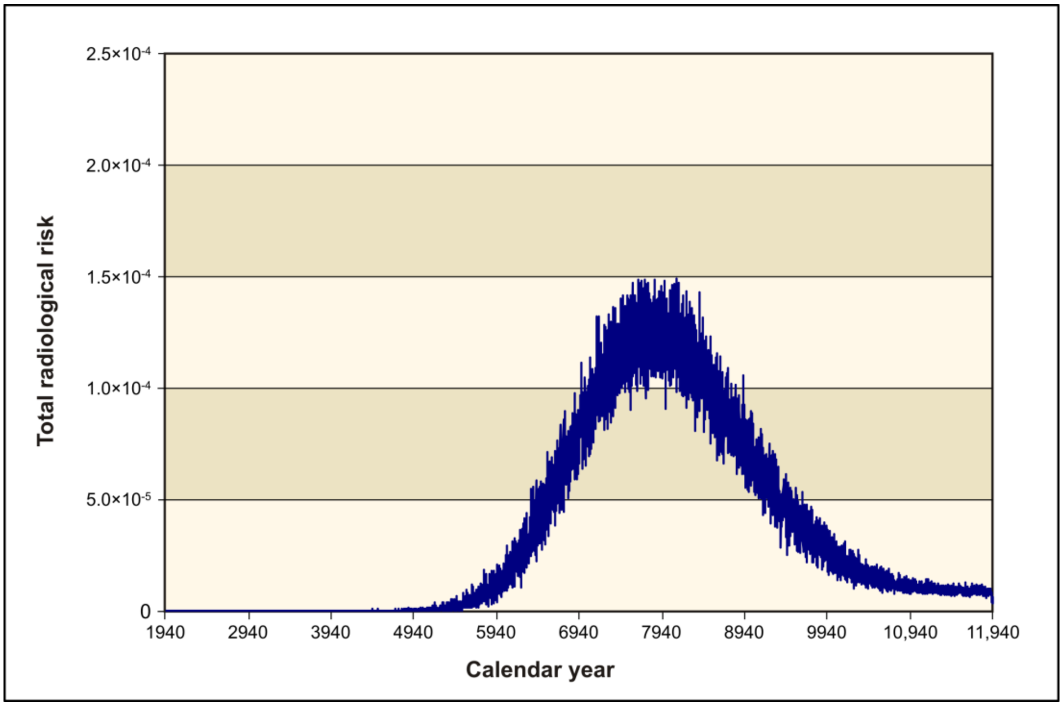


Figure Q–31. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

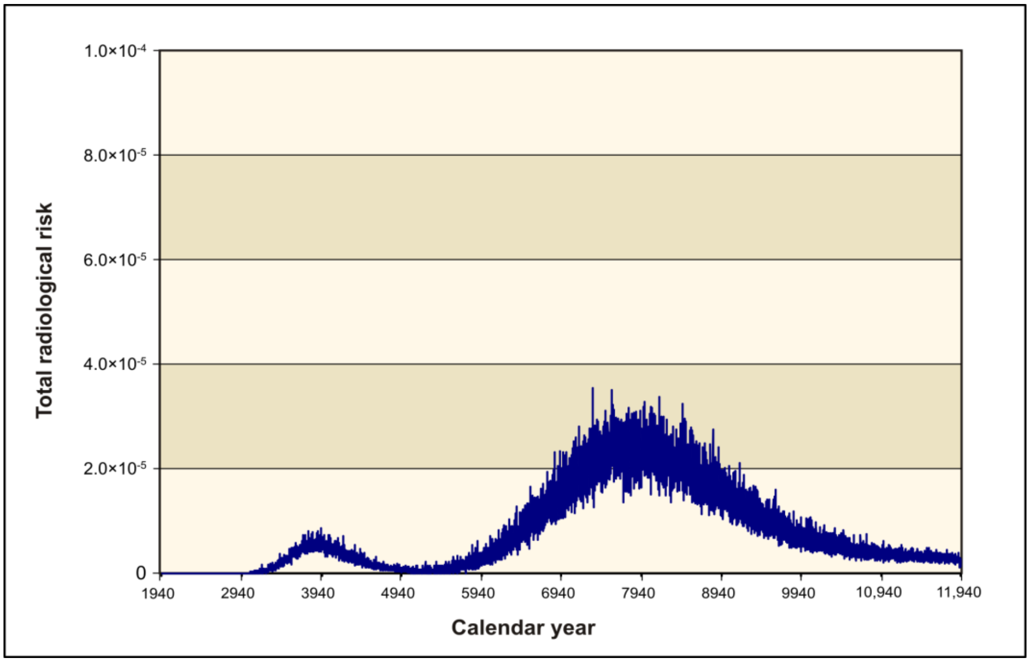


Figure Q–32. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

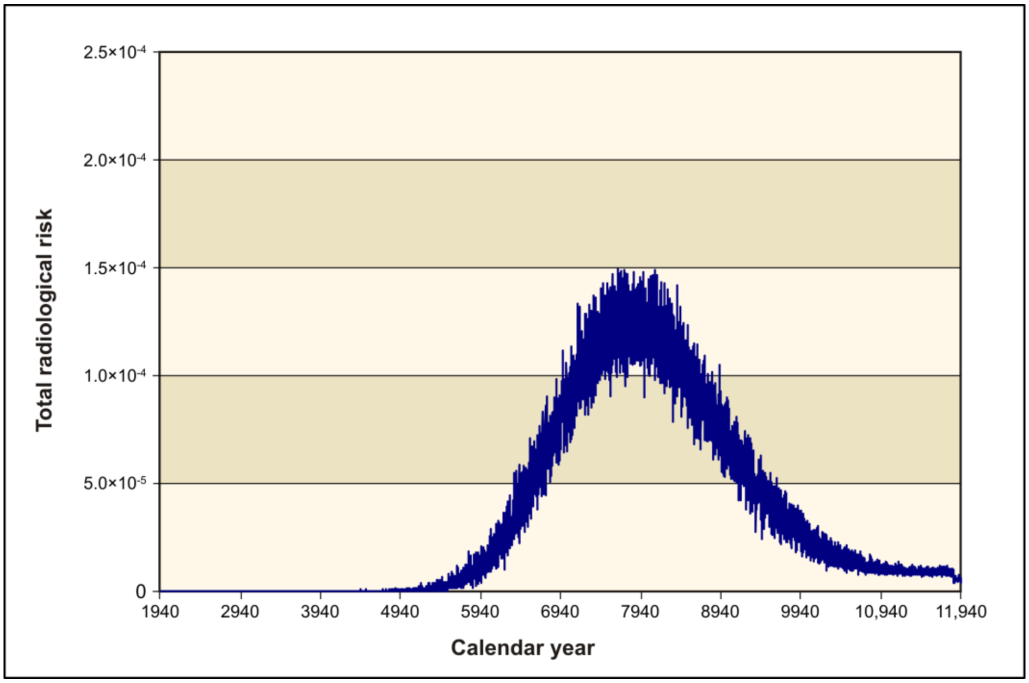


Figure Q–33. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

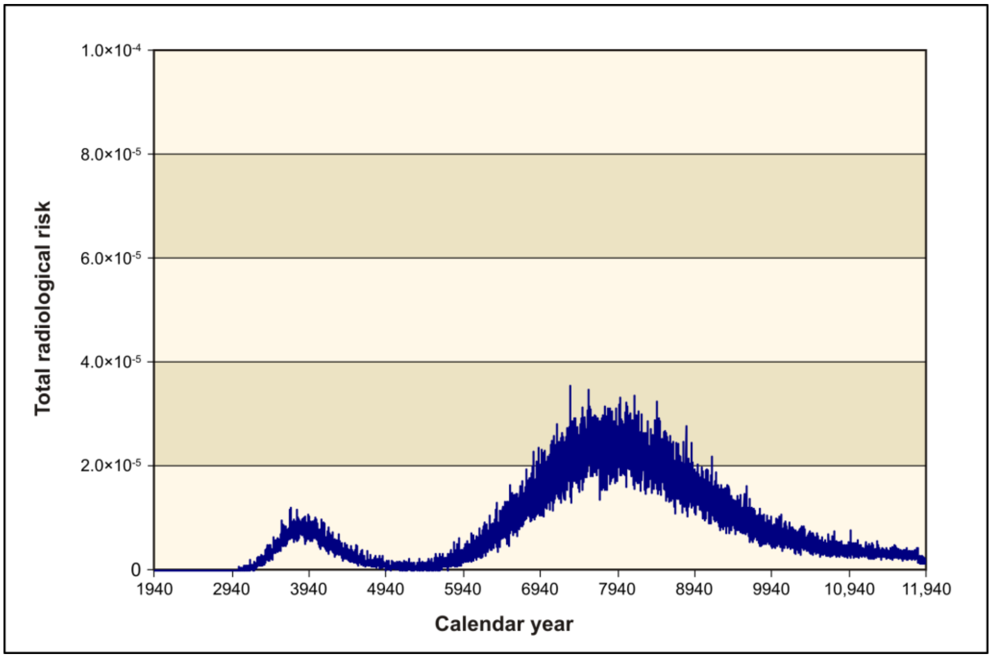


Figure Q–34. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.10 Waste Management Alternative 2, Disposal Group 3

Disposal Group 3 addresses the waste resulting from Tank Closure Alternative 6A (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- PPF glass
- PPF melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6A, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–312 through Q–321, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location under both the Base and Option Cases. Under the Base Case, the Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Under the Option Case, the Hazard Index guideline would be exceeded for the resident farmer and American Indian resident farmer at the IDF-East barrier, the RPPDF barrier, and the Core Zone Boundary and for the American Indian resident farmer, at the Columbia River nearshore. Population dose is estimated for Disposal Group 3, Base Case, as 1.71×10^{-1} person-rem per year for the year of maximum impact and for Disposal Group 3, Option Case, as 1.73×10^{-1} person-rem per year for the year of maximum impact.

Table Q–312. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	2.44×10^{-6}	4.27	1.47×10^{-4}	2.44×10^{-6}	1.10×10^{1}	4.83×10^{-4}	2.44×10^{-6}	2.25×10^{1}	1.06×10^{-3}
Iodine-129	3.23×10^{-9}	9.21×10^{-1}	1.05×10^{-5}	3.23×10^{-9}	1.15	1.62×10^{-5}	3.23×10^{-9}	1.49	2.45×10^{-5}
Total	**N/A**	**5.19**	**1.57×10^{-4}**	**N/A**	**1.21×10^{1}**	**4.99×10^{-4}**	**N/A**	**2.39×10^{1}**	**1.08×10^{-3}**
Year of peak impact	7678	7678	7678	7678	7678	7678	7678	7678	7678
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.46×10^{-6}	3.51×10^{-7}	0.00	2.46×10^{-6}	3.65×10^{-7}	0.00	2.46×10^{-6}	3.98×10^{-7}	0.00
Chromium	1.14×10^{-3}	1.08×10^{-2}	0.00	1.14×10^{-3}	1.12×10^{-2}	7.64×10^{-12}	1.14×10^{-3}	1.69×10^{-2}	3.50×10^{-7}
Fluoride	2.09×10^{-4}	9.94×10^{-5}	0.00	2.09×10^{-4}	2.79×10^{-4}	0.00	2.09×10^{-4}	5.86×10^{-4}	0.00
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	**1.82×10^{-1}**	**0.00**	**N/A**	**1.36**	**7.64×10^{-12}**	**N/A**	**3.02**	**3.50×10^{-7}**
Year of peak impact	7983	7983	N/A	7983	7983	8326	7983	7983	8326

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–313. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.47×10^{-7}	2.58×10^{-1}	8.87×10^{-6}	1.47×10^{-7}	6.65×10^{-1}	2.92×10^{-5}	1.47×10^{-7}	1.36	6.38×10^{-5}
Iodine-129	1.97×10^{-10}	5.62×10^{-2}	6.39×10^{-7}	1.97×10^{-10}	7.02×10^{-2}	9.87×10^{-7}	1.97×10^{-10}	9.07×10^{-2}	1.49×10^{-6}
Total	**N/A**	**3.14×10^{-1}**	**9.51×10^{-6}**	**N/A**	**7.35×10^{-1}**	**3.02×10^{-5}**	**N/A**	**1.45**	**6.53×10^{-5}**
Year of peak impact	4013	4013	4013	4013	4013	4013	4013	4013	4013
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.66×10^{-7}	4.12×10^{-6}	0.00	8.66×10^{-7}	5.15×10^{-6}	0.00	8.66×10^{-7}	9.32×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.65×10^{-3}	3.61×10^{-2}	1.48×10^{-11}	3.65×10^{-3}	5.43×10^{-2}	6.79×10^{-7}
Nitrate	2.44×10^{-1}	4.36×10^{-3}	0.00	2.44×10^{-1}	3.43×10^{-2}	0.00	2.44×10^{-1}	7.64×10^{-2}	0.00
Total	**N/A**	**3.92×10^{-2}**	**0.00**	**N/A**	**7.03×10^{-2}**	**1.48×10^{-11}**	**N/A**	**1.31×10^{-1}**	**6.79×10^{-7}**
Year of peak impact	3929	3929	N/A	3929	3929	3869	3929	3929	3869

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–314. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.77×10^{-7}	1.01	3.48×10^{-5}	5.77×10^{-7}	2.60	1.14×10^{-4}	5.77×10^{-7}	5.32	2.50×10^{-4}
Iodine-129	6.86×10^{-10}	1.96×10^{-1}	2.22×10^{-6}	6.86×10^{-10}	2.44×10^{-1}	3.44×10^{-6}	6.86×10^{-10}	3.16×10^{-1}	5.20×10^{-6}
Total	**N/A**	**1.21**	**3.70×10^{-5}**	**N/A**	**2.85**	**1.18×10^{-4}**	**N/A**	**5.63**	**2.55×10^{-4}**
Year of peak impact	7891	7891	7891	7891	7891	7891	7891	7891	7891
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.86×10^{-4}	4.63×10^{-3}	0.00	4.86×10^{-4}	4.80×10^{-3}	1.29×10^{-11}	4.86×10^{-4}	7.22×10^{-3}	5.90×10^{-7}
Fluoride	5.11×10^{-5}	2.43×10^{-5}	0.00	5.11×10^{-5}	6.84×10^{-5}	0.00	5.11×10^{-5}	1.43×10^{-4}	0.00
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.05×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.29×10^{-11}**	**N/A**	**9.87×10^{-1}**	**5.90×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3701	7860	7860	3701

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–315. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.70×10^{-7}	6.47×10^{-1}	2.22×10^{-5}	3.70×10^{-7}	1.67	7.32×10^{-5}	3.70×10^{-7}	3.40	1.60×10^{-4}
Iodine-129	3.70×10^{-10}	1.05×10^{-1}	1.20×10^{-6}	3.70×10^{-10}	1.32×10^{-1}	1.85×10^{-6}	3.70×10^{-10}	1.70×10^{-1}	2.80×10^{-6}
Total	**N/A**	**7.52×10^{-1}**	**2.34×10^{-5}**	**N/A**	**1.80**	**7.50×10^{-5}**	**N/A**	**3.57**	**1.63×10^{-4}**
Year of peak impact	8233	8233	8233	8233	8233	8233	8233	8233	8233

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.67×10^{-8}	1.27×10^{-7}	0.00	2.67×10^{-8}	1.59×10^{-7}	0.00	2.67×10^{-8}	2.87×10^{-7}	0.00
Chromium	1.43×10^{-4}	1.36×10^{-3}	0.00	1.43×10^{-4}	1.41×10^{-3}	7.45×10^{-12}	1.43×10^{-4}	2.12×10^{-3}	3.42×10^{-7}
Fluoride	1.46×10^{-5}	6.95×10^{-6}	0.00	1.46×10^{-5}	1.95×10^{-5}	0.00	1.46×10^{-5}	4.10×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.96×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**7.45×10^{-12}**	**N/A**	**6.73×10^{-1}**	**3.42×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4608	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–316. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.81×10^{-12}	3.07×10^{-5}	1.35×10^{-9}	6.69×10^{-12}	6.96×10^{-5}	3.30×10^{-9}	3.70×10^{-7}	1.11×10^{-2}	5.95×10^{-7}
Iodine-129	9.88×10^{-15}	3.53×10^{-6}	4.97×10^{-11}	1.07×10^{-14}	5.86×10^{-5}	1.41×10^{-9}	3.70×10^{-10}	1.54×10^{-3}	3.78×10^{-8}
Total	**N/A**	**3.42×10^{-5}**	**1.40×10^{-9}**	**N/A**	**1.28×10^{-4}**	**4.71×10^{-9}**	**N/A**	**1.27×10^{-2}**	**6.33×10^{-7}**
Year of peak impact	8027	8027	8027	8234	8234	8234	8233	8233	8233
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	2.67×10^{-8}	1.60×10^{-7}	0.00
Chromium	0.00	0.00	1.64×10^{-16}	0.00	0.00	7.54×10^{-12}	1.43×10^{-4}	6.29×10^{-4}	3.41×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	1.46×10^{-5}	2.13×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.64×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.54×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.41×10^{-7}**
Year of peak impact	8188	8188	4184	8188	8188	4184	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–317. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.35×10^{-6}	4.11	1.46×10^{-4}	2.42×10^{-6}	1.09×10^{1}	4.80×10^{-4}	2.42×10^{-6}	2.23×10^{1}	1.05×10^{-3}
Iodine-129	3.90×10^{-9}	1.11	1.04×10^{-5}	3.22×10^{-9}	1.15	1.61×10^{-5}	3.22×10^{-9}	1.48	2.44×10^{-5}
Total	**N/A**	**5.22**	**1.56×10^{-4}**	**N/A**	**1.21×10^{1}**	**4.96×10^{-4}**	**N/A**	**2.38×10^{1}**	**1.07×10^{-3}**
Year of peak impact	7832	7832	7678	7678	7678	7678	7678	7678	7678

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	2.13×10^{-6}	3.05×10^{-7}	0.00	2.13×10^{-6}	3.17×10^{-7}	0.00	2.13×10^{-6}	3.45×10^{-7}	0.00
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.82×10^{-12}	1.75×10^{-3}	2.60×10^{-2}	4.05×10^{-7}
Fluoride	1.35×10^{-4}	6.43×10^{-5}	0.00	1.35×10^{-4}	1.81×10^{-4}	0.00	1.35×10^{-4}	3.79×10^{-4}	0.00
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.82×10^{-12}**	**N/A**	**4.60**	**4.05×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8501	7954	7954	8501

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–318. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.35×10^{-7}	4.12×10^{-1}	1.42×10^{-5}	2.35×10^{-7}	1.06	4.66×10^{-5}	2.35×10^{-7}	2.17	1.02×10^{-4}
Iodine-129	2.21×10^{-10}	6.30×10^{-2}	7.16×10^{-7}	2.21×10^{-10}	7.86×10^{-2}	1.11×10^{-6}	2.21×10^{-10}	1.02×10^{-1}	1.67×10^{-6}
Total	**N/A**	**4.75×10^{-1}**	**1.49×10^{-5}**	**N/A**	**1.14**	**4.77×10^{-5}**	**N/A**	**2.27**	**1.04×10^{-4}**
Year of peak impact	4018	4018	4018	4018	4018	4018	4018	4018	4018

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	7.61×10^{-7}	3.62×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.13×10^{-2}	2.98×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.27×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	5.82×10^{-6}
Nitrate	7.92	1.41×10^{-1}	0.00	9.27	1.30	0.00	9.27	2.90	0.00
Total	**N/A**	**4.39×10^{-1}**	**0.00**	**N/A**	**1.53**	**1.27×10^{-10}**	**N/A**	**3.24**	**5.82×10^{-6}**
Year of peak impact	3916	3916	N/A	3930	3930	3873	3930	3930	3873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–319. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.77×10^{-7}	1.01	3.47×10^{-5}	5.77×10^{-7}	2.60	1.14×10^{-4}	5.77×10^{-7}	5.31	2.50×10^{-4}
Iodine-129	5.72×10^{-10}	1.63×10^{-1}	1.85×10^{-6}	5.72×10^{-10}	2.04×10^{-1}	2.86×10^{-6}	5.72×10^{-10}	2.63×10^{-1}	4.33×10^{-6}
Total	**N/A**	**1.17**	**3.66×10^{-5}**	**N/A**	**2.81**	**1.17×10^{-4}**	**N/A**	**5.58**	**2.54×10^{-4}**
Year of peak impact	7723	7723	7723	7723	7723	7723	7723	7723	7723
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.57×10^{-7}	3.13×10^{-6}	0.00	4.84×10^{-7}	2.88×10^{-6}	0.00	4.84×10^{-7}	5.21×10^{-6}	0.00
Chromium	2.84×10^{-2}	2.71×10^{-1}	0.00	2.32×10^{-2}	2.29×10^{-1}	1.12×10^{-10}	2.32×10^{-2}	3.44×10^{-1}	5.12×10^{-6}
Nitrate	5.83	1.04×10^{-1}	0.00	7.82	1.10	0.00	7.82	2.45	0.00
Total	**N/A**	**3.75×10^{-1}**	**0.00**	**N/A**	**1.33**	**1.12×10^{-10}**	**N/A**	**2.79**	**5.12×10^{-6}**
Year of peak impact	3865	3865	N/A	3782	3782	3865	3782	3782	3865

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–320. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.73×10^{-7}	6.52×10^{-1}	2.24×10^{-5}	3.73×10^{-7}	1.68	7.38×10^{-5}	3.73×10^{-7}	3.43	1.61×10^{-4}
Iodine-129	3.98×10^{-10}	1.14×10^{-1}	1.29×10^{-6}	3.98×10^{-10}	1.42×10^{-1}	2.00×10^{-6}	3.98×10^{-10}	1.83×10^{-1}	3.02×10^{-6}
Total	**N/A**	**7.65×10^{-1}**	**2.37×10^{-5}**	**N/A**	**1.82**	**7.58×10^{-5}**	**N/A**	**3.61**	**1.64×10^{-4}**
Year of peak impact	8233	8233	8233	8233	8233	8233	8233	8233	8233
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.27×10^{-7}	2.98×10^{-6}	0.00	4.67×10^{-7}	2.78×10^{-6}	0.00	4.67×10^{-7}	5.02×10^{-6}	0.00
Chromium	2.08×10^{-2}	1.98×10^{-1}	0.00	1.10×10^{-2}	1.09×10^{-1}	8.15×10^{-11}	1.10×10^{-2}	1.64×10^{-1}	3.74×10^{-6}
Nitrate	3.40	6.06×10^{-2}	0.00	5.19	7.28×10^{-1}	0.00	5.19	1.62	0.00
Total	**N/A**	**2.58×10^{-1}**	**0.00**	**N/A**	**8.37×10^{-1}**	**8.15×10^{-11}**	**N/A**	**1.79**	**3.74×10^{-6}**
Year of peak impact	4487	4487	N/A	4701	4701	4487	4701	4701	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–321. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.88×10^{-12}	3.10×10^{-5}	1.36×10^{-9}	6.63×10^{-12}	6.90×10^{-5}	3.28×10^{-9}	3.73×10^{-7}	1.12×10^{-2}	6.00×10^{-7}
Iodine-129	9.81×10^{-15}	3.50×10^{-6}	4.93×10^{-11}	1.10×10^{-14}	5.97×10^{-5}	1.43×10^{-9}	3.98×10^{-10}	1.62×10^{-3}	3.98×10^{-8}
Total	**N/A**	**3.45×10^{-5}**	**1.41×10^{-9}**	**N/A**	**1.29×10^{-4}**	**4.71×10^{-9}**	**N/A**	**1.28×10^{-2}**	**6.39×10^{-7}**
Year of peak impact	8027	8027	8027	8234	8234	8234	8233	8233	8233
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.13×10^{-7}	2.48×10^{-6}	0.00
Chromium	3.63×10^{-7}	3.58×10^{-6}	1.52×10^{-15}	3.63×10^{-7}	5.87×10^{-6}	6.98×10^{-11}	1.07×10^{-2}	4.71×10^{-2}	3.74×10^{-6}
Nitrate	1.10×10^{-4}	1.66×10^{-5}	0.00	1.10×10^{-4}	1.03×10^{-2}	0.00	4.53	2.39×10^{-1}	0.00
Total	**N/A**	**2.02×10^{-5}**	**1.52×10^{-15}**	**N/A**	**1.03×10^{-2}**	**6.98×10^{-11}**	**N/A**	**2.86×10^{-1}**	**3.74×10^{-6}**
Year of peak impact	4182	4182	4241	4182	4182	4241	4270	4270	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–35 through Q–38 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user over time. Under the Base Case, the peak radiological risk occurs around CY 7900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. Under the Option Case, the peak radiological risk occurs around CY 7700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

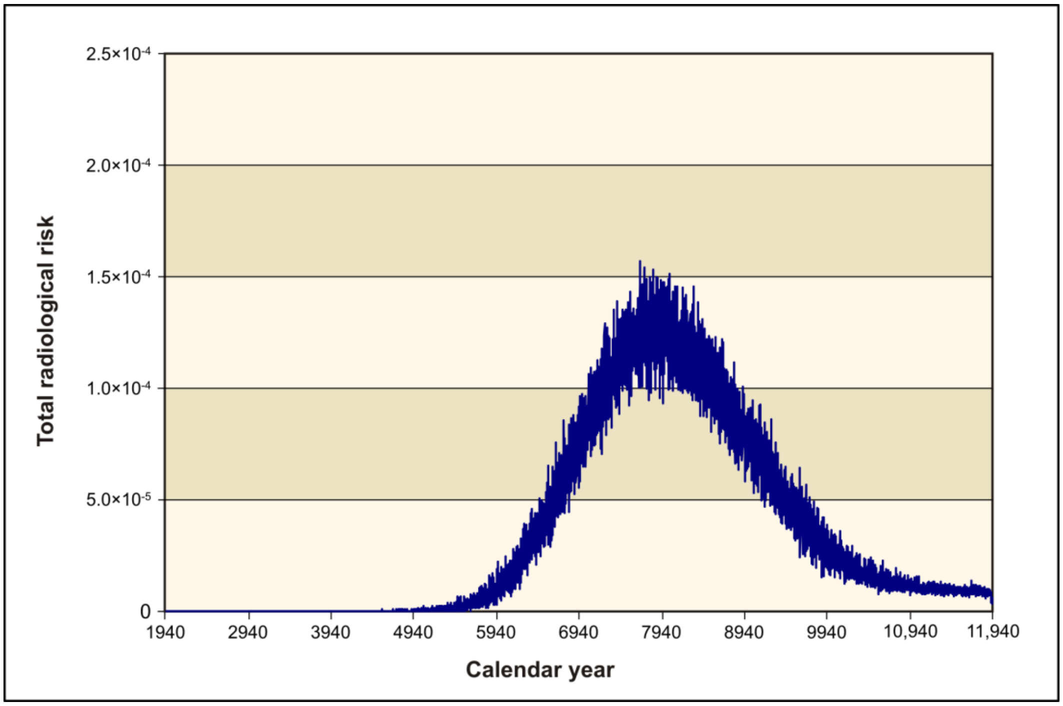


Figure Q–35. Waste Management Alternative 2, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

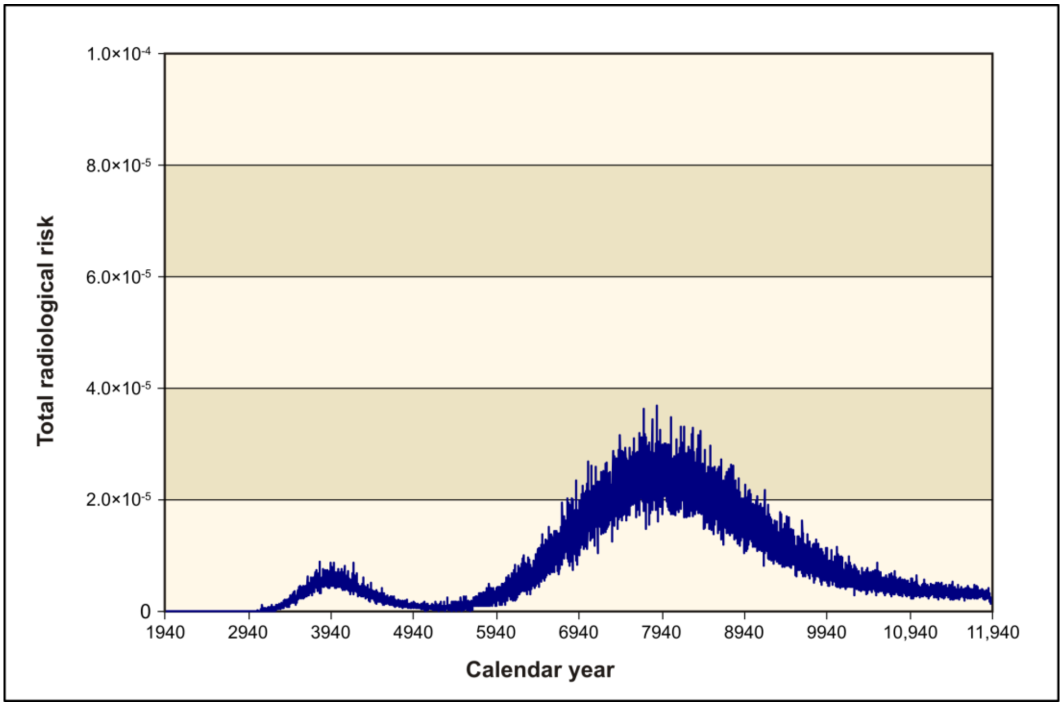


Figure Q–36. Waste Management Alternative 2, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

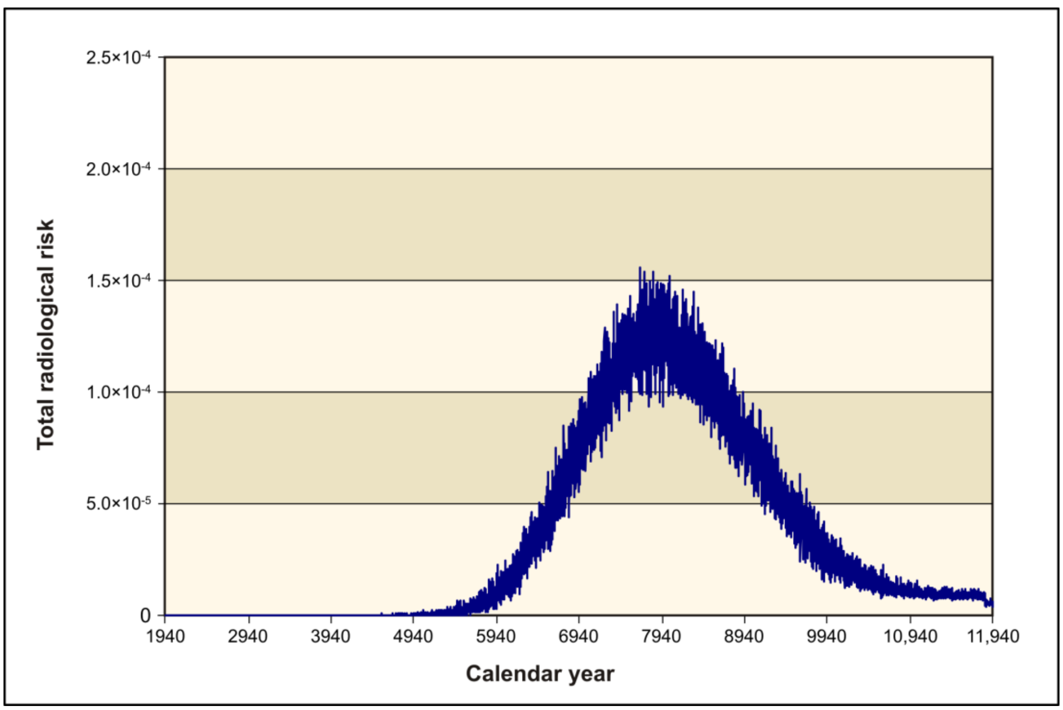


Figure Q–37. Waste Management Alternative 2, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

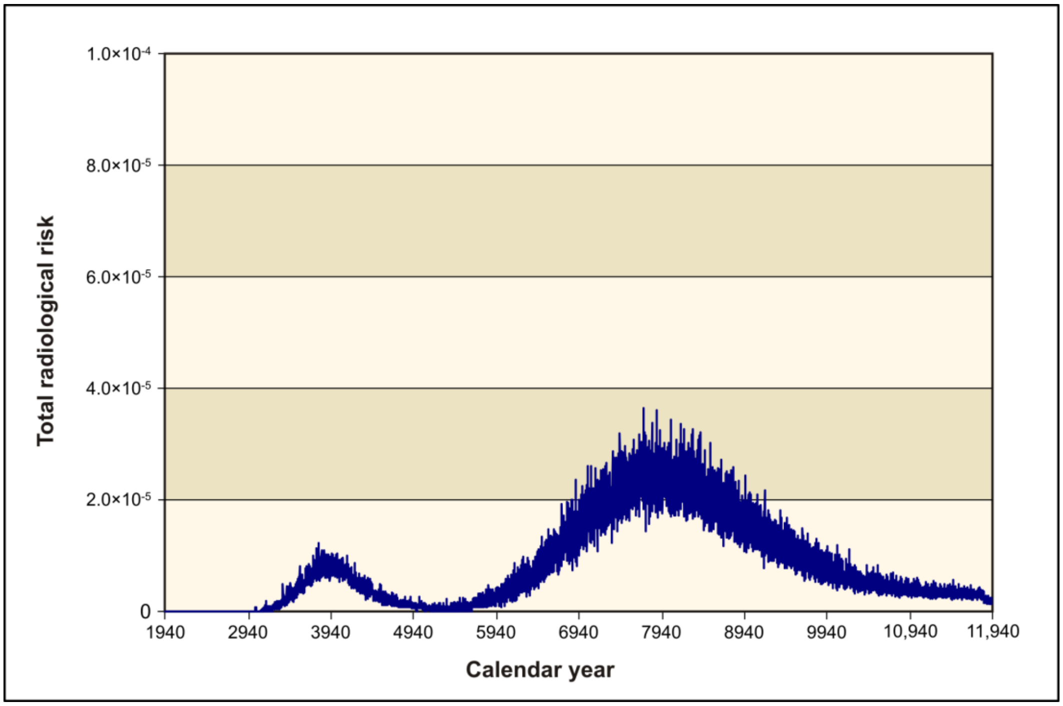


Figure Q–38. Waste Management Alternative 2, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

Under Waste Management Alternative 3, the waste from tank treatment operations would be disposed of in IDF-East, and waste from onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-West. Waste from tank farm cleanup operations would be disposed of in the RPPDF. As a result, the waste disposed of in these three facilities would become available for release to the environment. Because of the different waste types that result from the Tank Closure action alternatives, three disposal groups were considered to account for the different IDF-East sizes and operational time periods. In addition, within these three disposal groups, subgroups were identified to allow consideration of the different waste types resulting from the Tank Closure alternatives. Potential human health impacts of these subgroups under this alternative are discussed in the following sections.

Q.3.3.1.3.1 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A

Disposal Group 1, Subgroup 1-A, addresses the waste resulting from Tank Closure Alternative 2B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 2B.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–322 through Q–327, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129. The key chemical constituent contributors would be boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–322. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.90×10^{-7}	3.33×10^{-1}	1.24×10^{-5}	2.06×10^{-7}	9.27×10^{-1}	4.07×10^{-5}	2.06×10^{-7}	1.89	8.90×10^{-5}
Iodine-129	8.11×10^{-10}	2.31×10^{-1}	2.05×10^{-6}	6.34×10^{-10}	2.26×10^{-1}	3.18×10^{-6}	6.34×10^{-10}	2.92×10^{-1}	4.81×10^{-6}
Total	**N/A**	$\mathbf{5.64\times10^{-1}}$	$\mathbf{1.44\times10^{-5}}$	**N/A**	**1.15**	$\mathbf{4.39\times10^{-5}}$	**N/A**	**2.18**	$\mathbf{9.38\times10^{-5}}$
Year of peak impact	9827	9827	10129	10129	10129	10129	10129	10129	10129
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.32×10^{-3}	1.25×10^{-2}	0.00	1.32×10^{-3}	1.30×10^{-2}	8.22×10^{-12}	1.32×10^{-3}	1.96×10^{-2}	3.77×10^{-7}
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	$\mathbf{2.29\times10^{-1}}$	**0.00**	**N/A**	**1.71**	$\mathbf{8.22\times10^{-12}}$	**N/A**	**3.81**	$\mathbf{3.77\times10^{-7}}$
Year of peak impact	7962	7962	N/A	7962	7962	8438	7962	7962	8438

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–323. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the 200-West Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	$\mathbf{2.87\times10^{1}}$	$\mathbf{8.59\times10^{-4}}$	**N/A**	$\mathbf{6.66\times10^{1}}$	$\mathbf{2.72\times10^{-3}}$	**N/A**	$\mathbf{1.31\times10^{2}}$	$\mathbf{5.87\times10^{-3}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	$\mathbf{1.03\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.17\times10^{-2}}$	$\mathbf{4.13\times10^{-12}}$	**N/A**	$\mathbf{1.87\times10^{-2}}$	$\mathbf{1.89\times10^{-7}}$
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–324. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index**	**Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk**	**Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**	**American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index**	**American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–325. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.01×10^{-4}	3.82×10^{-3}	0.00	4.01×10^{-4}	3.96×10^{-3}	2.94×10^{-12}	4.01×10^{-4}	5.96×10^{-3}	1.35×10^{-7}
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.76×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–326. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	$\mathbf{1.07\times10^{-4}}$	**N/A**	**8.28**	$\mathbf{3.41\times10^{-4}}$	**N/A**	$\mathbf{1.63\times10^{1}}$	$\mathbf{7.39\times10^{-4}}$
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.45×10^{-4}	1.38×10^{-3}	0.00	1.45×10^{-4}	1.43×10^{-3}	1.87×10^{-12}	1.45×10^{-4}	2.15×10^{-3}	8.57×10^{-8}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.03	3.63×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	$\mathbf{3.77\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{2.87\times10^{-1}}$	$\mathbf{1.87\times10^{-12}}$	**N/A**	$\mathbf{6.39\times10^{-1}}$	$\mathbf{8.57\times10^{-8}}$
Year of peak impact	7927	7927	N/A	7927	7927	4481	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–327. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Hunter-Gatherer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Hunter-Gatherer: Dose at Year of Peak Dose (millirem per year)	American Indian Hunter-Gatherer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	$\mathbf{6.83\times10^{-5}}$	$\mathbf{2.79\times10^{-9}}$	**N/A**	$\mathbf{2.51\times10^{-4}}$	$\mathbf{9.31\times10^{-9}}$	**N/A**	$\mathbf{5.72\times10^{-2}}$	$\mathbf{2.85\times10^{-6}}$
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920

Chemical Constituent	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Hunter-Gatherer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Hunter-Gatherer: Hazard Index at Year of Peak Hazard Index	American Indian Hunter-Gatherer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.45×10^{-4}	6.38×10^{-4}	8.56×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	$\mathbf{5.67\times10^{-6}}$	**0.00**	**N/A**	$\mathbf{3.53\times10^{-3}}$	**0.00**	**N/A**	$\mathbf{1.01\times10^{-1}}$	$\mathbf{8.56\times10^{-8}}$
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–39, Q–40, and Q–41 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 11,300 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

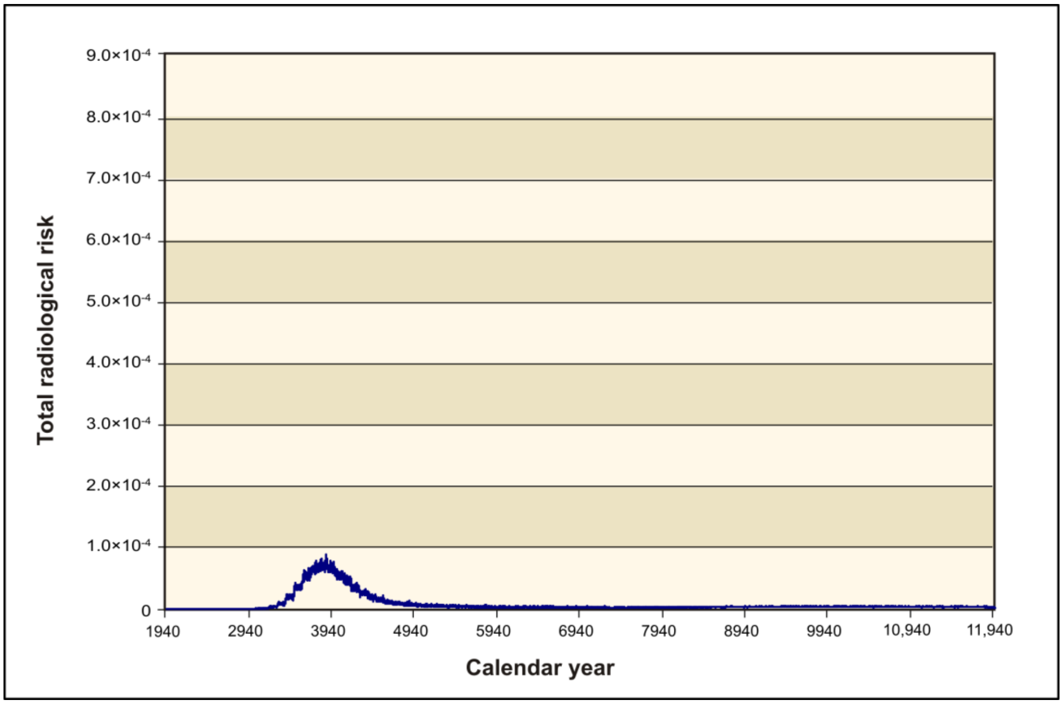


Figure Q–39. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

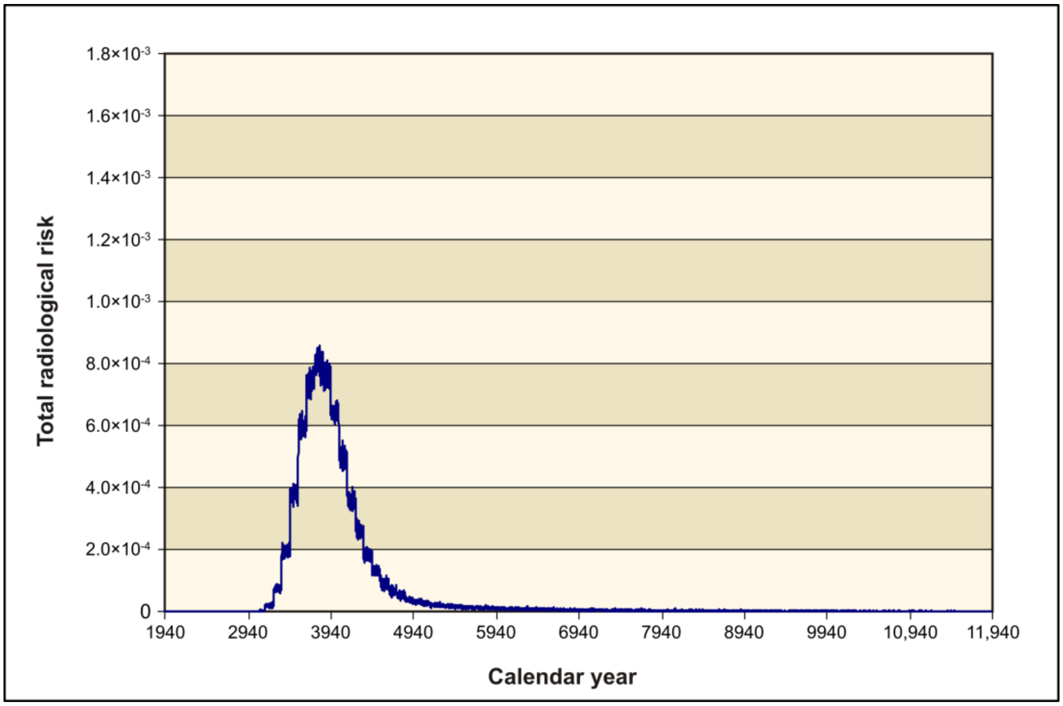


Figure Q–40. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

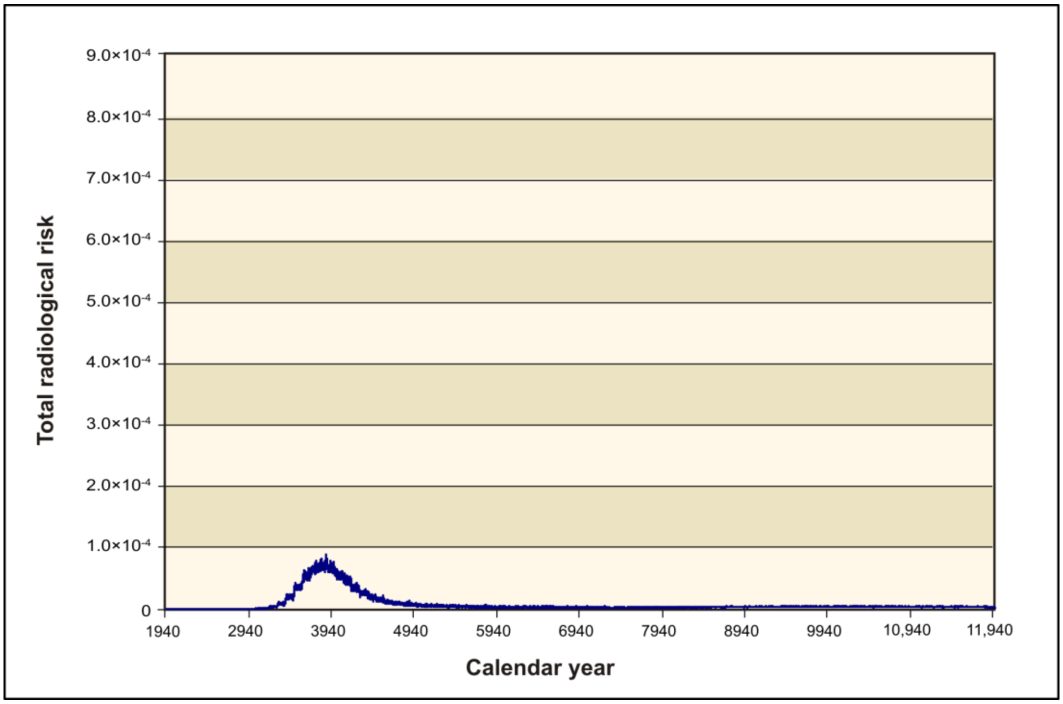


Figure Q–41. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.2 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B

Disposal Group 1, Subgroup 1-B, addresses the waste resulting from Tank Closure Alternative 3A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3A.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–328 through Q–333, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129. The key chemical constituent contributors would be boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–328. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.43×10^{-6}	2.50	8.60×10^{-5}	1.43×10^{-6}	6.44	2.83×10^{-4}	1.43×10^{-6}	1.32×10^{1}	6.19×10^{-4}
Iodine-129	3.08×10^{-10}	8.78×10^{-2}	9.98×10^{-7}	3.08×10^{-10}	1.10×10^{-1}	1.54×10^{-6}	3.08×10^{-10}	1.42×10^{-1}	2.34×10^{-6}
Total	**N/A**	**2.59**	$\mathbf{8.70\times10^{-5}}$	**N/A**	**6.55**	$\mathbf{2.84\times10^{-4}}$	**N/A**	$\mathbf{1.33\times10^{1}}$	$\mathbf{6.21\times10^{-4}}$
Year of peak impact	7629	7629	7629	7629	7629	7629	7629	7629	7629
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.87×10^{-4}	5.59×10^{-3}	0.00	5.87×10^{-4}	5.80×10^{-3}	3.72×10^{-12}	5.87×10^{-4}	8.72×10^{-3}	1.71×10^{-7}
Nitrate	1.03×10^{1}	1.83×10^{-1}	0.00	1.03×10^{1}	1.44	0.00	1.03×10^{1}	3.22	0.00
Total	**N/A**	$\mathbf{1.89\times10^{-1}}$	**0.00**	**N/A**	**1.45**	$\mathbf{3.72\times10^{-12}}$	**N/A**	**3.22**	$\mathbf{1.71\times10^{-7}}$
Year of peak impact	8052	8052	N/A	8052	8052	8691	8052	8052	8691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–329. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–330. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	$\mathbf{8.94\times10^{-2}}$	$\mathbf{2.69\times10^{-6}}$	**N/A**	$\mathbf{2.08\times10^{-1}}$	$\mathbf{8.54\times10^{-6}}$	**N/A**	$\mathbf{4.10\times10^{-1}}$	$\mathbf{1.85\times10^{-5}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.84\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.96\times10^{-2}}$	$\mathbf{1.05\times10^{-11}}$	**N/A**	$\mathbf{9.17\times10^{-2}}$	$\mathbf{4.81\times10^{-7}}$
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–331. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.73×10^{-4}	1.65×10^{-3}	0.00	1.73×10^{-4}	1.71×10^{-3}	2.94×10^{-12}	1.73×10^{-4}	2.57×10^{-3}	1.35×10^{-7}
Nitrate	2.79	4.99×10^{-2}	0.00	2.79	3.92×10^{-1}	0.00	2.79	8.75×10^{-1}	0.00
Total	**N/A**	**5.15×10^{-2}**	**0.00**	**N/A**	**3.94×10^{-1}**	**2.94×10^{-12}**	**N/A**	**8.77×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8095	8095	N/A	8095	8095	3846	8095	8095	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–332. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.04×10^{-4}	9.93×10^{-4}	0.00	1.04×10^{-4}	1.03×10^{-3}	1.87×10^{-12}	1.04×10^{-4}	1.55×10^{-3}	8.57×10^{-8}
Fluoride	1.24×10^{-5}	5.90×10^{-6}	0.00	1.24×10^{-5}	1.66×10^{-5}	0.00	1.24×10^{-5}	3.48×10^{-5}	0.00
Nitrate	2.21	3.94×10^{-2}	0.00	2.21	3.10×10^{-1}	0.00	2.21	6.90×10^{-1}	0.00
Total	**N/A**	**4.04×10^{-2}**	**0.00**	**N/A**	**3.11×10^{-1}**	**1.87×10^{-12}**	**N/A**	**6.92×10^{-1}**	**8.57×10^{-8}**
Year of peak impact	7940	7940	N/A	7940	7940	4481	7940	7940	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–333. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.04×10^{-4}	4.59×10^{-4}	8.56×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	1.24×10^{-5}	1.81×10^{-6}	0.00
Nitrate	3.37×10^{-5}	5.11×10^{-6}	0.00	3.37×10^{-5}	3.18×10^{-3}	0.00	2.21	1.00×10^{-1}	0.00
Total	**N/A**	**5.11×10^{-6}**	**0.00**	**N/A**	**3.18×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**8.56×10^{-8}**
Year of peak impact	8025	8025	N/A	8025	8025	N/A	7940	7940	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–42, Q–43, and Q–44 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3800 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 7600 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

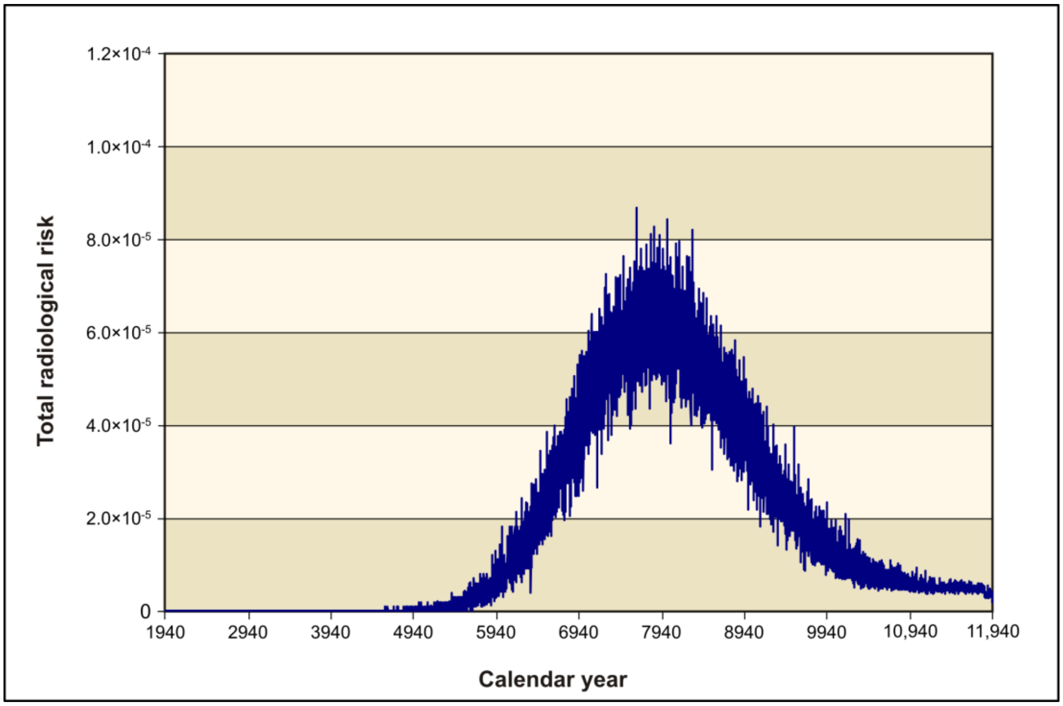


Figure Q–42. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

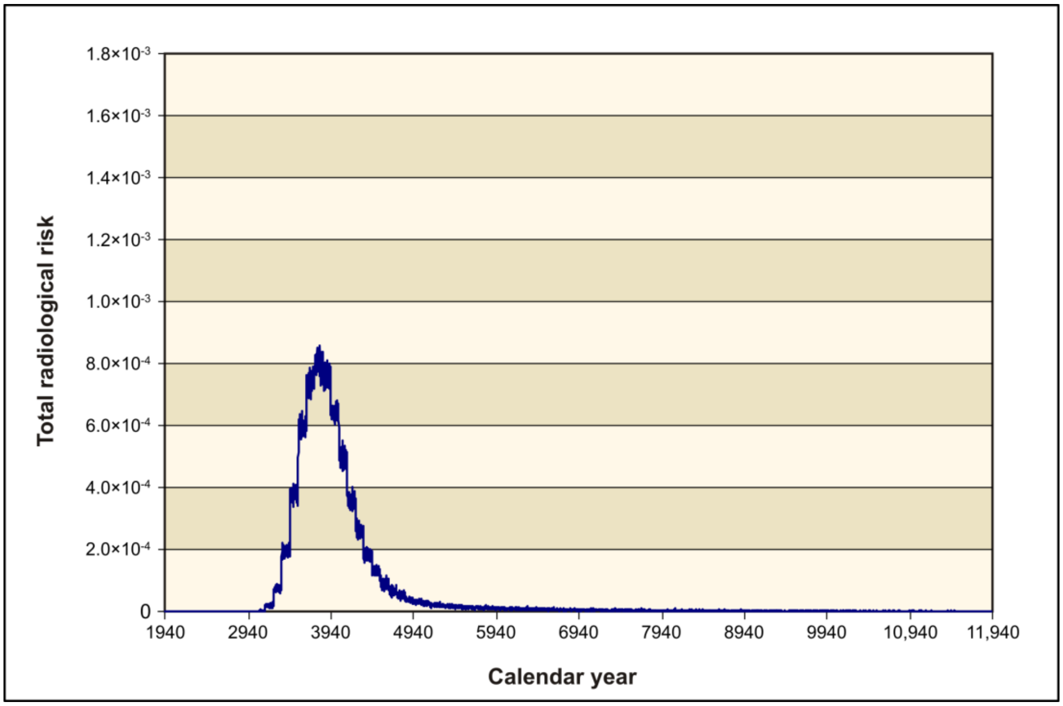


Figure Q–43. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

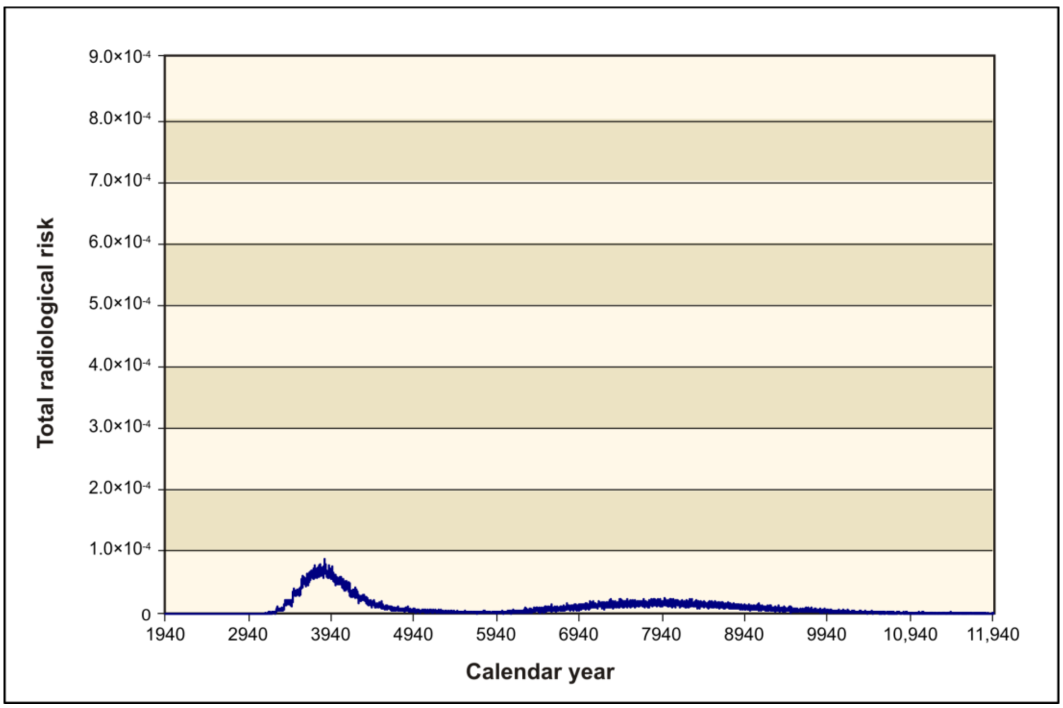


Figure Q–44. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.3 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C

Disposal Group 1, Subgroup 1-C, addresses the waste resulting from Tank Closure Alternative 3B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Cast stone waste
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3B.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–334 through Q–339, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user, resident farmer, and American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded at the Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–334. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.97×10^{-6}	5.20	1.79×10^{-4}	2.97×10^{-6}	1.34×10^{1}	5.88×10^{-4}	2.97×10^{-6}	2.73×10^{1}	1.29×10^{-3}
Iodine-129	2.47×10^{-10}	7.05×10^{-2}	8.02×10^{-7}	2.47×10^{-10}	8.81×10^{-2}	1.24×10^{-6}	2.47×10^{-10}	1.14×10^{-1}	1.88×10^{-6}
Total	**N/A**	**5.27**	**1.80×10^{-4}**	**N/A**	**1.35×10^{1}**	**5.89×10^{-4}**	**N/A**	**2.75×10^{1}**	**1.29×10^{-3}**
Year of peak impact	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.15×10^{-2}	5.45×10^{-2}	0.00	1.63×10^{-2}	9.69×10^{-2}	0.00	1.63×10^{-2}	1.75×10^{-1}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.34×10^{-1}	2.31	1.16×10^{-9}	2.34×10^{-1}	3.47	5.32×10^{-5}
Nitrate	2.96×10^{1}	5.28×10^{-1}	0.00	4.26×10^{1}	5.98	0.00	4.26×10^{1}	1.33×10^{1}	0.00
Total	**N/A**	**3.39**	**0.00**	**N/A**	**8.38**	**1.16×10^{-9}**	**N/A**	**1.70×10^{1}**	**5.32×10^{-5}**
Year of peak impact	8608	8608	N/A	8888	8888	8608	8888	8888	8608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–335. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–336. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	$\mathbf{8.94\times10^{-2}}$	$\mathbf{2.69\times10^{-6}}$	**N/A**	$\mathbf{2.08\times10^{-1}}$	$\mathbf{8.54\times10^{-6}}$	**N/A**	$\mathbf{4.10\times10^{-1}}$	$\mathbf{1.85\times10^{-5}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.84\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.96\times10^{-2}}$	$\mathbf{1.05\times10^{-11}}$	**N/A**	$\mathbf{9.17\times10^{-2}}$	$\mathbf{4.81\times10^{-7}}$
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–337. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.24×10^{-3}	1.54×10^{-2}	0.00	3.60×10^{-3}	2.14×10^{-2}	0.00	3.60×10^{-3}	3.88×10^{-2}	0.00
Chromium	1.02×10^{-1}	9.68×10^{-1}	0.00	7.55×10^{-2}	7.45×10^{-1}	3.99×10^{-10}	7.55×10^{-2}	1.12	1.83×10^{-5}
Nitrate	7.02	1.25×10^{-1}	0.00	1.61×10^{1}	2.26	0.00	1.61×10^{1}	5.04	0.00
Total	**N/A**	**1.11**	**0.00**	**N/A**	**3.03**	**3.99×10^{-10}**	**N/A**	**6.20**	**1.83×10^{-5}**
Year of peak impact	8680	8680	N/A	8973	8973	8680	8973	8973	8680

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–338. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.34×10^{-3}	1.12×10^{-2}	0.00	2.16×10^{-3}	1.29×10^{-2}	0.00	2.16×10^{-3}	2.33×10^{-2}	0.00
Chromium	7.85×10^{-2}	7.47×10^{-1}	0.00	6.39×10^{-2}	6.31×10^{-1}	3.08×10^{-10}	6.39×10^{-2}	9.50×10^{-1}	1.41×10^{-5}
Fluoride	2.48×10^{-6}	1.18×10^{-6}	0.00	4.95×10^{-6}	6.62×10^{-6}	0.00	4.95×10^{-6}	1.39×10^{-5}	0.00
Nitrate	5.45	9.74×10^{-2}	0.00	1.09×10^{1}	1.52	0.00	1.09×10^{1}	3.40	0.00
Total	**N/A**	**8.56×10^{-1}**	**0.00**	**N/A**	**2.17**	**3.08×10^{-10}**	**N/A**	**4.37**	**1.41×10^{-5}**
Year of peak impact	8594	8594	N/A	8469	8469	8594	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–339. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.92×10^{-8}	3.52×10^{-7}	0.00	5.89×10^{-8}	6.34×10^{-7}	0.00	2.16×10^{-3}	1.30×10^{-2}	0.00
Chromium	1.06×10^{-6}	1.05×10^{-5}	4.59×10^{-15}	1.04×10^{-6}	1.68×10^{-5}	2.10×10^{-10}	6.39×10^{-2}	2.81×10^{-1}	1.41×10^{-5}
Nitrate	1.89×10^{-4}	2.87×10^{-5}	0.00	1.91×10^{-4}	1.80×10^{-2}	0.00	1.09×10^{1}	5.23×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-5}**	**4.59×10^{-15}**	**N/A**	**1.80×10^{-2}**	**2.10×10^{-10}**	**N/A**	**8.18×10^{-1}**	**1.41×10^{-5}**
Year of peak impact	8702	8702	9094	8672	8672	9094	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–45, Q–46, and Q–47 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At IDF-East, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,800 as a result of slower movement in the vadose zone for waste forms disposed of in IDF-East.

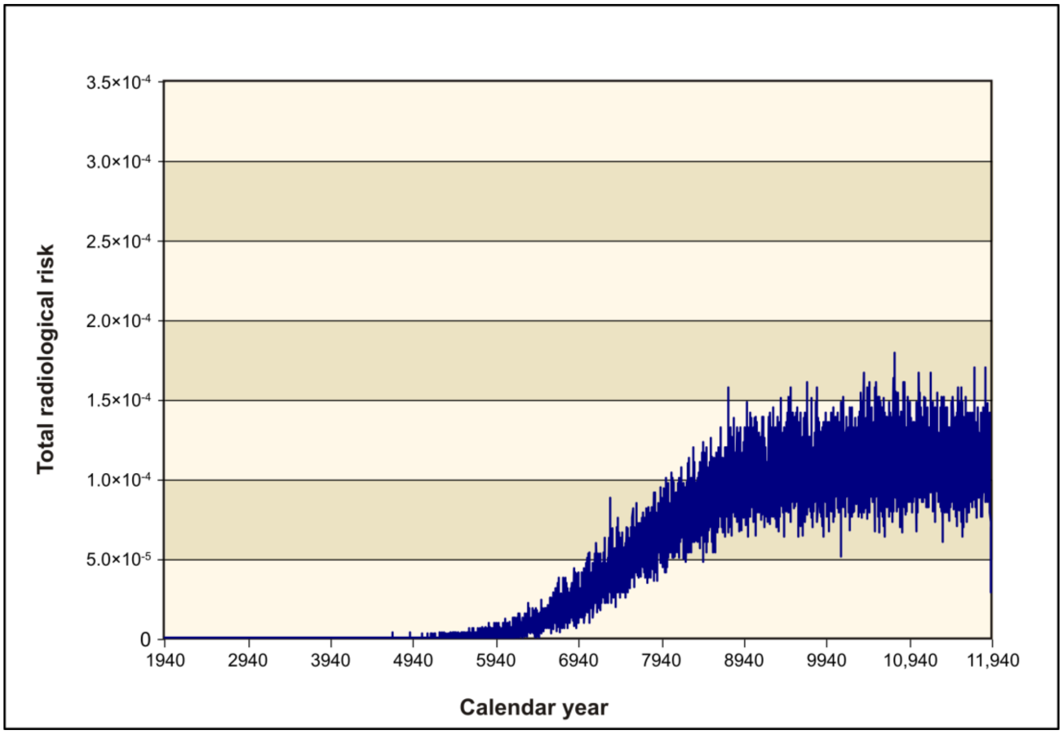


Figure Q–45. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

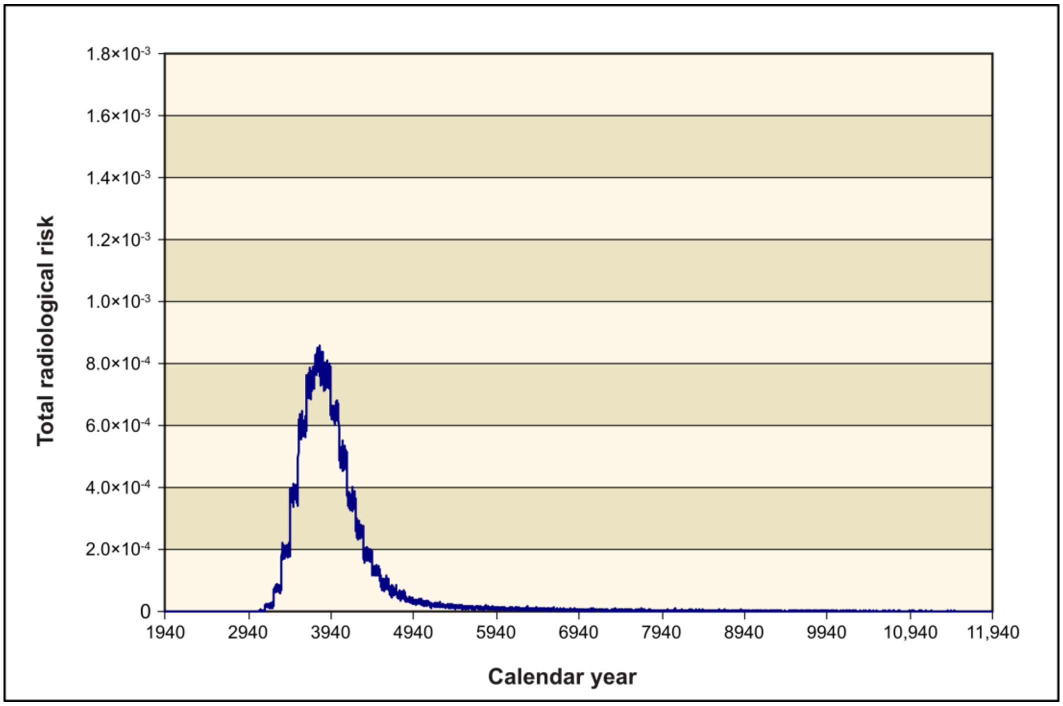


Figure Q–46. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

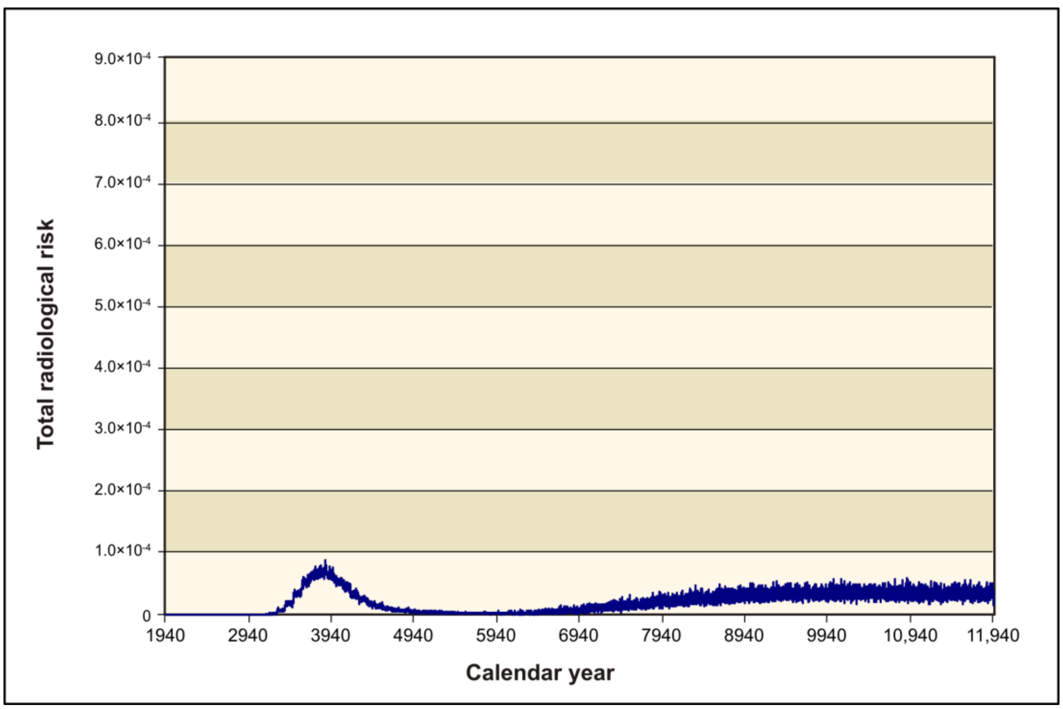


Figure Q–47. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.4 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D

Disposal Group 1, Subgroup 1-D, addresses the waste resulting from Tank Closure Alternative 3C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Steam reforming waste
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3C.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–340 through Q–345, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the resident farmer and American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 2.21×10^{-1} person-rem per year for the year of maximum impact.

Table Q–340. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.16×10^{-6}	2.02	6.97×10^{-5}	1.16×10^{-6}	5.22	2.29×10^{-4}	1.16×10^{-6}	1.07×10^{1}	5.01×10^{-4}
Iodine-129	9.00×10^{-10}	2.57×10^{-1}	2.92×10^{-6}	9.00×10^{-10}	3.21×10^{-1}	4.51×10^{-6}	9.00×10^{-10}	4.14×10^{-1}	6.83×10^{-6}
Total	**N/A**	**2.28**	**7.26×10^{-5}**	**N/A**	**5.54**	**2.34×10^{-4}**	**N/A**	**1.11×10^{1}**	**5.08×10^{-4}**
Year of peak impact	11,434	11,434	11,434	11,434	11,434	11,434	11,434	11,434	11,434
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.05×10^{-2}	9.95×10^{-2}	0.00	1.05×10^{-2}	1.03×10^{-1}	7.57×10^{-11}	1.05×10^{-2}	1.55×10^{-1}	3.47×10^{-6}
Nitrate	1.15×10^{1}	2.04×10^{-1}	0.00	1.15×10^{1}	1.61	0.00	1.15×10^{1}	3.58	0.00
Total	**N/A**	**3.04×10^{-1}**	**0.00**	**N/A**	**1.71**	**7.57×10^{-11}**	**N/A**	**3.74**	**3.47×10^{-6}**
Year of peak impact	8207	8207	N/A	8207	8207	11,378	8207	8207	11,378

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–341. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the 200-West Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	$\mathbf{2.87\times10^{1}}$	$\mathbf{8.59\times10^{-4}}$	**N/A**	$\mathbf{6.66\times10^{1}}$	$\mathbf{2.72\times10^{-3}}$	**N/A**	$\mathbf{1.31\times10^{2}}$	$\mathbf{5.87\times10^{-3}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	$\mathbf{1.03\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.17\times10^{-2}}$	$\mathbf{4.13\times10^{-12}}$	**N/A**	$\mathbf{1.87\times10^{-2}}$	$\mathbf{1.89\times10^{-7}}$
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–342. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	$\mathbf{8.94\times10^{-2}}$	$\mathbf{2.69\times10^{-6}}$	**N/A**	$\mathbf{2.08\times10^{-1}}$	$\mathbf{8.54\times10^{-6}}$	**N/A**	$\mathbf{4.10\times10^{-1}}$	$\mathbf{1.85\times10^{-5}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	$\mathbf{2.84\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.96\times10^{-2}}$	$\mathbf{1.05\times10^{-11}}$	**N/A**	$\mathbf{9.17\times10^{-2}}$	$\mathbf{4.81\times10^{-7}}$
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–343. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	$\mathbf{8.86\times10^{-5}}$	**N/A**	**6.84**	$\mathbf{2.81\times10^{-4}}$	**N/A**	$\mathbf{1.35\times10^{1}}$	$\mathbf{6.09\times10^{-4}}$
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.26×10^{-3}	4.05×10^{-2}	0.00	2.42×10^{-3}	2.39×10^{-2}	2.38×10^{-11}	2.42×10^{-3}	3.59×10^{-2}	1.09×10^{-6}
Nitrate	2.90	5.18×10^{-2}	0.00	3.15	4.42×10^{-1}	0.00	3.15	9.86×10^{-1}	0.00
Total	**N/A**	$\mathbf{9.23\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.66\times10^{-1}}$	$\mathbf{2.38\times10^{-11}}$	**N/A**	**1.02**	$\mathbf{1.09\times10^{-6}}$
Year of peak impact	8317	8317	N/A	8121	8121	10,691	8121	8121	10,691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–344. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	$\mathbf{1.07\times10^{-4}}$	**N/A**	**8.28**	$\mathbf{3.41\times10^{-4}}$	**N/A**	$\mathbf{1.63\times10^{1}}$	$\mathbf{7.39\times10^{-4}}$
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.56×10^{-3}	3.39×10^{-2}	0.00	1.95×10^{-3}	1.92×10^{-2}	1.83×10^{-11}	1.95×10^{-3}	2.89×10^{-2}	8.39×10^{-7}
Fluoride	7.43×10^{-6}	3.54×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	1.66	2.96×10^{-2}	0.00	2.40	3.38×10^{-1}	0.00	2.40	7.53×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.35\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{3.57\times10^{-1}}$	$\mathbf{1.83\times10^{-11}}$	**N/A**	$\mathbf{7.82\times10^{-1}}$	$\mathbf{8.39\times10^{-7}}$
Year of peak impact	8284	8284	N/A	7899	7899	11,049	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–345. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	$\mathbf{6.83\times10^{-5}}$	$\mathbf{2.79\times10^{-9}}$	**N/A**	$\mathbf{2.51\times10^{-4}}$	$\mathbf{9.31\times10^{-9}}$	**N/A**	$\mathbf{5.72\times10^{-2}}$	$\mathbf{2.85\times10^{-6}}$
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.01×10^{-8}	3.96×10^{-7}	2.90×10^{-16}	3.45×10^{-8}	5.59×10^{-7}	1.33×10^{-11}	1.95×10^{-3}	8.56×10^{-3}	8.38×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.88×10^{-5}	5.87×10^{-6}	0.00	3.90×10^{-5}	3.68×10^{-3}	0.00	2.40	1.11×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.26\times10^{-6}}$	$\mathbf{2.90\times10^{-16}}$	**N/A**	$\mathbf{3.68\times10^{-3}}$	$\mathbf{1.33\times10^{-11}}$	**N/A**	$\mathbf{1.20\times10^{-1}}$	$\mathbf{8.38\times10^{-7}}$
Year of peak impact	8293	8293	11,332	8166	8166	11,332	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–48, Q–49, and Q–50 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8200 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-West barrier, the radiological lifetime risk of incidence of cancer occurs around CY 3700, and at the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs near the end of the analysis period as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

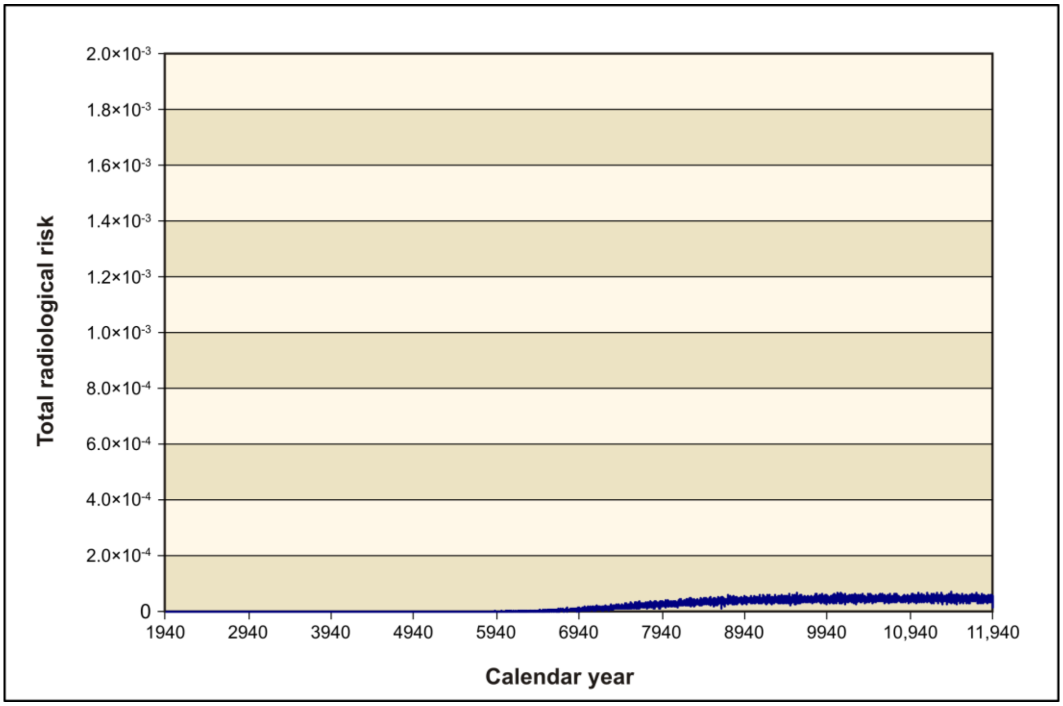


Figure Q–48. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

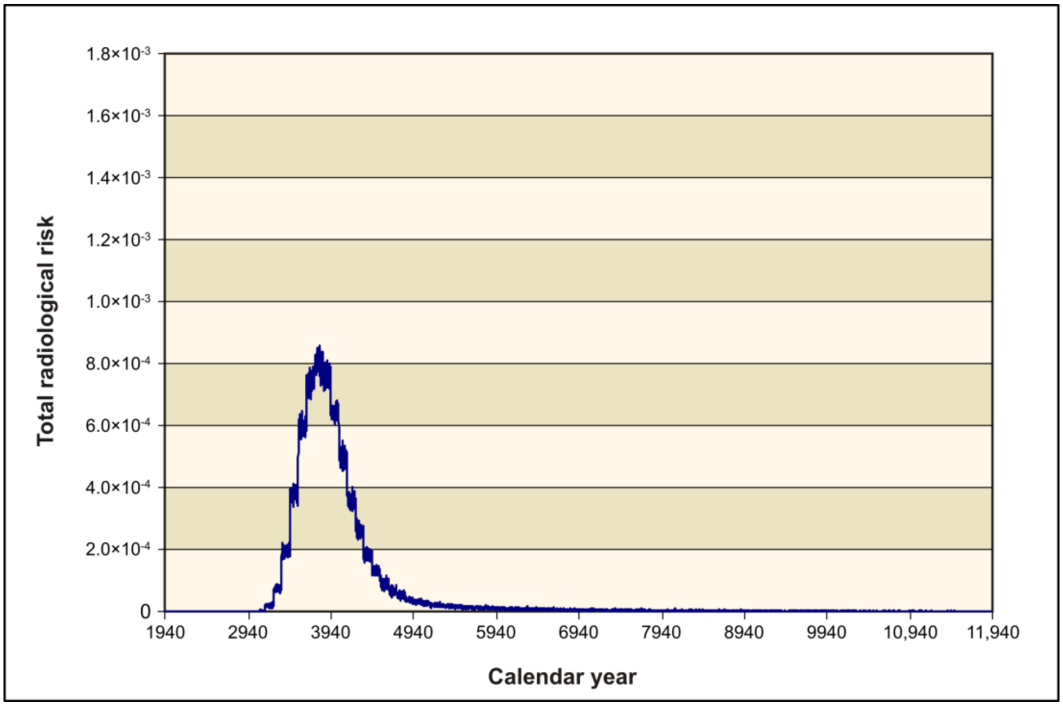


Figure Q–49. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

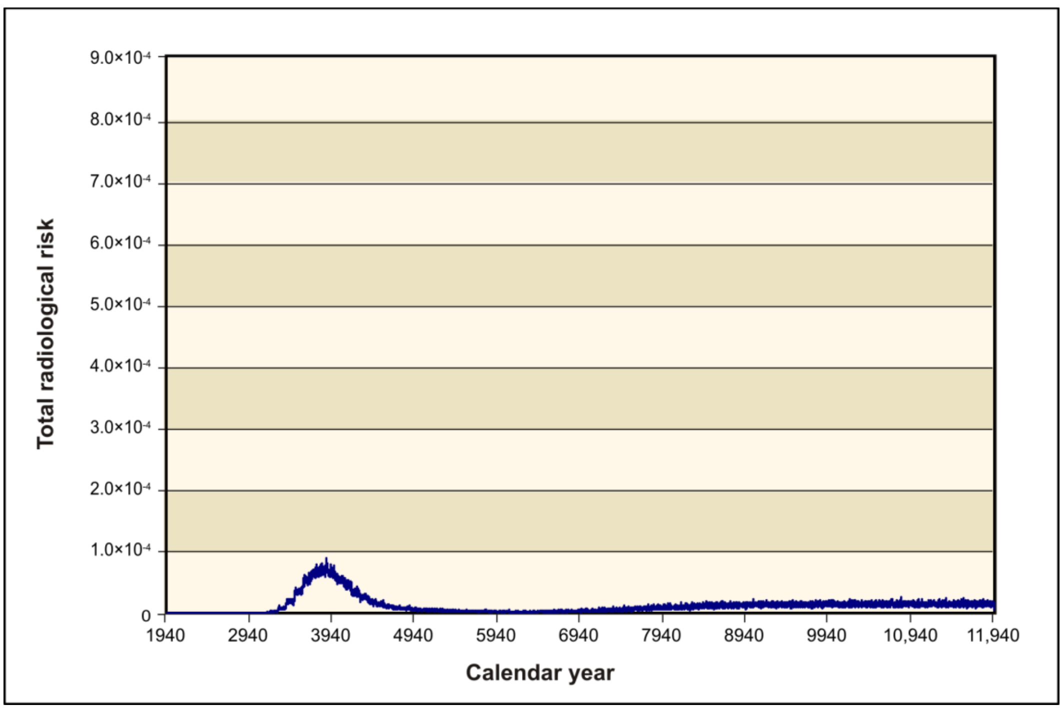


Figure Q–50. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.5 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E

Disposal Group 1, Subgroup 1-E, addresses the waste resulting from Tank Closure Alternative 4, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Sulfate grout
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 4.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–346 through Q–351, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer, and at the Core Zone Boundary and Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 4.43×10^{-1} person-rem per year for the year of maximum impact.

Table Q–346. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.84×10^{-6}	6.71	2.31×10^{-4}	3.84×10^{-6}	1.73×10^{1}	7.60×10^{-4}	3.84×10^{-6}	3.53×10^{1}	1.66×10^{-3}
Iodine-129	4.59×10^{-10}	1.31×10^{-1}	1.49×10^{-6}	4.59×10^{-10}	1.63×10^{-1}	2.30×10^{-6}	4.59×10^{-10}	2.11×10^{-1}	3.48×10^{-6}
Total	**N/A**	**6.84**	$\mathbf{2.32\times10^{-4}}$	**N/A**	$\mathbf{1.75\times10^{1}}$	$\mathbf{7.62\times10^{-4}}$	**N/A**	$\mathbf{3.55\times10^{1}}$	$\mathbf{1.66\times10^{-3}}$
Year of peak impact	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	9.03×10^{-3}	4.30×10^{-2}	0.00	7.76×10^{-3}	4.62×10^{-2}	0.00	7.76×10^{-3}	8.35×10^{-2}	0.00
Chromium	1.75×10^{-1}	1.67	0.00	1.41×10^{-1}	1.40	6.88×10^{-10}	1.41×10^{-1}	2.10	3.15×10^{-5}
Nitrate	2.05×10^{1}	3.67×10^{-1}	0.00	2.63×10^{1}	3.70	0.00	2.63×10^{1}	8.24	0.00
Total	**N/A**	**2.08**	**0.00**	**N/A**	**5.14**	$\mathbf{6.88\times10^{-10}}$	**N/A**	$\mathbf{1.04\times10^{1}}$	$\mathbf{3.15\times10^{-5}}$
Year of peak impact	9008	9008	N/A	8599	8599	9008	8599	8599	9008

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–347. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the 200-West Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–348. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.07×10^{-7}	1.87×10^{-1}	6.45×10^{-6}	1.07×10^{-7}	4.83×10^{-1}	2.12×10^{-5}	1.07×10^{-7}	9.86×10^{-1}	4.64×10^{-5}
Iodine-129	1.74×10^{-10}	4.95×10^{-2}	5.62×10^{-7}	1.74×10^{-10}	6.18×10^{-2}	8.70×10^{-7}	1.74×10^{-10}	7.99×10^{-2}	1.32×10^{-6}
Total	**N/A**	**2.37×10^{-1}**	**7.01×10^{-6}**	**N/A**	**5.45×10^{-1}**	**2.21×10^{-5}**	**N/A**	**1.07**	**4.77×10^{-5}**
Year of peak impact	3785	3785	3785	3785	3785	3785	3785	3785	3785
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.84×10^{-3}	6.51×10^{-2}	0.00	6.47×10^{-3}	6.39×10^{-2}	2.69×10^{-11}	6.47×10^{-3}	9.61×10^{-2}	1.23×10^{-6}
Nitrate	2.25×10^{-1}	4.01×10^{-3}	0.00	2.63×10^{-1}	3.69×10^{-2}	0.00	2.63×10^{-1}	8.23×10^{-2}	0.00
Total	**N/A**	**6.92×10^{-2}**	**0.00**	**N/A**	**1.01×10^{-1}**	**2.69×10^{-11}**	**N/A**	**1.78×10^{-1}**	**1.23×10^{-6}**
Year of peak impact	3666	3666	N/A	3682	3682	3666	3682	3682	3666

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–349. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.60×10^{-3}	7.61×10^{-3}	0.00	2.30×10^{-3}	1.37×10^{-2}	0.00	2.00×10^{-3}	2.15×10^{-2}	0.00
Chromium	5.25×10^{-2}	5.00×10^{-1}	0.00	4.45×10^{-2}	4.40×10^{-1}	2.06×10^{-10}	3.34×10^{-2}	4.97×10^{-1}	9.45×10^{-6}
Nitrate	6.66	1.19×10^{-1}	0.00	8.37	1.18	0.00	8.96	2.80	0.00
Total	**N/A**	**6.26×10^{-1}**	**0.00**	**N/A**	**1.63**	**2.06×10^{-10}**	**N/A**	**3.32**	**9.45×10^{-6}**
Year of peak impact	8873	8873	N/A	8787	8787	8873	8189	8189	8873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–350. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.30×10^{-3}	6.18×10^{-3}	0.00	1.60×10^{-3}	9.51×10^{-3}	0.00	1.60×10^{-3}	1.72×10^{-2}	0.00
Chromium	3.98×10^{-2}	3.79×10^{-1}	0.00	1.91×10^{-2}	1.89×10^{-1}	1.56×10^{-10}	1.91×10^{-2}	2.84×10^{-1}	7.17×10^{-6}
Fluoride	2.48×10^{-6}	1.18×10^{-6}	0.00	2.48×10^{-6}	3.31×10^{-6}	0.00	2.48×10^{-6}	6.95×10^{-6}	0.00
Nitrate	4.62	8.25×10^{-2}	0.00	6.82	9.57×10^{-1}	0.00	6.82	2.13	0.00
Total	**N/A**	**4.68×10^{-1}**	**0.00**	**N/A**	**1.16**	**1.56×10^{-10}**	**N/A**	**2.43**	**7.17×10^{-6}**
Year of peak impact	8827	8827	N/A	9059	9059	8827	9059	9059	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–351. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.38×10^{-11}	6.21×10^{-5}	2.85×10^{-9}	1.36×10^{-11}	1.42×10^{-4}	6.73×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.00×10^{-14}	7.13×10^{-6}	1.14×10^{-11}	2.08×10^{-14}	1.14×10^{-4}	2.73×10^{-9}	2.11×10^{-9}	7.11×10^{-3}	1.74×10^{-7}
Total	**N/A**	$\mathbf{6.92\times10^{-5}}$	$\mathbf{2.86\times10^{-9}}$	**N/A**	$\mathbf{2.55\times10^{-4}}$	$\mathbf{9.46\times10^{-9}}$	**N/A**	$\mathbf{5.72\times10^{-2}}$	$\mathbf{2.85\times10^{-6}}$
Year of peak impact	4019	4019	9205	4077	4077	4077	3920	3920	3920
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.12×10^{-8}	1.86×10^{-7}	0.00	3.12×10^{-8}	3.36×10^{-7}	0.00	1.30×10^{-3}	7.79×10^{-3}	0.00
Chromium	5.50×10^{-7}	5.43×10^{-6}	2.58×10^{-15}	5.50×10^{-7}	8.90×10^{-6}	1.18×10^{-10}	3.98×10^{-2}	1.75×10^{-1}	7.16×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.48×10^{-6}	3.61×10^{-7}	0.00
Nitrate	1.16×10^{-4}	1.75×10^{-5}	0.00	1.16×10^{-4}	1.09×10^{-2}	0.00	4.62	2.46×10^{-1}	0.00
Total	**N/A**	$\mathbf{2.32\times10^{-5}}$	$\mathbf{2.58\times10^{-15}}$	**N/A**	$\mathbf{1.09\times10^{-2}}$	$\mathbf{1.18\times10^{-10}}$	**N/A**	$\mathbf{4.29\times10^{-1}}$	$\mathbf{7.16\times10^{-6}}$
Year of peak impact	8855	8855	8960	8855	8855	8960	8827	8827	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–51, Q–52, and Q–53 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,900 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

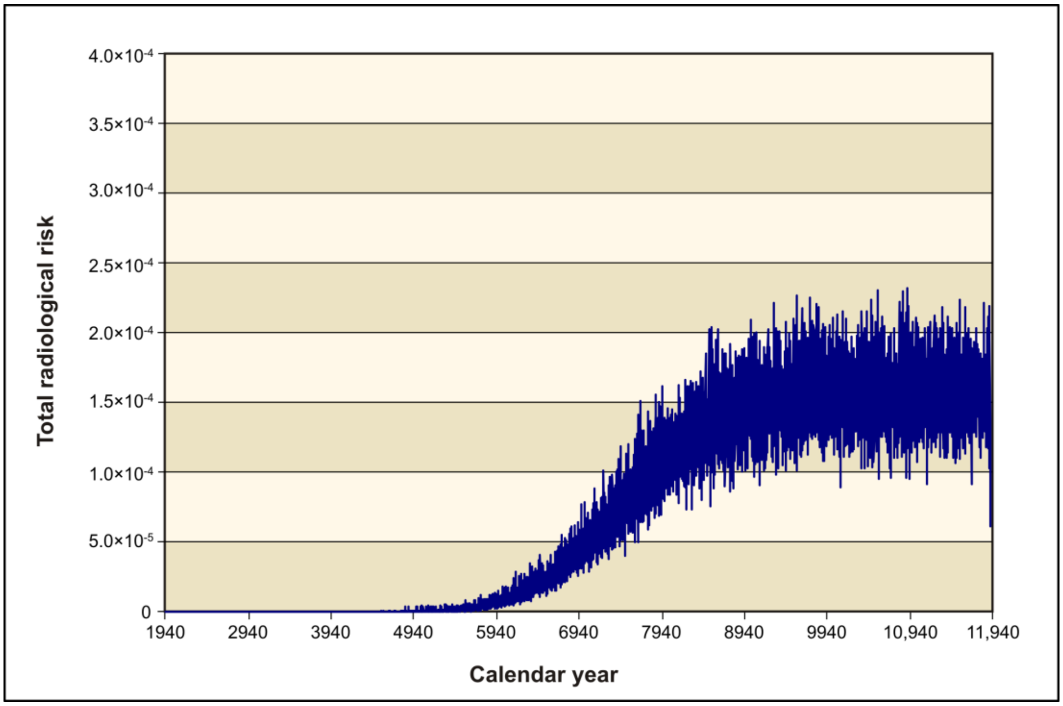


Figure Q–51. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

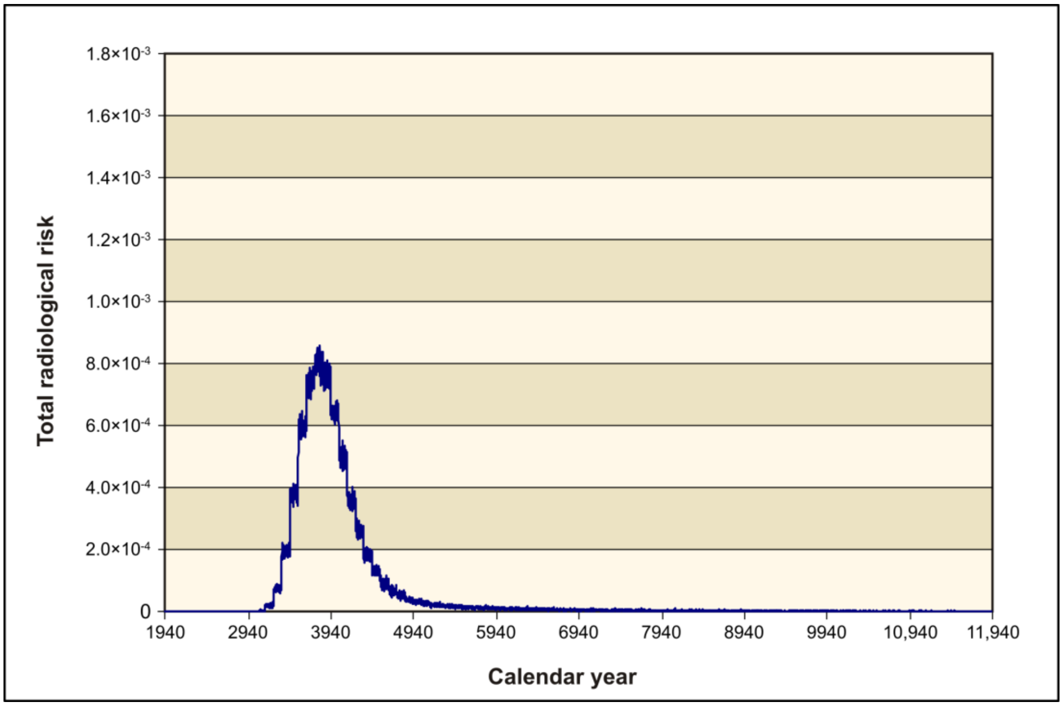


Figure Q–52. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

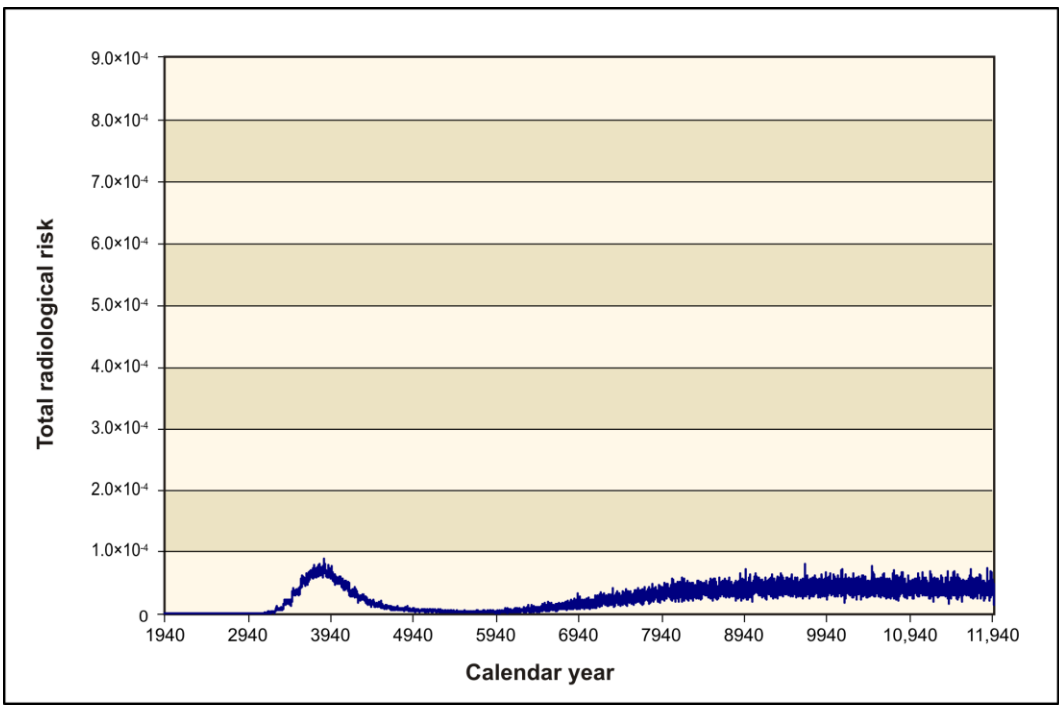


Figure Q–53. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.6 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F

Disposal Group 1, Subgroup 1-F, addresses the waste resulting from Tank Closure Alternative 5, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Sulfate grout
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 5 because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–352 through Q–356, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded at the Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact.

Table Q–352. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.38×10^{-6}	2.42	8.33×10^{-5}	1.38×10^{-6}	6.24	2.74×10^{-4}	1.38×10^{-6}	1.27×10^{1}	5.99×10^{-4}
Iodine-129	3.97×10^{-10}	1.13×10^{-1}	1.29×10^{-6}	3.97×10^{-10}	1.41×10^{-1}	1.99×10^{-6}	3.97×10^{-10}	1.83×10^{-1}	3.01×10^{-6}
Total	**N/A**	**2.53**	$\mathbf{8.45\times10^{-5}}$	**N/A**	**6.38**	$\mathbf{2.76\times10^{-4}}$	**N/A**	$\mathbf{1.29\times10^{1}}$	$\mathbf{6.02\times10^{-4}}$
Year of peak impact	8878	8878	8878	8878	8878	8878	8878	8878	8878

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.15×10^{-3}	1.02×10^{-2}	0.00	2.34×10^{-3}	1.39×10^{-2}	0.00	2.34×10^{-3}	2.51×10^{-2}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.50×10^{-1}	2.47	1.16×10^{-9}	2.50×10^{-1}	3.72	5.31×10^{-5}
Nitrate	1.16×10^{1}	2.07×10^{-1}	0.00	1.78×10^{1}	2.49	0.00	1.78×10^{1}	5.56	0.00
Total	**N/A**	**3.03**	**0.00**	**N/A**	**4.98**	$\mathbf{1.16\times10^{-9}}$	**N/A**	**9.31**	$\mathbf{5.31\times10^{-5}}$
Year of peak impact	8882	8882	N/A	8636	8636	8882	8636	8636	8882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–353. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–354. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	9.92×10^{-4}	4.72×10^{-3}	0.00	3.97×10^{-4}	2.36×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	7.78×10^{-2}	7.41×10^{-1}	0.00	5.78×10^{-2}	5.71×10^{-1}	3.06×10^{-10}	5.78×10^{-2}	8.59×10^{-1}	1.40×10^{-5}
Nitrate	4.19	7.48×10^{-2}	0.00	6.25	8.77×10^{-1}	0.00	6.25	1.96	0.00
Total	**N/A**	**8.20×10^{-1}**	**0.00**	**N/A**	**1.45**	**3.06×10^{-10}**	**N/A**	**2.82**	**1.40×10^{-5}**
Year of peak impact	8588	8588	N/A	7810	7810	9057	7810	7810	9057

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–355. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.62×10^{-4}	2.68×10^{-3}	0.00	5.62×10^{-4}	3.35×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	5.87×10^{-2}	5.59×10^{-1}	0.00	5.87×10^{-2}	5.80×10^{-1}	2.34×10^{-10}	4.39×10^{-2}	6.53×10^{-1}	1.07×10^{-5}
Fluoride	4.95×10^{-6}	2.36×10^{-6}	0.00	4.95×10^{-6}	6.62×10^{-6}	0.00	4.95×10^{-6}	1.39×10^{-5}	0.00
Nitrate	2.80	4.99×10^{-2}	0.00	2.80	3.93×10^{-1}	0.00	3.66	1.15	0.00
Total	**N/A**	**6.11×10^{-1}**	**0.00**	**N/A**	**9.75×10^{-1}**	**2.34×10^{-10}**	**N/A**	**1.80**	**1.07×10^{-5}**
Year of peak impact	8535	8535	N/A	8535	8535	8241	8522	8522	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–356. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.35×10^{-11}	6.08×10^{-5}	2.67×10^{-9}	1.33×10^{-11}	1.39×10^{-4}	6.58×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.94×10^{-14}	6.93×10^{-6}	9.77×10^{-11}	2.03×10^{-14}	1.10×10^{-4}	2.65×10^{-9}	2.11×10^{-9}	7.09×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.78×10^{-5}**	**2.77×10^{-9}**	**N/A**	**2.49×10^{-4}**	**9.24×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.06×10^{-8}	6.29×10^{-8}	0.00	1.04×10^{-8}	1.12×10^{-7}	0.00	5.62×10^{-4}	3.37×10^{-3}	0.00
Chromium	9.73×10^{-7}	9.61×10^{-6}	4.03×10^{-15}	8.17×10^{-7}	1.32×10^{-5}	1.85×10^{-10}	5.87×10^{-2}	2.58×10^{-1}	1.07×10^{-5}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	4.95×10^{-6}	7.23×10^{-7}	0.00
Nitrate	7.30×10^{-5}	1.11×10^{-5}	0.00	7.90×10^{-5}	7.44×10^{-3}	0.00	2.80	1.55×10^{-1}	0.00
Total	**N/A**	**2.07×10^{-5}**	**4.03×10^{-15}**	**N/A**	**7.45×10^{-3}**	**1.85×10^{-10}**	**N/A**	**4.16×10^{-1}**	**1.07×10^{-5}**
Year of peak impact	8457	8457	8987	8385	8385	8987	8535	8535	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–54, Q–55, and Q–56 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 8900 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

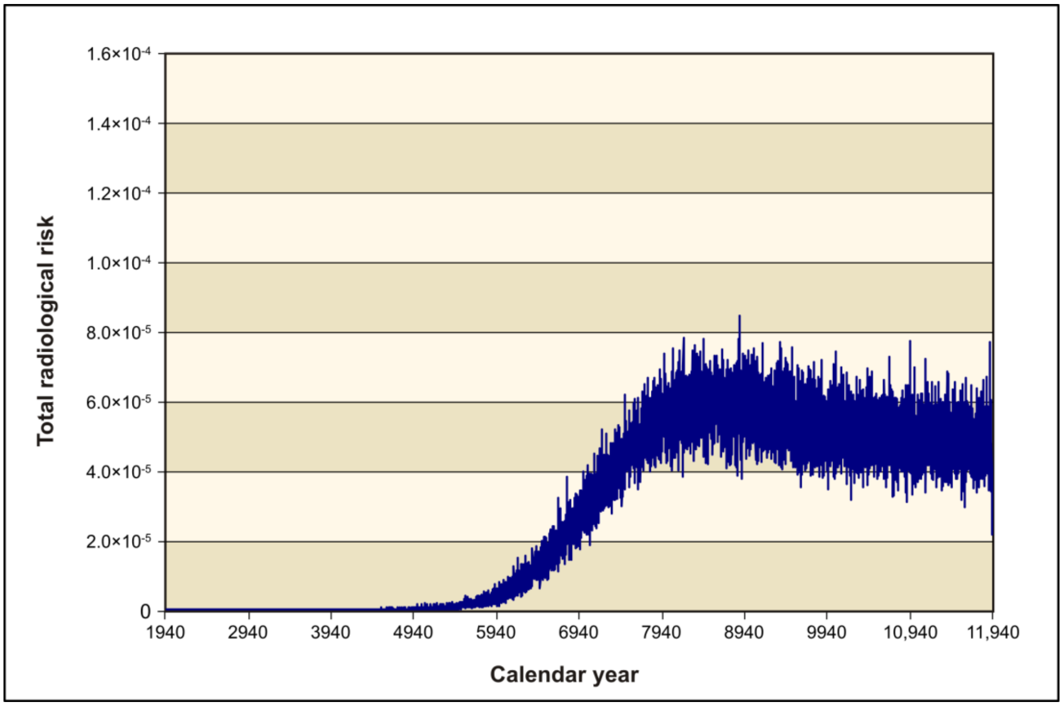


Figure Q–54. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

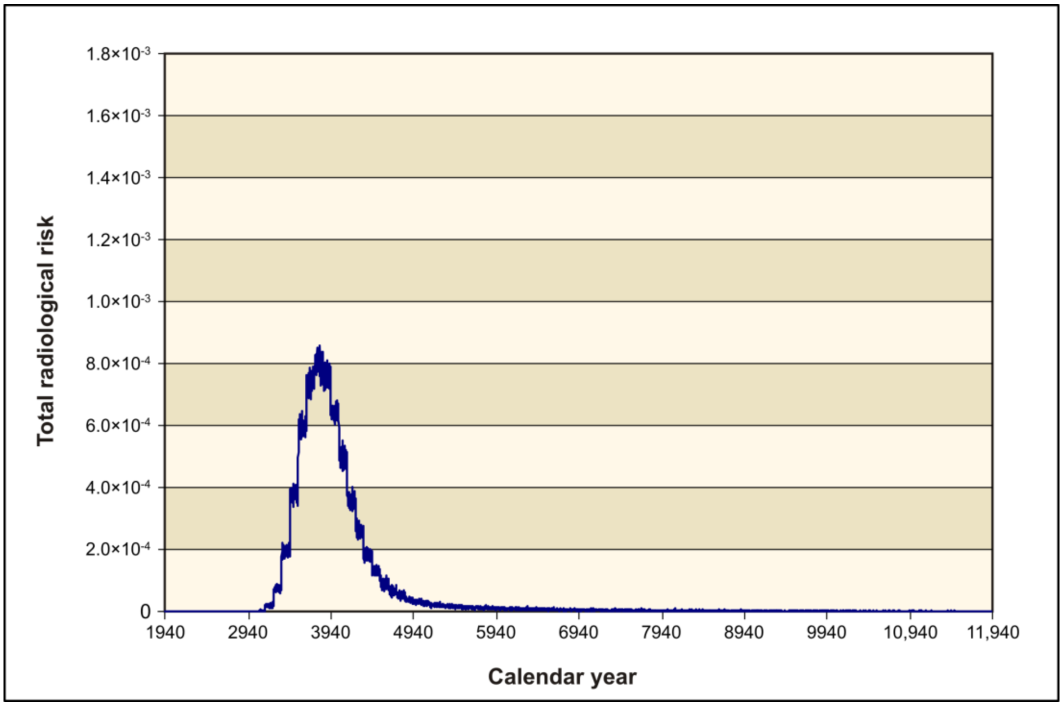


Figure Q–55. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

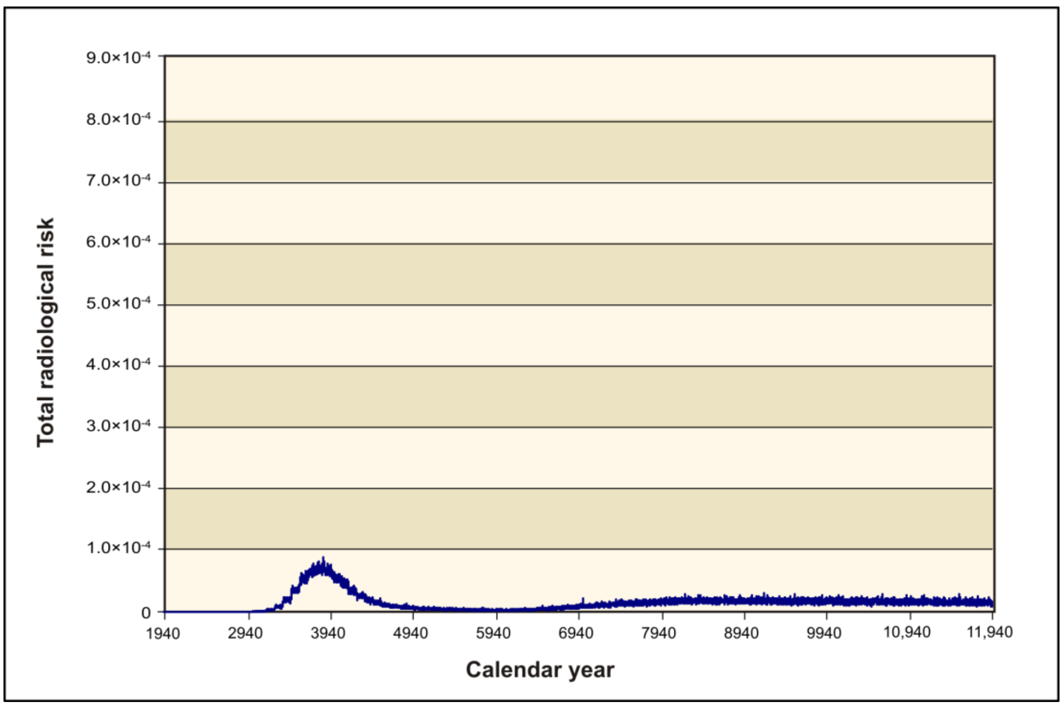


Figure Q–56. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.7 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G

Disposal Group 1, Subgroup 1-G, addresses the waste resulting from Tank Closure Alternative 6C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6C.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–357 through Q–362, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–357. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	2.08×10^{-7}	3.64×10^{-1}	1.25×10^{-5}	2.08×10^{-7}	9.38×10^{-1}	4.12×10^{-5}	2.08×10^{-7}	1.92	9.01×10^{-5}
Iodine-129	6.52×10^{-10}	1.86×10^{-1}	2.11×10^{-6}	6.52×10^{-10}	2.32×10^{-1}	3.26×10^{-6}	6.52×10^{-10}	3.00×10^{-1}	4.94×10^{-6}
Total	**N/A**	$\mathbf{5.50\times10^{-1}}$	$\mathbf{1.46\times10^{-5}}$	**N/A**	**1.17**	$\mathbf{4.44\times10^{-5}}$	**N/A**	**2.22**	$\mathbf{9.50\times10^{-5}}$
Year of peak impact	11,385	11,385	11,385	11,385	11,385	11,385	11,385	11,385	11,385
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.31×10^{-3}	1.24×10^{-2}	0.00	1.31×10^{-3}	1.29×10^{-2}	8.05×10^{-12}	1.31×10^{-3}	1.94×10^{-2}	3.69×10^{-7}
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	$\mathbf{2.29\times10^{-1}}$	**0.00**	**N/A**	**1.71**	$\mathbf{8.05\times10^{-12}}$	**N/A**	**3.81**	$\mathbf{3.69\times10^{-7}}$
Year of peak impact	7962	7962	N/A	7962	7962	8555	7962	7962	8555

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–358. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the 200-West Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	$\mathbf{2.87\times10^{1}}$	$\mathbf{8.59\times10^{-4}}$	**N/A**	$\mathbf{6.66\times10^{1}}$	$\mathbf{2.72\times10^{-3}}$	**N/A**	$\mathbf{1.31\times10^{2}}$	$\mathbf{5.87\times10^{-3}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	$\mathbf{1.03\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.17\times10^{-2}}$	$\mathbf{4.13\times10^{-12}}$	**N/A**	$\mathbf{1.87\times10^{-2}}$	$\mathbf{1.89\times10^{-7}}$
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–359. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–360. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.17×10^{-4}	3.97×10^{-3}	0.00	4.17×10^{-4}	4.12×10^{-3}	2.94×10^{-12}	4.17×10^{-4}	6.20×10^{-3}	1.35×10^{-7}
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.77×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–361. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.60×10^{-4}	1.52×10^{-3}	0.00	1.60×10^{-4}	1.58×10^{-3}	1.87×10^{-12}	1.60×10^{-4}	2.38×10^{-3}	8.57×10^{-8}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.03	3.63×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	**3.78×10^{-2}**	**0.00**	**N/A**	**2.87×10^{-1}**	**1.87×10^{-12}**	**N/A**	**6.39×10^{-1}**	**8.57×10^{-8}**
Year of peak impact	7927	7927	N/A	7927	7927	4481	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–362. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Hunter-Gatherer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Hunter-Gatherer: Dose at Year of Peak Dose (millirem per year)	American Indian Hunter-Gatherer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920

Chemical Constituent	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Hunter-Gatherer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Hunter-Gatherer: Hazard Index at Year of Peak Hazard Index	American Indian Hunter-Gatherer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.60×10^{-4}	7.04×10^{-4}	8.56×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**8.56×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–57, Q–58, and Q–59 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 11,400 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

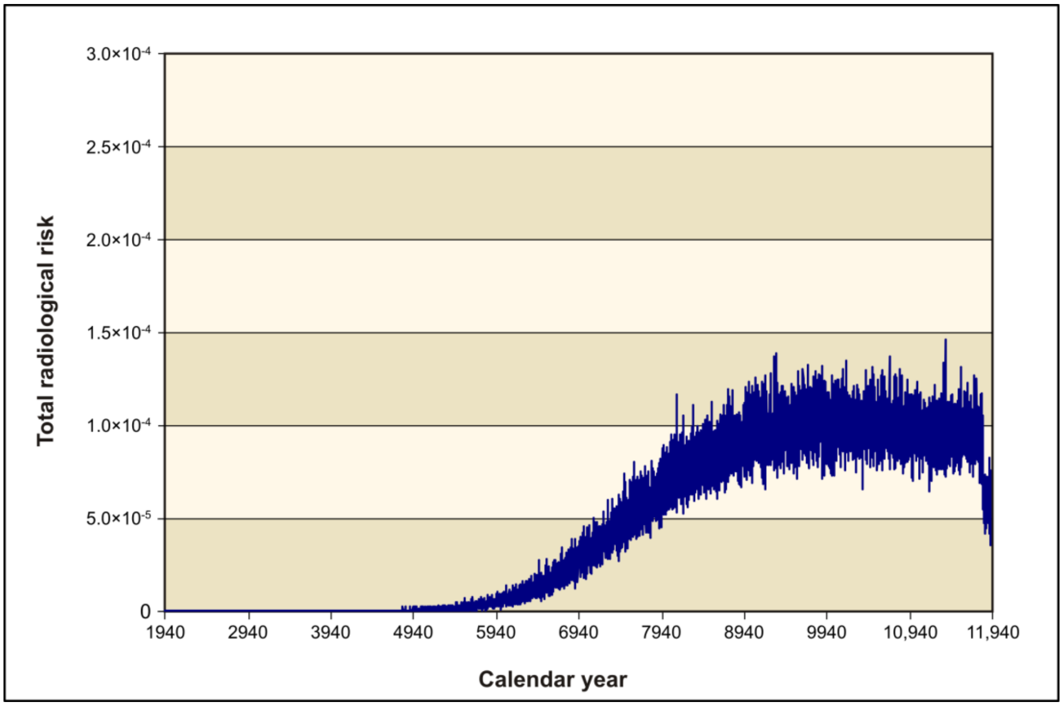


Figure Q–57. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

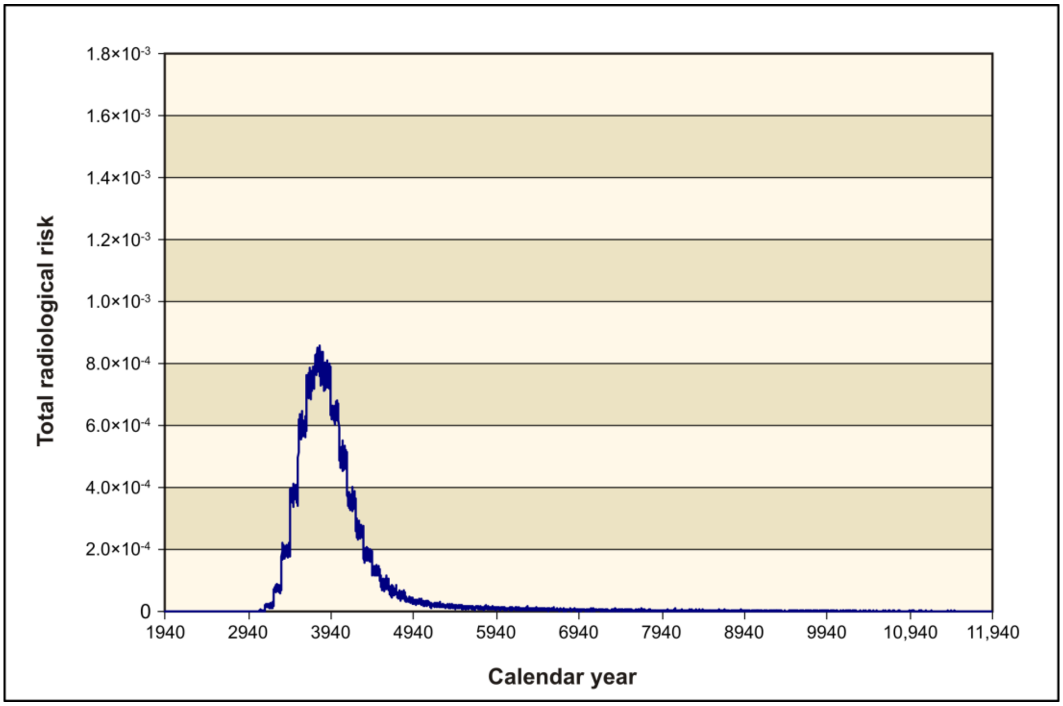


Figure Q–58. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

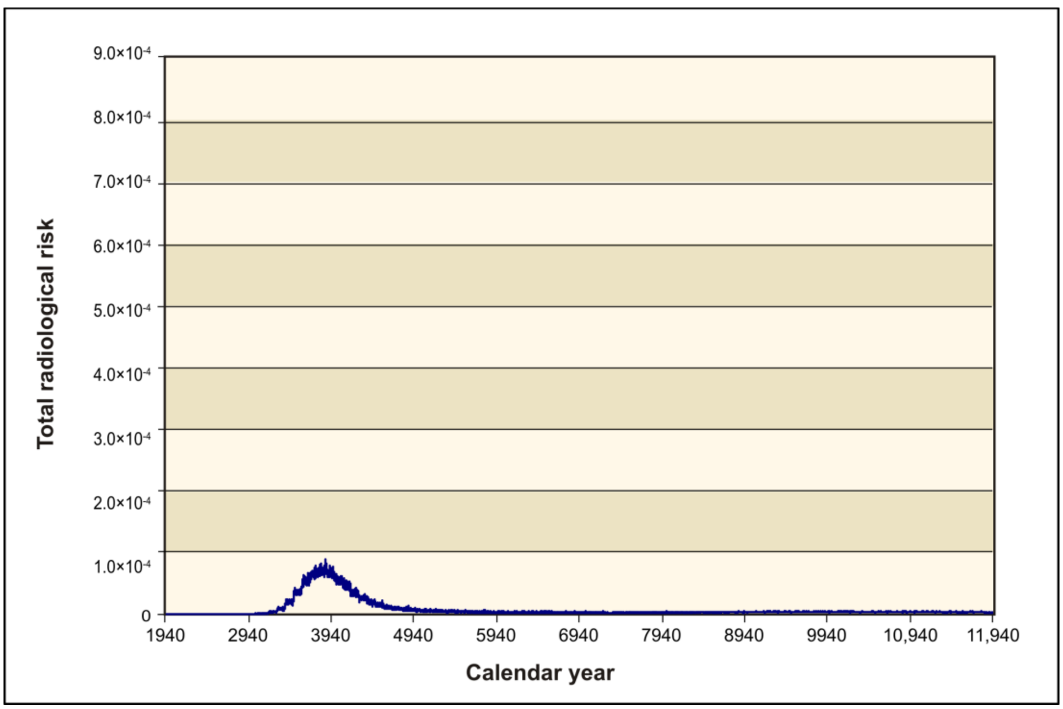


Figure Q–59. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.8 Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A

Disposal Group 2, Subgroup 2-A, addresses the waste resulting from Tank Closure Alternative 2A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 2A because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–363 through Q–367, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact.

Table Q–363. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.76×10^{-7}	3.09×10^{-1}	1.13×10^{-5}	1.88×10^{-7}	8.46×10^{-1}	3.83×10^{-5}	1.88×10^{-7}	1.73	8.37×10^{-5}
Iodine-129	6.65×10^{-10}	1.89×10^{-1}	1.93×10^{-6}	5.95×10^{-10}	2.12×10^{-1}	2.26×10^{-6}	5.95×10^{-10}	2.74×10^{-1}	3.42×10^{-6}
Total	**N/A**	**4.98×10^{-1}**	**1.32×10^{-5}**	**N/A**	**1.06**	**4.05×10^{-5}**	**N/A**	**2.00**	**8.71×10^{-5}**
Year of peak impact	10,979	10,979	11,050	11,050	11,050	10,056	11,050	11,050	10,056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.11×10^{-3}	1.06×10^{-2}	0.00	1.11×10^{-3}	1.10×10^{-2}	6.97×10^{-12}	1.11×10^{-3}	1.65×10^{-2}	3.20×10^{-7}
Nitrate	9.30	1.66×10^{-1}	0.00	9.30	1.31	0.00	9.30	2.91	0.00
Total	**N/A**	**1.77×10^{-1}**	**0.00**	**N/A**	**1.32**	**6.97×10^{-12}**	**N/A**	**2.93**	**3.20×10^{-7}**
Year of peak impact	7960	7960	N/A	7960	7960	8791	7960	7960	8791

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–364. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–365. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.48×10^{-4}	4.26×10^{-3}	0.00	4.48×10^{-4}	4.42×10^{-3}	2.79×10^{-12}	4.48×10^{-4}	6.65×10^{-3}	1.28×10^{-7}
Nitrate	2.92	5.21×10^{-2}	0.00	2.92	4.10×10^{-1}	0.00	2.92	9.14×10^{-1}	0.00
Total	**N/A**	**5.64×10^{-2}**	**0.00**	**N/A**	**4.14×10^{-1}**	**2.79×10^{-12}**	**N/A**	**9.20×10^{-1}**	**1.28×10^{-7}**
Year of peak impact	8123	8123	N/A	8123	8123	8053	8123	8123	8053

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–366. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.49×10^{-4}	2.37×10^{-3}	0.00	2.49×10^{-4}	2.45×10^{-3}	1.68×10^{-12}	2.49×10^{-4}	3.69×10^{-3}	7.68×10^{-8}
Fluoride	2.48×10^{-6}	1.18×10^{-6}	0.00	2.48×10^{-6}	3.31×10^{-6}	0.00	2.48×10^{-6}	6.95×10^{-6}	0.00
Nitrate	1.86	3.33×10^{-2}	0.00	1.86	2.62×10^{-1}	0.00	1.86	5.84×10^{-1}	0.00
Total	**N/A**	**3.57×10^{-2}**	**0.00**	**N/A**	**2.64×10^{-1}**	**1.68×10^{-12}**	**N/A**	**5.87×10^{-1}**	**7.68×10^{-8}**
Year of peak impact	8406	8406	N/A	8406	8406	7640	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–367. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.35×10^{-11}	6.08×10^{-5}	2.67×10^{-9}	1.33×10^{-11}	1.39×10^{-4}	6.58×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.94×10^{-14}	6.93×10^{-6}	9.77×10^{-11}	2.03×10^{-14}	1.10×10^{-4}	2.65×10^{-9}	2.11×10^{-9}	7.09×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.78×10^{-5}**	**2.77×10^{-9}**	**N/A**	**2.49×10^{-4}**	**9.24×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	2.49×10^{-4}	1.09×10^{-3}	7.68×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.48×10^{-6}	3.61×10^{-7}	0.00
Nitrate	3.55×10^{-5}	5.37×10^{-6}	0.00	3.55×10^{-5}	3.34×10^{-3}	0.00	1.86	9.02×10^{-2}	0.00
Total	**N/A**	**5.37×10^{-6}**	**0.00**	**N/A**	**3.34×10^{-3}**	**0.00**	**N/A**	**9.13×10^{-2}**	**7.68×10^{-8}**
Year of peak impact	8238	8238	N/A	8238	8238	N/A	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–60, Q–61, and Q–62 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 11,000 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

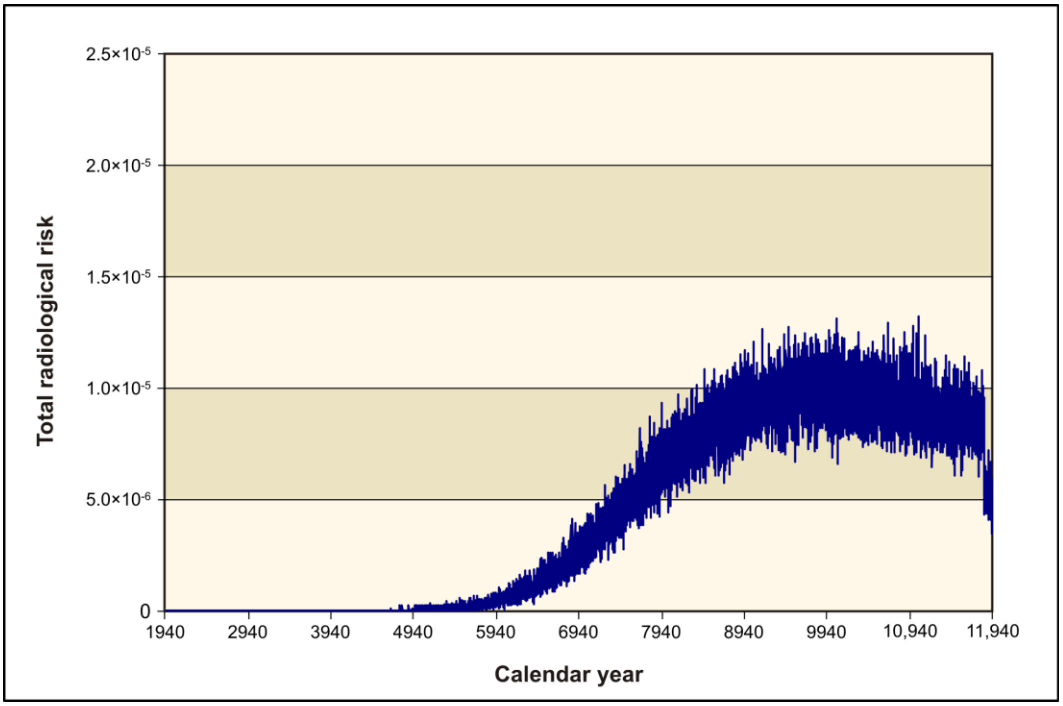


Figure Q–60. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

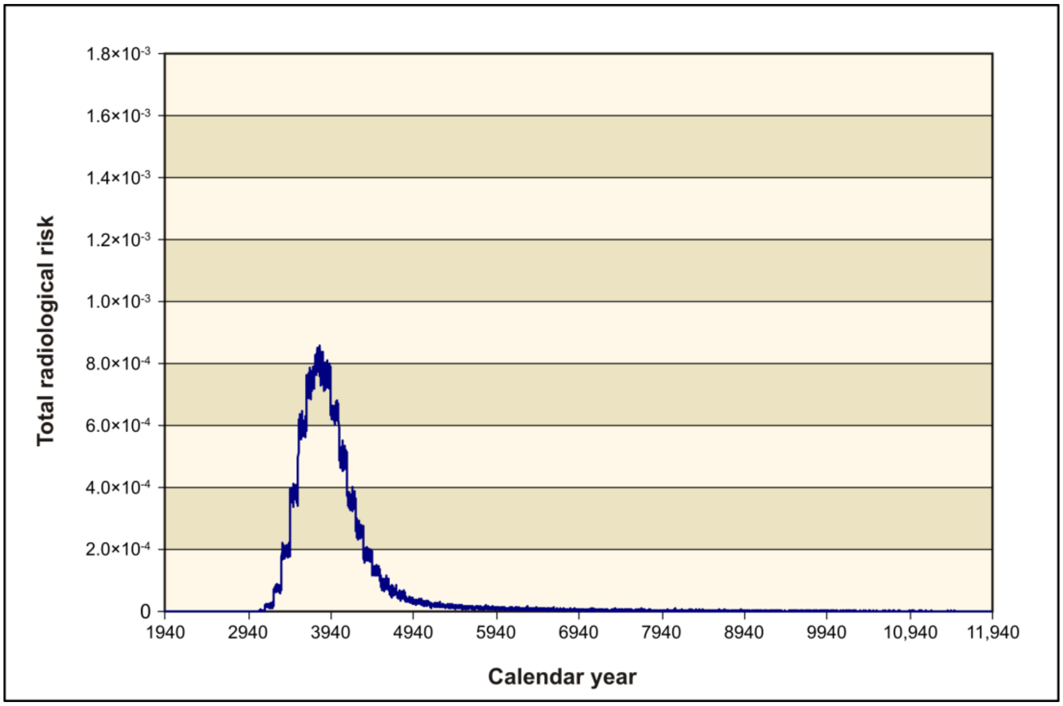


Figure Q–61. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

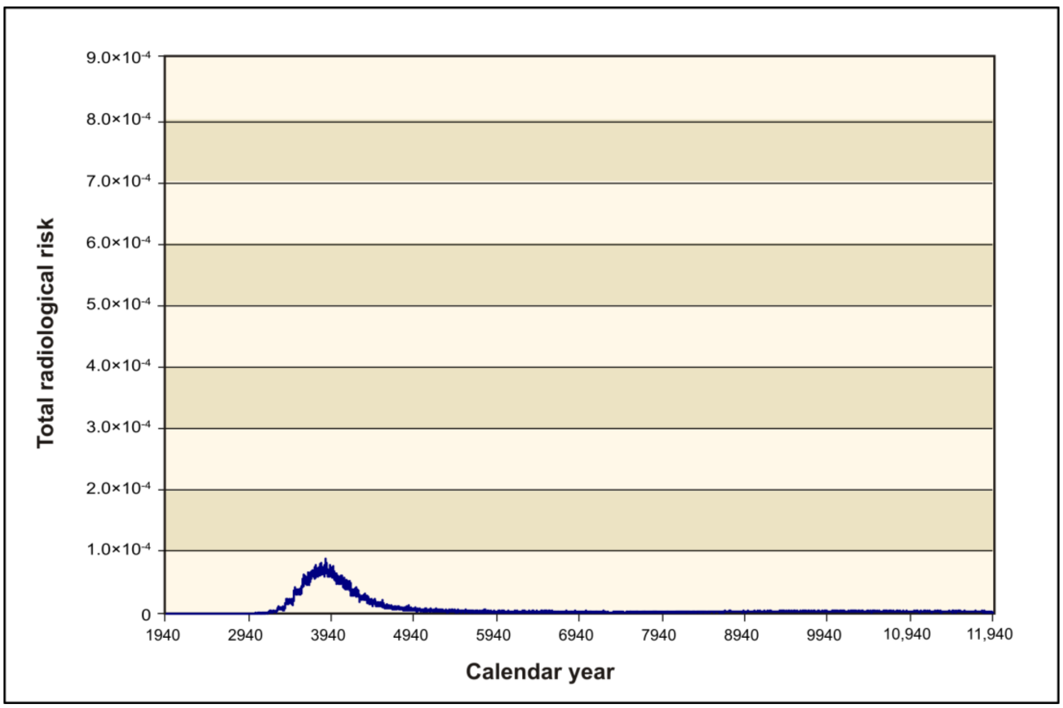


Figure Q–62. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.9 Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B

Disposal Group 2, Subgroup 2-B, addresses the waste resulting from Tank Closure Alternative 6B (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- PPF glass
- PPF melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6B, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–368 through Q–379. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer under both the Base and Option Cases. The Hazard Index guideline would be exceeded under both the Base and Option Cases at the IDF-East barrier for the resident farmer and the American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded under the Option Case at the RPPDF barrier and Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose under the Base Case is estimated as 3.77×10^{-1} person-rem per year for the year of maximum impact and under the Option Case, as 3.99×10^{-1} person-rem per year for the year of maximum impact.

Table Q–368. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-7}	2.93×10^{-1}	1.16×10^{-5}	1.94×10^{-7}	8.73×10^{-1}	3.83×10^{-5}	1.94×10^{-7}	1.78	8.38×10^{-5}
Iodine-129	8.21×10^{-10}	2.34×10^{-1}	1.92×10^{-6}	5.92×10^{-10}	2.11×10^{-1}	2.97×10^{-6}	5.92×10^{-10}	2.72×10^{-1}	4.49×10^{-6}
Total	**N/A**	**5.27×10^{-1}**	**1.36×10^{-5}**	**N/A**	**1.08**	**4.13×10^{-5}**	**N/A**	**2.05**	**8.83×10^{-5}**
Year of peak impact	10,636	10,636	10,188	10,188	10,188	10,188	10,188	10,188	10,188
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.09×10^{-3}	1.04×10^{-2}	0.00	1.09×10^{-3}	1.08×10^{-2}	7.44×10^{-12}	1.09×10^{-3}	1.62×10^{-2}	3.41×10^{-7}
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	**1.82×10^{-1}**	**0.00**	**N/A**	**1.36**	**7.44×10^{-12}**	**N/A**	**3.02**	**3.41×10^{-7}**
Year of peak impact	7983	7983	N/A	7983	7983	8251	7983	7983	8251

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–369. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–370. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	$1.55{\times}10^{-7}$	$2.71{\times}10^{-1}$	$9.34{\times}10^{-6}$	$1.55{\times}10^{-7}$	$7.00{\times}10^{-1}$	$3.07{\times}10^{-5}$	$1.55{\times}10^{-7}$	1.43	$6.72{\times}10^{-5}$
Iodine-129	$1.92{\times}10^{-10}$	$5.48{\times}10^{-2}$	$6.23{\times}10^{-7}$	$1.92{\times}10^{-10}$	$6.84{\times}10^{-2}$	$9.63{\times}10^{-7}$	$1.92{\times}10^{-10}$	$8.84{\times}10^{-2}$	$1.46{\times}10^{-6}$
Total	**N/A**	$\mathbf{3.26{\times}10^{-1}}$	$\mathbf{9.96{\times}10^{-6}}$	**N/A**	$\mathbf{7.68{\times}10^{-1}}$	$\mathbf{3.17{\times}10^{-5}}$	**N/A**	**1.52**	$\mathbf{6.86{\times}10^{-5}}$
Year of peak impact	3769	3769	3769	3769	3769	3769	3769	3769	3769
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	$1.04{\times}10^{-6}$	$4.93{\times}10^{-6}$	0.00	$9.29{\times}10^{-7}$	$5.53{\times}10^{-6}$	0.00	$7.28{\times}10^{-7}$	$7.83{\times}10^{-6}$	0.00
Chromium	$3.65{\times}10^{-3}$	$3.48{\times}10^{-2}$	0.00	$3.00{\times}10^{-3}$	$2.97{\times}10^{-2}$	$1.43{\times}10^{-11}$	$2.65{\times}10^{-3}$	$3.94{\times}10^{-2}$	$6.58{\times}10^{-7}$
Nitrate	$1.67{\times}10^{-1}$	$2.98{\times}10^{-3}$	0.00	$2.52{\times}10^{-1}$	$3.54{\times}10^{-2}$	0.00	$2.77{\times}10^{-1}$	$8.66{\times}10^{-2}$	0.00
Total	**N/A**	$\mathbf{3.78{\times}10^{-2}}$	**0.00**	**N/A**	$\mathbf{6.51{\times}10^{-2}}$	$\mathbf{1.43{\times}10^{-11}}$	**N/A**	$\mathbf{1.26{\times}10^{-1}}$	$\mathbf{6.58{\times}10^{-7}}$
Year of peak impact	3710	3710	N/A	3724	3724	3710	3789	3789	3710

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–371. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.53×10^{-4}	4.31×10^{-3}	0.00	4.53×10^{-4}	4.47×10^{-3}	1.34×10^{-11}	4.53×10^{-4}	6.73×10^{-3}	6.13×10^{-7}
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.02×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.34×10^{-11}**	**N/A**	**9.86×10^{-1}**	**6.13×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3977	7860	7860	3977

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–372. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	$1.67{\times}10^{-6}$	2.92	$1.01{\times}10^{-4}$	$1.67{\times}10^{-6}$	7.54	$3.31{\times}10^{-4}$	$1.67{\times}10^{-6}$	$1.54{\times}10^{1}$	$7.24{\times}10^{-4}$
Iodine-129	$2.11{\times}10^{-9}$	$6.02{\times}10^{-1}$	$6.84{\times}10^{-6}$	$2.11{\times}10^{-9}$	$7.52{\times}10^{-1}$	$1.06{\times}10^{-5}$	$2.11{\times}10^{-9}$	$9.72{\times}10^{-1}$	$1.60{\times}10^{-5}$
Total	**N/A**	**3.53**	**$1.07{\times}10^{-4}$**	**N/A**	**8.29**	**$3.41{\times}10^{-4}$**	**N/A**	**$1.64{\times}10^{1}$**	**$7.40{\times}10^{-4}$**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	$1.33{\times}10^{-8}$	$6.35{\times}10^{-8}$	0.00	$1.33{\times}10^{-8}$	$7.93{\times}10^{-8}$	0.00	$1.33{\times}10^{-8}$	$1.43{\times}10^{-7}$	0.00
Chromium	$1.28{\times}10^{-4}$	$1.22{\times}10^{-3}$	0.00	$1.28{\times}10^{-4}$	$1.26{\times}10^{-3}$	$8.71{\times}10^{-12}$	$1.28{\times}10^{-4}$	$1.90{\times}10^{-3}$	$3.99{\times}10^{-7}$
Fluoride	$9.90{\times}10^{-6}$	$4.72{\times}10^{-6}$	0.00	$9.90{\times}10^{-6}$	$1.32{\times}10^{-5}$	0.00	$9.90{\times}10^{-6}$	$2.78{\times}10^{-5}$	0.00
Nitrate	2.14	$3.82{\times}10^{-2}$	0.00	2.14	$3.01{\times}10^{-1}$	0.00	2.14	$6.70{\times}10^{-1}$	0.00
Total	**N/A**	**$3.95{\times}10^{-2}$**	**0.00**	**N/A**	**$3.02{\times}10^{-1}$**	**$8.71{\times}10^{-12}$**	**N/A**	**$6.72{\times}10^{-1}$**	**$3.99{\times}10^{-7}$**
Year of peak impact	7994	7994	N/A	7994	7994	4632	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–373. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.49×10^{-11}	6.73×10^{-5}	2.95×10^{-9}	1.46×10^{-11}	1.52×10^{-4}	7.32×10^{-9}	1.67×10^{-6}	5.02×10^{-2}	2.68×10^{-6}
Iodine-129	2.26×10^{-14}	8.07×10^{-6}	1.14×10^{-10}	2.37×10^{-14}	1.29×10^{-4}	3.04×10^{-9}	2.11×10^{-9}	7.20×10^{-3}	1.77×10^{-7}
Total	**N/A**	**7.53×10^{-5}**	**3.07×10^{-9}**	**N/A**	**2.81×10^{-4}**	**1.04×10^{-8}**	**N/A**	**5.74×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4074	4074	4074	4095	4095	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	1.33×10^{-8}	8.00×10^{-8}	0.00
Chromium	0.00	0.00	1.73×10^{-16}	0.00	0.00	7.93×10^{-12}	1.28×10^{-4}	5.61×10^{-4}	3.99×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.73×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.93×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.99×10^{-7}**
Year of peak impact	8188	8188	4046	8188	8188	4046	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–374. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.52×10^{-7}	2.67×10^{-1}	1.18×10^{-5}	1.96×10^{-7}	8.82×10^{-1}	3.87×10^{-5}	1.96×10^{-7}	1.80	8.47×10^{-5}
Iodine-129	8.46×10^{-10}	2.41×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**5.08×10^{-1}**	**1.35×10^{-5}**	**N/A**	**1.07**	**4.14×10^{-5}**	**N/A**	**2.05**	**8.87×10^{-5}**
Year of peak impact	9990	9990	9705	9705	9705	9705	9705	9705	9705

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.80×10^{-12}	1.75×10^{-3}	2.60×10^{-2}	4.04×10^{-7}
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.80×10^{-12}**	**N/A**	**4.60**	**4.04×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8152	7954	7954	8152

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–375. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–376. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.20×10^{-7}	3.85×10^{-1}	1.32×10^{-5}	2.20×10^{-7}	9.92×10^{-1}	4.35×10^{-5}	2.20×10^{-7}	2.03	9.52×10^{-5}
Iodine-129	2.99×10^{-10}	8.53×10^{-2}	9.70×10^{-7}	2.99×10^{-10}	1.07×10^{-1}	1.50×10^{-6}	2.99×10^{-10}	1.38×10^{-1}	2.27×10^{-6}
Total	**N/A**	**4.70×10^{-1}**	**1.42×10^{-5}**	**N/A**	**1.10**	**4.50×10^{-5}**	**N/A**	**2.16**	**9.75×10^{-5}**
Year of peak impact	3812	3812	3812	3812	3812	3812	3812	3812	3812

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	8.24×10^{-7}	3.92×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.29×10^{-2}	3.13×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.33×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	6.11×10^{-6}
Nitrate	7.17	1.28×10^{-1}	0.00	9.86	1.38	0.00	9.86	3.09	0.00
Total	**N/A**	**4.41×10^{-1}**	**0.00**	**N/A**	**1.61**	**1.33×10^{-10}**	**N/A**	**3.43**	**6.11×10^{-6}**
Year of peak impact	3680	3680	N/A	3733	3733	3807	3733	3733	3807

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–377. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	5.39×10^{-7}	2.57×10^{-6}	0.00	6.91×10^{-7}	4.11×10^{-6}	0.00	6.91×10^{-7}	7.44×10^{-6}	0.00
Boron and compounds	2.22×10^{-6}	3.17×10^{-7}	0.00	3.04×10^{-6}	4.52×10^{-7}	0.00	3.04×10^{-6}	4.92×10^{-7}	0.00
Chromium	2.84×10^{-2}	2.70×10^{-1}	0.00	2.08×10^{-2}	2.06×10^{-1}	1.12×10^{-10}	2.08×10^{-2}	3.09×10^{-1}	5.15×10^{-6}
Fluoride	1.66×10^{-4}	7.90×10^{-5}	0.00	2.10×10^{-4}	2.82×10^{-4}	0.00	2.10×10^{-4}	5.91×10^{-4}	0.00
Nitrate	4.79	8.56×10^{-2}	0.00	7.22	1.01	0.00	7.22	2.26	0.00
Total	**N/A**	**3.56×10^{-1}**	**0.00**	**N/A**	**1.22**	**1.12×10^{-10}**	**N/A**	**2.57**	**5.15×10^{-6}**
Year of peak impact	3688	3688	N/A	3858	3858	3901	3858	3858	3901

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–378. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	$\mathbf{1.07\times10^{-4}}$	**N/A**	**8.28**	$\mathbf{3.41\times10^{-4}}$	**N/A**	$\mathbf{1.63\times10^{1}}$	$\mathbf{7.39\times10^{-4}}$
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.60×10^{-7}	2.67×10^{-6}	0.00	4.93×10^{-7}	2.93×10^{-6}	0.00	4.93×10^{-7}	5.31×10^{-6}	0.00
Boron and compounds	3.34×10^{-6}	4.77×10^{-7}	0.00	3.61×10^{-6}	5.35×10^{-7}	0.00	3.61×10^{-6}	5.83×10^{-7}	0.00
Chromium	1.86×10^{-2}	1.77×10^{-1}	0.00	1.49×10^{-2}	1.47×10^{-1}	7.56×10^{-11}	1.49×10^{-2}	2.21×10^{-1}	3.47×10^{-6}
Fluoride	2.35×10^{-4}	1.12×10^{-4}	0.00	2.48×10^{-4}	3.31×10^{-4}	0.00	2.48×10^{-4}	6.95×10^{-4}	0.00
Nitrate	3.30	5.90×10^{-2}	0.00	4.15	5.83×10^{-1}	0.00	4.15	1.30	0.00
Total	**N/A**	$\mathbf{2.36\times10^{-1}}$	**0.00**	**N/A**	$\mathbf{7.30\times10^{-1}}$	$\mathbf{7.56\times10^{-11}}$	**N/A**	**1.52**	$\mathbf{3.47\times10^{-6}}$
Year of peak impact	4560	4560	N/A	4465	4465	4558	4465	4465	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–379. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.58×10^{-11}	7.13×10^{-5}	3.13×10^{-9}	1.57×10^{-11}	1.63×10^{-4}	7.75×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.38×10^{-14}	8.51×10^{-6}	1.20×10^{-10}	2.48×10^{-14}	1.35×10^{-4}	3.25×10^{-9}	2.11×10^{-9}	7.26×10^{-3}	1.78×10^{-7}
Total	**N/A**	$\mathbf{7.98\times10^{-5}}$	$\mathbf{3.25\times10^{-9}}$	**N/A**	$\mathbf{2.98\times10^{-4}}$	$\mathbf{1.10\times10^{-8}}$	**N/A**	$\mathbf{5.74\times10^{-2}}$	$\mathbf{2.86\times10^{-6}}$
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.00×10^{-7}	2.40×10^{-6}	0.00
Boron and compounds	0.00	0.00	0.00	0.00	0.00	0.00	3.64×10^{-6}	3.97×10^{-8}	0.00
Chromium	3.69×10^{-7}	3.64×10^{-6}	1.55×10^{-15}	3.69×10^{-7}	5.97×10^{-6}	7.10×10^{-11}	1.22×10^{-2}	5.36×10^{-2}	3.47×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.30×10^{-4}	3.36×10^{-5}	0.00
Nitrate	1.10×10^{-4}	1.67×10^{-5}	0.00	1.10×10^{-4}	1.04×10^{-2}	0.00	3.96	2.29×10^{-1}	0.00
Total	**N/A**	$\mathbf{2.03\times10^{-5}}$	$\mathbf{1.55\times10^{-15}}$	**N/A**	$\mathbf{1.04\times10^{-2}}$	$\mathbf{7.10\times10^{-11}}$	**N/A**	$\mathbf{2.83\times10^{-1}}$	$\mathbf{3.47\times10^{-6}}$
Year of peak impact	4079	4079	4055	4079	4079	4055	4055	4055	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figures Q–63 through Q–68 depict the cumulative radiological lifetime risk of incidence of cancer over time at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary for the drinking-water well user. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary under the Base and Option Cases and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,000 under the Base and Option Cases as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

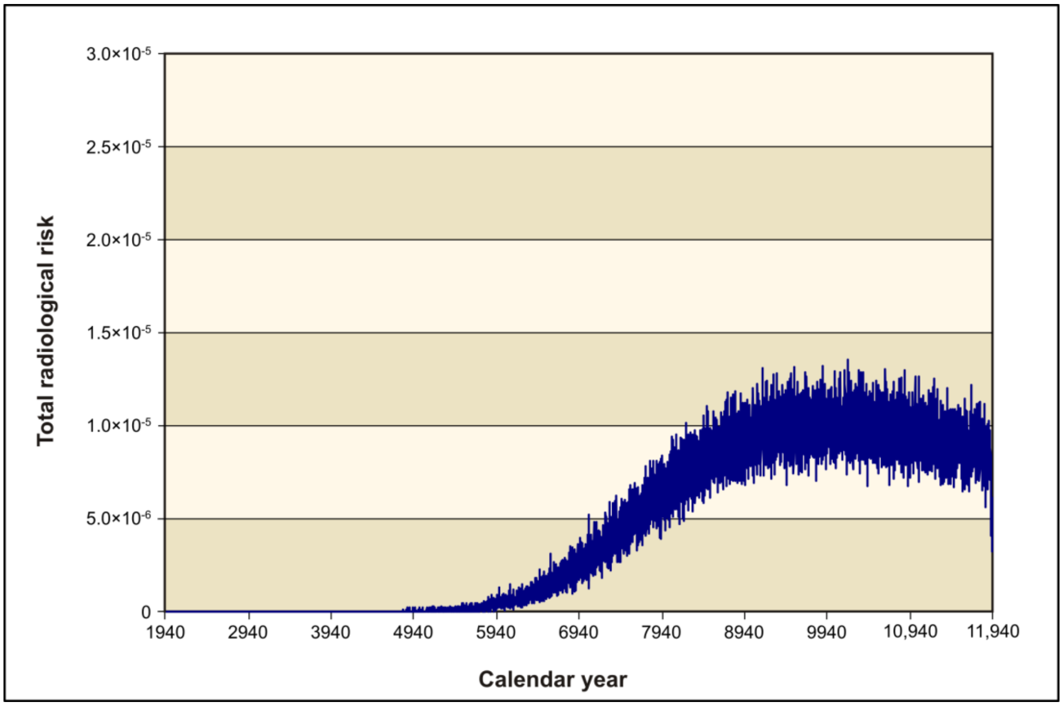


Figure Q–63. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

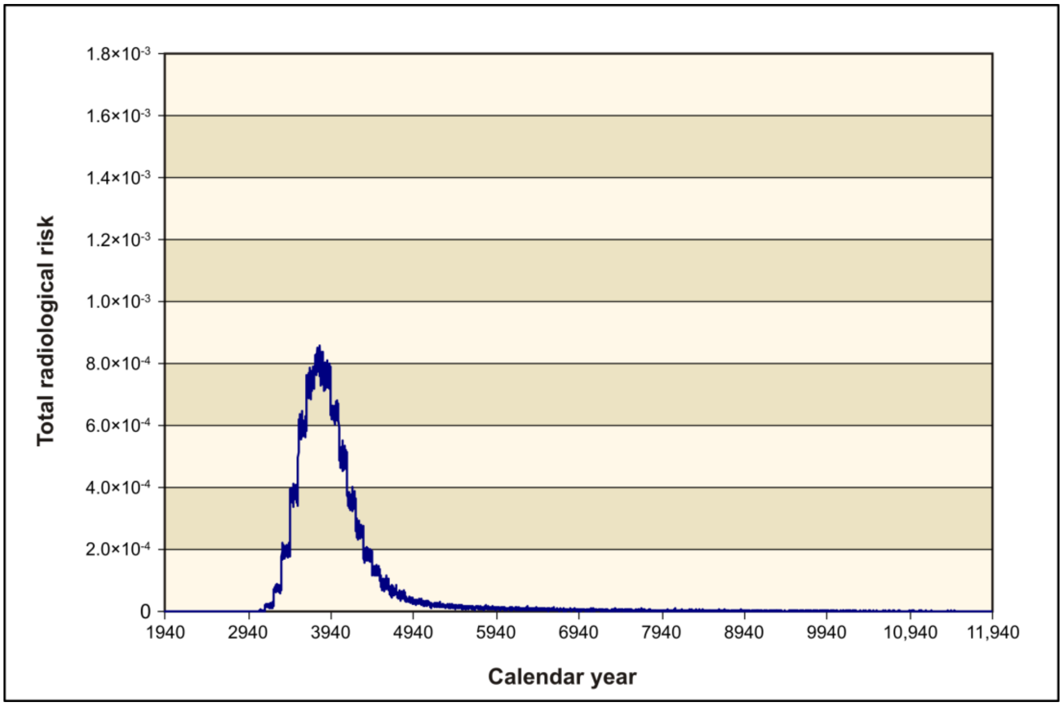


Figure Q–64. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

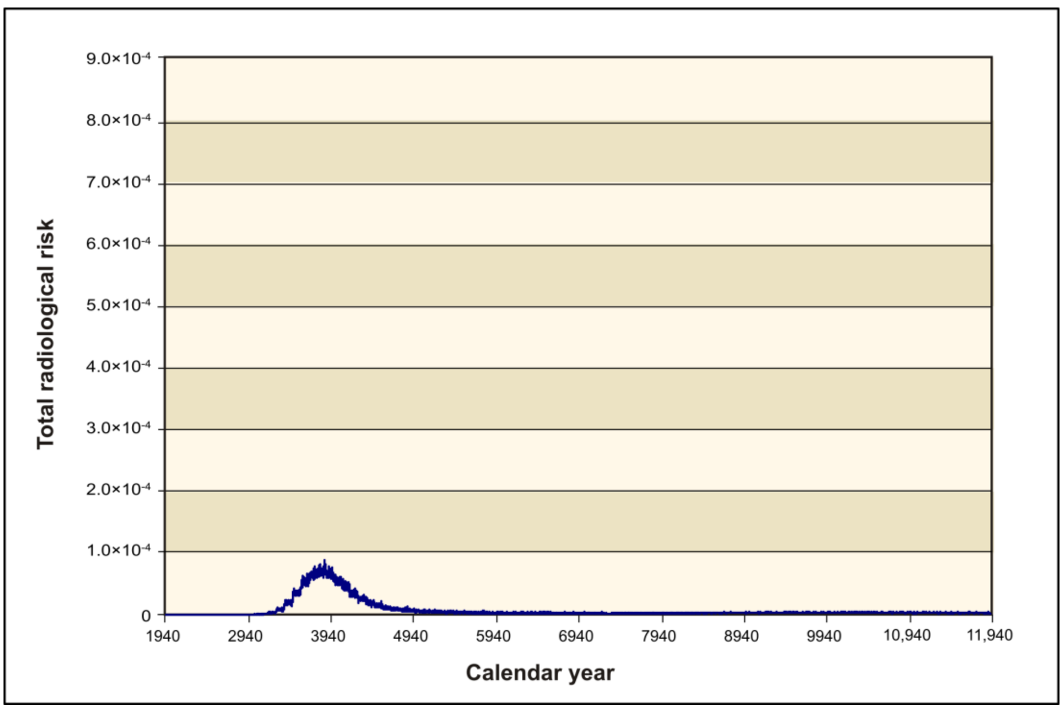


Figure Q–65. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

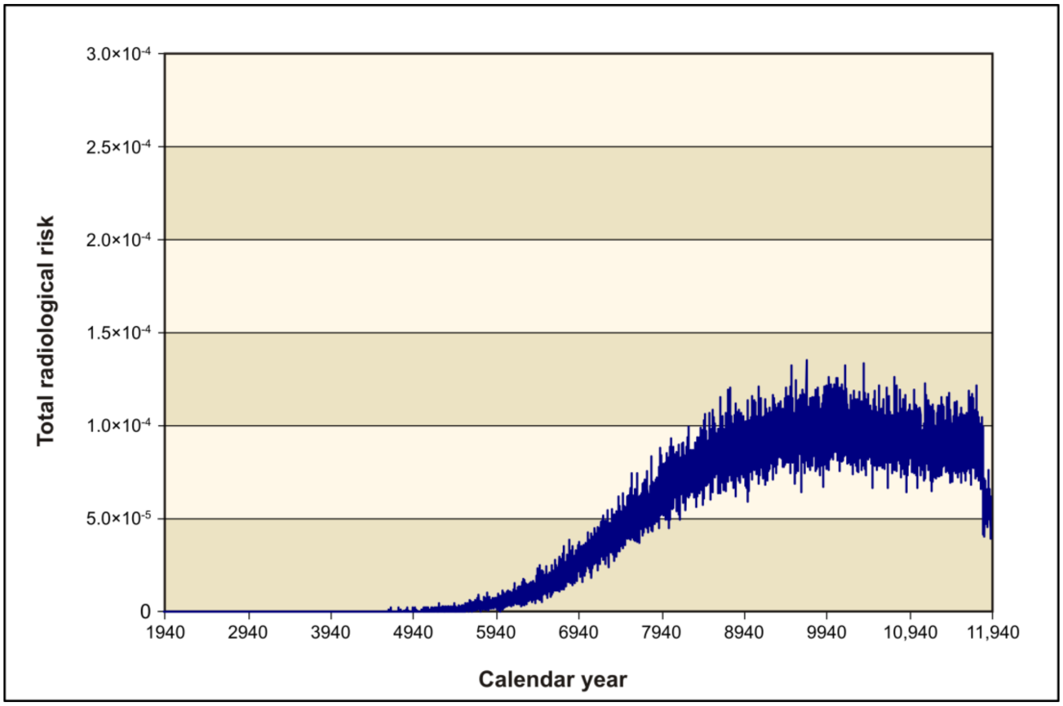


Figure Q–66. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

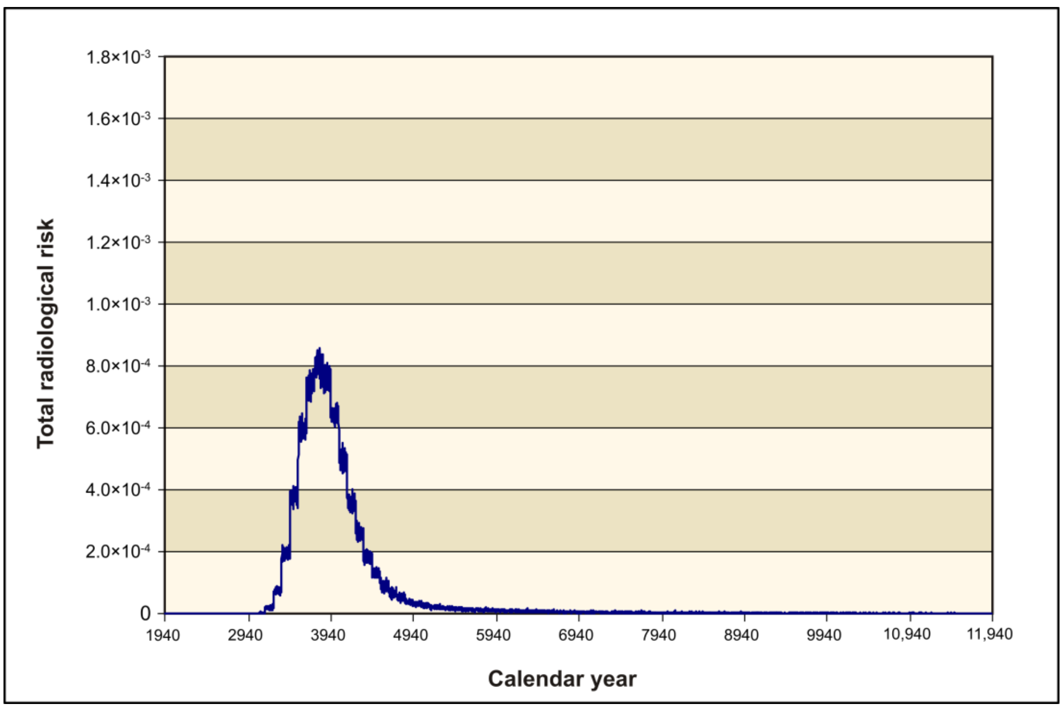


Figure Q–67. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

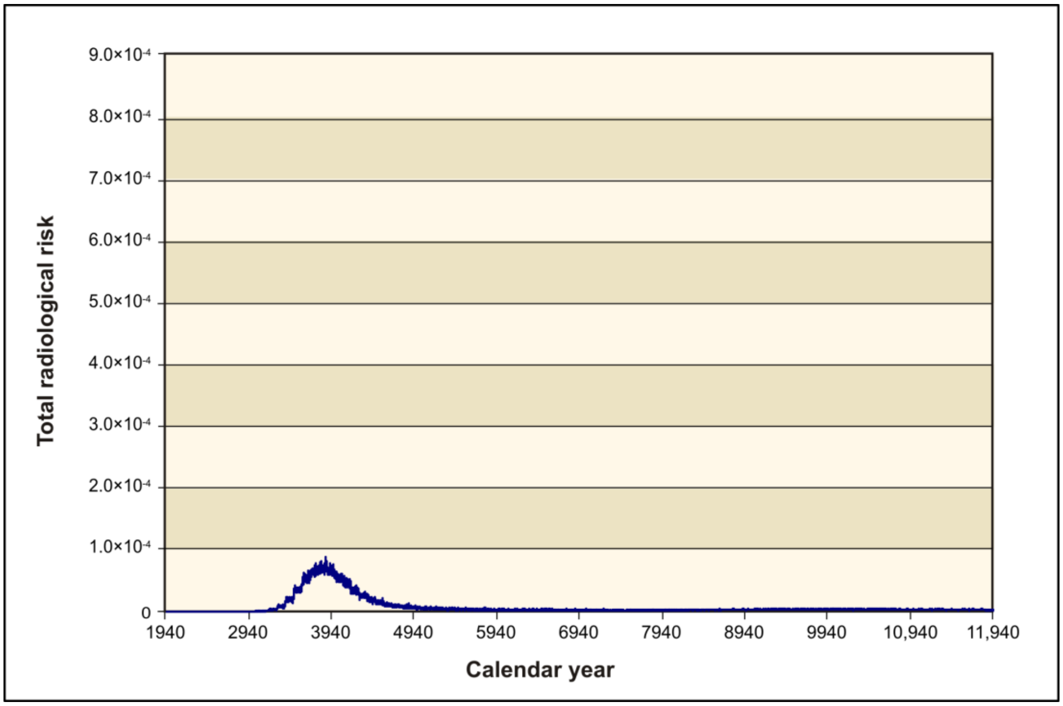


Figure Q–68. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.10 Waste Management Alternative 3, Disposal Group 3

Disposal Group 3 addresses the waste resulting from Tank Closure Alternative 6A (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- PPF glass
- PPF melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6A, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–380 through Q–391, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer under the Base and Option Cases. Under both the Base and Option Cases, the Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded under the Option Case at the RPPDF barrier and Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose under the Base Case is estimated as 3.76×10^{-1} person-rem per year for the year of maximum impact and under the Option Case, as 3.98×10^{-1} person-rem per year for the year of maximum impact.

Table Q–380. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-7}	2.93×10^{-1}	1.16×10^{-5}	1.94×10^{-7}	8.73×10^{-1}	3.83×10^{-5}	1.94×10^{-7}	1.78	8.38×10^{-5}
Iodine-129	8.21×10^{-10}	2.34×10^{-1}	1.92×10^{-6}	5.92×10^{-10}	2.11×10^{-1}	2.97×10^{-6}	5.92×10^{-10}	2.72×10^{-1}	4.49×10^{-6}
Total	**N/A**	$\mathbf{5.27\times10^{-1}}$	$\mathbf{1.36\times10^{-5}}$	**N/A**	**1.08**	$\mathbf{4.13\times10^{-5}}$	**N/A**	**2.05**	$\mathbf{8.83\times10^{-5}}$
Year of peak impact	10,636	10,636	10,188	10,188	10,188	10,188	10,188	10,188	10,188
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.09×10^{-3}	1.04×10^{-2}	0.00	1.09×10^{-3}	1.08×10^{-2}	7.44×10^{-12}	1.09×10^{-3}	1.62×10^{-2}	3.41×10^{-7}
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	$\mathbf{1.82\times10^{-1}}$	**0.00**	**N/A**	**1.36**	$\mathbf{7.44\times10^{-12}}$	**N/A**	**3.02**	$\mathbf{3.41\times10^{-7}}$
Year of peak impact	7983	7983	N/A	7983	7983	8251	7983	7983	8251

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–381. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	$\mathbf{2.87\times10^{1}}$	$\mathbf{8.59\times10^{-4}}$	**N/A**	$\mathbf{6.66\times10^{1}}$	$\mathbf{2.72\times10^{-3}}$	**N/A**	$\mathbf{1.31\times10^{2}}$	$\mathbf{5.87\times10^{-3}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	$\mathbf{1.03\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.17\times10^{-2}}$	$\mathbf{4.13\times10^{-12}}$	**N/A**	$\mathbf{1.87\times10^{-2}}$	$\mathbf{1.89\times10^{-7}}$
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–382. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.47×10^{-7}	2.58×10^{-1}	8.87×10^{-6}	1.47×10^{-7}	6.65×10^{-1}	2.92×10^{-5}	1.47×10^{-7}	1.36	6.38×10^{-5}
Iodine-129	1.97×10^{-10}	5.62×10^{-2}	6.39×10^{-7}	1.97×10^{-10}	7.02×10^{-2}	9.87×10^{-7}	1.97×10^{-10}	9.07×10^{-2}	1.49×10^{-6}
Total	**N/A**	**3.14×10^{-1}**	**9.51×10^{-6}**	**N/A**	**7.35×10^{-1}**	**3.02×10^{-5}**	**N/A**	**1.45**	**6.53×10^{-5}**
Year of peak impact	4013	4013	4013	4013	4013	4013	4013	4013	4013
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.66×10^{-7}	4.12×10^{-6}	0.00	8.66×10^{-7}	5.15×10^{-6}	0.00	8.66×10^{-7}	9.32×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.65×10^{-3}	3.61×10^{-2}	1.48×10^{-11}	3.65×10^{-3}	5.43×10^{-2}	6.79×10^{-7}
Nitrate	2.44×10^{-1}	4.36×10^{-3}	0.00	2.44×10^{-1}	3.43×10^{-2}	0.00	2.44×10^{-1}	7.64×10^{-2}	0.00
Total	**N/A**	**3.92×10^{-2}**	**0.00**	**N/A**	**7.03×10^{-2}**	**1.48×10^{-11}**	**N/A**	**1.31×10^{-1}**	**6.79×10^{-7}**
Year of peak impact	3929	3929	N/A	3929	3929	3869	3929	3929	3869

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–383. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	$\mathbf{8.86\times10^{-5}}$	**N/A**	**6.84**	$\mathbf{2.81\times10^{-4}}$	**N/A**	$\mathbf{1.35\times10^{1}}$	$\mathbf{6.09\times10^{-4}}$
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.53×10^{-4}	4.32×10^{-3}	0.00	4.53×10^{-4}	4.47×10^{-3}	1.29×10^{-11}	4.53×10^{-4}	6.73×10^{-3}	5.90×10^{-7}
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.02\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{4.44\times10^{-1}}$	$\mathbf{1.29\times10^{-11}}$	**N/A**	$\mathbf{9.86\times10^{-1}}$	$\mathbf{5.90\times10^{-7}}$
Year of peak impact	7860	7860	N/A	7860	7860	3701	7860	7860	3701

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–384. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.67×10^{-8}	1.27×10^{-7}	0.00	2.67×10^{-8}	1.59×10^{-7}	0.00	2.67×10^{-8}	2.87×10^{-7}	0.00
Chromium	1.28×10^{-4}	1.22×10^{-3}	0.00	1.28×10^{-4}	1.26×10^{-3}	8.11×10^{-12}	1.28×10^{-4}	1.90×10^{-3}	3.72×10^{-7}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**8.11×10^{-12}**	**N/A**	**6.72×10^{-1}**	**3.72×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4608	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–385. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.49×10^{-11}	6.72×10^{-5}	2.95×10^{-9}	1.46×10^{-11}	1.51×10^{-4}	7.36×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.25×10^{-14}	8.02×10^{-6}	1.13×10^{-10}	2.36×10^{-14}	1.28×10^{-4}	2.94×10^{-9}	2.11×10^{-9}	7.19×10^{-3}	1.76×10^{-7}
Total	**N/A**	**7.52×10^{-5}**	**3.06×10^{-9}**	**N/A**	**2.80×10^{-4}**	**1.03×10^{-8}**	**N/A**	**5.73×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4074	4074	4074	4095	4095	4074	3920	3920	3920

Chemical Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	2.67×10^{-8}	1.60×10^{-7}	0.00
Chromium	0.00	0.00	1.74×10^{-16}	0.00	0.00	7.98×10^{-12}	1.28×10^{-4}	5.61×10^{-4}	3.72×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.74×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.98×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.72×10^{-7}**
Year of peak impact	8188	8188	4184	8188	8188	4184	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–386. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.52×10^{-7}	2.67×10^{-1}	1.18×10^{-5}	1.96×10^{-7}	8.82×10^{-1}	3.87×10^{-5}	1.96×10^{-7}	1.80	8.47×10^{-5}
Iodine-129	8.46×10^{-10}	2.41×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**5.08×10^{-1}**	**1.35×10^{-5}**	**N/A**	**1.07**	**4.14×10^{-5}**	**N/A**	**2.05**	**8.87×10^{-5}**
Year of peak impact	9990	9990	9705	9705	9705	9705	9705	9705	9705
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.80×10^{-12}	1.75×10^{-3}	2.60×10^{-2}	4.04×10^{-7}
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.80×10^{-12}**	**N/A**	**4.60**	**4.04×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8501	7954	7954	8501

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–387. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	$\mathbf{2.87\times10^{1}}$	$\mathbf{8.59\times10^{-4}}$	**N/A**	$\mathbf{6.66\times10^{1}}$	$\mathbf{2.72\times10^{-3}}$	**N/A**	$\mathbf{1.31\times10^{2}}$	$\mathbf{5.87\times10^{-3}}$
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	$\mathbf{1.03\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{1.17\times10^{-2}}$	$\mathbf{4.13\times10^{-12}}$	**N/A**	$\mathbf{1.87\times10^{-2}}$	$\mathbf{1.89\times10^{-7}}$
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–388. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User: Concentration at Year of Peak Dose (curies per cubic meter)	Drinking-Water Well User: Dose at Year of Peak Dose (millirem per year)	Drinking-Water Well User: Radiological Risk at Year of Peak Radiological Risk	Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	Resident Farmer: Dose at Year of Peak Dose (millirem per year)	Resident Farmer: Radiological Risk at Year of Peak Radiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Dose (curies per cubic meter)	American Indian Resident Farmer: Dose at Year of Peak Dose (millirem per year)	American Indian Resident Farmer: Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.35×10^{-7}	4.12×10^{-1}	1.42×10^{-5}	2.35×10^{-7}	1.06	4.66×10^{-5}	2.35×10^{-7}	2.17	1.02×10^{-4}
Iodine-129	2.21×10^{-10}	6.30×10^{-2}	7.16×10^{-7}	2.21×10^{-10}	7.86×10^{-2}	1.11×10^{-6}	2.21×10^{-10}	1.02×10^{-1}	1.67×10^{-6}
Total	**N/A**	**4.75×10^{-1}**	**1.49×10^{-5}**	**N/A**	**1.14**	**4.77×10^{-5}**	**N/A**	**2.27**	**1.04×10^{-4}**
Year of peak impact	4018	4018	4018	4018	4018	4018	4018	4018	4018

Chemical Constituent	Drinking-Water Well User: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Drinking-Water Well User: Hazard Index at Year of Peak Hazard Index	Drinking-Water Well User: Nonradiological Risk at Year of Peak Nonradiological Risk	Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	Resident Farmer: Hazard Index at Year of Peak Hazard Index	Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk	American Indian Resident Farmer: Concentration at Year of Peak Hazard Index (grams per cubic meter)	American Indian Resident Farmer: Hazard Index at Year of Peak Hazard Index	American Indian Resident Farmer: Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	7.61×10^{-7}	3.62×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.13×10^{-2}	2.98×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.27×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	5.82×10^{-6}
Nitrate	7.92	1.41×10^{-1}	0.00	9.27	1.30	0.00	9.27	2.90	0.00
Total	**N/A**	**4.39×10^{-1}**	**0.00**	**N/A**	**1.53**	**1.27×10^{-10}**	**N/A**	**3.24**	**5.82×10^{-6}**
Year of peak impact	3916	3916	N/A	3930	3930	3873	3930	3930	3873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–389. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the Core Zone Boundary

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	$\mathbf{8.86\times10^{-5}}$	**N/A**	**6.84**	$\mathbf{2.81\times10^{-4}}$	**N/A**	$\mathbf{1.35\times10^{1}}$	$\mathbf{6.09\times10^{-4}}$
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.57×10^{-7}	3.13×10^{-6}	0.00	4.84×10^{-7}	2.88×10^{-6}	0.00	4.84×10^{-7}	5.21×10^{-6}	0.00
Boron and compounds	3.34×10^{-6}	4.77×10^{-7}	0.00	2.38×10^{-6}	3.54×10^{-7}	0.00	2.38×10^{-6}	3.85×10^{-7}	0.00
Chromium	2.84×10^{-2}	2.71×10^{-1}	0.00	2.32×10^{-2}	2.29×10^{-1}	1.12×10^{-10}	2.32×10^{-2}	3.44×10^{-1}	5.12×10^{-6}
Fluoride	3.00×10^{-4}	1.43×10^{-4}	0.00	2.23×10^{-4}	2.98×10^{-4}	0.00	2.23×10^{-4}	6.25×10^{-4}	0.00
Nitrate	5.83	1.04×10^{-1}	0.00	7.82	1.10	0.00	7.82	2.45	0.00
Total	**N/A**	$\mathbf{3.75\times10^{-1}}$	**0.00**	**N/A**	**1.33**	$\mathbf{1.12\times10^{-10}}$	**N/A**	**2.79**	$\mathbf{5.12\times10^{-6}}$
Year of peak impact	3865	3865	N/A	3782	3782	3865	3782	3782	3865

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–390. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Nearshore

	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	$\mathbf{1.07\times10^{-4}}$	**N/A**	**8.28**	$\mathbf{3.41\times10^{-4}}$	**N/A**	$\mathbf{1.63\times10^{1}}$	$\mathbf{7.39\times10^{-4}}$
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
	Drinking-Water Well User			**Resident Farmer**			**American Indian Resident Farmer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.27×10^{-7}	2.98×10^{-6}	0.00	4.67×10^{-7}	2.78×10^{-6}	0.00	4.67×10^{-7}	5.02×10^{-6}	0.00
Boron and compounds	3.67×10^{-6}	5.25×10^{-7}	0.00	3.01×10^{-6}	4.47×10^{-7}	0.00	3.01×10^{-6}	4.87×10^{-7}	0.00
Chromium	2.09×10^{-2}	1.99×10^{-1}	0.00	1.12×10^{-2}	1.11×10^{-1}	8.22×10^{-11}	1.12×10^{-2}	1.67×10^{-1}	3.77×10^{-6}
Fluoride	2.55×10^{-4}	1.21×10^{-4}	0.00	2.08×10^{-4}	2.78×10^{-4}	0.00	2.08×10^{-4}	5.84×10^{-4}	0.00
Nitrate	3.40	6.07×10^{-2}	0.00	5.19	7.29×10^{-1}	0.00	5.19	1.62	0.00
Total	**N/A**	$\mathbf{2.60\times10^{-1}}$	**0.00**	**N/A**	$\mathbf{8.40\times10^{-1}}$	$\mathbf{8.22\times10^{-11}}$	**N/A**	**1.79**	$\mathbf{3.77\times10^{-6}}$
Year of peak impact	4487	4487	N/A	4701	4701	4487	4701	4701	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–391. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Surface Water

	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
Radioactive Constituent	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.57×10^{-11}	7.09×10^{-5}	3.12×10^{-9}	1.54×10^{-11}	1.61×10^{-4}	7.77×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.44×10^{-14}	8.71×10^{-6}	1.20×10^{-10}	2.51×10^{-14}	1.37×10^{-4}	3.20×10^{-9}	2.11×10^{-9}	7.23×10^{-3}	1.77×10^{-7}
Total	**N/A**	**7.96×10^{-5}**	**3.24×10^{-9}**	**N/A**	**2.98×10^{-4}**	**1.10×10^{-8}**	**N/A**	**5.73×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4077	4077	4074	4095	4095	4077	3920	3920	3920
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.13×10^{-7}	2.48×10^{-6}	0.00
Boron and compounds	0.00	0.00	0.00	0.00	0.00	0.00	3.28×10^{-6}	3.57×10^{-8}	0.00
Chromium	3.65×10^{-7}	3.60×10^{-6}	1.53×10^{-15}	3.65×10^{-7}	5.91×10^{-6}	7.02×10^{-11}	1.09×10^{-2}	4.80×10^{-2}	3.77×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.67×10^{-4}	3.90×10^{-5}	0.00
Nitrate	1.10×10^{-4}	1.66×10^{-5}	0.00	1.10×10^{-4}	1.03×10^{-2}	0.00	4.53	2.39×10^{-1}	0.00
Total	**N/A**	**2.02×10^{-5}**	**1.53×10^{-15}**	**N/A**	**1.03×10^{-2}**	**7.02×10^{-11}**	**N/A**	**2.87×10^{-1}**	**3.77×10^{-6}**
Year of peak impact	4182	4182	4241	4182	4182	4241	4270	4270	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–69 through Q–74 depict the cumulative radiological lifetime risk of the incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary under the Base and Option Cases and is dominated by technetium-99 and iodine-129 from naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,000 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

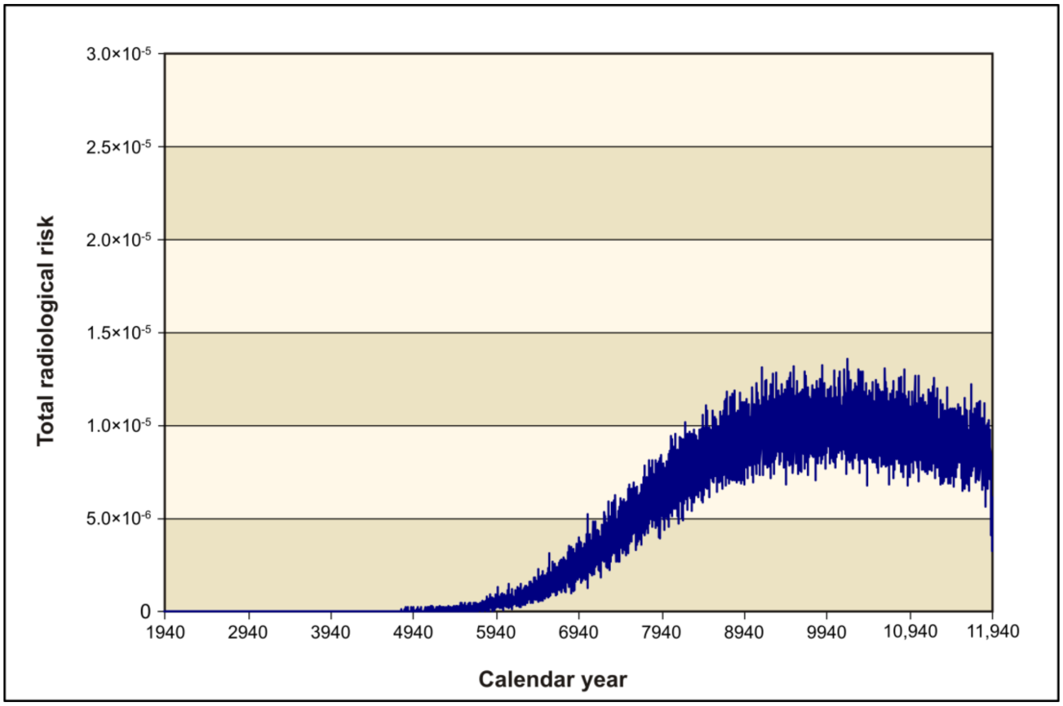


Figure Q–69. Waste Management Alternative 3, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

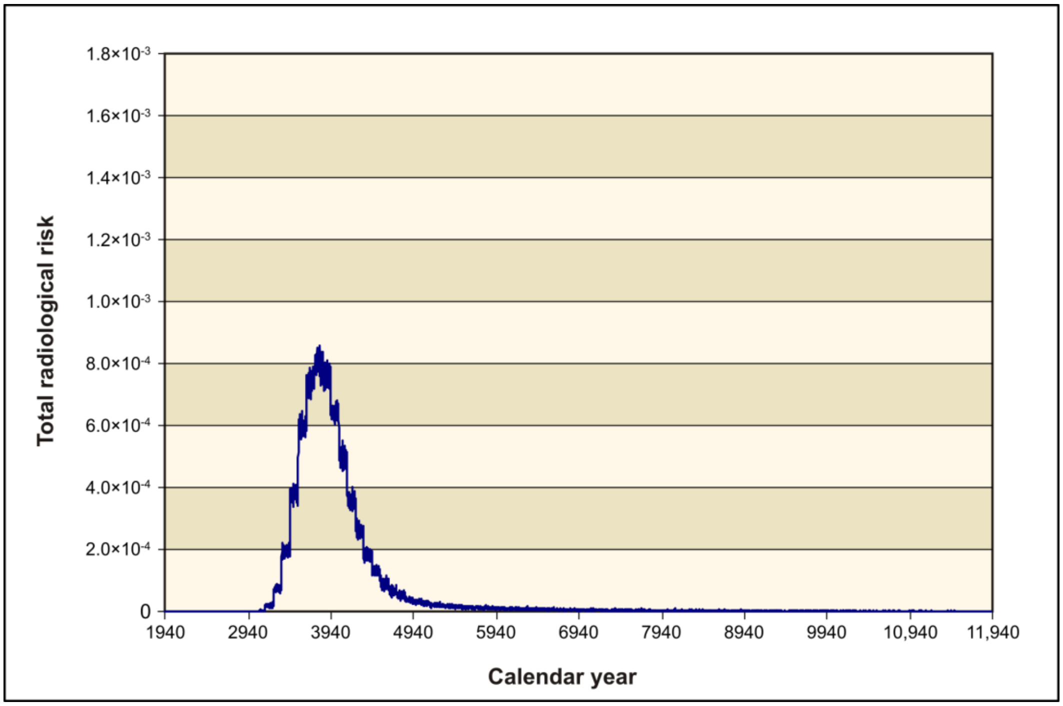


Figure Q–70. Waste Management Alternative 3, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

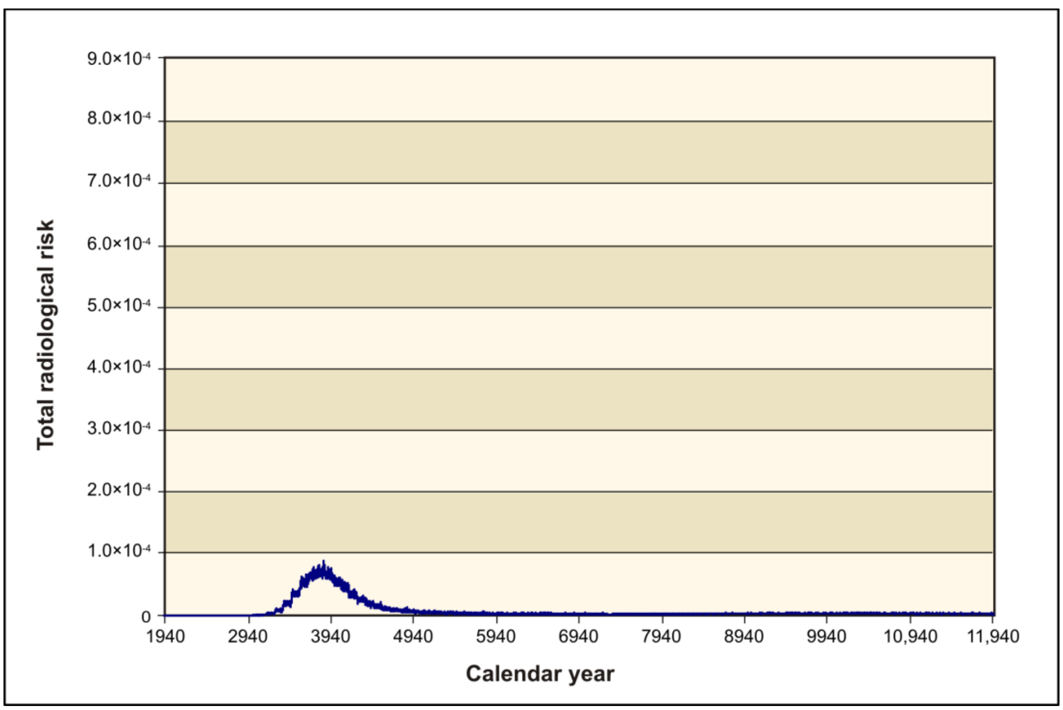


Figure Q–71. Waste Management Alternative 3, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

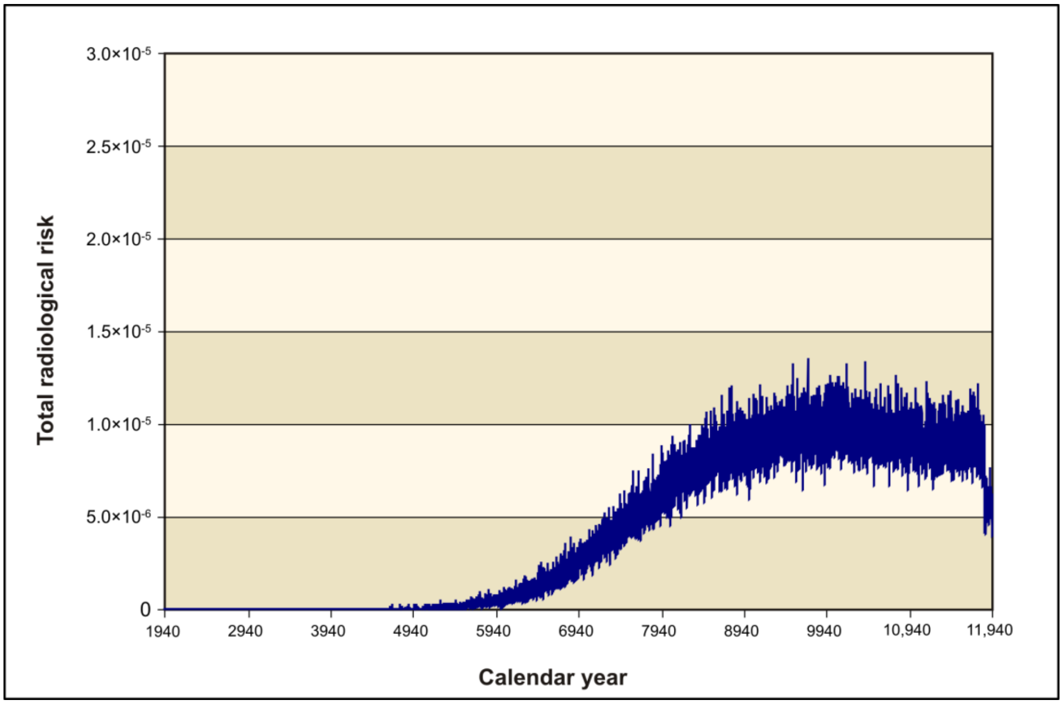


Figure Q–72. Waste Management Alternative 3, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

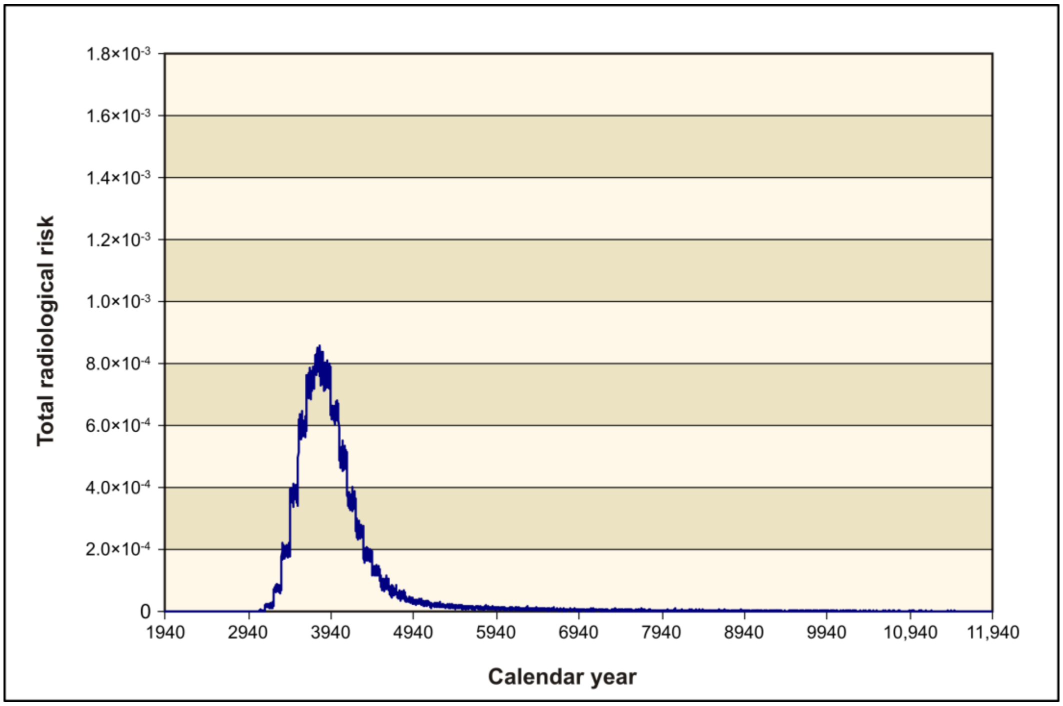


Figure Q–73. Waste Management Alternative 3, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

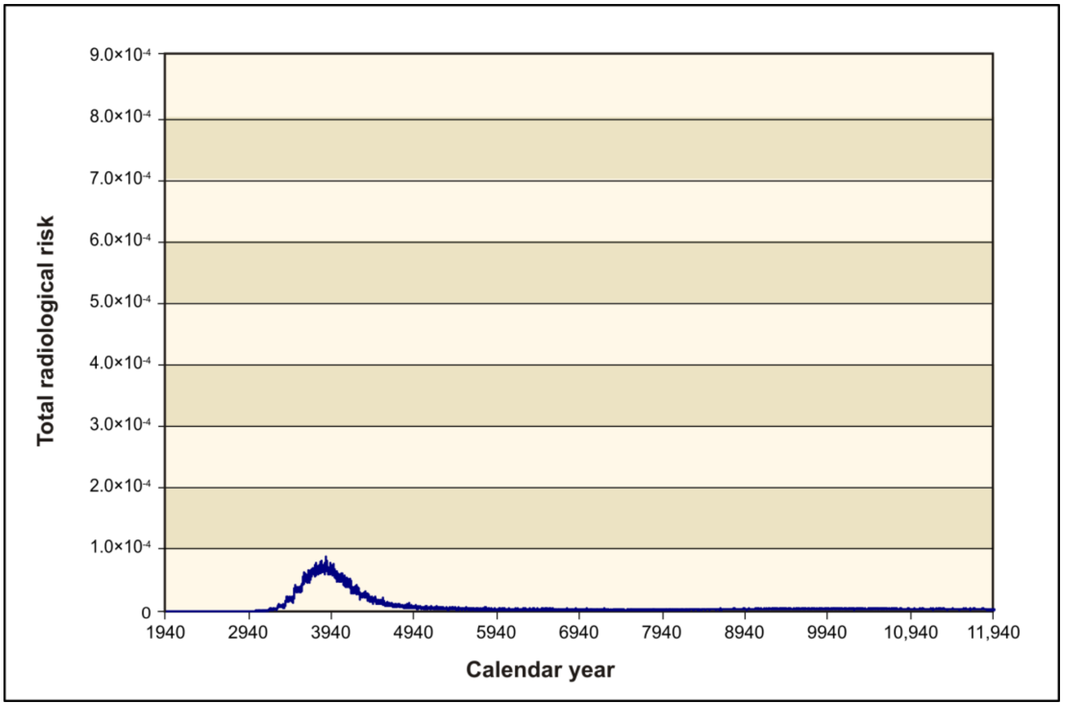


Figure Q–74. Waste Management Alternative 3, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.4 Waste Management Intruder Scenario

Intruders are individuals who enter IDF-East, IDF-West, or the RPPDF and engage in activity that could cause direct contact with residual contamination in the stabilized, below-grade waste. Waste types that would be disposed of in IDF-East and IDF-West include waste generated during activities related to tank closure and activities not related to tank closure. Waste types related to tank closure that would be disposed of in IDF-East include the following:

- ILAW glass
- Bulk vitrification glass
- Cast stone waste
- Steam reforming waste
- PPF glass
- Effluent Treatment Facility (ETF)–generated secondary waste
- Sulfate grout
- Tank closure secondary waste
- Discarded melters

In addition, rubble, soil and equipment generated during tank closure activities would be disposed of in the RPPDF under some Tank Closure alternatives. Waste types not related to tank closure that would be disposed of in either IDF-East or IDF-West include the following:

- Onsite non-CERCLA waste
- Waste management secondary waste
- Offsite waste
- FFTF decommissioning secondary waste

As in the case of Tank Closure alternatives, two types of receptors and two types of scenarios were considered. The receptor types were the resident farmer and American Indian resident farmer, and the scenario types were home construction and well drilling. Because the waste at the disposal areas is at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker involved in well drilling would be the same for the resident farmer and American Indian resident farmer. Screening analysis also determined that impacts of intrusion were dominated by contact with short-lived radionuclides, strontium-90 and cesium-137, for all waste types except ETF-generated secondary waste. Consequently, impacts of intrusion at the disposal areas are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose, which occurs immediately after loss of institutional control.

The impacts under this intrusion scenario at IDF-East or IDF-West for waste types related to tank closure are summarized in Tables Q–392 and Q–393 for the American Indian resident farmer and worker intruders, respectively. For all waste types and alternatives except ETF-generated secondary waste, resident farmer impacts are dominated by exposure to strontium-90 and cesium-137. Estimates of impact on the drilling worker are dominated by external exposure to cesium-137. For both the American Indian resident farmer and drilling worker, impacts related to ETF-generated secondary waste are dominated by exposure to iodine-129. Due to high waste loadings of cesium-137, the DOE intruder dose guideline of 500 millirem is exceeded for both primary- and secondary-waste forms. The estimated impacts of intrusion into the rubble, soil, and equipment related to tank closure that are disposed of in the RPPDF are presented in Table Q–394. As for other tank closure waste types, doses are dominated by exposure to cesium-137. The DOE intruder dose guideline is not exceeded for any Tank Closure alternatives. The estimated impacts of intrusion into waste types not related to tank closure that are disposed of in either IDF-East or IDF-West are presented in Table Q–395 for an American Indian resident farmer and a drilling worker. The DOE intruder dose guideline of 500 millirem is exceeded for offsite waste due to high loading of cesium-137.

Table Q–392. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture Following Well Drilling at an Integrated Disposal Facility

	Dose (rem per year)								
	Waste Type								
Alternative	ILAW Glass	Bulk Vitrification Glass	Cast Stone Waste	Steam Reforming Waste	PPF Glass	ETF-Generated Secondary Waste	Sulfate Grout	Tank Closure Secondary Waste	Discarded Melters
2A	0.74	N/A[a]	N/A[a]	N/A[a]	N/A[a]	0.34	N/A[a]	1.22	0.028
2B	0.74	N/A[a]	N/A[a]	N/A[a]	N/A[a]	0.34	N/A[a]	1.30	0.028
3A	0.93	7.7	N/A[a]	N/A[a]	N/A[a]	0.56	N/A[a]	1.64	0.035
3B	0.93	N/A[a]	5.9	N/A[a]	N/A[a]	0.26	N/A[a]	2.19	0.035
3C	0.93	N/A[a]	N/A[a]	7.7	N/A[a]	0.56	N/A[a]	2.20	0.035
4	1.30	18.6	0.47	N/A[a]	N/A[a]	0.62	N/A[a]	1.84	0.048
5	1.24	20.5	0.46	N/A[a]	N/A[a]	0.54	0.47	1.41	0.046
6A, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	64.2	0.34	N/A[a]	1.46	0.91
6A, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.37	0.34	N/A[a]	1.36	0.039
6B, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	62.8	0.34	N/A[a]	1.46	0.91
6B, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.36	0.34	N/A[a]	1.36	0.039
6C	N/A[a]	N/A[a]	N/A[a]	N/A[a]	N/A[a]	0.34	N/A[a]	1.30	N/A[a]

[a] This waste type would not be generated under this alternative.

Key: ETF=Effluent Treatment Facility; ILAW=immobilized low-activity waste; N/A=not applicable; PPF=Preprocessing Facility.

Table Q–393. Doses by Tank Closure Waste Type to a Well-Drilling Worker at an Integrated Disposal Facility

Alternative	Dose (rem)								
	Waste Type								
	ILAW Glass	Bulk Vitrification Glass	Cast Stone Waste	Steam Reforming Waste	PPF Glass	ETF-Generated Secondary Waste	Sulfate Grout	Tank Closure Secondary Waste	Discarded Melters
2A	1.6×10^{-3}	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.6×10^{-4}	N/A[a]	1.9×10^{-3}	5.8×10^{-5}
2B	1.6×10^{-3}	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.6×10^{-4}	N/A[a]	2.1×10^{-3}	5.8×10^{-5}
3A	2.0×10^{-3}	1.7×10^{-2}	N/A[a]	N/A[a]	N/A[a]	5.8×10^{-4}	N/A[a]	2.5×10^{-3}	7.3×10^{-5}
3B	2.0×10^{-3}	N/A[a]	1.3×10^{-2}	N/A[a]	N/A[a]	2.0×10^{-4}	N/A[a]	3.4×10^{-3}	7.3×10^{-5}
3C	2.0×10^{-3}	N/A[a]	N/A[a]	1.6×10^{-2}	N/A[a]	5.8×10^{-4}	N/A[a]	3.4×10^{-3}	7.3×10^{-5}
4	2.9×10^{-3}	4.0×10^{-2}	9.9×10^{-4}	N/A[a]	N/A[a]	6.8×10^{-4}	N/A[a]	2.8×10^{-3}	1.0×10^{-4}
5	2.7×10^{-3}	4.9×10^{-2}	9.6×10^{-4}	N/A[a]	N/A[a]	5.8×10^{-4}	9.9×10^{-4}	2.2×10^{-3}	9.7×10^{-5}
6A, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	7.9×10^{-2}	2.6×10^{-4}	N/A[a]	2.3×10^{-3}	1.9×10^{-3}
6A, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	6.0×10^{-3}	2.6×10^{-4}	N/A[a]	2.2×10^{-3}	1.2×10^{-4}
6B, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	7.9×10^{-2}	2.6×10^{-4}	N/A[a]	2.3×10^{-3}	1.9×10^{-3}
6B, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	6.0×10^{-3}	2.6×10^{-4}	N/A[a]	2.2×10^{-3}	1.2×10^{-4}
6C	N/A[a]	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.6×10^{-4}	N/A[a]	2.1×10^{-3}	N/A[a]

[a] This waste type would not be generated under this alternative.

Key: ETF=Effluent Treatment Facility; ILAW=immobilized low-activity waste; N/A=not applicable; PPF=Preprocessing Facility.

Table Q–394. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture and a Well-Drilling Worker at the RPPDF

Alternative	Dose for American Indian Resident Farmer (rem per year)	Dose for Drilling Worker (rem)
2A	N/A[a]	N/A[a]
2B	0.017	3.3×10^{-5}
3A	0.017	3.3×10^{-5}
3B	0.017	3.3×10^{-5}
3C	0.017	3.3×10^{-5}
4	0.044	8.9×10^{-5}
5	N/A[a]	N/A[a]
6A, Base Case	0.053	1.1×10^{-4}
6A, Option Case	0.016	3.5×10^{-5}
6B, Base Case	0.053	1.1×10^{-4}
6B, Option Case	0.016	3.5×10^{-5}
6C	0.017	3.3×10^{-5}

[a] The RPPDF would not be constructed under this alternative.

Key: N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–395. Doses by Waste Management Waste Type to an American Indian Engaged in Residential Agriculture and a Well-Drilling Worker at an Integrated Disposal Facility

Waste Type	Dose for American Indian Resident Farmer (rem per year)	Dose for Drilling Worker (rem)
Onsite non-CERCLA waste	0.179	4.4×10^{-4}
Waste management secondary waste	6.6×10^{-4}	3.0×10^{-6}
Offsite waste	2.62	5.1×10^{-3}
FFTF decommissioning secondary waste	0.0034	1.4×10^{-5}

Key: CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; FFTF=Fast Flux Test Facility.

Q.4 REFERENCES

Baes C.F., III, R.D. Sharp, A. L. Sjoreen, and R.W. Shor, 1984, *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture*, ORNL-5786, Oak Ridge National Laboratory, Oak Ridge, Tennessee, September.

Beyeler, W.E., W.A. Hareland, F.A. Durán, T.J. Brown, E. Kalinina, D.P. Gallegos, and P.A. Davis, 1999, *Residual Radioactive Contamination from Decommissioning, Parameter Analysis, Draft Report for Comment*, NUREG/CR-5512, Vol. 3, U.S. Nuclear Regulatory Commission, Washington, D.C., October.

Chiao, F.F., R.C. Currie, and T.E. McKone, 1995, *Intermedia Transfer Factors for Contaminants Found at Hazardous Waste Sites, BENZO(a)PYRENE [B(a)P], Final Draft Report*, Risk Science Program, Department of Environmental Toxicology, University of California, Davis, California, March.

DOE (U.S. Department of Energy), 1987, *Final Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington*, DOE/EIS-0113, Richland Operations Office, Richland, Washington, December.

DOE (U.S. Department of Energy), 1995, *Hanford Site Risk Assessment Methodology*, DOE/RL-91-45, Rev. 3, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 2005, *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses*, Final Rev. 0, Office of River Protection, Richland, Washington, March 25.

DOE and Ecology (U.S. Department of Energy, Richland Operations Office, Richland, Washington, and Washington State Department of Ecology, Olympia, Washington), 1996, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, August.

Eckerman, K.F., and J.C. Ryman, 1993, *External Exposure to Radionuclides in Air, Water, and Soil*, Federal Guidance Report No. 12, EPA-402-R-93-081, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C., September.

Eckerman, K.F., R.W. Leggett, C.B. Nelson, J.S. Puskin, and A.C.B. Richardson, 1999, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13, EPA 402-R-99-001, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C., September.

EPA (U.S. Environmental Protection Agency), 1991, *Risk Assessment Guidance for Superfund*, Vol. 1, *Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors, Interim Final*, OSWER Directive 9285.6-03, Office of Emergency and Remedial Response, Washington, D.C., March 25.

EPA (U.S. Environmental Protection Agency), 1996a, *Soil Screening Guidance: User's Guide*, 2nd ed., EPA/540/R-96/018, Office of Emergency and Remedial Response, Washington, D.C., July.

EPA (U.S. Environmental Protection Agency), 1996b, *Soil Screening Guidance: Technical Background Document*, 2nd ed., EPA/540/R95/128, Office of Solid Waste and Emergency Response, Washington, D.C., May.

EPA (U.S. Environmental Protection Agency), 1999a, *Exposure Factors Handbook (EFH)*, EPA/600/C-99/001, Office of Research and Development, National Center for Environmental Assessment, Washington, D.C., February.

EPA (U.S. Environmental Protection Agency), 1999b, *Understanding Variations in Partition Coefficients, K_d, Values*, Vol. II, *Review of Geochemistry and Available K_d Values for Cadmium, Cesium, Chromium, Lead, Plutonium, Radon, Strontium, Thorium, Tritium (^3H), and Uranium*, EPA 402-R-99-004B, Office of Radiation and Indoor Air, Office of Solid Waste and Emergency Response, Washington, D.C., August.

EPA (U.S. Environmental Protection Agency), 2000, *Soil Screening Guidance for Radionuclides: User's Guide*, EPA/540-R-00-007, Office of Radiation and Indoor Air, Office of Solid Waste and Emergency Response, Washington, D.C., October.

EPA (U.S. Environmental Protection Agency), 2001, *Radionuclide Carcinogenicity Slope Factors: HEAST*, Radionuclide Table, "Radionuclide Carcinogenicity – Slope Factors," accessed through http://www.epa.gov/radiation/heast/, April 16.

EPA (U.S. Environmental Protection Agency), 2002, *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, OSWER 9355.4-24, Office of Emergency and Remedial Response, Washington, D.C., December.

EPA (U.S. Environmental Protection Agency), 2009a, *Integrated Risk Information System (IRIS)*, accessed through http://www.epa.gov/iris, March 5.

EPA (U.S. Environmental Protection Agency), 2009b, *Risk Assessment Guidance for Superfund*, Vol. I, *Human Health Evaluation Manual*, Part F, "Supplemental Guidance for Inhalation Risk Assessment," EPA-540-R-070-002, OSWER 9285.7-82, Office of Superfund Remediation and Technology Innovation, Washington, D.C., January.

Evans, R.G., M.J. Hattendorf, and C.T. Kincaid, 2000, *Evaluation of the Potential for Agricultural Development at the Hanford Site*, PNNL-13125, Pacific Northwest National Laboratory, Richland, Washington, February.

Harper, B.L., and S.G. Harris, 2008, "A Possible Approach for Setting a Mercury Risk-Based Action Level Based on Tribal Fish Ingestion Rates," *Environmental Research*, Vol. 107, pp. 60–68.

Hoitink, D.J., K.W. Burk, J.V. Ramsdell, Jr., and W.J. Shaw, 2005, *Hanford Site Climatological Summary 2004 with Historical Data*, PNNL-15160, Pacific Northwest National Laboratory, Richland, Washington, May.

Kennedy, W.E., Jr., and D.L. Strenge, 1992, *Residual Radioactive Contamination from Decommissioning: Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent, Final Report*, NUREG/CR-5512, Vol. 1, U.S. Nuclear Regulatory Commission, Washington, D.C., October.

Lee, P.L., and T.W. Coffield, 2007, *Baseline Parameter Update for Human Health Input and Transfer Factors for Radiological Performance Assessments at the Savannah River Site*, WSRC-STI-2007-00004, Rev. 2, Savannah River National Laboratory, Washington Savannah River Company, Aiken, South Carolina, August 13.

Mann, F.M., and R.J. Puigh, 2001, *Data Packages for the Hanford Immobilized Low-Activity Tank Waste Performance Assessment: 2001 Version*, HNF-5636, Rev. 0A, Fluor Federal Services, Inc., Richland, Washington, February.

McKone, T.E., 1994, "Uncertainty and Variability in Human Exposures to Soil Contaminants Through Home-Grown Food: A Monte Carlo Assessment," *Risk Analysis*, Vol. 14, No. 4, pp. 449–463.

Meyer, P.D., and G.W. Gee, 1999, *Information on Hydrologic Conceptual Models, Parameters, Uncertainty Analysis, and Data Sources for Dose Assessments at Decommissioning Sites*, NUREG/CR-6656, U.S. Nuclear Regulatory Commission, Division of Risk Analysis and Applications, Washington, D.C., November.

Napier, B.A., D.L. Strenge, J.V. Ramsdell, P.W. Eslinger, and C. Fosmire, 2004, *GENII Version 2 Software Design Document*, PNNL-14584, Pacific Northwest National Laboratory, Richland, Washington, November.

NCRP (National Council on Radiation Protection and Measurements), 2009, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 160, Bethesda, Maryland, March 3.

NRC (U.S. Nuclear Regulatory Commission), 1982, *Final Environmental Impact Statement on 10 CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste,"* NUREG-0945, Vol. 1, Office of Nuclear Material Safety and Safeguards, Washington, D.C., November.

NRC (U.S. Nuclear Regulatory Commission), 2000, *NMSS Decommissioning Standard Review Plan*, NUREG-1727, Office of Nuclear Material Safety and Safeguards, Division of Waste Management, Washington, D.C., September.

RAIS (Risk Assessment Information System), 2009, *Tools*, U.S. Department of Energy, Office of Environmental Management, Oak Ridge Operations Office, accessed through http://rais.ornl.gov/.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter II, and C.J.E. Welsh, 1997, *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants*, ORNL/TM-13391, Oak Ridge National Laboratory, Oak Ridge, Tennessee, October.

Serne, R.J., 2007, *K_d Values for Agricultural and Surface Soils for Use in Hanford Site Farm, Residential, and River Shoreline Scenarios*, PNNL-16531, Pacific Northwest National Laboratory, Richland, Washington, August.

Sheppard, M.I., and D.H. Thibault, 1990, "Default Soil Solid/Liquid Partition Coefficients, K_ds, for Four Major Soil Types: A Compendium," *Health Physics*, Vol. 59, No. 4, pp. 471–482, October.

Staven, L.H., K. Rhoads, B.A. Napier, and D.L. Strenge, 2003, *A Compendium of Transfer Factors for Agricultural and Animal Products*, PNNL-13421, Pacific Northwest National Laboratory, Richland, Washington, June.

USDA (U.S. Department of Agriculture), 1994, *Borax Pesticide Fact Sheet*.

USGS (U.S. Geological Survey), 2004, *MODFLOW 2000 Engine, Version 1.15.00*, August 6.

White, M.D., and M. Oostrom, 2000, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0: Theory Guide*, PNNL-12030, Pacific Northwest National Laboratory, Richland, Washington, March.

White, M.D., and M. Oostrom, 2006, *STOMP Subsurface Transport Over Multiple Phases, Version 4.0: User's Guide*, PNNL-15782, Pacific Northwest National Laboratory, Richland, Washington, June.

Yu, C., A.J. Zeilen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson, 2001, *User's Manual for RESRAD Version 6*, ANL/EAD-4, Argonne National Laboratory, Argonne, Illinois, July.

Code of Federal Regulations

40 CFR 141, U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations."

Executive Orders

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, February 11, 1994.

U.S. Department of Energy Guides and Orders

DOE Guide 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*, July 9, 1999.

DOE Order 458.1, *Radiation Protection of the Public and the Environment*, Change 2, June 6, 2011.

APPENDIX R
CUMULATIVE IMPACTS: ASSESSMENT METHODOLOGY

This appendix describes the cumulative impacts methodology for the U.S. Department of Energy's *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*. The appendix is organized into sections on (1) regulations and guidance, (2) previous studies, (3) history of land use at the Hanford Site and in surrounding regions, (4) future land use at the Hanford Site, (5) future land use in surrounding regions, (6) approach to cumulative impacts analysis, (7) uncertainties, (8) selection of resource areas for analysis, (9) resource area methodologies, (10) spatial and temporal considerations, (11) past and present actions, and (12) selection of reasonably foreseeable future actions. The results of the cumulative impacts analysis are presented in Chapter 6. Supporting information for the short-term cumulative impacts analysis is presented in Appendix T; long-term, in Appendix U. The details of inventory development and end states for the cumulative groundwater modeling are described in Appendix S.

The Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (40 CFR 1500–1508) define cumulative impacts as impacts on the environment that result from the proposed actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR 1508.7). Thus, the cumulative impacts of an action on a resource (e.g., land, air, water, soil), ecosystem, or human community are the total effects of that action and all other activities affecting that resource no matter what entity (Federal, non-Federal, or private) is taking the action (EPA 1999:2).

Cumulative impacts are analyzed for activities occurring at the Hanford Site (Hanford). Options were evaluated for management and disposition of the Fast Flux Test Facility (FFTF) remote-handled special components (Idaho Option) and bulk sodium (Idaho Reuse Option) at Idaho National Laboratory (INL) as part of the FFTF Decommissioning Entombment and Removal Alternatives. These options involve shipping the remote-handled special components to the INL Remote Treatment Project for treatment and the bulk sodium to the existing INL Sodium Processing Facility for processing to produce a caustic sodium hydroxide solution, which would be returned to Hanford for reuse in the Waste Treatment Plant (WTP) pretreatment processes. The additional materials processing would not contribute substantially to the cumulative impacts of activities at INL because (1) there would be no marked increase in daily effluent emissions from, or waste generation by, the facilities; (2) sodium hydroxide, produced at INL, would be returned to Hanford for use in processing tank waste; (3) hazardous and radioactive wastes would not be disposed of at INL; and (4) impacts of the activities would be small. Accordingly, only the cumulative impacts of transporting materials and waste to and from INL are evaluated in this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)*. Cumulative impacts of activities at INL have been evaluated in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs, Final Environmental Impact Statement* (DOE 1995a:C-4.6.7-1) and *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE 2005a:4-65).

R.1 REGULATIONS AND GUIDANCE

Cumulative impacts analysis in U.S. Department of Energy (DOE) NEPA documents is governed by CEQ regulations (40 CFR 1500–1508) and DOE NEPA implementing procedures (10 CFR 1021). Additional guidance on how to conduct such analyses was obtained from *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997) and *Consideration of Cumulative Impacts in EPA Review of NEPA Documents* (EPA 1999).

As noted, cumulative impacts on the environment result from proposed actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over an extended period of time. They can also result from the spatial or temporal crowding of environmental perturbations. That is, increased environmental impact can be expected when a second perturbation occurs at a site before that site can fully rebound from the effects of the first.

While there is no universally accepted framework for cumulative impacts analysis, eight general principles (CEQ 1997:8) have gained acceptance and thus inform the methodology adopted for this *TC & WM EIS*. These principles are based on the premise that any resource, ecosystem, or human community can experience stress, and that for each there are thresholds, or levels of stress, beyond which conditions degrade. The following is a summary of the CEQôs eight principles of cumulative effects analysis:

1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions. This includes all actions that affect the same resources.

2. Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, or human community of all actions taken, no matter who (Federal, non-Federal, or private entity) has taken the actions. Effects of individual activities may interact to cause additional effects not apparent when looking at individual effects one at a time.

3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, or human community being affected, rather than from the perspective of the proposed actions. Analyzing cumulative effects involves developing an understanding of how the resources are susceptible to effects.

4. It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those effects that are truly meaningful. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly.

5. Cumulative effects on a given resource, ecosystem, or human community are rarely aligned with political or administrative boundaries. Cumulative effects analysis of natural systems must use natural boundaries, and analysis of human communities must use actual sociocultural boundaries to ensure that all effects are included.

6. Cumulative effects may result from accumulation of similar effects or from the synergistic interaction of different effects. Accordingly, the cumulative effect can in some cases be greater than the sum of the individual effects.

7. Cumulative effects may last for many years beyond the life of the action(s) that caused the effects. Radioactive contamination is an example. Cumulative effects analysis must involve application of the best science and forecasting techniques.

8. Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters. The most effective cumulative effects analysis focuses on what is needed to ensure long-term productivity or sustainability of the resource.

In *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (known as the *Green Book*) (DOE 2004a:1, 2, 19, 20), DOE expands on the CEQ instruction (40 CFR 1502.2(b)) by stating that impacts should be discussed in proportion to their significance and that this sliding-scale approach applies to all *Green Book* recommendations. The *Green Book* stipulates use of the sliding scale for impact identification and quantification and provides the following basic recommendations:

- Quantify impacts consistent with the sliding-scale approach and available information.

- Provide sufficient information so the validity of analytical methods and results can be reviewed.
- Acknowledge uncertainty and incompleteness in data and how they may affect significance in the analysis.
- Do not quantify impacts when they are virtually absent.
- Define and compare impacts in their appropriate context using both relative and absolute information.
- Define, where possible, the actual impact on health or the environment, not just contaminant concentrations or release rates.

Included in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997:49ï57) is discussion of various techniques for analyzing cumulative effects. Implicit in that discussion is the idea that there is no one appropriate method for such an analysis.

R.2 PREVIOUS STUDIES

Cumulative impacts at Hanford were evaluated in the *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (*TWRS EIS*) (DOE and Ecology 1996) and the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (Hanford Comprehensive Land-Use Plan EIS)* (DOE 1999a). Presented in Table Rï1 is a breakdown of the resource areas addressed in those evaluations. While the entries attest to evaluation of certain areas in both documents, they do not necessarily reflect evaluations at the same level of detail.

Table R–1. Resource Areas Evaluated in Recent Major Hanford Site Cumulative Impact Analyses

Resource Area	*TWRS EIS*[a]	*Hanford Comprehensive Land-Use Plan EIS*[b]
Land resources	X	X
Noise and vibration	ï	X
Air quality	X	X
Geology and soils	ï	X
Water resources	ï	X
Ecological resources	X	X
Cultural resources	ï	X
Socioeconomics	X	X
Public health and safety ð normal operations	X	X
Occupational health and safety	ï	X
Long-term groundwater quality	X	ï

[a] DOE and Ecology 1996:5-237ï5-251.
[b] DOE 1999a:5-65ï5-72.

Key: *Hanford Comprehensive Land-Use Plan EIS=Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement; TWRS EIS=Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement.*

R.3 HISTORY OF LAND USE AT THE HANFORD SITE AND IN SURROUNDING REGIONS

This section provides information on past land use in the region to illustrate how the land and its resources have changed since European-American colonization. Such information helps determine the impacts of past actions.

The 151,775-hectare (375,040-acre) Hanford Site is in the Columbia Basin Ecoregion, an area historically including over 6 million hectares (14.8 million acres) of steppe and shrub-steppe vegetation extending across most of central and southeastern Washington and portions of north-central Oregon. In the early 1800s, the dominant plant in the Hanford area was big sagebrush underlain by perennial Sandbergôs bluegrass and bluebunch wheatgrass. Many places on Hanford are fairly free of nonnative species and extensive enough to retain characteristic populations of shrub-steppe plants and animals absent or scarce in developed areas of the ecoregion. Hanfordôs location provides important connectivity with other undeveloped portions of the ecoregion (Neitzel 2005:4.73). Washington State considers pristine shrub-steppe habitat as a priority habitat because it is scarce in the state and important to several state-listed wildlife species (WDFW 2007). Sagebrush communities are also considered a Level III resource under the *Hanford Site Biological Resources Management Plan* (DOE 2001a). Impacts on such resources should be avoided or minimized; however, when avoidance and minimization are not possible, rectification or compensatory mitigation is recommended (DOE 2001a:iii).

In prehistoric and early historic times, American Indians of various tribal affiliations heavily populated the area along the Columbia River in eastern Washington, including the area occupied by Hanford, and some of their descendants still live in the region (DOE 2000a:3-125). When European-American explorers arrived in the early 1800s, people presently referred to as ñthe Wanapumò (the River People) were observed inhabiting numerous villages and fishing camps scattered throughout this segment of the mid-Columbia River. Neighboring groups known today as the Yakama, Umatilla, Cayuse, Walla Walla, Palus, Nez Perce, and Middle Columbia Salish frequented the area to trade, gather resources, and conduct other activities. Many descendants of these tribes and bands are affiliated with the Wanapum, Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe of Idaho, or the Confederated Tribes of the Colville Reservation (Neitzel 2005:4.102, 4.103). Present-day tribal members retain traditional secular and religious ties to the region, and many have knowledge of their cultural ceremonies and lifeways (DOE 2000a:3-125).

Under separate treaties signed in 1855, the land area of much of what is now eastern Washington, Oregon, and Idaho was ceded to the United States by a number of regional American Indian tribes. The land area includes land occupied by Hanford. Under these treaties, the tribes retained the right to fish in usual and accustomed places. Tribal fishing rights are recognized on rivers within the ceded lands, including the Columbia River, which flows through Hanford. In addition to fishing rights, the tribes retained under the treaties the privilege to hunt, gather roots and berries, and pasture horses and cattle on open and unclaimed lands. It is the position of DOE that Hanford, like other ceded lands that were settled or used for specific purposes, is not open and unclaimed land. While reserving all rights to assert their respective positions regarding treaty rights, the tribes are participants in DOEôs land use planning process, and DOE considers tribal concerns in that process. For example, tribal concerns were considered by DOE in the development of this *TC & WM EIS*. American Indian tribal governmentsô perspectives on the cleanup of Hanford are provided in Appendix W of this *TC & WM EIS*

American Indian traditional cultural places within Hanford include, but are not limited to, a wide variety of places and landscapes: archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant-gathering areas, holy lands, landmarks, important places in American Indian history and culture, places of persistence and resistance, and landscapes of the heart

(Neitzel 2005:4.104). Culturally important localities and geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, Coyote Rapids, and the White Bluffs portion of the Columbia River. The Wanapum resided on land that is now part of Hanford until 1942, when the site was established, then moved to Priest Rapids (DOE 1987).

Lewis and Clark were among the first European Americans to visit the Hanford region during their 1804ï1806 expedition. They were followed by fur trappers, military units, and miners. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach, and gold miners began to work the gravel bars. Cattle ranches opened in the 1880s, and farmers soon followed. Land use began to change as settlers populated the area (Neitzel 2005:4.104). By the beginning of the twentieth century, much of the area was used for farming and grazing (DOE 1999a:4-1, 4-3). The Grand Coulee Dam was built on the Columbia River in the 1940s, and the Columbia Irrigation Project brought more water for farming. The population then increased in Franklin County, across the Columbia River from Hanford (DOE 2005b:2.1).

Several small, thriving towns, including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early twentieth century. The accessibility of these communities to outside markets expanded with the arrival of the Chicago, Milwaukee, St. Paul, and Pacific Railroad branch line in 1913. These towns, and nearly all other structures, were razed after the U.S. Government acquired the land for the original Hanford Engineer Works in 1943 (part of the Manhattan Project). Although agriculture and livestock production were the primary activities within the region and in Hanford at the beginning of the twentieth century, these activities ceased at the site when it was acquired by the Government (Neitzel 2005:4.73, 4.104). Today, remnants of homesteads, farm fields, ranches, abandoned military installations, and other buildings can be found throughout Hanford. Nearly 5,200 hectares (13,000 acres) of abandoned agricultural lands remain on the site (DOE and Ecology 1996:4-37).

During the Manhattan Project and Cold War era, numerous nuclear reactors and associated reprocessing facilities were constructed at Hanford. The reactor sites cover over 930 hectares (2,300 acres) of land. All reactor buildings still stand, although many ancillary support structures have been removed (DOE and Ecology 1996:4-37; Neitzel 2005:4.107).

Hanford is owned and used primarily by DOE, but portions are owned, leased, or administered by other Government agencies. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities (Neitzel 2005:4.144).

Currently, land use within the Hanford vicinity includes wildlife protection areas and areas used for urban and industrial development, recreation, military training, irrigated and dryland farming, and grazing. At the time of the 2007 Census of Agriculture, Benton, Franklin, and Grant Counties had a total of 942,780 hectares (2.33 million acres) of land in farms. Of that farmland, 71 to 77 percent was used as cropland, 11 to 22 percent was pastureland, and 6 to 14 percent had other uses (USDA 2009). In 2006, land committed for the Conservation Reserve Program of the U.S. Department of Agriculture included 49,067 hectares (121,246 acres) in Benton County, 47,819 hectares (118,163 acres) in Franklin County, and 34,756 hectares (85,882 acres) in Grant County (USDA 2006:275).

Residential, commercial, and industrial land uses are predominant in the Tri-Cities area (Richland, Kennewick, and Pasco) southeast of Hanford and around other cities near the southern boundary of Hanford, including Benton City, Prosser, and West Richland (USDA 1997).

R.4 FUTURE LAND USE AT THE HANFORD SITE

This section contains a description of the land use planning at Hanford. An understanding of expected future land use at Hanford sets the stage for reasonably foreseeable actions that may occur.

On May 15, 1989, DOE, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) signed a comprehensive agreement for cleaning up Hanford. The Hanford Federal Facility Agreement and Consent Order (Ecology, EPA, and DOE 1989), or Tri-Party Agreement (TPA), is an agreement for achieving compliance with the remedial action provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the treatment, storage, and disposal unit regulations and corrective action provisions of the Resource Conservation and Recovery Act (RCRA). The TPA (1) defines and ranks CERCLA and RCRA cleanup commitments, (2) establishes responsibilities, (3) provides a basis for budgeting, and (4) establishes aggressive goals for site remediation, with enforceable milestones to ensure compliance. Compliance with the TPA necessitates that DOE consider future land use at Hanford.

Recognizing the need for a comprehensive land use plan, DOE issued the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) in September 1999; this document provides the framework within which future use of lands and resources at Hanford would occur. The overall Hanford Comprehensive Land-Use Plan as adopted by the Record of Decision (ROD) (64 FR 61615) is to accomplish the following for Hanford:

- Protect the Columbia River and associated natural and cultural resources and water quality.
- Wherever possible, locate new development, including cleanup- and remediation-related projects, in previously disturbed areas.
- Protect and preserve the natural and cultural resources for the enjoyment, education, study, and use of future generations.
- Honor treaties with American Indian tribes as they relate to land uses and resource uses.
- Reduce exclusive-use zone areas to maximize the amount of land available for alternative uses while still protecting the public from inherently hazardous operations.
- Allow access for other uses (e.g., recreation) outside of active waste management areas, consistent with the land use designation.
- Ensure that a public involvement process is used for amending the *Hanford Comprehensive Land-Use Plan EIS* and land use designations to respond to changing conditions.
- As feasible and practical, remove pre-existing, nonconforming uses.
- Facilitate cleanup and waste management.

These *Hanford Comprehensive Land-Use Plan EIS* policies are intended to provide for the protection of environmental and cultural resources; the siting of new development, utility, and transportation corridors; and economic development (DOE 2008a:2-6).

Figure R–1 shows the generalized land use at Hanford as developed in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) and modified by establishment of the Hanford Reach National Monument (65 FR 37253). DOE anticipates multiple uses of Hanford, including consolidation of waste management activities in the Central Plateau; industrial development in the eastern and southern portions, including the 400 Area; increased recreational access to the Columbia River; expansion of the Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope; and management of the Fitzner-Eberhardt Arid Lands Ecology Reserve by the U.S. Fish and Wildlife Service (USFWS) (64 FR 61615).

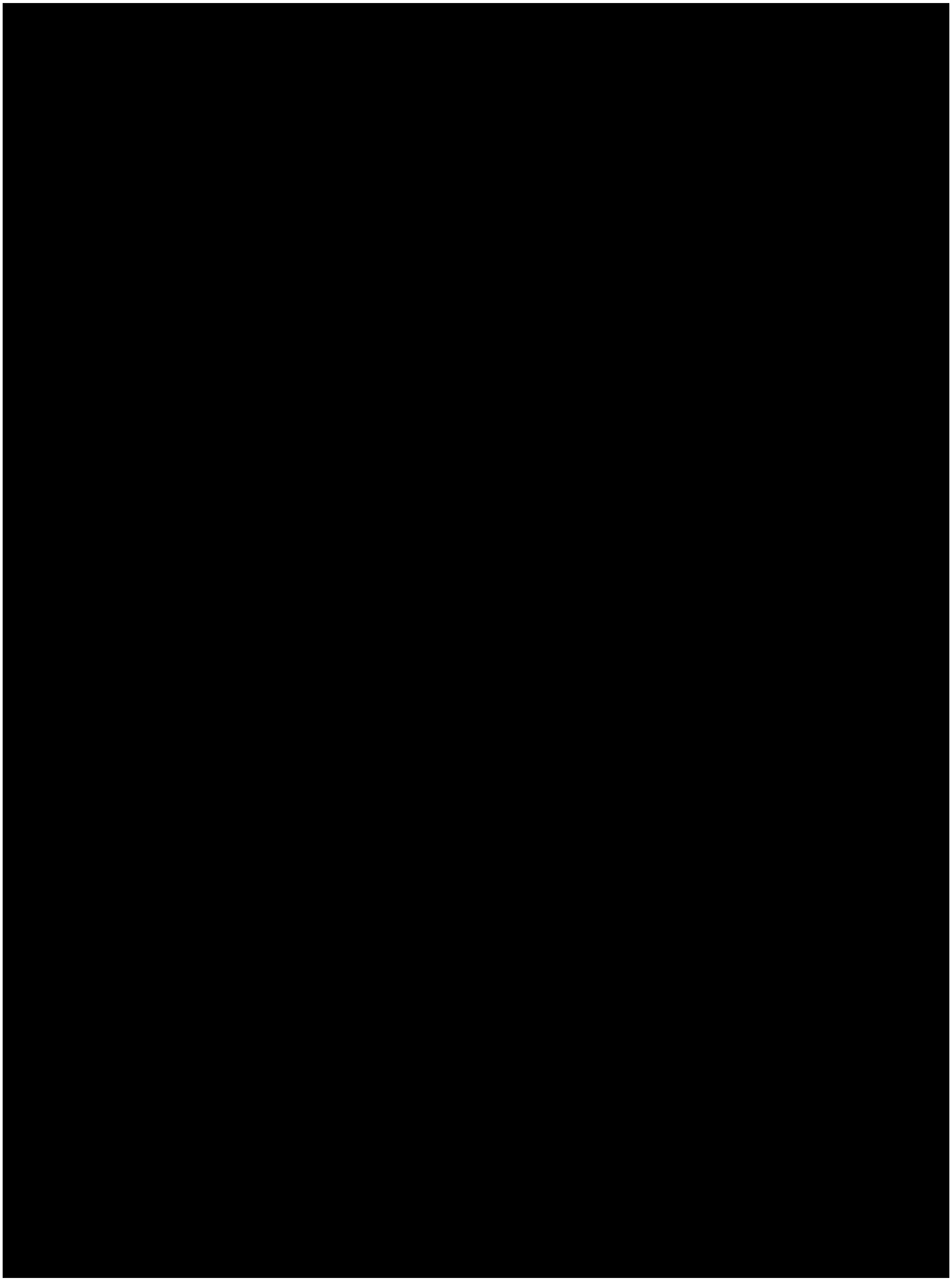


Figure R–1. Generalized Land Use at the Hanford Site

Important areas within the Preservation land use designation include the 78,900-hectare (195,000-acre) Hanford Reach National Monument, which incorporates a portion of the Columbia River corridor (65 FR 37253). The area known as the Hanford Reach includes the quarter-mile strip of public land on either side of the last free-flowing, nontidal segment of the Columbia River in the United States (DOE 2000a:3-91). USFWS (with DOE as a cooperating agency) prepared the *Hanford Reach National Monument Final Comprehensive Conservation Plan and Environmental Impact Statement, Adams, Benton, Grant, and Franklin Counties, Washington* (USFWS 2008) for all lands within the monument. Alternative E, selected as the Preferred Alternative in that environmental impact statement (EIS), attempts to strike a balance between resource protection and the level of public use and access USFWS believes the public will expect.

Since the issuance of the *Hanford Comprehensive Land-Use Plan EIS* and ROD, numerous actions have been taken and decision documents issued pertaining to Hanford that potentially could impact the land use plan. A supplement analysis to the *Hanford Comprehensive Land-Use Plan EIS* was recently prepared to help inform DOEôs determination of whether that EIS remains adequate, or whether a new EIS or supplement to the existing EIS should be prepared (DOE 2008a:Summary-1, Summary-2). The supplement analysis concludes that the information on land use developed since issuance of the *Hanford Comprehensive Land-Use Plan EIS* continues to support the land use designations and stated policies of the land use plan (DOE 2008a:Summary-3). DOE has not identified significant changes in circumstances or substantial new information since 1999 that would affect the basis for its decisions as documented in the *Hanford Comprehensive Land-Use Plan EIS* ROD (64 FR 61615).

The *Hanford Site End State Vision* (DOE 2005b) describes a postcleanup condition for Hanford. That end state is based on the land use plan contained in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a). The following paragraphs describe the end-state vision for the 100, 200, and 300 Areas:

100 Areas. Contamination in the 100 Areas will be remediated according to 50-year Conservation (Mining) and Preservation land use exposure scenarios for recreational, resident park ranger, and tribal activities, including fishing. Unlimited use is anticipated after 50 years. Remediation of waste sites consistent with the current CERCLA Interim Action RODs will continue. There will be no further degradation of the quality of groundwater that is currently above drinking water standards, and groundwater quality will be restored when practicable (DOE 2005b:iv).

Eight of nine reactors will be cocooned and left in place to decay for up to 75 years. B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS*. DOE will make a final decision on whether to cut up and move the eight reactor cores to the Central Plateau after sufficient decay has occurred. Reactor pipelines will be left in place in the Columbia River if risk levels are acceptable and removal would result in additional impacts. The pipelines will be stabilized if required (DOE 2005b:vi).

200 Areas. A Central Plateau Core Zone will be designated as a permanent waste management area to remain under Federal control for the next 150 years or longer. A buffer area will be maintained between the Core Zone and the remainder of the Central Plateau during cleanup operations. After Core Zone cleanup is complete, the buffer area will be reduced, and land use between the Core Zone and the Columbia River will be similar to that in the 100 Areas (DOE 2005b:v).

Waste sites in the Core Zone will be addressed through the CERCLA process consistent with Industrial-Exclusive, Conservation (Mining), or Preservation land use scenarios identified in the land use plan and within the timeframe identified in the *Hanford Comprehensive Land-Use Plan EIS* ROD (at least 50 years). Waste sites will be remediated and monitored to achieve human health and environmental protection goals under CERCLA. Small waste sites will be removed and consolidated to optimize placement and minimize the number of surface barriers. Disposition of buried pipelines in the Central Plateau will be achieved through the RCRA and CERCLA remove-treat-dispose of or stabilize-in-place processes. Canyon buildings that are robust will be used as engineered waste disposal facilities. Equipment, debris, and plutonium holdup material are being removed from the Plutonium Finishing Plant (PFP) and disposed of at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, or on site in accordance with waste acceptance criteria and CERCLA decision documents. DOE plans to demolish the PFP to slab-on-grade by 2013 (DOE 2011a).

As of 2009, more than 400 shipments of retrievably stored transuranic (TRU) waste had been transported off the Hanford Site to WIPP, and the equivalent of over 46,000 drums of waste had been removed from the ground (DOE 2011b). The low-level radioactive waste (LLW) portion of the retrieved waste will be treated and disposed of on site. Radioactive waste buried before 1970 containing TRU materials will be managed per CERCLA decisions (DOE 2005b:v).

Groundwater contamination across the Central Plateau Core Zone will be managed in accordance with the *Hanford Site Groundwater Strategy: Protection, Monitoring, and Remediation* (DOE 2004b, 2005b:v; Ecology and EPA 2007:7).

300 Area. Waste sites in the 300 Area will be remediated to achieve remedial action objectives based on industrial land use exposure scenarios. Remediation of waste sites to industrial standards will continue as required under the current CERCLA Interim Action RODs. Remediated sites will be backfilled to support unlimited surface use where practicable, and, depending on the success of future groundwater cleanup activities, irrigation and groundwater use may be restricted. DOE will work to meet the goals of no further degradation of the groundwater that is currently above drinking water standards and restoration of groundwater quality when practicable (DOE 2005b:iv).

The *Plan for Central Plateau Closure* (Fluor Hanford 2004) presents a strategic approach to closing the Central Plateau area of Hanford. That approach addresses nearly 4,000 items requiring closure action consistent with Hanfordôs environmental restoration mission. It divides the Central Plateau into 22 geographic zones organized around significant processing and waste management facilities, then organizes the major constituents of those zones into five logically grouped closure elements: canyons, underground tanks (the subject of this *TC & WM EIS*), waste sites, structures, and wells. The *Plan for Central Plateau Closure* provides the framework for integrating ongoing operations with the closure of facilities no longer used, all with a view to closing the Central Plateau by 2035. Primary objectives are to demolish structures; remove or stabilize contaminants; and establish institutional controls, such as postclosure groundwater care, consistent with long-term stewardship. The ultimate goals are to minimize risks to groundwater and return the Central Plateau to a state that supports the ecosystem (Fluor Hanford 2004:ES-2). The plan is based on the following assumptions (Fluor Hanford 2004:ES-3, ES-4):

- The Central Plateau will remain under institutional control for the foreseeable future.
- Ninety-five percent of the plutonium currently present on Hanford will be removed and shipped off site.
- Contaminated materials and soils will be left in place, unless removal and disposal are more cost-effective.
- Barriers over contaminated structures and waste sites will effectively minimize biointrusion and reduce the transport rate of contaminants to the groundwater.

This approach represents the first planning effort to identify the full range of actions that must be accomplished to close the Central Plateau and position DOE to complete its environmental management mission (DOE 2010a; Fluor Hanford 2004:ES-9). The closure approaches listed in the *Plan for Central Plateau Closure* (Fluor Hanford 2004) for the waste sites, structures, wells, and canyons closure elements are described below. The closure approach for the underground tanks closure element is not described because it has been superseded by the alternatives for tank closure that are being evaluated in this *TC & WM EIS*.

The waste sites closure element of the *Plan for Central Plateau Closure* focuses on 884 sites, including cribs, ponds, ditches, retention basins, burial grounds, pipelines, and areas of unplanned releases (i.e., areas in which liquid or solid waste contaminated with radioactive materials or hazardous chemicals was disposed of or released). In compliance with CERCLA, remedial actions are being taken at waste sites in groups of operable units as established by the TPA. The closure approach for these waste sites involves a combination of the following actions (Fluor Hanford 2004:ES-5, ES-6):

- Removing, treating, and disposing of contaminated materials, especially soil
- Taking no action for sites that represent minimal hazard
- Maintaining the existing soil cover
- Capping with protective barriers where required to protect groundwater or mitigate intrusion

The structures closure element of the *Plan for Central Plateau Closure* consists of 955 varied structures, including offices, shops, trailers, and water tanks, as well as large processing, storage, or handling facilities such as the PFP. The closure approach for structures is as follows (Fluor Hanford 2004:ES-6):

- Demolish aboveground structures.
- Fill voids in belowground structures.
- Stabilize the surface.
- Cap with protective barriers where required to protect groundwater or mitigate intrusion.

The wells closure element for the *Plan for Central Plateau Closure* includes 1,968 groundwater or vadose zone wells that have been used for monitoring and characterization and are noncompliant with applicable regulations or will not be needed following closure. These wells will be closed to eliminate a pathway for migration of contamination to the groundwater. The closure approach for wells is to decommission through filling or demolition (Fluor Hanford 2004:ES-6).

The canyons closure element for the *Plan for Central Plateau Closure* includes the five major defense production facilities originally designed for fuel-reprocessing operations. Four of the five ð the U Plant, B Plant, PUREX [Plutonium-Uranium Extraction] Plant, and REDOX [Reduction-Oxidation] Facility (S Plant) ð are currently under surveillance and maintenance. The fifth ð T Plant ð is being used for waste management. The remedial action for each canyon will be evaluated using the CERCLA process (Fluor Hanford 2004:ES-4).

The Canyon Disposition Initiative is the result of the 1996 Agreement-in-Principle among the signatories of the TPA to define the path forward for determining the final disposition of Hanfordôs five canyon buildings (i.e., B Plant, S Plant, T Plant, U Plant, and the PUREX Plant). The purpose of the initiative is to investigate the potential for using the canyon buildings as disposal sites for Hanford remediation waste, rather than demolishing the structures and transferring the resulting waste to the Environmental Restoration Disposal Facility (DOE 2004c:4).

The 221-U Facility is the first canyon building to be addressed under the Canyon Disposition Initiative. The selected remedy is to partially demolish 221-U, dispose of contaminated equipment and demolition debris inside and adjacent to the remaining structure, fill void spaces with grout, and cover the remnants with an engineered barrier (DOE 2005c). Disposition of 221-U is considered to be a pilot project for disposition of the remaining four canyon buildings. However, the complexity and costs of implementation could vary significantly for each building because of varying amounts, types, and locations of radioactive contamination within the five canyon buildings (DOE 2004c:1, 4).

The PUREX tunnels in the 200-East Area contain equipment contaminated with approximately 2.8 million curies of various radionuclides and with other hazardous materials (DOE 2003a:552, 553). These tunnels will be managed as an RCRA storage unit until closure can be coordinated with the final closure plan for the PUREX Plant. The current DOE vision calls for the PUREX tunnels to be filled with grout and covered with a surface barrier (DOE 2005b:vi; Fluor Hanford 2004:A3-2). Final closure of the tunnels will require an evaluation of alternatives (Bergeron et al. 2001:3.26).

The *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste,* released in February 2011 (DOE 2011c), analyzed various alternatives for the disposal of 12,000 cubic meters (420,000 cubic feet) of waste. Hanford is included as a potential disposal location under three alternatives: an intermediate-depth borehole facility requiring about 44 hectares (110 acres) of land for 930 boreholes and supporting infrastructure, a near-surface trench disposal facility requiring about 20 hectares (50 acres) for 29 trenches and supporting infrastructure, or an above-grade vault disposal facility requiring about 24 hectares (60 acres) of land for 12 vaults and supporting infrastructure. The disposal facility for the three alternatives would be south of the 200-East Area on the Central Plateau (DOE 2011c).

Because most of the 300 Area is within the City of Richlandôs Urban Growth Boundary, Richland funded a *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area* (Richland 2005a). The recently issued *Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 2008a) considered the City of Richlandôs *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area* in its review of new information on land use considerations developed since the *Hanford Comprehensive Land-Use Plan EIS* was issued in 1999 (DOE 1999a). The supplement analysis concluded that no significant new information or changes in circumstances had developed since 1999 that would affect the basis for DOEôs land use decisions as documented in the ROD for the *Hanford Comprehensive Land-Use Plan EIS* (64 FR 61615).

A Notice of Intent to prepare an Environmental Impact Statement for the Acquisition of a Natural Gas Pipeline and Natural Gas Utility Service at the Hanford Site, Richland, Washington was released in January 2012 (77 FR 3255). The proposed pipeline would provide natural gas to facilities located on the Central Plateau of Hanford. The pipeline would begin at the existing Williams Northwest Pipe transmission line in Franklin County and run westerly across non-DOE lands and under the Columbia River into the 300 Area before turning northwest and paralleling Route 4S. The pipeline would terminate at facilities in the 200-East Area; the length of the proposed pipeline is estimated at approximately 30 miles (48 kilometers). The proposed pipeline is not analyzed in detail in this *TC & WM EIS* because of a lack of information on potential impacts; the EIS has not been issued.

R.5 FUTURE LAND USE IN SURROUNDING REGIONS

This section contains a description of the land use planning in the counties surrounding Hanford. An understanding of expected future land use and development provides the underpinnings for reasonably foreseeable actions that may occur in the region.

The 1990 Washington State Growth Management Act (RCW 36.70A.020) requires counties in the region around Hanford to have comprehensive plans. Cities and other government jurisdictions adopt comprehensive plans to serve as guides for future activities within their jurisdictions. These plans attempt to project 20 years into the future for land development, housing, infrastructure, and community services needs. Table Rï2 describes the 13 broad goals described in the Washington State Growth Management Act that local governments must consider when developing their comprehensive plans.

Table R–2. Washington State Growth Management Act Planning Goals

Goal	Description
Urban growth	Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner.
Reduce sprawl	Reduce the inappropriate conversion of undeveloped land into sprawling, low-density development.
Transportation	Encourage efficient multimodal transportation systems that are based on regional priorities and coordinated with county and city comprehensive plans.
Housing	Encourage the availability of affordable housing to all economic segments of the population of this state, promote a variety of residential densities and housing types, and encourage preservation of existing housing stock.
Economic development	Encourage economic development throughout the state that is consistent with adopted comprehensive plans, promote economic opportunity for all citizens of this state, especially for unemployed and for disadvantaged persons, and encourage growth in areas experiencing insufficient economic growth, all within the capacities of the stateôs natural resources, public services, and public facilities.
Property rights	Private property shall not be taken for public use without just compensation having been made. The property rights of landowners shall be protected from arbitrary and discriminatory actions.
Permits	Applications for both state and local government permits should be processed in a timely and fair manner to ensure predictability.
Natural resources industries	Maintain and enhance natural-resource-based industries, including productive timber, agricultural, and fisheries industries. Encourage the conservation of productive forest lands and productive agricultural lands, and discourage incompatible uses.
Open space and recreation	Encourage the retention of open space and development of recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands and water, and develop parks.
Environment	Protect the environment and enhance the stateôs high quality of life, including air and water quality, and the availability of water.
Citizen participation and coordination	Encourage the involvement of citizens in the planning process and ensure coordination between communities and jurisdictions to reconcile conflicts.
Public facilities and services	Ensure that those public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards.
Historic preservation	Identify and encourage the preservation of lands, sites, and structures that have historical or archaeological significance.

Source: RCW 36.70A.020; Yakima County 1998:I-4.

The following plans exist for counties in the region around Hanford and for the Cities of Richland and Kennewick:

- *Adams County Comprehensive Plan* (ACPC 2005)
- *Benton County Comprehensive Land Use Plan* (BCPC 2009)
- *City of Richland Comprehensive Land Use Plan* (Richland 2002, 2005b, 2008a)

- *City of Kennewick Comprehensive Plan* 2009, *Executive Document* (Kennewick 2010)
- *Franklin County Growth Management Comprehensive Plan* (Franklin County 2008)
- *Grant County Comprehensive Plan/Environmental Impact Statement* and *A Resolution Relating to Comprehensive Planning in Grant County in Accordance with the Washington State Growth Management Act* (*RCW36.70A*) and *Amending the 2006 Comprehensive Plan and Zone Changes* (GCDCD 1999, GCBOCC 2010)
- *Kittitas County Comprehensive Plan* (Kittitas County 2010)
- *Klickitat County, Washington, Comprehensive Plan* (Dreyer 2007)
- *Plan 2015: A Blueprint for Yakima County Progress* and *2010 Comprehensive Plan Amendment Cycle* (Yakima County 1998, 2010)
- *Walla Walla County Integrated Comprehensive Plan and EIS,* ñComprehensive Plan: Walla Walla County Comprehensive Plan Update 2007 and 2009òand *Walla Walla County Integrated Comprehensive Plan and EIS*, (Walla Walla County 2007, 2009)

These plans are updated periodically. Generally, the plans encourage growth in urban growth areas (UGAs) and discourage growth outside these areas. A comprehensive plan is not a legally enforceable document; zoning is the enforceable means for controlling growth.

Under the Washington State Growth Management Act (RCW 36.70A), the Washington State Office of Financial Management has the responsibility to project population growth rates for local planning purposes. Population projections are used by cities and counties to identify the amounts and locations of rural land needed for conversion to urban use as urban growth occurs (BCPC 2009:4-15).

To set aside or designate lands necessary for future population growth (beyond those undeveloped lands already within city boundaries), the Washington State Growth Management Act requires counties to designate UGAs outside of, but adjacent to, the corporate boundary of each city. UGAs are the land areas that, though not currently within a cityôs corporate limits, are designated for conversion to urban use in the normal process of urban growth. UGAs must be large enough to accommodate 20 years of urban growth. The identification of amounts of land to be converted to urban use has important economic implications for both cities and counties (BCPC 2009:4-15, 4-16).

The size of UGAs is not determined solely by the projected rate of population growth. Other possible considerations include a cityôs need for commercial- and industrial-zoned lands to meet the economic goals and objectives identified in its comprehensive plan. Land may also be deemed unsuitable as a UGA because of its value as natural resource land (i.e., agricultural, mineral, and forestland) or its value to local residents as a unique low-density rural community (BCPC 2009:4-16).

Of primary importance to the initial establishment and future expansion of UGAs into unincorporated areas is the projected need for additional lands in relation to the existing available supply of undeveloped land already inside a cityôs UGA. Equally important; however, is the maintenance of low-enough densities outside the UGA to enable its logical and cost-effective expansion in the distant future (30 to 70 years) (BCPC 2009:4-18).

The phenomenon of city boundary enlargement and expansion into rural county lands will continue with population growth. Designation of UGAs endeavors to set standards and mechanisms whereby legitimate needs for new urban lands are met while rural communities and natural resource lands are protected. Cities can neither annex lands nor generally extend municipal services to lands outside of UGAs (BCPC 2009:4-15).

Because the majority of Hanford lies within Benton County and the majority of Hanford workers live in Benton County and the city of Richland, the following discussion concentrates on future land use in these regions.

Benton County. As described in the *Benton County Sustainable Development: Overall Economic Development Plan* (Benton County 2007), 263,049 hectares (650,000 acres) of the county are planned for agriculture and agribusiness; 2,045 hectares (5,053 acres), for commercial and industrial use; and 5,541 hectares (13,693 acres), for tourism and recreation. This does not include the areas designated for Conservation (Mining) (44,183 hectares [109,179 acres]); Industrial/Industrial-Exclusive use (20,399 hectares [50,217 acres]); Preservation (78,127 hectares [193,056 acres]); Recreation, including both High Intensity and Low Intensity (459 hectares [1,134 acres]); and Research and Development (4,912 hectares [12,138 acres]) in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a:S-46, S-47).

Historically, the Cities of West Richland, Richland, and Kennewick have aggressively pursued annexation of unincorporated lands, largely in response to the boom-and-bust cycles of Hanford. Between 1985 and 1998, 7,328 hectares (18,107 acres) were annexed even though each city still had over half its incorporated acreage undeveloped. Kennewick has 2,428 hectares (6,000 acres) of vacant or undeveloped land designated for low-density residential use; Richland, 549 hectares (1,356 acres); and West Richland, 5,520 hectares (13,641 acres), some of which is actually designated for rural and lesser densities (BCPC 2009:4-15, 4-19).

City of Richland. The City of Richland released an updated *City of Richland Comprehensive Land Use Plan* in 2008 (Richland 2008a). Although this plan is for the period ending in 2035, it contains few quantitative estimates of future changes. Therefore, the 1997 *City of Richland Comprehensive Land Use Plan*, as amended through December 10, 2002 (Richland 2002), was used to obtain the pertinent information. The 1995ï2015 planning horizon of that plan (Richland 2002:ES 1-1ïES 1-5) reflects the following projected changes:

- Gain of 11,041 jobs
- Demand for 3,134 residential units requiring 170 hectares (420 acres) of the 1,281 hectares (3,165 acres) of currently vacant land
- Demand for an additional 490 hectares (1,212 acres) of vacant developable land
- Demand for an additional 42 hectares (104 acres) of parkland
- Growth in the student population of 1,504
- Falling level-of-service ratings on 19 roadway segments
- Increasing demand for irrigation water for landscaping as unused open space and agricultural land are converted to public facility and residential uses

Also indicated (Richland 2002:3-6) are the following changes in land use patterns expected between 1995 and 2015:

- Land designated for residential uses will increase from 31 to 33 percent of the total land area.
- Land designated for industrial uses will increase from 19 to 26 percent of the total land area. Most of this increase will be attributable to the addition of Hanford land.
- Land designated for commercial uses will increase slightly to 6 percent of the total land area.
- Land designated for Urban Reserve uses will be approximately 8 percent of the total land area.

The following changes in land use patterns were reflected in the planning horizon of the amended 2008 plan (Richland 2008a:AL-II, AL-III, PF-VII):

- Land designated for agricultural uses will decrease from 21 to 3 percent of the total land area. Most of this decrease will result from continuing the redesignation of lands in the Horn Rapids area from agricultural to Urban Reserve and public facility uses.
- Land designated for public facilities and open space will increase from 12 to 21 percent of the total land area.

The UGA in the *City of Richland Comprehensive Land Use Plan* (Richland 2008a:LU 3-2) covers an area of 10,126 hectares (25,021 acres).

Although changes will inevitably occur due to the pressures of continued population growth, land use in the region surrounding Hanford is not expected to change drastically during the upcoming decades. It is assumed that the largest land use in the region will continue to be agricultural, and that populations will increase mainly around the current urban areas (DOE 2005b:2.2).

R.6 APPROACH TO CUMULATIVE IMPACTS ANALYSIS

A flowchart of the methodology used to estimate cumulative impacts is presented as Figure Rï2. This flowchart, which incorporates the CEQôs eight principles of cumulative effects analysis (CEQ 1997:8), is divided into four phases: (1) selection of resource areas and appropriate regions of influence (ROIs), (2) selection of reasonably foreseeable future actions, (3) estimation of cumulative impacts, and (4) identification of monitoring and mitigation.

Region of Influence:
A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

Phase 1—Selection of Resource Areas and Appropriate ROIs. This phase concentrates on selecting resource areas most likely to incur meaningful cumulative impacts. Steps in this process include the following:

1a. Examine resource areas evaluated in recent Hanford NEPA documents, areas evaluated in this *TC & WM EIS* (see Chapter 4), and areas subjected to historically significant impacts to develop a list of resource areas likely to exhibit cumulative effects.

1b. Identify the ROI ð i.e., the spatial limits ð for each resource area to be evaluated for cumulative impacts. ROIs are described in the introduction to Chapter 3 of this *TC & WM EIS* and are summarized in Section R.9.

Phase 2—Selection of Reasonably Foreseeable Future Actions. In this phase, reasonably foreseeable future actions are examined and screened to determine which must be included in the cumulative impacts analysis. Steps in this process include the following:

2a. Identify future actions ð Federal, non-Federal, or private ð occurring in the ROI. Typical information sources include RODs, RCRA, CERCLA, NEPA, and Washington State Environmental Policy Act documents; the TPA; permits and permit applications; and land use and development plans.

> **Reasonably foreseeable actions** are ongoing and will continue into the future, are funded for future implementation, or are included in firm, near-term plans.

2b. Examine each future action to determine whether the action is reasonably foreseeable, occurs within the ROI, occurs within the same timeframe as the *TC & WM EIS* action, and is not already accounted for in the baseline impacts.

2c. Retain for analysis future actions meeting the criteria listed in item 2b, and eliminate from further consideration future actions not meeting all those criteria.

Phase 3—Estimation of Cumulative Impacts. In this phase, impact indicators for the proposed actions are added to baseline values and to values for reasonably foreseeable future actions to estimate cumulative impacts. Steps in this process include the following:

3a. Identify and, to the extent possible, quantify baseline impacts. Baseline impacts (i.e., the level of degradation that a resource is currently experiencing) include effects of past and present actions. These impacts are generally those described in Chapter 3 of this *TC & WM EIS*. Present actions include cleanup activities that could reduce impacts of a past action, as well as actions that could add to the degradation of a resource. The importance of past actions to cumulative impacts is resource-specific. For example, past air pollutant releases would not affect the baseline (current) site air quality, whereas liquid releases to the ground could have a lasting effect and could impact the baseline. Therefore, only past actions continuing to have impacts on the resource are considered in the cumulative impacts analysis.

3b. Identify impacts of the *TC & WM EIS* Preferred Alternatives and the *TC & WM EIS* alternative combinations from Chapter 4.

3c. Identify impacts of the reasonably foreseeable future actions identified in Phase 2. If quantitative data are available, incorporate the values into a quantitative or semiquantitative cumulative impacts analysis. If quantitative data are not available, use qualitative data.

3d. Aggregate the effects on each resource of past, present, and reasonably foreseeable future actions, including the proposed actions. Use aggregate effects to estimate cumulative impacts for each resource area. Determine the degree of impact using largely the same impact measures that were used for Chapter 4 of this *TC & WM EIS*.

The results of the cumulative impacts analysis are presented in Chapter 6. Supporting information for the short-term cumulative impacts analysis is presented in Appendix T; long-term, in Appendix U.

Phase 4—Identification of Monitoring and Mitigation. In this phase, resultant estimates of cumulative impacts are examined to determine whether monitoring and/or mitigation activities are needed. Steps in this process include the following:

4a. Determine those resource areas where appreciable cumulative impacts are predicted.

4b. Describe measures that may be used to monitor or mitigate these potentially appreciable cumulative impacts.

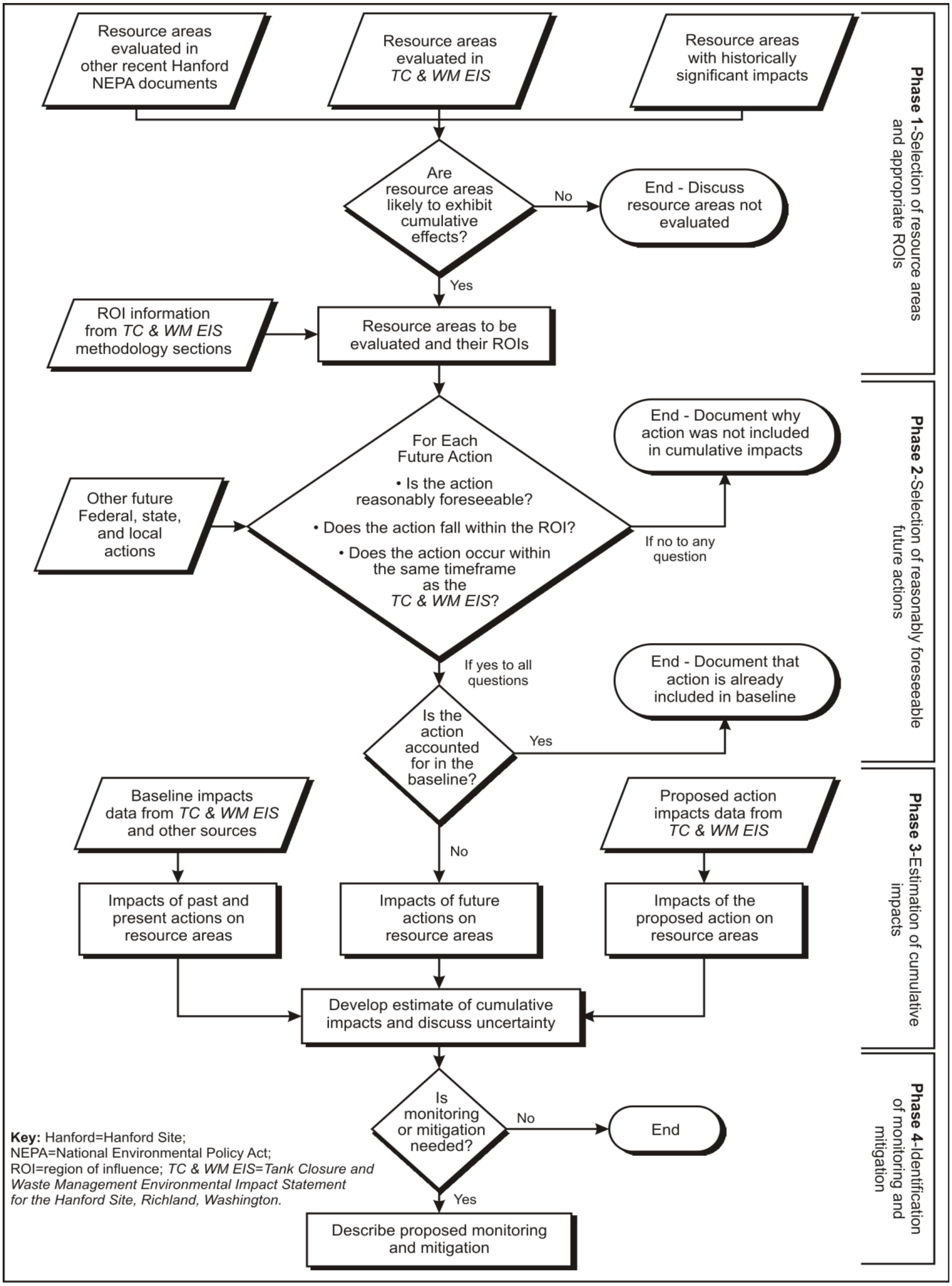


Figure R–2. Flowchart for Identifying and Evaluating Cumulative Impacts

R.7 UNCERTAINTIES

Many uncertainties are inherent in the estimation of cumulative impacts. The uncertainties in the cumulative impacts described in this *TC & WM EIS* are largely the result of the following assumptions and conditions:

- Small changes in current activities are generally not documented and therefore not considered.
- Individual activities disturbing less than 40 hectares (100 acres) are generally not considered.
- Detailed information for many of the future activities considered in this cumulative impacts analysis is limited.
- Information on projects to be implemented 10 or more years in the future is limited.
- Future changes to laws and regulations cannot be considered.
- Future fluctuations and changes to the environment, including climate change and the effects of climate change on water resources, ecological resources, and man, cannot be considered quantitatively.

The contribution of most of these assumptions and conditions to the determination of Hanfordôs cumulative impacts is believed to be small, at least for the short term. Although not quantified, these assumptions and conditions are unlikely to change the conclusions of the *TC & WM EIS* cumulative impacts analysis. Given the extended duration of the analysis, resulting projections of long-term cumulative impacts are subject to a high degree of uncertainty.

As described in the previous sections, cumulative impacts were assessed by combining the potential effects of *TC & WM EIS* activities with the effects of other past, present, and reasonably foreseeable actions in the ROI. It must be noted, of course, that many actions occur at different times and locations across the ROI ð e.g., the set of actions impacting air quality ð and thus their impacts are not entirely cumulative. Therefore, this approach should yield a conservative estimate of cumulative impacts for the activities considered.

R.8 SELECTION OF RESOURCE AREAS FOR ANALYSIS

Because of the comprehensive nature of this *TC & WM EIS*, cumulative short-term impacts were evaluated for all resource areas except for the impacts of accidents on public and occupational health and safety. Except under an extremely unlikely catastrophic earthquake scenario, it is highly unlikely that accidents in separate facilities would occur at the same time and be close enough to each other to have appreciable additive effects. The resource areas evaluated for long-term impacts were groundwater, human health, environmental justice, and ecological risk.

R.9 RESOURCE AREA METHODOLOGIES

This *TC & WM EIS* incorporates a range of methods for evaluating cumulative impacts because of differences in the anticipated significance of the impact on a given resource area, the availability of adequate data, and the specific needs of decisionmakers and the public.

In general, long-term impacts, including impacts on groundwater quality, were evaluated quantitatively (i.e., they were modeled). Analyses of short-term impacts were generally semiquantitative (i.e., simple addition of impact indicators) or qualitative (i.e., descriptions were based on nonnumerical data). Where data were not uniformly available or comparable for a particular resource across its ROI; however, analysis entailed a combination of semiquantitative and qualitative methods. In regard to those resource areas for which a detailed analysis was preferable but data were simply insufficient to support that level of analysis, the analysis was performed qualitatively. Table Rï3 identifies, for each resource area, the method of analysis and the rationale for its application.

Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas

Resource Area	Region of Influence	Method of Analysis	Indicator	Note
Short-Term Impacts				
Land use	Hanford and nearby offsite areas	Semiquantitative	Land area disturbed or occupied	Amount of land disturbed or occupied for other actions[a] is added to present a total.
Visual resources	Hanford and nearby offsite areas in the viewshed	Qualitative	Visual resource alteration in the viewshed	Resource area does not lend itself to a quantitative analysis.
Infrastructure	Hanford utility infrastructure	Semiquantitative	Utility use (electricity, fuel, and water)	Utility resources used for other actions[a] are added to present a site total.
Noise	Hanford, nearby offsite areas, and access routes to the site	Qualitative	Noise levels	Noise data are not likely to be available to perform a quantitative analysis.
Air quality	Hanford and nearby offsite areas within the airshed	Semiquantitative	Concentrations of criteria and toxic air pollutants	Air quality indicators for other actions[a] are added to present a conservative total, given that the values likely occur at different locations and at different times.
Geology and soils	Hanford and nearby offsite areas where geologic and soil resources may be affected	Semiquantitative	Volumes of geologic and soil resources used	Geologic and soil resources used for other actions[a] are added to present a total.
Water resources	Hanford and nearby offsite areas in the Columbia River and Yakima River watersheds	Semiquantitative	Amount of surface water and groundwater used	Water use for other actions[a] is added to present a total.
		Qualitative	Surface-water and groundwater quality	
Ecological resources	Hanford and nearby offsite areas with similar habitat	Semiquantitative	Sensitive habitat (e.g., shrub steppe) disturbed or occupied	Amount of habitat disturbed for other actions[a] is added to present a total.
		Qualitative	Disturbance of threatened and endangered species	

Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas *(continued)*

Resource Area	Region of Influence	Method of Analysis	Indicator	Note
Short-Term Impacts *(continued)*				
Cultural and paleontological resources	Hanford and nearby offsite areas that may contain significant cultural resources	Qualitative	Disturbance of National Register of Historic Places ïlisted or ïeligible historic properties or archaeologic, American Indian, or paleontologic resources	Potential for cumulative impacts on cultural resources is discussed qualitatively.
Socioeconomics	Hanford and nearby counties where at least 90 percent of Hanford employees reside	Semiquantitative	Direct and indirect employment Traffic from employee and truck trips	Employment and vehicle trips for other actions[a] are added to present a total.
Public and occupational health and safety ð normal operations	Hanford and offsite areas within 80 kilometers (50 miles) of the site	Semiquantitative	Population and MEI doses and LCFs from radioactive air emissions and Hazard Indices for chemical air emissions	Public health indicators for other actions[a] are added to present a total.
	Occupational impacts limited to Hanford workers		Worker doses and LCFs from radiological exposure and Hazard Indices for chemical exposure	Worker health indicators for other actions[a] are added to present a total, as resource is suitable for addition of impact indicators.
Public and occupational health and safety ð transportation	Hanford roads and railroads and selected offsite transportation corridors to waste disposal facilities	Semiquantitative	Population and MEI doses and LCFs for transport crew and public along transportation routes	Transportation indicators for other actions[a] are added to present a total.
Waste management	Hanford waste management facilities and offsite facilities where Hanford waste is managed	Semiquantitative	Waste generation for transuranic, low-level radioactive, mixed low-level radioactive, hazardous, dangerous, and nonhazardous wastes	Waste volumes/weights generated for other actions[a] are added to present a total.
Industrial safety	Industrial safety impacts limited to Hanford workers	Semiquantitative	Total recordable cases (TRCs) and fatalities	TRCs and fatalities are added to present a total.

Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas *(continued)*

Resource Area	Region of Influence	Method of Analysis	Indicator	Note
Long-Term Impacts				
Groundwater	Portions of the groundwater basin that may be adversely affected by *TC & WM EIS* activities; bounded by groundwater discharge locations along the Columbia River	Quantitative	Radionuclide and chemical contaminant concentrations	Analysis required by Settlement Agreement re: *State of Washington v. Bodman* (Civil No. 2:03-cv-05018-AAM). Analysis is per the *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses*, Final Rev. 0, dated March 25, 2005 (DOE 2005d), due to ñsignificanceò of the resource area (groundwater) at Hanford.
Human health	Potential future onsite groundwater users and users of the Columbia River downstream from the site	Quantitative	MEI dose, LCFs, and Hazard Indices for drinking-water well user, resident farmer, American Indian resident farmer, and American Indian hunter-gatherer, and population dose, LCFs, and Hazard Indices for downstream surface-water users	Direct inputs are obtained from long-term groundwater modeling results.
Environmental justice	Potential future onsite subsistence farmers and American Indian users, and users of the Columbia River downstream from the site	Quantitative	MEI dose, LCFs, and Hazard Indices for future onsite subsistence farmers and American Indians	Direct inputs are obtained from long-term groundwater modeling results.

Table R–3. Methods of Cumulative Impacts Analysis for Different Resource Areas *(continued)*

Resource Area	Region of Influence	Method of Analysis	Indicator	Note
Long-Term Impacts *(continued)*				
Ecological risk	Plants and animals using Hanford and the Columbia River adjacent to and downstream from the site	Quantitative	Risk to indicator species at the shore of the Columbia River (terrestrial) and in the river (aquatic)	Direct inputs are obtained from long-term groundwater modeling results.

[a] Other past, present, and future actions in the region of influence that may contribute to cumulative impacts. The proposed approaches for evaluating cumulative impacts described in this table are dependent on the availability of information for other past, present, and reasonably foreseeable future actions. If numerical data are not available, qualitative cumulative impact analyses are performed.

Key: Hanford=Hanford Site; LCF=latent cancer fatality; MEI=maximally exposed individual; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*.

Source: Based on Chapter 3, Table 3ï1.

R.10 SPATIAL AND TEMPORAL CONSIDERATIONS

Cumulative environmental impacts ð i.e., the impacts of all past, present, and reasonably foreseeable actions ð have limits in space and time. For cumulative impacts analysis, those recognized spatial limits help determine the specific geographic expanse (ROI) to be evaluated for each resource area. The ROIs used in the cumulative impacts analysis ð many are the same as those described in the introduction to Chapter 3 ð are summarized in Table Rï3.

To conclusively address the temporal limits of environmental impact, short- and long-term cumulative impact analyses were performed for each resource area. Short-term cumulative impacts are associated with the active project phase, extending through the applicable administrative control, institutional control, or postclosure care period. Long-term cumulative impacts extend beyond the active project phase, thus beyond the appropriate period of administrative control, institutional control, or postclosure care. For this EIS, long-term cumulative impacts were assessed for approximately 10,000 years into the future.

R.11 PAST AND PRESENT ACTIONS

To determine the baseline impacts on a resource, the impacts of past and present actions must be identified. For most resource areas, baseline impacts were taken from information on the affected environment provided in Chapter 3 of this *TC & WM EIS*. For example, the current air quality in the ROI as described in Chapter 3 adequately reflects both past and present activities. In contrast, current resource use alone may not adequately account for past resource loss, and thus may not be a good indicator of baseline impacts.

Past and present actions that may contribute to cumulative impacts include those conducted by government agencies, businesses, or individuals within the ROIs considered. Examples of past Hanford activities include operation of the fuel fabrication plants, production reactors, the PUREX Plant and other fuel-reprocessing facilities, the PFP, and research facilities, as well as the treatment and disposal of waste. Current Hanford activities include site cleanup, waste disposal, and tank waste stabilization.

Examples of past and present offsite activities that may contribute to cumulative impacts include the clearing of land for agriculture and urban development, water diversion and irrigation projects, waste management, industrial and commercial development, mining, power generation, and the development of transportation and utility networks.

R.12 SELECTION OF REASONABLY FORESEEABLE FUTURE ACTIONS

In *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997), Principle 1 of cumulative effects analysis reads, ñCumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.ò Principle 2 reads, in part, ñCumulative effects are the total effect é of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions.ò Therefore, it is important to identify future actions that may appreciably degrade the resources or add to the impacts of the proposed actions, regardless of the agency or individual undertaking the actions.

The *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) lays out the future vision for land use at Hanford. Both DOE and non-DOE actions may occur within the current Hanford boundaries. The major DOE activities will include continuation of site cleanup, waste consolidation and disposal, facility closure and decontamination and decommissioning, and the various high-level radioactive waste treatment and tank closure activities. Non-DOE actions are expected within the areas at Hanford set aside for Industrial, Research and Development, Preservation, Conservation (Mining), and Recreation uses (see Figure Rï1).

DOE Actions at Hanford

The *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) describes the major DOE activities that are occurring or would occur at Hanford to achieve the vision set forth in the *Hanford Comprehensive Land-Use Plan EIS*. The list of activities reflected in that plan was modified by eliminating those activities within the scope of this *TC & WM EIS* and those that have already been completed, and adding new activities planned for Hanford (72 FR 40135; 77 FR 3255; DOE 2006a; DOE, EPA, and Ecology 2006, 2007, 2009; PHMC 2006a, 2006b; Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011). Present and future DOE activities at Hanford include the following:

- Cleanup and restoration activities across all areas of Hanford
- Decommissioning of surplus production reactors and their support facilities in the 100 Areas along the Columbia River[1]
- Deactivation of the PFP in the 200-West Area
- Actions to remove the sludge and decommission the K Basins in the 100-K Area
- U Plant regional closure
- Final disposition of the canyon buildings, PUREX tunnels, and other facilities in the 200 Areas, and cleanup of the Central Plateau to Industrial-Exclusive land use standards
- Transport of sodium-bonded spent nuclear fuel from FFTF in the 400 Area to INL for treatment
- Excavation and use of geologic materials
- Continued disposal of waste in the Environmental Restoration Disposal Facility near the 200-West Area

[1] B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS*.

- Implementation of the programmatic waste management decisions described in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a)
- Retrieval of suspect TRU waste buried after 1970
- Cleanup and protection of groundwater
- Potential disposal of greater-than-Class C LLW
- Transport of TRU waste to WIPP
- Acquisition of natural gas pipeline and natural gas utility service

Non-DOE Actions at Hanford

The aforementioned review of documentation for data bearing on cumulative impacts also entailed consideration of non-DOE activities inside the Hanford boundary. These included Federal, state, or local initiatives; industrial or commercial ventures; utility or infrastructure construction and operation; and waste treatment and disposal. Specific non-DOE activities at Hanford include the following:

- Continued transport of U.S. Navy reactor plants via the Columbia River and disposal thereof in trench 218-E-12B in the 200-East Area
- Continued operation of the Columbia Generating Station (previously Washington Public Power Supply System, Nuclear Project No. 2)
- Continued operation of the US Ecology Commercial Low-Level Radioactive Waste Disposal Site
- Management of the Hanford Reach of the Columbia River as a national monument and a national wildlife refuge

Other Actions in the Region

It was also necessary to consider activities outside Hanford but within the ROI. These included Federal actions, state and local development initiatives, industrial and commercial ventures, residential development, and infrastructure projects. Activities in the region surrounding Hanford include the following:

- Future land use in the region as described in city and county comprehensive land use plans
- Base realignment and closure and other U.S. Department of Defense activities
- Cleanup of toxic, hazardous, and dangerous waste disposal sites
- Columbia River and Yakima River water management
- Power generation and transmission line projects
- Wind energy projects
- Pipeline projects
- Transportation projects

For more information on anticipated future activities that could contribute to cumulative impacts, data were also collected from the Cities of Kennewick, Pasco, Richland, West Richland, and Yakima in Washington; the Counties of Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima in Washington; the Counties of Morrow and Umatilla in Oregon; and the Yakama Nation, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation. No additional major future actions were identified by the city of Pasco in Washington; Adams, Franklin, Kittitas, Klickitat, or Walla Walla County in Washington; Umatilla County in Oregon; or the Nez Perce Tribe (Adams 2007, 2011; Benson 2011; DôHondt 2011; Jennings 2011; Kelsey 2011; Prentice 2011; Romine 2007, 2011; Smith 2011; Wendt 2011; Wiltse 2011). Future activities that were identified for the region surrounding Hanford include the following:

- The 1,012-hectare (2,500-acre) South Ridge Development Zone in Kennewick, Washington, designated for mixed-use development over the next 5 to 10 years (Romine 2007).
- The 130-hectare (320-acre) Red Mountain Center mixed-use development area in West Richland, Washington, which broke ground in 2007 and will undergo phased construction over the next few years (Gouk 2011).
- The annexation of approximately 648 hectares (1,600 acres) of land near the Apple Tree Golf Course by the City of Yakima for residential development over the next 5 to 10 years (Benson 2007).
- The 567-hectare (1,400-acre) Multi-Purpose Motor Speedway Project 4.8 kilometers (3 miles) west of Boardman, Oregon, that began construction in 2007. Expansions could total 2,833 hectares (7,000 acres) over the next 10 years; however, this project is currently on hold due to a lack of funding (McClane 2007, 2011; PNMP 2007).
- The 115-hectare (284-acre) subdivisions near Pasco, Washington, located northwest and southwest of the airport (Adams 2007).
- The 162-hectare (400-acre) multitenant industrial park for the Port of Morrow in Boardman, Oregon, part of which has been constructed and is in use (McClane 2007; POM 2011).
- The 208-hectare (515-acre) industrial development adjacent to the Port of Morrow in Boardman, Oregon, which could include rail development and a container facility (McClane 2011).
- The 648-hectare (1,600-acre) Destination Resort Complex mixed vacation-style residential development with golf course and marina along the Columbia River 4.8 kilometers (3 miles) west of Boardman, Oregon, which is expected to begin construction within 5 years (McClane 2007).
- The development of biofuels (including ethanol) facilities in Finley, Moses Lake, and Plymouth, Washington, and biodiesel facilities in Burbank, Ellensburg, Sunnyside, Toppenish, and Warden, Washington (Riggsbee 2007; WSU 2008a).
- The construction of a carbon fiber manufacturing plant in Moses Lake, Washington, which broke ground in 2010 (Cooper 2011).
- Boardman Power Plant air emissions reduction by 2020 owing to the installation of new controls and emissions-reduction equipment. Portland General Electric is investigating replacing coal with a carbon-neutral renewable resource after 2020, which could involve converting approximately 40,469 hectares (100,000 acres) into agriculture to grow the biomass (PGE 2011; Skeen 2011).
- Under the Badger Mountain Subarea Plan, the December 2010 annexation of 815 hectares (2,014 acres) from Benton County for conversion to private ownership and incorporation into the City of Richland for mostly residential and some industrial use (Rolph 2011; Shuttleworth 2011).

Because of the distance from Hanford; the routine nature of most actions; and various zoning, permitting, environmental review, and construction requirements, most other actions are not expected to interact with Hanford activities to produce cumulative impacts.

Benton, Franklin, and Grant Counties had a total of 942,780 hectares (2.33 million acres) of farmland in 2007 (USDA 2009). This farmland area is 65 percent of the 1.46 million hectares (3.6 million acres) of the total land area of these counties (WOFM 2007). Little growth in agriculture is expected through 2025 (WSTC 2006:B-8).

Many areas of the Columbia River Basin have the potential for natural gas accumulations in underground sediments. Although significant production has not occurred, small amounts of gas were produced from the Rattlesnake Hills Gas Field north of Richland. No oil or gas production wells have been completed in the state of Washington since 1962 (Lingley 2005), although state and Federal lands in the region around Hanford continue to be leased for natural gas exploration (WDNR 2007a).

As described in Chapter 3, sand, gravel, and basalt are the primary geologic resources extracted from the earth in the region around Hanford. There are many commercial surface mines in the region (WDNR 2006), and it is expected that mines will be expanded and new mines developed to satisfy the future need for these construction materials. Long-term cumulative impacts of these activities are not expected because the Washington State Surface Mining Act (RCW 78.44) ensures that surface mines more than 1.2 hectares (3 acres) in size or with a highwall that is higher than 9.1 meters (30 feet) and steeper than 45 degrees are reclaimed (WDNR 2007b).

The Yakima Training Center is in central Washington in Yakima and Kittitas Counties, approximately 11 kilometers (7 miles) northeast of the city of Yakima (Army 2007:365). Land use at the center is separated into two major areas: the cantonment area (approximately 400 hectares [1,000 acres]) and the training areas (approximately 132,000 hectares [326,000 acres]) (Army 2007:367). The cantonment area, which includes residential, administrative, commercial, light industrial, and open spaces, is in the southwest corner of the installation (Army 2007:365). The training areas include a large maneuver area; a variety of large- and small-caliber live-fire ranges; and a digital, multipurpose range complex (Army 2007:355, 2010:2-20). Units from Fort Lewis and elsewhere use the Yakima Training Center to conduct maneuver and live-fire training, and then return home to their respective installations (Army 2007:355).

Construction activities planned for the foreseeable future at the Yakima Training Center include the following (Army 2007:369; 2010:2-20, A-1, A-2, A-6):

- Construction of a sniper field fire range for fiscal year 2011
- Construction of a multipurpose machine gun range for fiscal year 2014
- Three 5.68-million-liter (1.5-million-gallon) drinking water reservoirs with wells for firefighting needs for fiscal year 2012
- Construction of an air cavalry squadron complex for fiscal year 2014
- Construction of a fire station for fiscal year 2014

In May 2005, the U.S. Department of Defense announced its latest round of base realignment and closure activities (AFIS 2005; BRAC 2005). These activities can impact areas around military facilities by reducing or increasing direct and indirect employment and activities that have environmental impacts. The Umatilla Army Depot is the only major military facility in the Hanford ROI to be closed.

Closure of the depot and the associated loss of 884 regional jobs (512 direct and 372 indirect) (BRAC 2005:Ind-14, C-20) and reduction in activities will have inevitable environmental impacts. In August 2010, the Umatilla Army Depot Reuse Authority (UMADRA) released a reuse plan featuring three principal land use categories: a major training facility for the Oregon National Guard; a U.S. Fish and Wildlife Refuge for habitat protection; and an industrial zone to aid in offsetting the economic impact of base closure on the community (UMADRA 2010). While the precise impacts of closure of the depot have not been evaluated, they will be the subject of future NEPA documentation. Because the depot is over 48 kilometers (30 miles) from the Hanford boundary, little in the way of cumulative impacts is expected.

The sites on EPAôs National Priorities List (NPL) (also known as Superfund [Superfund Amendments and Reauthorization Act] sites) were reviewed to determine whether any could contribute to cumulative impacts at Hanford. Seven active NPL sites are in Hanford or within 80 kilometers (50 miles) of the site boundary. Three of these sites are the Hanford 100, 200, and 300 Areas. The closest of the remaining four NPL sites is the Pasco Sanitary Landfill near Pasco, Washington, approximately 19 kilometers (12 miles) southeast of the site boundary (EPA 2006a, 2006b, 2010). The State of Washington also actively pursues the cleanup of contaminated sites through the State Toxics Cleanup Program. A total of 213 State of Washington sites are within 80 kilometers (50 miles) of Hanford, including 4 in Adams County, 70 in Benton County (6 in the city of Richland), 13 in Franklin County, 21 in Grant County, 8 in Kittitas County, 7 in Walla Walla County, and 90 in Yakima County (Ecology 2010). In addition to being some distance from Hanford, most of the NPL and Washington State Toxics Cleanup Program sites are well into the control and cleanup process, and thus would not substantially contribute to cumulative impacts.

The Columbia River Basin Water Supply Act (RCW 90.90) requires Ecology to ñaggressively pursue the development of water supplies to benefit both in-stream and out-of-stream uses.ò Ecology developed a Columbia River Water Management Program to facilitate compliance with the legislation. Applications for 15 projects within the ROI have been submitted to Ecology (Ecology 2011).

The Black Rock Reservoir, a water storage and electric power generation project that was evaluated for the Yakima River Basin, could have substantial environmental and economic effects on the region. This project could include the construction of a 160-meter-high (525-foot-high), central-core rockfill dam, creating a reservoir with an active storage volume of 1.3 million acre-feet. A pipeline would take water from the Columbia River upstream of Priest Rapids Dam, store it in the reservoir, and then discharge it to the Yakima River Valley. The total project construction cost is estimated at $4.5 billion, with an annual operating cost of $60.2 million. This reservoir would be approximately 8 kilometers (5 miles) west of Hanfordôs nearest boundary (BOR and Ecology 2008:xvi, xxi, xviii, 2-37).

In December 2008, the U.S. Bureau of Reclamation (BOR) issued the *Final Planning Report/Environmental Impact Statement, Yakima River Basin Water Storage Feasibility Study, Yakima Project, Washington* (BOR 2008), which evaluated three action alternatives for Yakima River Basin water storage: a Black Rock Reservoir Alternative, a Wymer Dam and Reservoir Alternative, and a Wymer Dam Plus Yakima River Pump Exchange Alternative. In April 2009, BOR concluded that none of these action alternatives evaluated met Federal criteria for an economically and environmentally sound water project; therefore, the No Action Alternative was identified as the Preferred Alternative (BOR 2009). In June 2009, Ecology issued the *Final Environmental Impact Statement, Yakima River Basin Integrated Water Resource Management Alternative* (Ecology 2009) as a supplement to the final EIS issued by BOR. Ecology prepared the final EIS to evaluate an additional water supply alternative, which incorporated elements from the three State Alternatives evaluated in the 2008 BOR and Ecology draft EIS. The Integrated Water Resource Management Alternative included in the final EIS includes seven general elements to improve water resources in the Yakima River Basin: fish passage improvements, modification of existing operations and facilities, new or expanded storage reservoirs, groundwater storage, fish habitat enhancement on main-stem rivers and tributaries, enhanced water conservation, and market-based reallocation of water resources. The analysis in the final EIS is programmatic in nature. If the decision is made to implement this alternative, any individual projects that are carried forward will require additional environmental review when they are proposed (Ecology 2009:FS-1, FS-2).

The Priest Rapids Hydroelectric Project, consisting of the Priest Rapids and Wanapum Dams, is directly upstream of Hanford. The project occupies an estimated 1,256 hectares (3,104 acres) of Federal land managed by BOR, the U.S. Bureau of Land Management, the U.S. Department of the Army, USFWS, DOE, and the Bonneville Power Administration. It also occupies an estimated 1,135 hectares (2,804 acres) of Washington State land (FERC 2006:xvi). The project has operated since 1955 under a 50-year license with the Federal Energy Regulatory Commission. In anticipation of license expiration in 2005, the Grant County Public Utility District filed a relicensing application with the commission in October 2003, and an EIS was completed in 2006 (FERC 2006; Grant County PUD 2003). The Grant County Public Utility District proposed to improve the project by installing advanced-design turbines, improving downstream fish bypass facilities, enacting new programs to protect and enhance anadromous and resident fish and wildlife, and implementing additional cultural resources protections (Grant County PUD 2003:1, 2). It is expected that these improvements will reduce the impacts of operation of the Priest Rapids Hydroelectric Project to levels below those currently experienced. A 44-year license extension was granted for the project in April 2008 (FERC 2008:58). In 2009, the fifth of 10 new turbines was installed at Wanapum Dam, with installation of the remaining turbines expected in 2012 (Grant County PUD 2009:6). The improved fish bypass at Wanapum Dam demonstrated excellent results in passing juvenile salmonids downstream in 2009, with research showing that sockeye salmon had migrated through the lake and were successfully spawning in the upper Cle Elum River (Grant County PUD 2009:7).

Information on power generation and transmission line projects was collected to determine whether major projects are planned for the region around Hanford (BPA 2009a, 2011a, 2011b; EFSEC 2011; Grant County PUD 2009; RNP 2011). Long-term planning by the Bonneville Power Administration and the Pacific Northwest Electric Power Planning and Conservation Council suggests a need for up to 8,000 megawatts of electricity in the region (BPA 2003:2). To that end, a number of power generation projects have been proposed for the ROI. Utility projects either proposed or recently completed include the following:

- Plymouth Generation Facility, a 306-megawatt natural-gas-fired turbine electricity-generating facility (Benton and BPA 2003; BPA 2009a)
- Wanapa Energy Center, a 1,200-megawatt gas and steam turbine electricity-generating facility (BIA 2004; BPA 2009a)
- Wind projects, including Big Horn, Combine Hills II, Juniper Canyon I, Juniper Canyon II, and Wild Horse (BPA 2011b, 2011c; EFSEC 2011)
- New transmission lines, including the 127-kilometer (79-mile), 500-kilovolt line between McNary and John Day Substations; the 45-kilometer (28-mile), 500-kilovolt line between Big Eddy and Knight Substations; the 61-kilometer (38-mile), 500-kilovolt line between Central Ferry and Lower Monumental Substations; the 48-kilometer (30-mile), 230-kilovolt line between Walla Walla and McNary Substations; and the approximately 105-kilometer (65-mile), 230-kilovolt line between Vantage and Pomona Heights Substations (BLM 2011; BPA 2010, 2011a; Pacific Power 2011)

- Transmission line upgrades, including the Tucannon RiverïNorth Lewiston Rebuild, Big EddyïMidway Rebuild, and FranklinïWalla Walla Rebuild (BPA 2011a)

The Plymouth Generation Facility would be approximately 40 kilometers (25 miles) south of the Hanford boundary (Benton and BPA 2003); the Wanapa Energy Center, approximately 48 kilometers (30 miles) south (BIA 2004:3.6-4). These facilities would be approximately 64 kilometers (40 miles) from the 200 Areas. As of March 2009, both projects were on hold (BPA 2009a).

Six wind projects would be within 80 kilometers (50 miles) of Hanfordôs boundary. The Big Horn Wind Project is approximately 72 kilometers (45 miles) southwest of Hanfordôs boundary, and construction for a 50-megawatt expansion is currently under way (RNP 2011). The Combine Hills I and II Wind Projects are southeast of Hanfordôs boundary approximately 56 kilometers (35 miles) away. The proposed Juniper Canyon I and II Wind Projects are approximately 64 kilometers (40 miles) from Hanfordôs boundary. A 22-turbine expansion of the Wild Horse Wind Project, approximately 56 kilometers (35 miles) northwest of Hanfordôs boundary, was completed in November 2009 (BLM 2005; BPA 2011b; EFSEC 2011). In total, these wind projects involve the construction of 485 wind turbines that would generate 877 megawatts of electricity (EFSEC 2011; NPCC 2010; RNP 2011).

Most transmission line projects are some distance from Hanfordôs boundary. The McNaryïJohn Day transmission line would be approximately 40 kilometers (25 miles) from Hanford (BPA 2009a). Although this project was on hold for a period of time, in February 2009, the Bonneville Power Administration decided to build the project (BPA 2011a). The Big EddyïKnight transmission line would be approximately 24 kilometers (15 miles) from Hanford. A draft EIS was published in December 2010 (BPA 2010, 2011a). The Central FerryïLower Monumental transmission line would be approximately 56 kilometers (35 miles) from Hanford (BPA 2011a, 2011d). The Walla WallaïMcNary transmission line would be approximately 48 kilometers (30 miles) from Hanford (Pacific Power 2010). A conditional-use permit and State Environmental Policy Act checklist were submitted to Walla Walla County in September 2008 (Pacific Power 2008a, 2008b). The VantageïPomona Heights transmission line would be approximately 32 kilometers (20 miles) from Hanford (BLM 2011).

In addition, information on water and gas pipeline projects was reviewed. The Blue Bridge Pipeline Project would involve the construction of up to 253 kilometers (157 miles) of 76- or 91-centimeter-diameter (30- or 36-inch-diameter) pipeline from central Clark County to Plymouth, Washington, approximately 48 kilometers (30 miles) from Hanford (FERC 2010a, 2011a; Williams Energy 2011).

Information on road and rail transportation projects was collected to determine whether major projects could impact the region around Hanford (WFLHD 2010, 2011; WSDOT 2011). Some of the more substantial transportation projects in the region include the following:

- Adding 4.8 kilometers (3 miles) of additional lanes to State Route 240 between Kennewick and Richland and constructing two new bridges over the Yakima River (completed in 2007) (WSDOT 2011)

- Widening two connecting highways between Moses Lake and Ephrata, including 13 kilometers (8 miles) of State Route 17 (State Route 17, Grant County Airport North project, completed in 2007) and 8 kilometers (5 miles) of State Route 282 (State Route 282 Ephrata South project, currently on hold due to funding) (WSDOT 2011)

- Constructing a new 16-kilometer (10-mile) road between Interstate 82 and State Route 397 in the Finley area (completed in 2008) (WSDOT 2011)

- Realigning approximately 823 meters (2,700 feet) of the Naches River channel away from U.S. Route 12 in Yakima to protect the roadway from future flooding (completed in 2008) (WSDOT 2011)

- Widening 29 kilometers (18 miles) of State Route 240 between Beloit Road and Kingsgate Way in Hanford (completed in 2009) (WSDOT 2011)

- Widening 64 kilometers (40 miles) of U.S. Route 12 between State Route 124 and the Walla Walla River, in seven construction phases (partially completed; remaining phases on hold due to funding) (WSDOT 2011)

Some of the major development activities planned in Richland over the next several years are described below. Future development beyond the next several years is, for the most part, speculative.

Pacific Northwest National Laboratory (PNNL) selected a parcel of land just north of Horn Rapids Road to construct a new Physical Sciences Facility to replace that which will be lost in the 300 Areas. The parcel, referred to as the ñHorn Rapids Triangle,ò is adjacent to PNNLôs existing campus and the Tri-Cities Science and Technology Park (DOE 2004d). Construction of the Physical Sciences Facility was completed in 2010 (PNNL 2010). In addition, ground was broken for the new PNNL Biological Sciences Facility and Computational Sciences Facility in 2008. These facilities were completed in 2009 (PNNL 2009).

Plans have been approved for Richlandôs Washington State University Tri-Cities (WSU-TC) campus to more than double in size over the next 10 years in three different building phases. The campus, which borders the Columbia River in North Richland, serves about 1,200 students (TVA 2008). WSU-TC partnered with PNNL to open a new Bioproducts, Sciences, and Engineering Laboratory at its North Richland campus in 2008 (WSU 2008b).

The Kadlec Medical Center and Columbia Basin Community College opened a new health science building near the Kadlec Medical Center campus in 2006 (Trumbo 2006). The Kadlec Medical Center broke ground in 2006 on a $70 million expansion of its Richland campus, including a six-story tower (Kadlec 2008; Richland 2006:4). The new tower was completed in 2008 (Kadlec 2008). The hospitalôs workforce has been increasing rapidly, with 267 new employees added between 2004 and 2008 (Richland 2004, 2008b).

Ground was broken on the Hanford Reach National Monument Heritage and Visitors Center on December 5, 2003. The $40 million center will include interpretive galleries, office space, classrooms, and a 220-seat auditorium, and will focus on increasing understanding and appreciation of the history and resources of the Hanford Reach and the Columbia River (Richland 2004). Construction will begin once $32.4 million has been raised (The Reach 2008).

The Red Mountain American Viticultural Area (AVA), established in 2001, is a 1,781-hectare (4,400-acre) federally designated grape- and wine-producing region on the south-facing slope of Red Mountain. There are at least 10 wineries in the AVA, with about 283 hectares (700 acres) currently planted in wine grapes; more wineries are likely to be constructed in the next 5 years. Visitor projections show that, by the year 2025, the Red Mountain AVA will attract approximately 175,000 wine-oriented visitors ð a nearly ninefold increase over the current level. Elements of the Red Mountain AVA conceptual plan include the expansion of existing vineyard and winery operations; a number of new wineries; new visitor-oriented facilities, including recreation and interpretive experiences; and additional development of adjacent areas. When fully developed, the AVA will contain an estimated 20 to 30 additional wineries (Benton County 2007:B-18, B-19, G-4).

Table Rï4 shows the activities examined as potential contributors to cumulative impacts at Hanford, the sources used, and why activities were or were not carried forward for cumulative impacts analysis. This determination follows the methodology documented in Figure Rï2. Future activities that are speculative or not well defined were not carried forward for analysis. The activities and their end states considered in the cumulative groundwater modeling are described in Appendix S.

A number of actions considered in the cumulative transportation risk analysis are not listed in Table Rï4. These other actions are listed in Appendix T, Table Tï4, and include transportation of radioactive materials and wastes in the United States from DOE and non-DOE activities. The transportation risk analysis considers information from recently released DOE NEPA documents, including the *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE 2011d), *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center* (DOE and NYSERDA 2010), and *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*, *Los Alamos*, *New Mexico* (DOE 2008b). These actions are not considered elsewhere in the cumulative impacts analysis because (1) they do not include activities at Hanford, (2) the activities that would occur at Hanford are already considered in the *TC & WM EIS* alternatives, or (3) insufficient information is available to analyze their contribution to cumulative impacts at Hanford.

Table R–4. Activities Considered for the Cumulative Impacts Analysis

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities							
Cleanup and restoration activities across all areas of the Hanford Site	• *Draft Hanford Remedial Action EIS and Comprehensive Land Use Plan* (DOE 1996a)[e] • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) • *Hanford Site End State Vision* (DOE 2005b) • *Plan for Central Plateau Closure* (Fluor Hanford 2004) • *River Corridor Closure Project, TPA Quarterly Review for Period: March–May 2009* (DOE, EPA, and Ecology 2009) • *CERCLA Five-Year Review Report for the Hanford Site* (DOE 2006a) • *River Corridor Closure Project, March 2007 Monthly Performance Report* (WCH 2007) • *Cumulative Impact Data for "Tank Closure and Waste Management EIS"* (CEES 2006, 2011)	2146 (DOE 1996a:S-12, S-20) 2035 (DOE 2002a:8) 2035 (Fluor Hanford 2004:ES-8)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Changes in land use at the Hanford Site	• *Final Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) • ñROD: *Hanford Comprehensive Land-Use Plan EIS*ò (64 FR 61615) • *Supplement Analysis, Hanford Comprehensive Land-Use Plan EIS* (DOE 2008a) • ñAmended ROD for the *Hanford Comprehensive Land-Use Plan EIS*ò (73 FR 55824) • *Hanford Site End State Vision* (DOE 2005b)	2050 (64 FR 61615)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Decommissioning of the eight surplus production reactors and their support facilities in the 100 Areas along the Columbia River[f]	• *Draft EIS, Decommissioning of Eight Surplus Production Reactors at the Hanford Site* (DOE 1989) • *Addendum (Final EIS), Decommissioning of Eight Surplus Production Reactors at the Hanford Site* (DOE 1992) • ñROD; *Decommissioning of Eight Surplus Production Reactors at the Hanford Site*ò (58 FR 48509) • *Surplus Reactor Final Disposition Engineering Evaluation* (DOE 2005e)	2080 (DOE 1989:3.52)	Yes	Yes (on site)	Yes	No (five of the eight reactors have already been cocooned)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

			Evaluation Criteria[b]				
Activity	**Source Document**	**Completion Date[a]**	**Reasonably Foreseeable?**	**Within the Regions of Influence?[c]**	**Within the Timeframe of *TC & WM EIS*?**	**Accounted for in Baseline?**	**Considered in *TC & WM EIS* Cumulative Impacts?[d]**
DOE Activities *(continued)*							
Decommissioning of the eight surplus production reactors and their support facilities in the 100 Areas along the Columbia River[f] *(continued)*	• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) • ñDOI Designates B Reactor at DOEôs Hanford Site as a National Historic Landmarkò (DOE and DOI 2008)						
Decommissioning of the N Reactor and support facilities	• *Surplus Reactor Final Disposition Engineering Evaluation* (DOE 2005e)	2068 (DOE 2005e:19)	Yes	Yes (on site)	Yes	No	Yes
Safe storage of surplus plutonium at the Plutonium Finishing Plant in the 200-West Area until shipped to the Savannah River Site for disposition	• *Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS* (DOE 1996b) • ñROD for the *Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS*ò (62 FR 3014) • *Surplus Plutonium Disposition Final EIS* (DOE 1999b) • ñROD for the *Surplus Plutonium Disposition Final EIS*ò (65 FR 1608) • ñAmended ROD: Storage of Surplus Plutonium Materials at the Savannah River Siteò (72 FR 51807) • *Plutonium Finishing Plant* (DOE 2011a)	2009 (DOE 2011a)	Yes	Yes (on site)	Yes	Yes (ongoing activity)	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Deactivation of the Plutonium Finishing Plant in the 200-West Area	• *EA, Deactivation of the Plutonium Finishing Plant, Hanford Site* (DOE 2003b) • *FONSI, "EA, Deactivation of the Plutonium Finishing Plant"* (DOE 2003c) • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)	2009 (DOE 2002a:A-20) 2009 (DOE 2003c:5-7)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Actions to empty the K Basins in the 100-K Area and implement dry storage of the fuel rods in the Canister Storage Building in the 200-East Area	• *Draft EIS, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site* (DOE 1995b) • *Addendum (Final EIS), Management of Spent Nuclear Fuel from the K Basins at the Hanford Site* (DOE 1996c) • ñROD: *Management of Spent Nuclear Fuel from the K Basins at the Hanford Site*ò (61 FR 10736) • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)	2036 (61 FR 10736)	Yes	Yes (on site)	Yes (note: the movement of K Basin spent nuclear fuel to the 200 Areas was completed in 2005)	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Complete U Plant regional closure	• *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE 2004e) • *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)* (DOE 2004c) • *ROD, "221-U Facility (Canyon Disposition Initiative)," Hanford Site* (DOE 2005c) • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)	2014 (DOE 2004e:K-14)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Final disposition of the canyons, PUREX Plant, PUREX tunnels, and other facilities in the 200 Areas and cleanup to Industrial-Exclusive land use standards	• *Plan for Central Plateau Closure* (Fluor Hanford 2004) • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)	2035 (DOE 2002a:8)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Transport of sodium-bonded spent nuclear fuel to INL for treatment	• *Final EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000b) • ñROD for the *Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*ò (65 FR 56565)	2012 (DOE 2000b:4-21)	Yes	Yes (transportation corridors)	Yes	No	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Deactivation of FFTF in the 400 Area	• *EA, Shutdown of the FFTF, Hanford Site* (DOE 1995c) • *Shutdown of the FFTF, Hanford Site, DOE, FONSI* (DOE 1995d) • *EA, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, FFTF Project, Hanford Site* (DOE 2006b) • *FONSI, "EA, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, FFTF Project, Hanford Site"* (DOE 2006c) • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)	2016 (SAIC 2010)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Construction and operation of a PNNL Physical Sciences Facility	• *EA, Construction and Operation of a Physical Sciences Facility at the PNNL* (DOE 2007a) • *FONSI for "Construction and Operation of a Physical Sciences Facility at the PNNL"* (DOE 2007b)	Construction completed in 2010 (PNNL 2010)	Yes	Yes (on site)	Yes	No (relocation of activities from 300 Area)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Excavation and use of geologic materials from existing borrow pits	• *Final Hanford Comprehensive Land-Use Plan EIS* (DOE 1999a) • ñROD: *Hanford Comprehensive Land-Use Plan EIS*ò (64 FR 61615) • *EA, Use of Existing Borrow Areas, Hanford Site* (DOE 2001b) • *FONSI, "Use of Existing Borrow Areas, Hanford Site"* (DOE 2001c) • *EA, Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas* (DOE 2003d) • *FONSI, "Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas"* (DOE 2003e) • *Supplement Analysis, Hanford Comprehensive Land-Use Plan EIS* (DOE 2008a) • ñAmended ROD for the *Hanford Comprehensive Land-Use Plan EIS*ò (73 FR 55824)	2050 (64 FR 61615) 2011 (DOE 2001c) 2013 (DOE 2003e)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Construction and operation of the Environmental Restoration Disposal Facility near the 200-West Area	• *Remedial Investigation and Feasibility Study Report for the Environmental Restoration Disposal Facility* (DOE 1994) • *Proposed Plan for an Amendment to the Environmental Restoration Disposal Facility ROD, Hanford Site* (DOE 2001d)	2024 (DOE 1994:9-23)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Implementation of the programmatic waste management decisions described in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*	• *Final Waste Management PEIS for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a) • ñROD for the DOEôs Waste Management Program: Treatment and Storage of Transuranic Wasteò (63 FR 3629) • ñROD for the DOEôs Waste Management Program: Treatment of Non-wastewater Hazardous Wasteò (63 FR 41810) • ñROD for the DOEôs Waste Management Program: Storage of High-Level Radioactive Wasteò (64 FR 46661)	2017 (DOE 1997a)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Implementation of the programmatic waste management decisions described in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (continued)*	• ñROD for the DOEôs Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Wasteò (65 FR 10061) • ñRevision to the ROD for the DOEôs Waste Management Program: Treatment and Storage of Transuranic Wasteò (65 FR 82985) • ñRevision to the ROD for the DOEôs Waste Management Program: Treatment and Storage of Transuranic Wasteò (66 FR 38646) • ñRevision to the ROD for the DOEôs Waste Management Program: Treatment and Storage of Transuranic Wasteò (67 FR 56989) • ñRevision to the ROD for the DOEôs Waste Management Program: Treatment and Storage of Transuranic Wasteò (69 FR 39446) • ñRevision to the ROD for the DOEôs Waste Management Programò (70 FR 60508) • ñAmendment to the ROD for the DOEôs Waste Management Program: Treatment and Storage of Transuranic Wasteò (73 FR 12401)						

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Closure of Nonradioactive Dangerous Waste Landfill and 600 Area Central Landfill[g]	• *EA, Closure of Nonradioactive Dangerous Waste Landfill (NRDWL) and Solid Waste Landfill (SWL), Hanford Site, Richland, Washington* (DOE 2011e)	Not available	Yes	Yes (on site)	Yes	No	Yes
Retrieval of suspect TRU waste buried after 1970	• *EA, Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site* (DOE 2002b) • *FONSI, "Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site"* (DOE 2002c) • *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a)	2007 (DOE 2002b) 2010 (DOE 2002a:47)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Construction and operation of facilities for disposal of greater-than-Class C low-level radioactive waste	• *Draft EIS for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011c)	2083 (DOE 2011c:S-17)	Yes	Yes (on site)	Yes	No	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
DOE Activities *(continued)*							
Cleanup and protection of groundwater	• *Performance Management Plan for the Accelerated Cleanup of the Hanford Site* (DOE 2002a) • *CERCLA Five-Year Review Report for the Hanford Site* (DOE 2006a) • *Hanford Site Cleanup Completion Framework* (DOE 2010a) • *Hanford Site Groundwater Monitoring and Performance Report for 2009* (DOE 2010b) • *Long-Range Deep Vadose Zone Program Plan* (DOE 2010c) • *Considerations for Cleanup of the Hanford 200 Area National Priorities List Site* (Ecology and EPA 2007)	2018 (DOE 2002a:A-33)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Transport of TRU waste to WIPP near Carlsbad, New Mexico	• *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997b) • ñROD for the DOEôs *WIPP Disposal Phase*ò (63 FR 3624)	2033 (63 FR 3624)	Yes	Yes (transportation corridors)	Yes	No (ongoing activity)	Yes
Acquisition of natural gas pipeline and natural gas utility service	• ñNotice of Intent to Prepare an EIS for the Acquisition of a Natural Gas Pipeline and Natural Gas Utility Service at the Hanford Site, Richland, WA, and Notice of Floodplains and Wetlands Involvementò (77 FR 3255)	Not available	Yes	Yes (on site)	Yes	No (proposed activity)	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]				Considered in *TC & WM EIS* Cumulative Impacts?[d]
			Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	
Non-DOE Activities on Hanford Site							
Transport of Navy reactor plants from the Columbia River and their disposal in trench 218-E-12B in the 200-East Area	• *Final EIS on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants* (Navy 1996) • ñNEPA ROD for the *Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants*ò (61 FR 41596)	2029 (Navy 1996:S-11)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Continued operation and license renewal of the Columbia Generating Station (previously Washington Public Power Supply System, Nuclear Project No. 2)	• *Hanford Site Environmental Report for Calendar Year 2006, 2007, 2008, 2009, and 2010* (Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011) • *2004 Annual Report* (Energy Northwest 2004) • *Columbia Generating Station 2005 Annual Radiological Environmental Operating Report* (Energy Northwest 2006) • ñNOI to Prepare an EIS and Conduct the Scoping Process for the Columbia Generating Stationò (75 FR 11576)	2026 (Energy Northwest 2004)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Non-DOE Activities on Hanford Site *(continued)*							
Operation of the US Ecology Commercial Low-Level Radioactive Waste Disposal Site near the 200-East Area	• *Final EIS, Commercial Low-Level Radioactive Waste Disposal Site, Richland, Washington* (Ecology and WSDOH 2004) • *Hanford Site Environmental Report for Calendar Year 2006, 2007, 2008, 2009, and 2010* (Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011) • *Annual Environmental Monitoring Report for Calendar Year 2006* (US Ecology 2007)	2056 (Ecology and WSDOH 2004:i)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes
Management of the Hanford Reach National Monument and Saddle Mountain National Wildlife Refuge	• *Hanford Reach of the Columbia River: Final River Conservation Study and EIS* (NPS 1994) • *ROD, "Hanford Reach of the Columbia River Final EIS for Comprehensive River Conservation Study"* (DOI 1996) • ROD, ñExtension of the Saddle Mountain National Wildlife Refuge Acquisition Boundaryò (64 FR 66928) • *Hanford Reach Protection and Management Program Interim Action Plan* (CAP 1998)	2022 (USFWS 2008:i)	Yes	Yes (on site)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Non-DOE Activities on Hanford Site *(continued)*							
Management of the Hanford Reach National Monument and Saddle Mountain National Wildlife Refuge *(continued)*	• ñEstablishment of the Hanford Reach National Monumentò (65 FR 37253) • *Hanford Reach National Monument Final Comprehensive Conservation Plan and EIS* (USFWS 2008)						
Rattlesnake Mountain cleanup	• *EA, Combined Community Communications Facility and Infrastructure Cleanup on the Fitzner/Eberhardt Arid Lands Ecology Reserve, Hanford Site, Richland, Washington* (DOE 2009a) • *FONSI for the "Combined Community Communications Facility Infrastructure Cleanup on the Fitzner/Eberhardt Arid Lands Ecology Reserve, Hanford Site, Richland, Washington"* (DOE 2009b)	Not available	Yes	Yes (on site)	Yes	No	Yes
Operation of the Laser Interferometer Gravitational-Wave Observatory	• *Hanford Site Environmental Report for Calendar Year 2006, 2007, 2008, 2009, and 2010* (Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011)	Not available	Yes	Yes (on site)	Yes	Yes (ongoing activity)	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

			Evaluation Criteria[b]				
Activity	**Source Document**	**Completion Date[a]**	**Reasonably Foreseeable?**	**Within the Regions of Influence?[c]**	**Within the Timeframe of *TC & WM EIS*?**	**Accounted for in Baseline?**	**Considered in *TC & WM EIS* Cumulative Impacts?[d]**
Other Activities in the Region							
Changes in land use in the region	• *Adams County Comprehensive Plan* (ACPC 2005) • *Benton County Comprehensive Land Use Plan* (BCPC 2009) • *Benton County Sustainable Development: Overall Economic Development Plan* (Benton County 2007) • *City of Richland Comprehensive Land Use Plan* (Richland 2002, 2005b, 2008a) • *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area* (Richland 2005a) • *City of Kennewick Comprehensive Plan 2009* (Kennewick 2010) • *Franklin County Growth Management Comprehensive Plan* (Franklin County 2008) • *Grant County Comprehensive Plan/EIS* and *Amending the 2006 Comprehensive Plan and Zone Changes* (GCDCD 1999, GCBOCC 2010)	2024 (Richland 2008a: U 5-2) 2025 (Kennewick 2010:23) 2028 (BCPC 2009:4-15) 2015 (Yakima County 1998, 2010) 2018 (GCDCD 1999; GCBOCC 2010) 2030 (Kittitas County 2010: 61) 2027 (Benton County 2007:1) 2025 (Franklin County 2008) 2025 (Walla Walla County 2007:1-14, 2009)	Yes	Yes (various)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

			Evaluation Criteria[b]				
Activity	**Source Document**	**Completion Date[a]**	**Reasonably Foreseeable?**	**Within the Regions of Influence?[c]**	**Within the Timeframe of *TC & WM EIS*?**	**Accounted for in Baseline?**	**Considered in *TC & WM EIS* Cumulative Impacts?[d]**
Other Activities in the Region *(continued)*							
Changes in land use in the region *(continued)*	• *Kittitas County Comprehensive Plan* (Kittitas County 2010) • *Klickitat County, Washington, Comprehensive Plan* (Dreyer 2007) • *Plan 2015: A Blueprint for Yakima County Progress* and *2010 Comprehensive Plan Amendment Cycle* (Yakima County 1998, 2010) • *Walla Walla County Integrated Comprehensive Plan and EIS* and *County Comprehensive Plan and EIS* (Walla Walla County 2007, 2009)						
Operation of the Perma-Fix Northwest (formerly Pacific EcoSolutions) waste treatment facility in Richland, Washington	• *EA, Non-thermal Treatment of Hanford Site Low-Level Mixed Waste* (DOE 1998a) • *FONSI, "Non-thermal Treatment of Hanford Site Low-Level Mixed Waste"* (DOE 1998b) • *Final EIS for Treatment of Low-Level Mixed Waste* (Richland 1998) • *EA, Offsite Thermal Treatment of Low-Level Mixed Waste* (DOE 1999c) • *"EA, Offsite Thermal Treatment of Low-Level Mixed Waste," FONSI* (DOE 1999d)	2019 (Richland 1998:1, 25)	Yes	Yes (0.8 km south)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Operation of the Perma-Fix Northwest (formerly Pacific EcoSolutions) waste treatment facility in Richland, Washington *(continued)*	• *Hanford Site Environmental Report for Calendar Year 2006, 2007, 2008, 2009, and 2010* (Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011) • *Annual Environmental Monitoring Report for 2006* (Pacific EcoSolutions 2007)						
Operation of the AREVA NP nuclear fuel fabrication facility in Richland, Washington	• *NRC Inspection Report No. 70-1257/2004-001* (NRC 2004) • *NRC Inspection Report No. 70-1257/2005-002* (NRC 2005) • *NRC Inspection Report No. 70-1257/2010-203* (NRC 2010) • *Hanford Site Environmental Report for Calendar Year 2006, 2007, 2008, 2009, and 2010* (Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011) • *Supplement to Applicant's Environmental Report* (AREVA 2006)	Not available	Yes	Yes (directly south)	Yes	No (ongoing activity)	Yes
Operation of the Westinghouse Service Center decontamination facility in Richland, Washington	• *Hanford Site Environmental Report for Calendar Year 2006, 2007, 2008, 2009, and 2010* (Poston et al. 2007; Poston, Duncan, and Dirkes 2008, 2009, 2010, 2011)	Not available	Yes	Yes (1.5 km south)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Operation of the IsoRay medical facility in Richland, Washington	• Annual NESHAPs reports for 2008 through 2010 (IsoRay 2009, 2011a, 2011b)	Not available	Yes	Yes (1 km south)	Yes	No (ongoing activity)	Yes
Operation of the Moravek Biochemicals facility in Richland, Washington	• *Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions* (Moravek 2005)	Not available	Yes	Yes (2 km south)	Yes	No (ongoing activity)	Yes
Cleanup of EPA NPL sites and state toxic waste sites	• *National Priorities List Sites in Oregon* (EPA 2006a) • *National Priorities List Sites in Washington* (EPA 2006b) • *Proposed National Priorities List Sites—by Proposed Date* (EPA 2010) • *Hazardous Sites List* (Ecology 2010)	Various	Yes	Yes (various)	Yes	No (ongoing activity)	Yes
Oil and gas leasing and exploration	• *Leasing Washington State-Owned Lands for Oil and Gas Exploration* (WDNR 2007a) • *Final Supplemental EIS on the Oil and Gas Leasing Program for State Lands* (WDNR 2005)	Not applicable (ongoing)	Yes	Yes (various)	Yes	No (ongoing activity)	Yes
Surface mining	• *Surface Mining Reclamation Program* (WDNR 2007b) • *Directory of Washington State Surface Mining Reclamation Sites–2006* (WDNR 2006)	Not applicable (ongoing)	Yes	Yes (various)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]				Considered in *TC & WM EIS* Cumulative Impacts?[d]
			Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	
Other Activities in the Region *(continued)*							
Operation of the U.S. Army Yakima Training Center	• *Final PEIS for Army Growth and Force Structure Realignment* (Army 2007) • *Final EIS for the Fort Lewis Army Growth and Force Structure Realignment* (Army 2010)	Realignment complete in 2013 (Army 2007:iii)	Yes	Yes (10 km northwest)	Yes	No (ongoing activity)	Yes
DoD base realignment and closure ð Umatilla Army Depot	• *2005 Defense Base Closure and Realignment Commission Report* (BRAC 2005) • ñCommission Makes More BRAC Decisionsò (AFIS 2005) • *U.S. Army Umatilla Chemical Depot Base Redevelopment Plan* (UMADRA 2010)	2012 or later (UMADRA 2010: A-xiv)	Yes	Yes (55 km south)	Yes	No	Yes
Boardman Power Plant upgrades	• *Boardman Plant Air Emissions* (PGE 2011) • *DEQ Regulation of PGE Boardman* (ODEQ 2011)	Air emissions reduction by 2020 (PGE 2011) Switch to biofuel in 2020 (PGE 2011)	Yes	Yes (72 km south)	Yes	No (ongoing activity)	Yes
Construction and operation of the Wanapa Energy Center	• *Wanapa Energy Center Final EIS* (BIA 2004) • ñWanapa Energy Center; Notice of Availability of RODò (70 FR 10612) • *Generation and Interconnection Projects on Hold* (BPA 2009a)	2055 (BIA 2004:ES-14)	No; project on hold (BPA 2009a)	Yes (48 km south)	Yes	No	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Construction and operation of the Plymouth generating facility	• *Final EIS, Plymouth Generating Facility* (Benton and BPA 2003) • ROD, ñ*Plymouth Generating Facility*ò (68 FR 60342) • *Generation and Interconnection Projects on Hold* (BPA 2009a)	Not available	No; project on hold (BPA 2009a)	Yes (40 km south)	Yes	No	No
Big Horn Wind Project	• *How BPA Supports Wind Power in the Pacific Northwest* (BPA 2009b) • *Completed Wind Projects* (BPA 2011c) • *ROD for the Electrical Interconnection of the Big Horn Wind Energy Project* (BPA 2005) • ñPPM Announces 200 MW Big Horn Wind Projectò (PPM Energy, Inc. 2005) • *Renewable Energy Projects* (RNP 2011)	Not available	Yes	Yes (72 km southwest)	Yes	No (ongoing activity)	Yes
Combine Hills II Wind Project	• *How BPA Supports Wind Power in the Pacific Northwest* (BPA 2009b) • *Current Wind Projects* (BPA 2011b)	Not available	Yes	Yes (56 km southeast)	Yes	No	Yes
Juniper Canyon I and II Wind Projects	• *How BPA Supports Wind Power in the Pacific Northwest* (BPA 2009b) • *Current Wind Projects* (BPA 2011b) • ñNotice of Availability of the Revised Final EIS ï Juniper Canyon Wind Projectò (Dreyer 2010)	Not available	Yes	Yes (64 km south)	Yes	No	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Wild Horse Wind Project	• *How BPA Supports Wind Power in the Pacific Northwest* (BPA 2009b) • *Renewable Energy Projects* (RNP 2011) • *Final PEIS on Wind Energy Development on BLM-Administered Lands in the Western United States* (BLM 2005)	Not available	Yes	Yes (56 km northwest)	Yes	No (ongoing activity)	Yes
Designation of West-wide energy corridors	• *PEIS, Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE and BLM 2008)	Not applicable	Yes	No	Yes	No	No
McNary–John Day transmission line project	• *McNary–John Day Transmission Line Project, Draft EIS* (BPA and DOE 2002a) • *McNary–John Day Transmission Line Project, Abbreviated Final EIS* (BPA and DOE 2002b) • *McNary–John Day Transmission Line Project ROD* (BPA and DOE 2002c) • *Transmission Projects* (BPA 2011a)	2012 (BPA 2011a)	Yes	Yes (40 km south)	Yes	No	Yes
Big Eddy–Knight transmission line project	• *Generation and Interconnection Projects on Hold* (BPA 2009a) • *Big Eddy–Knight Transmission Project Draft EIS* (BPA 2010)	Not available	No; project on hold (BPA 2009a)	Yes (24 km southwest)	Yes	No	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Central Ferryï Lower Monumental transmission line project	• *Central Ferry–Lower Monumental 500-kilovolt Transmission Line Project Final EIS* (BPA 2011d) • *Transmission Projects* (BPA 2011a)	Not available	Yes	Yes (56 km east)	Yes	No	Yes
VantageïPomona Heights transmission line project	• *Vantage–Pomona Heights 230kV Transmission Line Project* (BLM 2011) • Interested Party Letter, ñVantage to Pomona Heights 230kV Transmission Line Projectò (Kelleher 2011)	Not available	Yes	Yes (32 km northwest)	Yes	No	Yes
Walla Wallaï McNary transmission line project	• *McNary to Walla Walla Transmission Line Conditional Use Permit Application* (Pacific Power 2008a) • *McNary–Walla Walla 230-kV Transmission Line Expanded SEPA Checklist* (Pacific Power 2008b) • *Walla Walla to McNary 230kV Transmission Line Project* (Pacific Power 2010) • *Segment A – Walla Walla to McNary* (Pacific Power 2011)	2013 (Pacific Power 2011)	Yes	Yes (48 km southeast)	Yes	No	Yes
Columbia River Basin water management	• *Final PEIS for the Columbia River Water Management Program* (Ecology 2007a) • *Upper Columbia Alternative Flood Control and Fish Operations, Columbia River Basin, Final EIS* (USACE 2006)	Ongoing management activities	Yes	Yes (various)	Yes	No (ongoing activity)	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Evaluation Criteria[b]: Within the Regions of Influence?[c]	Evaluation Criteria[b]: Within the Timeframe of *TC & WM EIS*?	Evaluation Criteria[b]: Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Columbia River Basin water management *(continued)*	• *Potholes Reservoir Supplemental Feed Route Finding of No Significant Impact, EA* (BOR 2007a) • *Initial Alternative Development and Evaluation: Odessa Subarea Special Study* (BOR 2006a)						
Priest Rapids Hydroelectric Project relicensing	• *Priest Rapids Project License Application, FERC No. 2114, Executive Summary* (Grant County PUD 2003) • *Final EIS, Priest Rapids Hydroelectric Project, Washington* (FERC 2006) • *Order Issuing New License* (FERC 2008)	2052 (FERC 2008)	Yes	Yes (6 km northwest)	Yes	No (upgrades not included in baseline)	Yes
Yakima River Basin water management (also see Black Rock Reservoir below)	• *Sunnyside Division Board of Control, Water Conservation Program, Yakima Project, Washington: FONSI and Final EA* (BOR 2004a) • *Phase I Assessment Report, Storage Dam Fish Passage Study, Yakima Project, Washington* (BOR 2005) • *Final EIS, Yakima River Basin Integrated Water Resource Management Alternative* (Ecology 2009)	Ongoing management activities	Yes	Yes (various)	Yes	No	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]: Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	Considered in *TC & WM EIS* Cumulative Impacts?[d]
Other Activities in the Region *(continued)*							
Construction and operation of the Black Rock Reservoir or Wymer Reservoir	• *Yakima River Storage Enhancement Initiative, Black Rock Reservoir Study* (WIS 2002) • *Summary Report Appraisal Assessment of the Black Rock Alternative*, Executive Summary (BOR 2004b) • *Yakima River Basin Storage Alternatives Appraisal Assessment* (BOR 2006b) • *Recreation Demand and User Preference Analysis: A Component of Yakima River Basin Water Storage Feasibility Study* (BOR 2007b) • *Potential Impacts of Leakage from Black Rock Reservoir on the Hanford Site Unconfined Aquifer* (Freedman 2008) • *Modeling Groundwater Hydrologic Impacts of the Potential Black Rock Reservoir* (BOR 2007c) • *One-Dimensional Hydraulic Modeling of the Yakima Basin* (Hilldale and Mooney 2007) • *Yakima River Basin Storage Study, Wymer Dam and Reservoir Appraisal Report* (BOR 2007d)	10-year construction period, 100-year operations period (McCartney 2007)	No	Yes Black Rock Reservoir (8 km west); Wymer Reservoir (45 km northwest)	Yes	No	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

			Evaluation Criteria[b]				Considered in *TC & WM EIS* Cumulative Impacts?[d]
Activity	**Source Document**	**Completion Date[a]**	**Reasonably Foreseeable?**	**Within the Regions of Influence?[c]**	**Within the Timeframe of *TC & WM EIS*?**	**Accounted for in Baseline?**	
Other Activities in the Region *(continued)*							
Construction and operation of the Black Rock Reservoir or Wymer Reservoir *(continued)*	• *Final Planning Report/EIS, Yakima River Basin Water Storage Feasibility Study* (BOR 2008) • *Final EIS, Yakima River Basin Integrated Water Resource Management Alternative* (Ecology 2009)						
Construction and operation of water pipelines	• *Projects Near You* (FERC 2011a)	Not applicable	Yes	No	Yes	No	No
Construction and operation of biofuels facilities	• *Biofuel Development in Washington* (WSU 2008a) • *NorthWest Biofuels, Inc., SEPA Checklist* (CCH 2006) • *SEPA Environmental Checklist for the Central Washington Biodiesel Ellensburg Plant* (Central Washington Biodiesel, LLC 2006) • *Walla Walla County Mitigated Determination of Non-significance, Gen-X Energy Group Biodiesel Production Facility* (Walla Walla County 2006) • *Determination of Non-significance, Central Washington Biodiesel,* Ellensburg Plant (Ecology 2006a)	Various	Yes	Yes (various)	Yes	No	Yes

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

			Evaluation Criteria[b]				
Activity	**Source Document**	**Completion Date[a]**	**Reasonably Foreseeable?**	**Within the Regions of Influence?[c]**	**Within the Timeframe of *TC & WM EIS*?**	**Accounted for in Baseline?**	**Considered in *TC & WM EIS* Cumulative Impacts?[d]**
Other Activities in the Region *(continued)*							
Construction and operation of biofuels facilities *(continued)*	• *SEPA Environmental Checklist, Washington Ethanol Plant, Moses Lake, Washington* (Washington Ethanol, LLC 2006) • ñBiofuel or Ethanol Productionò (Plummer 2007) • *Mitigated Determination of Non-significance, Liquafaction Corp., Moses Lake Ethanol Plant* (GCPD 2007) • *SEPA Checklist for the Moses Lake Ethanol Plant* (Liquafaction Corporation 2007) • *Mitigated Determination of Nonsignificance, Washington Ethanol LLC, Moses Lake* (Ecology 2007b) • *SEPA Environmental Checklist for the Columbia Ethanol Plant* (Columbia Ethanol Plant Holdings, LLC 2006) • *Revised SEPA Mitigated Determination of Nonsignificance for the Proposed Columbia Ethanol Facility* (Ecology 2006b) • *Notice of Construction, Final Order of Approval No. 2006-0009* (Benton Clean Air Authority 2007)						

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

Activity	Source Document	Completion Date[a]	Evaluation Criteria[b]				Considered in *TC & WM EIS* Cumulative Impacts?[d]
			Reasonably Foreseeable?	Within the Regions of Influence?[c]	Within the Timeframe of *TC & WM EIS*?	Accounted for in Baseline?	
Other Activities in the Region *(continued)*							
Construction and operation of natural gas terminals, pipelines, and storage projects	• *Projects Near You* (FERC 2011a) • *Major Storage Projects on the Horizon* (FERC 2010b) • *Major Pipeline Projects on the Horizon* (FERC 2010a) • *North American LNG Import/Export Terminals, Proposed* (FERC 2011b) • *North American LNG Import Terminals, Existing* (FERC 2011c)	Not applicable	Yes	No	Yes	No	No
Blue Bridge Pipeline project	• *Major Pipeline Projects on the Horizon* (FERC 2010a) • *Projects Near You* (FERC 2011a) • *Blue Bridge Pipeline Project* (Williams Energy 2011) • ñNOI to Prepare an EIS and Land and Resource Management Plan Amendment for the Planned Blue Bridge Pipeline Projectò (74 FR 38611)	2011 (Williams Energy 2011)	Yes	Yes (48 km southwest)	Yes	No	Yes
Regional road projects	• *Washington Projects* (WFLHD 2011) • *Oregon Projects* (WFLHD 2010) • *Making Every Dollar Count for Benton County* (WSDOT 2007) • *WSDOT – Projects* (WSDOT 2011)	Various	Yes	Yes (various)	Yes	No	Yes
Regional rail projects	• *WSDOT – Projects* (WSDOT 2011)	Not applicable	Yes	No	Yes	No	No

Table R–4. Activities Considered for the Cumulative Impacts Analysis *(continued)*

[a] The ñCompletion Dateò column provides the date the activity is expected to be completed. This information determines if the activity is within the same time period as the *TC & WM EIS* alternatives.

[b] These evaluation criteria are used to help determine if the activity should be considered in the *TC & WM EIS* cumulative impacts analysis. See Figure Rï2 (Phase 2) for a description of how the criteria are used.

[c] Because regions of influence vary by resource, the action may lie outside the region of influence for one resource and within it for another. Distances measured using Google Earth Version 4.2.0198.2451.

[d] This column presents the results of the assessment performed in Phase 2 of Figure Rï2 for each activity evaluated.

[e] Appendix A of the *Draft Hanford Remedial Action EIS and Comprehensive Land Use Plan* (DOE 1996a) describes the activities analyzed in that EIS. Page A-3 notes that decommissioning of major canyon facilities in the 200 Areas (i.e., T Plant, B Plant, and the PUREX Plant) are not included.

[f] B Reactor was recently designated a National Historic Landmark (DOE and DOI 2008). Therefore, B Reactor will not be decommissioned and moved to the Hanford Site Central Plateau for disposal as analyzed in the *Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1989, 1992) and assumed in this *TC & WM EIS*.

[g] The 600 Area Central Landfill is referred to as the ñSolid Waste Landfillò in *Environmental Assessment, Closure of Nonradioactive Dangerous Waste Landfill (NRDWL) and Solid Waste Landfill (SWL)*, Hanford Site, Richland, Washington (DOE 2011e).

Note: To convert kilometers to miles, multiply by 0.6214.

Key: BLM=U.S. Bureau of Land Management; BRAC=Base Realignment and Closure; CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; DEQ=Department of Environmental Quality; DoD=U.S. Department of Defense; DOE=U.S. Department of Energy; DOI=U.S. Department of the Interior; EA=environmental assessment; EIS=environmental impact statement; EPA=U.S. Environmental Protection Agency; FERC=Federal Energy Regulatory Commission; FFTF=Fast Flux Test Facility; FONSI=Finding of No Significant Impact; INL=Idaho National Laboratory; km=kilometers; MW=megawatt; NEPA=National Environmental Policy Act; NESHAPs=National Emission Standards for Hazardous Air Pollutants; NOI=Notice of Intent; NPL=National Priorities List; NRC=U.S. Nuclear Regulatory Commission; PEIS=programmatic environmental impact statement; PGE=Portland General Electric; PNNL=Pacific Northwest National Laboratory; PPM=Pacific Core Power Marketing, Inc.; PUREX=Plutonium-Uranium Extraction; ROD=Record of Decision; SEPA=State Environmental Policy Act; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*; TPA=Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement); TRU=transuranic; WIPP=Waste Isolation Pilot Plant; WSDOT=Washington State Department of Transportation.

R.13 REFERENCES

ACPC (Adams County Planning Commission), 2005, *Adams County Comprehensive Plan*, February 3.

Adams, J., 2007, City of Pasco, Pasco, Washington, personal communication (telephone conversation) with S.D. Heiser, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò June 12.

Adams, J., 2011, City of Pasco, Pasco, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 7.

AFIS (American Forces Information Service), 2005, ñCommission Makes More BRAC Decisions,ò August 26.

AREVA (AREVA NP, Inc.), 2006, *Supplement to Applicant's Environmental Report*, E06-04-004, Version 2.0, Richland, Washington, October.

Army (U.S. Army), 2007, *Final Programmatic Environmental Impact Statement for Army Growth and Force Structure Realignment*, U.S. Army Environmental Command, Aberdeen Proving Ground, Aberdeen, Maryland, October.

Army (U.S. Army), 2010, *Final Environmental Impact Statement for the Fort Lewis Army Growth and Force Structure Realignment*, Joint Base Lewis-McChord, Washington, July.

BCPC (Benton County Planning Commission), 2009, *Benton County Comprehensive Land Use Plan*, Prosser, Washington, November.

Benson, B., 2007, City of Yakima, Yakima, Washington, personal communication (telephone conversation) with S.D. Heiser, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò June 11.

Benson, B., 2011, City of Yakima, Yakima, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 11.

Benton and BPA (Benton County, Planning/Building Department, Prosser, Washington, and Bonneville Power Administration, Portland, Oregon), 2003, *Final Environmental Impact Statement, Plymouth Generating Facility, Plymouth, Washington*, DOE/EIS-0345, June.

Benton Clean Air Authority, 2007, *Notice of Construction, Final Order of Approval No. 2006-0009*, Richland, Washington, February 13.

Benton County, 2007, *Benton County Sustainable Development: Overall Economic Development Plan*, Prosser, Washington, June.

Bergeron, M.P., E.J. Freeman, S.K. Wurstner, C.T. Kincaid, M.M. Coony, D.L. Strenge, R.L. Aaberg, and P.S. Eslinger, 2001, *Addendum to Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*, PNNL-11800, Addendum 1, Pacific Northwest National Laboratory, Richland, Washington, September.

BIA (U.S. Bureau of Indian Affairs), 2004, *Wanapa Energy Center Final Environmental Impact Statement*, DOE/EIS-0342, Umatilla Agency, Pendleton, Oregon, December.

BLM (U.S. Bureau of Land Management), 2005, *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*, FES 05-11, Washington, D.C., June.

BLM (U.S. Bureau of Land Management), 2011, *Vantage–Pomona Heights 230kV Transmission Line Project*, accessed through http://www.blm.gov/or/districts/spokane/plans/vph230.php# on January 20.

BOR (U.S. Bureau of Reclamation), 2004a, *Sunnyside Division Board of Control, Water Conservation Program, Yakima Project, Washington: Finding of No Significant Impact and Final Environmental Assessment*, Pacific Northwest Region, Upper Columbia Area Office, Yakima, Washington, September 21.

BOR (U.S. Bureau of Reclamation), 2004b, *Summary Report Appraisal Assessment of the Black Rock Alternative: A Component of Yakima River Basin Water Storage Feasibility Study, Washington*, Executive Summary, Technical Series No. TS-YSS-7, Pacific Northwest Region, Boise, Idaho, December.

BOR (U.S. Bureau of Reclamation), 2005, *Phase I Assessment Report, Storage Dam Fish Passage Study, Yakima Project, Washington*, Technical Series No. PN-YDFP-001, Pacific Northwest Region, Boise, Idaho, April.

BOR (U.S. Bureau of Reclamation), 2006a, *Initial Alternative Development and Evaluation: Odessa Subarea Special Study, Columbia Basin Project, Washington*, Pacific Northwest Region, Upper Columbia Area Office, Yakima, Washington, September.

BOR (U.S. Bureau of Reclamation), 2006b, *Yakima River Basin Storage Alternatives Appraisal Assessment: A Component of Yakima River Basin Water Storage Feasibility Study, Washington*, Technical Series No. TS-YSS-8, Pacific Northwest Region, Boise, Idaho, May.

BOR (U.S. Bureau of Reclamation), 2007a, *Potholes Reservoir Supplemental Feed Route Finding of No Significant Impact, Environmental Assessment: Columbia Basin Project, Grant County, Washington*, Pacific Northwest Region, Boise, Idaho, August.

BOR (U.S. Bureau of Reclamation), 2007b, *Recreation Demand and User Preference Analysis: A Component of Yakima River Basin Water Storage Feasibility Study, Washington Pacific Northwest Region*, Technical Series No. TS-YSS-10, Upper Columbia Area Office, Yakima, Washington, February.

BOR (U.S. Bureau of Reclamation), 2007c, *Modeling Groundwater Hydrologic Impacts of the Potential Black Rock Reservoir: A Component of Yakima River Basin Water Storage Feasibility Study, Washington Pacific Northwest Region*, Technical Series No. TS-YSS-19, Pacific Northwest Region, Boise, Idaho, September.

BOR (U.S. Bureau of Reclamation), 2007d, *Yakima River Basin Storage Study, Wymer Dam and Reservoir Appraisal Report: A Component of the Yakima River Basin Water Storage Feasibility Study, Washington*, Technical Series No. TS-YSS-16, Pacific Northwest Region, Boise, Idaho, September.

BOR (U.S. Bureau of Reclamation), 2008, *Final Planning Report/Environmental Impact Statement, Yakima River Basin Water Storage Feasibility Study, Yakima Project, Washington*, INT-FES-08-65, Pacific Northwest Region, Upper Columbia Area Office, Yakima, Washington, December.

BOR (U.S. Bureau of Reclamation), 2009, ñReclamation Concludes Yakima River Basin Water Storage Feasibility Study,ò accessed through http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=27521, April 3.

BOR and Ecology (U.S. Bureau of Reclamation, Pacific Northwest Region, Upper Columbia Area Office, Yakima, Washington, and Washington State Department of Ecology, Central Regional Office, Yakima, Washington), 2008, *Draft Planning Report/Environmental Impact Statement, Yakima River Basin Water Storage Feasibility Study, Yakima Project, Washington*, January.

BPA (Bonneville Power Administration), 2003, *Bonneville Power Administration Record of Decision for the Wallula–McNary Transmission Line Project and Wallula Power Project*, Portland, Oregon, March 10.

BPA (Bonneville Power Administration), 2005, *Record of Decision for the Electrical Interconnection of the Big Horn Wind Energy Project*, Portland, Oregon, March 24.

BPA (Bonneville Power Administration), 2009a, *Generation and Interconnection Projects on Hold*, accessed through http://www.transmission.bpa.gov/PlanProj/Transmission_Projects/projectsonhold.cfm, March 3

BPA (Bonneville Power Administration), 2009b, *How BPA Supports Wind Power in the Pacific Northwest*, DOE/BP-4002, March.

BPA (Bonneville Power Administration), 2010, *Big Eddy–Knight Transmission Project Draft Environmental Impact Statement*, DOE/EIS-0421, Portland, Oregon, December.

BPA (Bonneville Power Administration), 2011a, *Transmission Projects*, accessed through http://www.transmission.bpa.gov/PlanProj/Transmission_Projects/ on January 19.

BPA (Bonneville Power Administration), 2011b, *Current Wind Projects*, accessed through http://transmission.bpa.gov/PlanProj/Wind/ on January 19.

BPA (Bonneville Power Administration), 2011c, *Completed Wind Projects*, accessed through http://transmission.bpa.gov/PlanProj/Wind/completed.cfm on January 19.

BPA (Bonneville Power Administration), 2011d, *Central Ferry–Lower Monumental 500-kilovolt Transmission Line Project Final Environmental Impact Statement*, DOE/EIS-0422, Portland, Oregon, February.

BPA and DOE (Bonneville Power Administration and U.S. Department of Energy), 2002a, *McNary–John Day Transmission Line Project, Draft Environmental Impact Statement*, DOE/EIS-0332, Portland, Oregon, February.

BPA and DOE (Bonneville Power Administration and U.S. Department of Energy), 2002b, *McNary–John Day Transmission Line Project, Abbreviated Final Environmental Impact Statement*, DOE/EIS-0332, Portland, Oregon, August.

BPA and DOE (Bonneville Power Administration and U.S. Department of Energy), 2002c, *McNary–John Day Transmission Line Project Record of Decision*, Portland, Oregon, October 30.

BRAC (Defense Base Closure and Realignment Commission), 2005, *2005 Defense Base Closure and Realignment Commission Report*, Arlington, Virginia, September.

CAP (Citizensô Advisory Panel), 1998, *Hanford Reach Protection and Management Program Interim Action Plan*, accessed through http://206.61.210.104/pl/iap/iapindex.htm, August 28.

CCH (Chemical Consortium Holdings, Inc.), 2006, *NorthWest Biofuels, Inc., SEPA Checklist*, Bellingham, Washington, August.

CEES (Columbia Energy & Environmental Services, Inc.), 2006, *Cumulative Impact Data for "Tank Closure and Waste Management EIS,"* Rev. 1, Richland, Washington, November 2.

CEES (Columbia Energy & Environmental Services, Inc.), 2011, *Cumulative Impact Data for "Tank Closure and Waste Management EIS,"* Rev. 2, Richland, Washington, January 19.

Central Washington Biodiesel, LLC, 2006, *State Environmental Policy Act Environmental Checklist for the Central Washington Biodiesel Ellensburg Plant, Ellensburg, WA*, Ellensburg, Washington, May 19.

CEQ (Council on Environmental Quality), 1997, *Considering Cumulative Effects Under the National Environmental Policy Act*, Executive Office of the President, Washington, D.C., January.

Columbia Ethanol Plant Holdings, LLC, 2006, *State Environmental Policy Act Environmental Checklist for the Columbia Ethanol Plant, Finley, WA*, Richland, Washington, August 30.

Cooper, D., 2011, Grant County, Ephrata, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 11.

DôHondt, D., 2011, Construction Management, Kittitas County, Ellensburg, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impact,ò January 11.

DOE (U.S. Department of Energy), 1987, *Final Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington*, DOE/EIS-0113, Richland Operations Office, Richland, Washington, December.

DOE (U.S. Department of Energy), 1989, *Draft Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D, Washington, D.C., March.

DOE (U.S. Department of Energy), 1992, *Addendum (Final Environmental Impact Statement), Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119F, Washington, D.C., December.

DOE (U.S. Department of Energy), 1994, *Remedial Investigation and Feasibility Study Report for the Environmental Restoration Disposal Facility*, DOE/RL-93-99, Rev. 1, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 1995a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs, Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, Idaho, April.

DOE (U.S. Department of Energy), 1995b, *Draft Environmental Impact Statement, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington*, DOE/EIS-0245D, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 1995c, *Environmental Assessment, Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington*, DOE/EA-0993, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 1995d, ñ*Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington," U.S. Department of Energy, Finding of No Significant Impact*, Richland Operations Office, Richland, Washington, May 1.

DOE (U.S. Department of Energy), 1996a, *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*, DOE/EIS-0222D, Washington, D.C., August.

DOE (U.S. Department of Energy), 1996b, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, D.C., December.

DOE (U.S. Department of Energy), 1996c, *Addendum (Final Environmental Impact Statement), Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington*, DOE/EIS-0245F, Richland Operations Office, Richland, Washington, January.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, D.C., May.

DOE (U.S. Department of Energy), 1997b, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 1998a, *Environmental Assessment, Non-thermal Treatment of Hanford Site Low-Level Mixed Waste*, DOE/EA-1189, Richland Operations Office, Richland, Washington, September.

DOE (U.S. Department of Energy), 1998b, *Finding of No Significant Impact, "Non-thermal Treatment of Hanford Site Low-Level Mixed Waste, Hanford Site, Richland, Washington,"* Richland Operations Office, Richland, Washington, September 29.

DOE (U.S. Department of Energy), 1999a, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE/EIS-0222-F, Richland Operations Office, Richland, Washington, September.

DOE (U.S. Department of Energy), 1999b, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, D.C., November.

DOE (U.S. Department of Energy), 1999c, *Environmental Assessment, Offsite Thermal Treatment of Low-Level Mixed Waste*, DOE/EA-1135, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 1999d, *"Environmental Assessment, Offsite Thermal Treatment of Low-Level Mixed Waste," Finding of No Significant Impact*, Richland Operations Office, Richland, Washington, May 6.

DOE (U.S. Department of Energy), 2000a, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, D.C., December.

DOE (U.S. Department of Energy), 2000b, *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, DOE/EIS-0306, Office of Nuclear Energy, Science and Technology, Washington, D.C., July.

DOE (U.S. Department of Energy), 2001a, *Hanford Site Biological Resources Management Plan*, DOE/RL 96-32, Rev. 0, Richland Operations Office, Richland, Washington, August.

DOE (U.S. Department of Energy), 2001b, *Environmental Assessment, Use of Existing Borrow Areas, Hanford Site, Richland, Washington*, DOE/EA-1403, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 2001c, *Finding of No Significant Impact, "Use of Existing Borrow Areas, Hanford Site, Richland, Washington,"* Richland Operations Office, Richland, Washington, October 10.

DOE (U.S. Department of Energy), 2001d, *Proposed Plan for an Amendment to the Environmental Restoration Disposal Facility Record of Decision, Hanford Site, Richland, Washington*, DOE/RL-2001-44, Rev. 0, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 2002a, *Performance Management Plan for the Accelerated Cleanup of the Hanford Site*, DOE/RL-2002-47, Rev. D, Richland Operations Office and Office of River Protection, Richland, Washington, August.

DOE (U.S. Department of Energy), 2002b, *Environmental Assessment, Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site, Richland, Washington*, DOE/EA-1405, Washington, D.C., March.

DOE (U.S. Department of Energy), 2002c, *Finding of No Significant Impact, "Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site, Richland, Washington,"* Richland Operations Office, Richland, Washington, March 22.

DOE (U.S. Department of Energy), 2003a, *Hanford Site Waste Management Units Report*, DOE/RL-88-30, Rev. 12, Richland Operations Office, Richland, Washington, January.

DOE (U.S. Department of Energy), 2003b, *Environmental Assessment, Deactivation of the Plutonium Finishing Plant, Hanford Site, Richland, Washington*, DOE/EA-1469, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 2003c, *Finding of No Significant Impact, "Environmental Assessment, Deactivation of the Plutonium Finishing Plant, Hanford Site, Richland, Washington"* Richland Operations Office, Richland, Washington, October 20.

DOE (U.S. Department of Energy), 2003d, *Environmental Assessment, Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas*, DOE/EA-1454, Rev. 0, Richland Operations Office, Richland, Washington, March.

DOE (U.S. Department of Energy), 2003e, *Finding of No Significant Impact, "Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas,"* Richland Operations Office, Richland, Washington, March 7.

DOE (U.S. Department of Energy), 2004a, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, 2nd ed., Office of Environment, Safety and Health, Office of NEPA Policy and Compliance, Washington, D.C., December.

DOE (U.S. Department of Energy), 2004b, *Hanford Site Groundwater Strategy: Protection, Monitoring, and Remediation*, DOE/RL-2002-59, Richland Operations Office, Richland, Washington, February.

DOE (U.S. Department of Energy), 2004c, *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative)*, DOE/RL-2001-29, Rev. 0, Richland Operations Office, Richland, Washington, November.

DOE (U.S. Department of Energy), 2004d, *Hanford Communities*, Winter 2005 Newsletter, Vol. 11, 1st ed., Richland Operations Office, Richland, Washington.

DOE (U.S. Department of Energy), 2004e, *Final Feasibility Study for the Canyon Disposition Initiative (221-U Facility)*, DOE/RL-2001-11, Rev. 1, Richland Operations Office, Richland, Washington, November.

DOE (U.S. Department of Energy), 2005a, *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems*, DOE/EIS-0373D, Office of Nuclear Energy, Science and Technology, Washington, D.C., June.

DOE (U.S. Department of Energy), 2005b, *Hanford Site End State Vision*, DOE/RL-2005-57, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 2005c, *Record of Decision, "221-U Facility (Canyon Disposition Initiative)," Hanford Site, Washington*, Richland Operations Office, Richland, Washington, October 3.

DOE (U.S. Department of Energy), 2005d, *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses*, Final Rev. 0, Office of River Protection, Richland, Washington, March 25.

DOE (U.S. Department of Energy), 2005e, *Surplus Reactor Final Disposition Engineering Evaluation*, DOE/RL-2005-45, Rev. 0, Richland Operations Office, Richland, Washington, August.

DOE (U.S. Department of Energy), 2006a, *CERCLA Five-Year Review Report for the Hanford Site*, DOE/RL-2006-20, Rev. 0, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 2006b, *Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington*, DOE/EA-1547F, Richland Operations Office, Richland, Washington, March.

DOE (U.S. Department of Energy), 2006c, *Finding of No Significant Impact, "Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington,"* Richland Operations Office, Richland, Washington, March 31.

DOE (U.S. Department of Energy), 2007a, *Environmental Assessment, Construction and Operation of a Physical Sciences Facility at the Pacific Northwest National Laboratory, Richland, Washington*, DOE/EA-1562, Pacific Northwest Site Office, Richland, Washington, January.

DOE (U.S. Department of Energy), 2007b, *Finding of No Significant Impact for "Construction and Operation of a Physical Sciences Facility at the Pacific Northwest National Laboratory, Richland, Washington," (DOE/EA-1562)*, Office of Science, Pacific Northwest Site Office, Richland, Washington, January 29.

DOE (U.S. Department of Energy), 2008a, *Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE/EIS-0222-SA-01, Richland Operations Office, Richland, Washington, June.

DOE (U.S. Department of Energy), 2008b, *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0380, National Nuclear Security Administration, Albuquerque, New Mexico, May.

DOE (U.S. Department of Energy), 2009a, *Environmental Assessment, Combined Community Communications Facility and Infrastructure Cleanup on the Fitzner/Eberhardt Arid Lands Ecology Reserve, Hanford Site, Richland, Washington*, DOE/EA-1660F, Richland Operations Office, Richland, Washington, July.

DOE (U.S. Department of Energy), 2009b, *Finding of No Significant Impact for the "Combined Community Communications Facility and Infrastructure Cleanup on the Fitzner/Eberhardt Arid Lands Ecology Reserve, Hanford Site, Richland, Washington,*ò *(DOE/EA-1660)*, Richland Operations Office, Richland, Washington, July 20.

DOE (U.S. Department of Energy), 2010a, *Hanford Site Cleanup Completion Framework*, DOE/RL-2009-10, Rev. 0, Richland Operations Office and Office of River Protection, Richland, Washington, July.

DOE (U.S. Department of Energy), 2010b, *Hanford Site Groundwater Monitoring and Performance Report for 2009*, DOE/RL-2010-11, Rev. 1, Richland Operations Office, Richland, Washington, August.

DOE (U.S. Department of Energy), 2010c, *Long-Range Deep Vadose Zone Program Plan*, DOE/RL-2010-89, Rev. 0, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 2011a, *Plutonium Finishing Plant*, accessed through http://www.hanford.gov/page.cfm/PFP, January 24.

DOE (U.S. Department of Energy), 2011b, *Transuranic Waste Retrieval and Certification*, accessed through http://www.hanford.gov/page.cfm/TRU, February 7.

DOE (U.S. Department of Energy), 2011c, *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*, DOE/EIS-0375-D, Office of Environmental Management, Washington, D.C., February.

DOE (U.S. Department of Energy), 2011d, *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0426D, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, July.

DOE (U.S. Department of Energy), 2011e, *Environmental Assessment, Closure of Nonradioactive Dangerous Waste Landfill (NRDWL) and Solid Waste Landfill (SWL), Hanford Site, Richland, Washington*, DOE/EA-1707D, Revised Predecisional Draft, Richland Operations Office, Richland, Washington, August.

DOE and BLM (U.S. Department of Energy and U.S. Department of the Interior, Bureau of Land Management), 2008, *Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States*, DOE/EIS-0386, November.

DOE and DOI (U.S. Department of Energy, Office of Public Affairs, Washington, D.C., and U.S. Department of the Interior, Office of Public Affairs, Washington, D.C.), 2008, ñDOI Designates B Reactor at DOEôs Hanford Site as a National Historic Landmark: DOE to Offer Regular Public Tours in 2009,ò August 25.

DOE and Ecology (U.S. Department of Energy, Richland Operations Office, Richland, Washington, and Washington State Department of Ecology, Olympia, Washington), 1996, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, August.

DOE and NYSERDA (U.S. Department of Energy and New York State Energy Research and Development Authority), 2010, *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*, DOE/EIS-0226, West Valley Demonstration Project, West Valley, New York, January.

DOE, EPA, and Ecology (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology), 2006, *River Corridor Closure Project, TPA Quarterly Review for Period: March 2006–May 2006*, Richland, Washington, June 15.

DOE, EPA, and Ecology (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology), 2007, *River Corridor Closure Project, TPA Quarterly Review for Period: December 2006–February 2007*, Richland, Washington, March 15.

DOE, EPA, and Ecology (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology), 2009, *River Corridor Closure Project, TPA Quarterly Review for Period: March–May 2009*, Richland, Washington, June 18.

DOI (U.S. Department of the Interior), 1996, *Record of Decision, "Hanford Reach of the Columbia River Final Environmental Impact Statement for Comprehensive River Conservation Study,"* July 16.

Dreyer, C., 2007, Klickitat County Planning, Goldendale, Washington, personal communication (email) to J. DiMarzio, Science Applications International Corporation, Germantown, Maryland, *"Klickitat County, Washington, Comprehensive Plan,"* November 9.

Dreyer, C., 2010, Planning Department, Klickitat County, Goldendale, Washington, personal communication (letter) to Interested Persons, ñNotice of Availability of the Revised Final Environmental Impact Statement ï Juniper Canyon Wind Project,ò September 13.

Ecology (Washington State Department of Ecology), 2006a, *Determination of Nonsignificance, Central Washington Biodiesel, LLC, Ellensburg, Washington*, Central Regional Office, Yakima, Washington, July 5.

Ecology (Washington State Department of Ecology), 2006b, *Revised State Environmental Policy Act (SEPA) Mitigated Determination of Nonsignificance (MDNS) for the Proposed Columbia Ethanol Facility*, Industrial Section, Olympia, Washington, October 30.

Ecology (Washington State Department of Ecology), 2007a, *Final Programmatic Environmental Impact Statement for the Columbia River Water Management Program*, Ecology Publication No. 07-11-009, Olympia, Washington, February 15.

Ecology (Washington State Department of Ecology), 2007b, *Mitigated Determination of Nonsignificance (MDNS), Washington Ethanol, LLC, Moses Lake, Washington*, Eastern Regional Office, Spokane, Washington, February 9.

Ecology (Washington State Department of Ecology), 2009, *Final Environmental Impact Statement, Yakima River Basin Integrated Water Resource Management Alternative,* Ecology Publication No. 09-12-009, Yakima, Washington, June.

Ecology (Washington State Department of Ecology), 2010, *Hazardous Sites List*, Publication No. 10-09-042A, Toxics Cleanup Program, Olympia, Washington, February 17.

Ecology (Washington State Department of Ecology), 2011, *2009–2011 Watershed Plan Implementation and Flow Achievement Capital Grant Program*, accessed through http://www.ecy.wa.gov/watershed/09_11wscg.html on January 11.

Ecology and EPA (Washington State Department of Ecology and U.S. Environmental Protection Agency), 2007, *Considerations for Cleanup of the Hanford 200 Area National Priorities List Site*, Olympia, Washington, December.

Ecology, EPA, and DOE (Washington State Department of Ecology, Olympia, Washington; U.S. Environmental Protection Agency, Washington, D.C.; and U.S. Department of Energy, Richland, Washington), 1989, Hanford Federal Facility Agreement and Consent Order, 89-10, as amended, accessed through http://www.hanford.gov/tpa/tpahome.htm, May 15.

Ecology and WSDOH (Washington State Department of Ecology, Nuclear Waste Program, and Washington State Department of Health, Office of Radiation Protection), 2004, *Final Environmental Impact Statement*, *Commercial Low-Level Radioactive Waste Disposal Site, Richland, Washington*, DOH Publication 320-031, Olympia, Washington, May 28.

EFSEC (Energy Facility Site Evaluation Council), 2011, *Projects Under EFSEC Jurisdiction*, accessed through http://www.efsec.wa.gov/proj.shtml on May 13.

Energy Northwest, 2004, *2004 Annual Report*, accessed through http://www.energy-northwest.com.

Energy Northwest, 2006, *Columbia Generating Station 2005 Annual Radiological Environmental Operating Report*, Richland, Washington.

EPA (U.S. Environmental Protection Agency), 1999, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA 315-R-99-002, Office of Federal Activities, Washington, D.C., May.

EPA (U.S. Environmental Protection Agency), 2006a, *National Priorities List Sites in Oregon*, accessed through http://www.epa.gov/superfund/sites/npl/or.htm, February 24.

EPA (U.S. Environmental Protection Agency), 2006b, *National Priorities List Sites in Washington*, accessed through http://www.epa.gov/superfund/sites/npl/wa.htm, April 25.

EPA (U.S. Environmental Protection Agency), 2010, *Proposed National Priorities List (NPL) Sites – by Proposed Date*, accessed through http://www.epa.gov/superfund/sites/query/queryhtm/nplprop2.htm, November 29.

FERC (Federal Energy Regulatory Commission), 2006, *Final Environmental Impact Statement, Priest Rapids Hydroelectric Project, Washington (FERC Project No. 2114)*, FERC/FEIS-0190F, Office of Energy Projects, Washington, D.C., November.

FERC (Federal Energy Regulatory Commission), 2008, *Public Utility District No. 2 of Grant County, Washington, Project No. 2114-116, Order Issuing New License*, April 17.

FERC (Federal Energy Regulatory Commission), 2010a, *Major Pipeline Projects on the Horizon (MMcf/d)*, accessed through http://www.ferc.gov/industries/gas/gen-info/horizon-pipe.pdf, August.

FERC (Federal Energy Regulatory Commission), 2010b, *Major Storage Projects on the Horizon*, accessed through http://www.ferc.gov/industries/gas/indus-act/storage/horizon.pdf, November 30.

FERC (Federal Energy Regulatory Commission), 2011a, *Projects Near You*, accessed through http://www.ferc.gov/for-citizens/projectsearch/SearchProjects.aspx?Region=Northwest, January 28.

FERC (Federal Energy Regulatory Commission), 2011b, *North American LNG Import/Export Terminals, Proposed*, accessed through http://ferc.gov/industries/gas/indus-act/lng/LNG-proposed.pdf, January 3.

FERC (Federal Energy Regulatory Commission), 2011c, *North American LNG Import Terminals, Existing*, accessed through http://ferc.gov/industries/gas/indus-act/lng/LNG-existing.pdf, January 3.

Fluor Hanford (Fluor Hanford, Inc.), 2004, *Plan for Central Plateau Closure*, CP-22319-DEL, Rev. 0, Richland, Washington, September.

Franklin County, 2008, *Franklin County Growth Management Comprehensive Plan*, Pasco, Washington, February 27.

Freedman, V.L., 2008, *Potential Impacts of Leakage from Black Rock Reservoir on the Hanford Site Unconfined Aquifer: Initial Hypothetical Simulations of Flow and Contaminant Transport*, PNNL-16272, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington, January.

GCBOCC (Grant County Board of County Commissioners), 2010, *A Resolution Relating to Comprehensive Planning in Grant County in Accordance with the Washington State Growth Management Act (RCW 36.70 A) and Amending the 2006 Comprehensive Plan and Zone Changes*, Ephrata, Washington, September 7.

GCDCD (Grant County Department of Community Development), 1999, *Grant County Comprehensive Plan/Environmental Impact Statement*, Chapter 14, ñEnvironmental Analysis,ò accessed through http://www.co.grant.wa.us/planning/LongRange/CompPlan/index.htm, October 11.

GCPD (Grant County Planning Department), 2007, *Mitigated Determination of Non-significance, Liquafaction Corp., Moses Lake Ethanol Plant, Washington*, File No. 07-4960, Ephrata, Washington.

Gouk, T., 2011, City of West Richland, Richland, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò February 1.

Grant County PUD (Grant County Public Utility District), 2003, *Priest Rapids Project License Application, FERC No. 2114, Executive Summary*, October.

Grant County PUD (Grant County Public Utility District), 2009, *Annual Report 2009, Public Utility District No. 2 of Grant County, WA.*

Hilldale, R., and D. Mooney, 2007, *One-Dimensional Hydraulic Modeling of the Yakima Basin: A Component of Yakima River Basin Water Storage Feasibility Study, Washington*, Technical Series No. TS-YSS-14, U.S. Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho, October.

IsoRay (IsoRay Medical), 2009, *Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions from the Comply Code – V1.6, IsoRay 2008 Air Emissions Report*, Richland, Washington, July 20.

IsoRay (IsoRay Medical), 2011a, *Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions from the Comply Code – V1.6, IsoRay Medical Clean Air Report 2009*, Richland, Washington, March 2.

IsoRay (IsoRay Medical), 2011b, *Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions from the Comply Code – V1.6, IsoRay 2010 Clean Air Report*, Richland, Washington, March 2.

Jennings, R., 2011, Planning Department, Umatilla County, Pendleton, Oregon, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 7.

Kadlec (Kadlec Medical Center), 2008, *Kadlec River Pavilion Opens to Patients*, accessed through http://www.kadlecmed.org/about/eventarticle.php?id=129 on September 19.

Kelleher, K., U.S. Department of the Interior, Bureau of Land Management, Wenatchee Field Office, Wenatchee, Washington, 2011, personal communication (letter) to Interested Party, ñVantage to Pomona Heights 230kV Transmission Line Project,ò January 14.

Kelsey, G., 2011, Public Works, Klickitat County, Goldendale, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 19.

Kennewick (City of Kennewick), 2010, *City of Kennewick Comprehensive Plan 2009, Executive Document*, Kennewick, Washington, March 6.

Kittitas County, 2010, *Kittitas County Comprehensive Plan*, December.

Lingley, Jr., W.S., 2005, *Background on Washington State's Petroleum Geology*, Washington State Department of Natural Resources.

Liquafaction Corporation, 2007, *SEPA Checklist for the Moses Lake Ethanol Plant*, No. 07-4960-01, Redmond, Washington, October 12.

McCartney, K., 2007, U.S. Bureau of Reclamation, Upper Columbia Area Office, Yakima, Washington, personal communication (email) to J.A. DiMarzio, Science Applications International Corporation, Germantown, Maryland, ñYakima River Basin Water Storage Study,ò May 31.

McClane, C., 2007, Planning Department, Morrow County, Irrigon, Oregon, personal communication (telephone conversation) with S.D. Heiser, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò June 6.

McClane, C., 2011, Planning Department, Morrow County, Irrigon, Oregon, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 12.

Moravek (Moravek Biochemicals, Inc.), 2005, *Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions from the Comply Code – VI.6*, Richland, Washington, January 4.

Navy (U.S. Department of the Navy), 1996, *Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants*, DOE/EIS-0259, Bremerton, Washington, April.

Neitzel, D.A., ed., 2005, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 17, Pacific Northwest National Laboratory, Richland, Washington, September.

NPCC (Northwest Power and Conservation Council), 2010, *Power Plant Development Activity in the Pacific Northwest 2002–Present*, accessed through http://www.nwcouncil.org/energy/powersupply/Default.asp, October 1.

NPS (National Park Service), 1994, *Hanford Reach of the Columbia River: Final River Conservation Study and Environmental Impact Statement*, Pacific Northwest Regional Office, Seattle, Washington, June.

NRC (U.S. Nuclear Regulatory Commission), 2004, *NRC Inspection Report No. 70-1257/2004-001*, February 23.

NRC (U.S. Nuclear Regulatory Commission), 2005, *NRC Inspection Report No. 70-1257/2005-002*, May 24.

NRC (U.S. Nuclear Regulatory Commission), 2010, *NRC Inspection Report No. 70-1257/2010-203*, October 22.

ODEQ (Oregon Department of Environmental Quality), 2011, *DEQ Regulation of PGE Boardman*, accessed through http://www.deq.state.or.us/aq/pge.htm on February 1.

Pacific EcoSolutions, 2007, *Annual Environmental Monitoring Report for 2006*, Richland, Washington, June 29.

Pacific Power, 2008a, *McNary to Walla Walla Transmission Line Conditional Use Permit Application*, Portland, Oregon, September.

Pacific Power, 2008b, *McNary–Walla Walla 230-kV Transmission Line Expanded SEPA Checklist*, Portland, Oregon, September.

Pacific Power, 2010, *Walla Walla to McNary 230kV Transmission Line Project*, Portland, Oregon, November.

Pacific Power, 2011, *Segment A – Walla Walla to McNary*, accessed through http://www.pacificpower.net/ed/tp/eg/sawwtm.html, January 26.

PGE (Portland General Electric), 2011, *Boardman Plant Air Emissions*, accessed through http://www.portlandgeneral.com/community_environment/initiatives/boardman_plant_air_emissions.aspx on January 31.

PHMC (Project Hanford Management Contract), 2006a, *PHMC Performance Report*, Section A, ñPHMC Contract Overview,ò DOE/RL-2000-76, Rev. 69, Richland, Washington, July.

PHMC (Project Hanford Management Contract), 2006b, *PHMC Performance Report*, Section A, ñPHMC Contract Overview,ò DOE/RL-2000-76, Rev. 72, Richland, Washington, October.

Plummer, P., 2007, Washington State Department of Ecology, SEPA Unit, Olympia, Washington, personal communication (letter) to J.A. DiMarzio, Science Applications International Corporation, Germantown, Maryland, ñBiofuel or Ethanol Production,ò November 28.

PNMP (Pacific Northwest Motorsports Park), 2007, ñGroundbreaking for Pacific Northwest Motorsports Park Thursday, October 25th,ò accessed through http://www.pnwmotorsportspark.com/textfiles/MediaAlert071022.rtf, October 22.

PNNL (Pacific Northwest National Laboratory), 2009, ñMedia Invited to Building Dedication,ò accessed through http://www.pnl.gov/news/release.aspx?id=412, October 7.

PNNL (Pacific Northwest National Laboratory), 2010, *Capability Replacement Laboratory, 300 Area Replacement Facilities Chronology*, accessed through http://www.pnl.gov/rcf/scope/schedule_300.stm, December.

POM (Port of Morrow), 2011, *Boardman Industrial Park*, accessed through http://www.portofmorrow.com/boardman_park.htm on January 31.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2008, *Hanford Site Environmental Report for Calendar Year 2007 (Including Some Early 2008 Information)*, PNNL-17603, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2009, *Hanford Site Environmental Report for Calendar Year 2008 (Including Some Early 2009 Information)*, PNNL-18427, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2010, *Hanford Site Environmental Report for Calendar Year 2009 (Including Some Early 2010 Information)*, PNNL-19455, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2011, *Hanford Site Environmental Report for Calendar Year 2010 (Including Some Early 2011 Information)*, PNNL-20548, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., R.W. Hanf, J.P. Duncan, and R.L. Dirkes, eds., 2007, *Hanford Site Environmental Report for Calendar Year 2006 (Including Some Early 2007 Information)*, PNNL-16623, Pacific Northwest National Laboratory, Richland, Washington, September.

PPM Energy, Inc., 2005, ñPPM Announces 200 MW Big Horn Wind Project,ò accessed through http://www.ppmenergy.com/rel_05.10.28a.html, October 28.

Prentice, L., 2011, Planning Commission, Walla Walla County, Walla Walla, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 12.

Richland (City of Richland), 1998, *Final Environmental Impact Statement for Treatment of Low-Level Mixed Waste*, Richland, Washington, February.

Richland (City of Richland), 2002, *City of Richland Comprehensive Land Use Plan, Final*, December 10.

Richland (City of Richland), 2004, *Business and Economic Development Report*, Vol. VIII, No. 4, Fall 2004, Office of Business and Economic Development, Richland, Washington.

Richland (City of Richland), 2005a, *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area, Final Report*, Pasco, Washington, March.

Richland (City of Richland), 2005b, *City of Richland Comprehensive Land Use Plan*, accessed through http://www.ci.richland.wa.us/RICHLAND/planning/index.cfm?PageNum=11, December 6.

Richland (City of Richland), 2006, *Economic Development Status Report: Status as of June 30, 2006*, Office of Business and Economic Development, Richland, Washington.

Richland (City of Richland), 2008a, *City of Richland Comprehensive Land Use Plan*, December 7.

Richland (City of Richland), 2008b, *Richland's 25 Largest Employers*, accessed through http://www.ci.richland.wa.us/index.aspx?nid=398, February 12.

Riggsbee, W., 2007, Environmental Restoration/Waste Management, Yakama Indian Nation, Richland, Washington, personal communication (in person) with M. Burandt, U.S. Department of Energy, Office of River Protection, Richland, Washington, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò August 28.

RNP (Renewable Northwest Project), 2011, *Renewable Energy Projects*, accessed through http://www.rnp.org/project_map?field_project_state%5B%5D=OR&field_project_state%5B%5D=WA&tid%5B%5D=7&field_project_opstatus%5B%5D=Approved&field_project_opstatus%5B%5D=Proposed&field_project_opstatus%5B%5D=Operating&field_project_opstatus%5B%5D=In+Permitting+Process&field_project_opstatus%5B%5D=Under+Contruction on January 19.

Rolph, J., 2011, City of Richland, Richland, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò February 1.

Romine, W., 2007, City of Kennewick, Kennewick, Washington, personal communication (telephone conversation) with S.D. Heiser, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò June 11.

Romine, W., 2011, City of Kennewick, Kennewick, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 11.

SAIC (Science Applications International Corporation), 2010, *Fast Flux Test Facility Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site*, *Richland, Washington,"* Germantown, Maryland, November 8.

Shuttleworth, M., 2011, Planning Department, Benton County, Prosser, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 11.

Skeen, R., 2011, Professional Services and Outreach, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 6.

Smith, T., 2011, Cultural Resources, Nez Perce Tribe, Lapwai, Idaho, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 6.

The Reach, 2008, *Frequently Asked Questions*, accessed through http://visitthereach.org/faqs.html on September 19.

Trumbo, J., 2006, ñCBC, Kadlec Team up for Health Sciences Center,ò *Tri-City Herald*, accessed through http://www.kadlecmed.org/about/eventarticle.php?id=90, September 24.

TVA (TVA Architects), 2008, *Washington State University Tri-Cities Master Plan*, Portland, Oregon, December.

UMADRA (Umatilla Army Depot Reuse Authority), 2010, *U.S. Army Umatilla Chemical Depot Base Redevelopment Plan*, Umatilla, Oregon, August.

US Ecology (U.S. Ecology Washington, Inc.), 2007, *Annual Environmental Monitoring Report for Calendar Year 2006: US Ecology Washington Low-Level Radioactive Waste Disposal Facility*, Richland, Washington, May 25.

USACE (U.S. Army Corps of Engineers), 2006, *Upper Columbia Alternative Flood Control and Fish Operations, Columbia River Basin, Final Environmental Impact Statement*, Seattle District, Seattle, Washington, April.

USDA (U.S. Department of Agriculture), 1997, *1997 Census of Agriculture, Highlights of Agriculture: 1997 and 1992, Washington*, accessed through http://www.agcensus.usda.gov/Publications/1997/Highlights/Washington/index.asp.

USDA (U.S. Department of Agriculture), 2006, *The Conservation Reserve Program, 33rd Signup, County by County Summary*, Farm Service Agency, Washington, D.C., June.

USDA (U.S. Department of Agriculture), 2009, *2007 Census of Agricultural County Profile: Benton, Franklin, and Grant Counties, Washington*, accessed through http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp, December.

USFWS (U.S. Fish and Wildlife Service), 2008, *Hanford Reach National Monument Final Comprehensive Conservation Plan and Environmental Impact Statement, Adams, Benton, Grant and Franklin Counties, Washington*, Burbank, Washington, August.

Walla Walla County, 2006, *Walla Walla County Mitigated Determination of Non-significance, Gen-X Energy Group Biodiesel Production Facility, Burbank, Washington*, Community Development Department, Walla Walla, Washington, July 20.

Walla Walla County, 2007, *Walla Walla County Integrated Comprehensive Plan and EIS*, Vol. I, ñComprehensive Plan: Walla Walla County Comprehensive Plan Update 2007,ò Department of Community Development, Walla Walla, Washington, December.

Walla Walla County, 2009, *Walla Walla County Integrated Comprehensive Plan and EIS*, Vol. I, ñComprehensive Plan: Walla Walla County Comprehensive Plan Update 2007 and 2009,ò Department of Community Development, Walla Walla, Washington, December.

Washington Ethanol, LLC, 2006, *SEPA Environmental Checklist, Washington Ethanol Plant, Moses Lake, Washington*, November 28.

WCH (Washington Closure Hanford), 2007, *River Corridor Closure Project, March 2007 Monthly Performance Report*, Richland, Washington, March.

WDFW (Washington Department of Fish and Wildlife), 2007, *Priority Habitats and Species*, accessed through http://wdfw.wa.gov/hab/phshabs.htm on June 27.

WDNR (Washington State Department of Natural Resources), 2005, *Final Supplemental Environmental Impact Statement on the Oil and Gas Leasing Program for State Lands*, Olympia, Washington, July.

WDNR (Washington State Department of Natural Resources), 2006, *Directory of Washington State Surface Mining Reclamation Sites – 2006*, Open File Report 2006-1, Washington Division of Geology and Earth Resources, Olympia, Washington, May.

WDNR (Washington State Department of Natural Resources), 2007a, *Leasing Washington State-Owned Lands for Oil and Gas Exploration*, accessed through http://www.dnr.wa.gov/htdocs/sales_leasing/leasing/oilandgas/auction/index.html on November 13.

WDNR (Washington State Department of Natural Resources), 2007b, *Surface Mining Reclamation Program*, accessed through http://www.dnr.wa.gov/geology/smr.htm, October 19.

Wendt, G., 2011, Planning and Building Department, Franklin County, Pasco, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 11.

WFLHD (Western Federal Lands Highway Division), 2010, *Oregon Projects*, accessed through http://www.wfl.fhwa.dot.gov/projects/or/, October 5.

WFLHD (Western Federal Lands Highway Division), 2011, *Washington Projects*, accessed through http://www.wfl.fhwa.dot.gov/projects/wa/, January 28.

Williams Energy, 2011, *Blue Bridge Pipeline Project*, accessed through http://www.williamsenergy.com /blue_bridge_pipeline/ on January 28.

Wiltse, L., 2011, Building and Planning, Adams County, Othello, Washington, personal communication (telephone conversation) with A.J. Stork, Science Applications International Corporation, Germantown, Maryland, ñCurrent or Future Actions Occurring in the Region That Should Be Considered in Evaluating Cumulative Impacts,ò January 7.

WIS (Washington Infrastructure Services, Inc.), 2002, *Yakima River Storage Enhancement Initiative, Black Rock Reservoir Study, Final Report*, Bellevue, Washington, May.

WOFM (Washington State Office of Financial Management), 2007, *Population Density and Land Area by County*, accessed through http://www.ofm.wa.gov/popden, July 12.

WSDOT (Washington State Department of Transportation), 2007, *Making Every Dollar Count for Benton County*, accessed through http://www.wsdot.wa.gov/accountability/2005GasTax/Benton/ Default.htm on January 11.

WSDOT (Washington State Department of Transportation), 2011, *WSDOT – Projects*, accessed through http://www.wsdot.wa.gov/Projects on January 27.

WSTC (Washington State Transportation Commission), 2006, *Statewide Rail Capacity and System Needs Study: Task 2.1.A – Economic Growth and Demand*, Olympia, Washington, July.

WSU (Washington State University), 2008a, *Biofuel Development in Washington*, Pacific Regional Biomass Energy Partnership, Extension Energy Program, Olympia, Washington, May.

WSU (Washington State University), 2008b, *The BSEL Building Dedication Ceremony, Richland, Washington*, accessed through http://www.tricity.wsu.edu/bsel/opening.html, May 8.

Yakima County, 1998, *Plan 2015: A Blueprint for Yakima County Progress*, Yakima County Planning Department, Yakima, Washington, December 28.

Yakima County, 2010, *2010 Comprehensive Plan Amendment Cycle*, accessed through http://www. yakimacounty.us/planning/CPA.htm, December 14.

Code of Federal Regulations

10 CFR 1021, U.S. Department of Energy, ñNational Environmental Policy Act Implementing Procedures.ò

40 CFR 1500ï1508, Council on Environmental Quality, ñRegulations for Implementing the Procedural Provisions of the National Environmental Policy Act.ò

40 CFR 1502.2, Council on Environmental Quality, ñEnvironmental Impact Statement: Implementation.ò

40 CFR 1508.7, Council on Environmental Quality, ñTerminology and Index: Cumulative Impact.ò

Federal Register

58 FR 48509, U.S. Department of Energy, 1993, ñRecord of Decision; *Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, WA*,ò September 16.

61 FR 10736, U.S. Department of Energy, 1996, ñRecord of Decision: *Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, WA*,ò March 15.

61 FR 41596, U.S. Department of Energy, 1996, ñNational Environmental Policy Act Record of Decision for the *Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants*,ò August 9.

62 FR 3014, U.S. Department of Energy, 1997, ñRecord of Decision for the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*,ò January 21.

63 FR 3624, U.S. Department of Energy, 1998, ñRecord of Decision for the Department of Energyôs *Waste Isolation Pilot Plant Disposal Phase*,ò January 23.

63 FR 3629, U.S. Department of Energy, 1998, ñRecord of Decision for the Department of Energyôs Waste Management Program: Treatment and Storage of Transuranic Waste,ò January 23.

63 FR 41810, U.S. Department of Energy, 1998, ñRecord of Decision for the Department of Energyôs Waste Management Program: Treatment of Non-wastewater Hazardous Waste,ò August 5.

64 FR 46661, U.S. Department of Energy, 1999, ñRecord of Decision for the Department of Energyôs Waste Management Program: Storage of High-Level Radioactive Waste,ò August 26.

64 FR 61615, U.S. Department of Energy, 1999, ñRecord of Decision: *Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)*,ò November 12.

64 FR 66928, U.S. Fish and Wildlife Service, 1999, Record of Decision, ñExtension of the Saddle Mountain National Wildlife Refuge Acquisition Boundary,ò November 30.

65 FR 1608, U.S. Department of Energy, 2000, ñRecord of Decision for the *Surplus Plutonium Disposition Final Environmental Impact Statement*,ò January 11.

65 FR 10061, U.S. Department of Energy, 2000, ñRecord of Decision for the Department of Energyôs Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site,ò February 25.

65 FR 37253, Executive Office of the President, 2000, ñProclamation 7319 of June 9, 2000: Establishment of the Hanford Reach National Monument,ò June 13.

65 FR 56565, U.S. Department of Energy, 2000, ñRecord of Decision for the *Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*,ò September 19.

65 FR 82985, U.S. Department of Energy, 2000, ñRevision to the Record of Decision for the Department of Energyôs Waste Management Program: Treatment and Storage of Transuranic Waste,ò December 29.

66 FR 38646, U.S. Department of Energy, 2001, ñRevision to the Record of Decision for the Department of Energyôs Waste Management Program: Treatment and Storage of Transuranic Waste,ò July 25.

67 FR 56989, U.S. Department of Energy, 2002, ñRevision to the Record of Decision for the Department of Energyôs Waste Management Program: Treatment and Storage of Transuranic Waste,ò September 6.

68 FR 60342, U.S. Department of Energy, Bonneville Power Administration, 2003, Record of Decision, ñPlymouth Generating Facility,ò October 22.

69 FR 39446, U.S. Department of Energy, 2004, ñRevision to the Record of Decision for the Department of Energyôs Waste Management Program: Treatment and Storage of Transuranic Waste,ò June 30.

70 FR 10612, U.S. Department of Energy, Bonneville Power Administration, 2005, ñWanapa Energy Center; Notice of Availability of Record of Decision (ROD),ò March 4.

70 FR 60508, U.S. Department of Energy, 2005, ñRevision to the Record of Decision for the Department of Energyôs Waste Management Program,ò October 18.

72 FR 40135, U.S. Department of Energy, 2007, ñNotice of Intent to Prepare an Environmental Impact Statement for the Disposal of Greater-Than-Class-C Low-Level Radioactive Waste,ò July 23.

72 FR 51807, U.S. Department of Energy, 2007, ñAmended Record of Decision: Storage of Surplus Plutonium Materials at the Savannah River Site,ò September 11.

73 FR 12401, U.S. Department of Energy, 2008, ñAmendment to the Record of Decision for the Department of Energyôs Waste Management Program: Treatment and Storage of Transuranic Waste,ò March 7.

73 FR 55824, U.S. Department of Energy, 2008, ñAmended Record of Decision for the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement*,ò September 26.

74 FR 38611, U.S. Department of Energy, 2009, ñNotice of Intent to Prepare an Environmental Impact Statement and Land and Resource Management Plan Amendment for the Planned Blue Bridge Pipeline Project and Request for Comments on Environmental Issues,ò August 4.

75 FR 11576, U.S. Nuclear Regulatory Commission, 2010, ñNotice of Intent to Prepare an Environmental Impact Statement and Conduct the Scoping Process for Columbia Generating Station,ò March 11.

77 FR 3255, U.S. Department of Energy, 2012, ñNotice of Intent to Prepare an Environmental Impact Statement for the Acquisition of a Natural Gas Pipeline and Natural Gas Utility Service at the Hanford Site, Richland, WA, and Notice of Floodplains and Wetlands Involvement, (DOE/EIS-0467)ò January 23.

Washington State Codes

Revised Code of Washington

RCW 36.70A, Growth Management Act ï Planning by Selected Counties and Cities.

RCW 36.70A.020, Growth Management Act ï Planning by Selected Counties and Cities: Planning Goals.

RCW 78.44, Surface Mining Act.

RCW 90.90, Columbia River Basin Water Supply Act.

APPENDIX S
WASTE INVENTORIES FOR CUMULATIVE IMPACT ANALYSES

Integral to development of the inventory data set for the cumulative impact analyses presented in this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* was identification of those waste sites potentially contributing to cumulative impacts on groundwater. Their identification involved two semi-independent, convergent processes: a Waste Information Data System screen and a technical baseline review.

S.1 WASTE INFORMATION DATA SYSTEM SCREEN

The Waste Information Data System (WIDS) screen began with the universe of sites reflected in the *Hanford Site Waste Management Units Report* (Shearer 2005a), also referred to as the "WIDS database," and focused on the assignment of each site to one of two classes: (1) those sites that potentially contribute significantly to cumulative impacts and (2) those sites that are not expected to contribute significantly to cumulative impacts. The WIDS database is an environmental database specific to the Hanford Site (Hanford) and includes information on the waste sites identified at Hanford. The objectives of the WIDS screening process are presented in Table S–1.

Table S–1. Objectives of Waste Information Data System Screening

Objective 1	Identify all potential groundwater sources (radioactive and chemical).
Objective 2	Confirm and screen out *de minimis* sources.
Objective 3	Identify inventories and associated information (e.g., end states) for screened groundwater sources.
Objective 4	Further screen sites remaining after completion of Objective 3 with risk/hazard analysis.
Objective 5	Record the source by name, location, source type, and reference.
Objective 6	Seek additional documentation from site owners.

Overall strategy for the screening involved the following four steps:

1. Reviewing approximately 2,800 WIDS sites included in the *Hanford Site Waste Management Units Report* (Shearer 2005a).
2. Applying the screening rules as described below.
3. Confirming the site locations using the Hanford Site Atlas (BHI 2001).
4. Performing quality assurance verifications of the sites that failed each round of screening and were therefore not included in the cumulative impacts inventory data set.

In preparation for the screening (step 2 above), various rules were specified for retaining sites as potentially significant contributors to cumulative impacts or for eliminating them from consideration. Those rules and the assignment of site screen codes are described in the following sections.

S.1.1 Screen 1 Rules

Screen 1 involved reviewing all WIDS sites and asking the question: Is this site a potential source to include in the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* cumulative impacts analysis?

If the answer to the question was "Yes," the site passed the Screen 1 test and was assigned a Screen 1 reason code, as follows:

1. Known inventory + potential for release
2. Reported cleanup + possible residual contamination
3. Unknown inventory

If the answer to the question was "No," the site failed the Screen 1 test and was assigned a Screen 1 reason code, as follows:

1. WIDS status for the site is rejected as a potential waste site and not reclassified as accepted for continued consideration in WIDS; plus, the site is inactive and has a description consistent with the designated WIDS status.
2. Site is a duplicate site.
3. Site has been consolidated with another WIDS site; sources for the consolidated site become part of the "parent" site.
4. Site is included in the *TC & WM EIS* alternatives. Facilities and equipment of the single-shell tank system are described in RPP-15043, *Single-Shell Tank System Description* (Field 2003).
5. Site is a satellite storage/accumulation site.

S.1.2 Screen 2 Rules

Screen 2 involved a review of all WIDS sites that passed the Screen 1 test and further screening based on the WIDS classification system for sites as potential waste sites.

WIDS sites were assigned a "No" (fail) for Screen 2 for any of the following WIDS classifications. (All of these "No" sites received an additional evaluation to determine if the *TC & WM EIS* team was in agreement with the classification, and some "No" sites were changed to "Yes" sites regardless of the WIDS classification if the *TC & WM EIS* team believed the site required further consideration or the information for its classification was not clear.)

- Rejected
- Accepted, then reclassified as rejected
- Accepted, then reclassified as "No Action" or "Closed Out"

WIDS sites were assigned a "Yes" (pass) for Screen 2 for all "Accepted" classifications.

S.1.3 Screen 3 Rules

Screen 3 involved a review of all WIDS sites that passed the Screen 2 test and focused on the waste types. Sites that met the criteria listed below under the Screen 3 rules were rejected.

General Screen 3 rules for all waste types were as follows:

- Non-liquid-effluent areas previously identified as contaminated areas that are not currently posted as such are assumed to contain no active contamination and do not pass through Screen 3.
- If the constituent distribution coefficient (K_d) is greater than 10, there was complete retention of the constituent in the vadose zone and the contamination was removed; consequently, there was no release to the groundwater and the site does not pass through Screen 3.
- If the site is not a groundwater source, then the site does not pass through Screen 3. For example, if the site is an outfall to the river, within 100 meters (328 feet) of the river shoreline, or within the river floodplain, then the site is not considered to be a source of groundwater contamination.
- If the release consists primarily of a petroleum product or polychlorinated biphenyls, then the site does not pass through Screen 3. Releases that contained polychlorinated biphenyls may continue for consideration if they are part of a large liquid release or solid disposal.

Screen 3 rules for each specific waste type are listed in Table S–2.

Table S–2. Screen 3 Rules of the Waste Information Data System for Specific Waste Types

Waste Type	Rule
Abandoned chemicals	No, if the quantities are laboratory or bench scale.
Abandoned pipe trench	No, if remediation is expected.
Animal waste	Yes, if the animals or animal byproducts were associated with radiological experiments or unknown.
Asbestos	No, if the only constituent of concern is asbestos; the site may contain demolition/building debris and miscellaneous trash.
Ash	No, if EP Toxicity Testing indicates it is nontoxic.
Barrels/drums/buckets/cans	No, if their content is clearly not associated with nuclear materials production/processing.
Batteries	No, if the site contains only batteries.
Building floor drains	No, if the building is clearly not associated with nuclear materials production/processing.
Bunker pipeline	No, if it is a petroleum-carrying pipeline.
Burial ground	Yes, but only if it is the site of a process- or production-related release or unknown.
Chemicals	Yes, but only if their release was production-related or unknown.
Chemical release	Yes, but only if it was production-related or unknown.
Construction debris	Yes, if it contains radioactive contaminants or unknown.
Contaminated ramp	Yes, if the contaminants are radioactive or unknown.
Contaminated soil	Yes, if it contains radioactive or chemical contaminants for which there is no remediation or unknown.
Contamination area	Yes, if it contains radioactive or chemical contaminants for which there is no remediation; no, if it is clearly only surface contamination or unknown.
Control structure	Yes, if it contains radioactive contaminants or unknown.
Demolition and inert waste	No, unless there is evidence of chemical or radioactive production waste.
Dry well	No, unless there is evidence of chemical or radioactive production waste.
Dumping area	No, unless there is evidence of chemical or radioactive production waste.
Electric substation	No, if the content is only petroleum-based waste or PCBs.
Equipment	Yes, but only if it was used in a process- or production-related release or unknown.
Floodplain	No, if it is a large, diffused area within 100 meters (328 feet) of the river.
French drain	Yes, but only if it was used in a process- or production-related release or unknown.
Fuel tank	No, if the content is only petroleum-based waste or PCBs.
Honey dump station	Yes, but only if it is the site of a process- or production-related release or unknown.
Injection/reverse well	Yes, but only if it is the site of a process- or production-related release or unknown.
Maintenance garage	No, if it is only a petroleum-based waste site.
Military compound	Yes, but only if the site was used for a process- or production-related release or unknown.
Miscellaneous pipelines	Yes, but only if they were used for a process- or production-related release or unknown.

Table S–2. Screen 3 Rules of the Waste Information Data System for Specific Waste Types *(continued)*

Waste Type	Rule
Miscellaneous trash and debris	Yes, but only if it is the result of a process- or production-related release or unknown.
Neutralization tank	Yes, but only if it is the site of a process- or production-related release or unknown.
Oil	No, if it is only petroleum-based waste or PCBs.
Ordnance	Yes, but only if it is the site of a process- or production-related release or unknown.
Process effluent	Yes, but only if it is the result of an untreated process- or production-related release or unknown; no, if the effluent was contained or treated.
Process sewer	Yes, but only if it is the site of an untreated process- or production-related release or unknown.
Product piping	Yes, but only if it is the site of an untreated process- or production-related release or unknown.
Rad site	Yes, but only if it is the site of an untreated process- or production-related release or unknown.
Reactor exhaust stack	Yes, but only if it is the site of an untreated process- or production-related release or unknown.
Sanitary sewer	Yes, if it is the site of an untreated process- or production-related release or if it was used for the disposal of animals or animal byproducts associated with radiological experiments or unknown.
Septic tank	Yes, if it is the site of an untreated process- or production-related release or if it was used for the disposal of animals or animal byproducts associated with radiological experiments or unknown.
Sludge	Yes, but only if it is the result of an untreated process- or production-related release or unknown.
Sodium storage facility	No, if it is an active regulated facility.
Soil	Yes, if it is the site of an untreated process- or production-related release; no, if only airborne contamination was involved or unknown.
Steam condensate	Yes, if it is the result of an untreated process- or production-related release or unknown.
Storage	Yes, if the site was used to store untreated process- or production-related waste or unknown.
Storage tank	Yes, if it was used to store untreated process- or production-related waste or unknown.
Stormwater runoff	No, unless it is chemically or radioactively contaminated or associated with a process- or production-related release.
Surface debris	Yes, if there is evidence of process- or production-related contamination or unknown.
Underground radioactive area	Yes, if it was the site of an untreated process- or production-related release or unknown.
Unplanned release	Yes, if it was an untreated process- or production-related release or unknown.
Vegetation	Yes, if it is the site of an untreated process- or production-related liquid release or unknown.
Waste storage	Yes, if the site was used to store untreated process- or production-related waste or unknown.

Table S–2. Screen 3 Rules of the Waste Information Data System for Specific Waste Types *(continued)*

Waste Type	Rule
Water	Yes, if it is associated with an untreated process- or production-related liquid release or unknown.
Water treatment facility	Yes, if it is the site of an untreated process- or production-related liquid release or unknown.
Wood and coal debris	Yes, if there is evidence of process- or production-related contamination or unknown.

Key: EP=extraction procedure; PCB=polychlorinated biphenyl.

S.1.4 Screen 4 Rules

In addition to a review of the Waste Management Units Area document used for Screens 1 through 3, Screen 4 included a review of an updated, more-detailed WIDS site description document (Shearer 2005b). Published Comprehensive Environmental Response, Compensation, and Liability Act Records of Decision were also reviewed to determine the status of WIDS sites reviewed in Screen 4. Furthermore, the Composite Analyses Revision 0 inventory was reviewed to validate independent screening decisions.

Screen 4 involved an additional review of all WIDS sites that passed the Screen 3 test. Under Screen 4 rules, sites that met the following criteria were rejected:

- Facility-Specific Screen: The WIDS site is assigned a "No" (fail) if the facility associated with the release is not a process- or production-related facility. A "Yes" (pass) is assigned to the WIDS site if the facility or original source is unknown.

- Minimum-Inventory Screen: The WIDS site is assigned a "No" (fail) if the inventory is identified and will be coded as noted below.

- For WIDS sites assigned a "No," one of the following Screen 4 codes is assigned. The *de minimis* criteria were selected by a team of subject matter experts using engineering judgment and groundwater modeling experience, the objective being to limit the WIDS sites to those that are likely to contribute significantly to the cumulative impacts. Given the waste information available, each criterion is believed to be the limit at which the WIDS site would have a significant impact.

  - Updated information provided in the new WIDS site description document (regulatory status does not drive the decision)

  - More specificity of process information (location/building/room)

  - *De minimis* contaminant quantity < 0.45 kilograms (1 pound) of chemicals

  - *De minimis* contaminant quantity < 1 curie of radionuclides

  - *De minimis* contaminant quantity < 379 liters (100 gallons)

  - *De minimis* contaminant quantity (dry, residual) < 50,000 disintegrations per minute of alpha, beta, gamma per gram

- For WIDS sites assigned a "Yes," one of the following Screen 4 codes is assigned:
  - Inventory information available in new WIDS description document
  - No inventory information available, but may be available in other documentation
  - Reference to inventory available in new WIDS description document
  - No inventory information available and no inventory data are expected to be found
  - Permitted facility inventory to be provided by applicable documentation, e.g., facility waste acceptance criteria

WIDS does not suffice for the analysis of cumulative impacts at Hanford. It is not a complete set of sites potentially contributing to cumulative impacts. Some Hanford facilities and some facilities not located at Hanford are not included in WIDS. Equally important, WIDS has little inventory data. Therefore, other sources of information about waste sites, such as Hanford technical baseline documents, were used to supplement the identification of sites potentially contributing significantly to cumulative impacts and to locate the waste inventory data for those sites. This process is described in Section S.2.

S.2 TECHNICAL BASELINE REVIEW

The technical baseline review (TBR) was a systematic search of documents and databases to identify waste sites and inventory data. Documents describing facilities and waste sites in the Hanford operable units were collected. In addition to the technical baseline documents for the 100, 200, 300, 400, and 600 Areas at Hanford, offsite sources such as those described in the Environmental Data Resources, Inc., online database were reviewed. References to additional documents potentially containing inventory data for these waste sites were recorded, and the referenced documents were reviewed (SAIC 2006).

All sites in a technical baseline or similar source document were assigned to one of four categories (see Table S–3) based on the information in the TBR source documents. (Note: Waste sites included in the *TC & WM EIS* alternatives analysis were excluded from this review.)

Table S–3. Technical Baseline Review Categories

Category 1	Sites containing radioactive or chemical COPCs above *de minimis* contamination levels
Category 2	Sites expected to contain a radioactive or chemical COPC inventory above *de minimis* contamination levels, but without inventory information
Category 3	Sites for which process knowledge indicates a lack of contamination, or sites containing radioactive or chemical COPCs below *de minimis* contamination levels
Category 4	Non-liquid-waste sites where the contamination would be removed and therefore would not contribute to groundwater contamination

Key: COPC=constituent of potential concern.

This accounting of waste sites potentially contributing to cumulative impacts is independent of the WIDS screen and serves as a check on the results of that screen for common sites. Combined, these two sets of sites (WIDS and the TBR) are expected to include all known sites, with most sites common to the two sets. In addition to identifying waste sites not in WIDS, the TBR identified reference documents for waste inventory data. It was also determined that the 1987 version of WIDS (specifically, the *Hanford Site Waste Management Units Report*, known as the *Cramer Report* [DOE 1987]) could be used as a waste inventory reference in lieu of the more recent WIDS because the more recent version of WIDS did not include the detailed inventory data.

S.3 "MARRIAGE" OF WASTE INFORMATION DATA SYSTEM SCREEN AND TECHNICAL BASELINE REVIEW

To develop the inventory for the cumulative impacts analysis, the WIDS sites had to be combined with the TBR waste sites. This was accomplished by the development of Excel spreadsheets that document site and inventory information by site areas. This included a significant "data mining" effort.

Excel Workbooks includes two individual worksheets: "Sites" and "Inventory." The elements of each are described in Tables S–4 and S–5. The columns in the Sites worksheet are explained in Table S–4.

The columns in the Inventory worksheet are described in Table S–5. It should be noted that there are uncertainties related to the contamination volumes and concentrations found in the available documents. Some of these uncertainties relate to the limited available data for many waste sites. More-detailed discussions on inventory uncertainties can be found in the documents used to develop the inventory worksheets described in Table S–5.

Table S–4. Content of Sites Worksheet of Excel Workbooks

Table Entry	Comment/Assumption[a]
Site number	Sequential numbering system to provide an efficient index between the site list on the spreadsheets for each area and the site locations on the maps developed to graphically represent the waste sites.
Common site name	Taken from (1) the technical baseline documents (SAIC 2006); (2) the latest version of WIDS (Shearer 2005b); (3) the *Hanford Site Waste Management Units Report* (DOE 1987), known as the *Cramer Report*; or (4) some other source.
WIDS ID	Taken from the latest version of WIDS (Shearer 2005b).
Operable unit	Taken from the latest version of WIDS (Shearer 2005b).
Site type	Based on available descriptive information, site was assigned a site type (e.g., pond, crib, trench, ditch, burial ground, tank, septic tank, building, equipment, contaminated soil). Conflicting information was resolved through reliance on the latest version of WIDS (Shearer 2005b).
Source type	Based on available descriptive information, source was assigned a type (i.e., liquid, solid, liquid/solid, N/A [not applicable], or UNK [unknown]).
Centroids (coordinates)	Taken from (1) the Hanford Site Atlas (BHI 2001) index, (2) the latest version of WIDS (Shearer 2005b), or (3) estimated from maps in the Hanford Site Atlas (BHI 2001).
Effective area (bottom area [L×W] of feature) in square feet	Taken from (1) the latest version of WIDS (Shearer 2005b), (2) the technical baseline documents (SAIC 2006), or (3) the *Cramer Report* (DOE 1987). If the *Cramer Report* was used for inventory data, it was also used for effective area.
Liquid volume (volume of liquid released) in liters	If inventory was found, then it was taken from that reference. Otherwise, liquid volume was taken from (1) the *Hanford Soil Inventory Model, Rev. 1* (Corbin et al. 2005); (2) *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site* (Diediker 1999); (3) the *Cramer Report* (DOE 1987); (4) the latest version of WIDS (Shearer 2005b); or (5) the technical baseline documents (SAIC 2006).
Solid volume, solid mass (volume or mass of waste) in cubic meters or kilograms	Generally, these entries were used only for burial grounds. If inventory was found, then it was taken from that reference. Otherwise, it was taken from (1) the latest version of WIDS (Shearer 2005b), (2) the *Cramer Report* (DOE 1987), or (3) the technical baseline documents (SAIC 2006).
Decay date	If radionuclide inventory was found, then it was taken from that reference.

Table S–4. Content of Sites Worksheet of Excel Workbooks *(continued)*

Table Entry	Comment/Assumption[a]
Start/stop dates (year unit started and stopped operation or started and stopped receiving waste)	If inventory was found, then it was taken from that reference. Otherwise, it was taken from (1) the latest version of WIDS (Shearer 2005b), (2) the technical baseline documents (SAIC 2006), or (3) the *Cramer Report* (DOE 1987).
Status (current status including important cleanup and closure milestones)	Taken from (1) the latest version of WIDS (Shearer 2005b), (2) the technical baseline documents (SAIC 2006), or (3) the *Cramer Report* (DOE 1987).
End state, barrier type, completion date	For the 200 Areas, it was taken from the *Plan for Central Plateau Closure* (Fluor Hanford 2004). For other areas, it was taken from applicable cleanup (1) RODs, (2) closure plans, and (3) other documents.
Comments to analysts	References and page numbers are provided. Important comments are also noted.
Comparison to WIDS	If differences were found between the results of the WIDS screening and the results of the TBR, they were resolved and noted.
References	References for each area are included at the bottom of the Sites worksheet.

[a] Numerical listings of source documents are in order of priority.

Key: ID=identifier; L×W=length times width; ROD=Record of Decision; TBR=technical baseline review; WIDS=Waste Information Data System.

Table S–5. Content of Inventory Worksheet of Excel Workbooks

Table Entry	Comment/Assumption[a]
Site number	Sequential numbering system to provide an efficient index between the site list on the spreadsheets for each area and the site locations on the maps developed to graphically represent the waste sites.
Common site name	Taken from (1) the technical baseline documents (SAIC 2006), (2) the latest version of WIDS (Shearer 2005b), (3) the *Hanford Site Waste Management Units Report*, known as the *Cramer Report* (DOE 1987), or (4) some other source.
WIDS ID	Taken from the latest version of WIDS (Shearer 2005b).
Radionuclides[b]	Liquid release inventories taken from (1) *Hanford Soil Inventory Model, Rev. 1* (Corbin et al. 2005), (2) *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site* (Diediker 1999), (3) the *Cramer Report* (DOE 1987), (4) the technical baseline documents (SAIC 2006), (5) the latest version of WIDS (Shearer 2005b), or (6) other sources. Solid waste inventories taken from (1) *Summary of Radioactive Solid Waste Received in the 200 Areas During Calendar Year 1995* (Anderson and Hagel 1996) or other site-specific solid waste references, (2) the *Cramer Report* (DOE 1987), (3) technical baseline documents (SAIC 2006), (4) the latest version of WIDS (Shearer 2005b), or (5) other sources.
Chemicals[c]	Liquid release inventories taken from (1) *Hanford Soil Inventory Model, Rev. 1* (Corbin et al. 2005), (2) the *Cramer Report* (DOE 1987), (3) technical baseline documents (SAIC 2006), (4) the latest version of WIDS (Shearer 2005b), or (5) other sources. Solid waste inventories taken from (1) site-specific solid waste references, (2) the *Cramer Report* (DOE 1987), (3) the technical baseline documents (SAIC 2006), (4) the latest version of WIDS (Shearer 2005b), or (5) other sources.

Table S–5. Content of Inventory Worksheet of Excel Workbooks *(continued)*

Table Entry	Comment/Assumption[a]
Comments	Important comments regarding the inventories are noted.

[a] Numerical listings of source documents are in order of priority.
[b] Curies of radionuclides (half-life greater than 10 years and inventory greater than 1 curie [cumulative or individual]).
[c] Kilograms of chemicals (inventory greater than 0.45 kilograms [1 pound] of chemicals that have MCLs or a health-based ingestion standard in IRIS, and compounds that have constituents with MCLs or a health-based ingestion standard in IRIS).

Key: ID=identifier; IRIS=Integrated Risk Information System maintained by the U.S. Environmental Protection Agency; MCL=maximum contaminant level; WIDS=Waste Information Data System.

Combining the WIDS screening results and the TBR results requires resolving any conflicts between the two independent screening processes. The WIDS screening sites were compared with the TBR sites and the differences were reviewed and reconciled. For example, during the "marriage" of the two processes, the TBR sites were reclassified from sites having inventories with a potential to contribute significantly to cumulative impacts to sites that are not expected to contribute significantly to cumulative impacts if the only contamination present or released from the site was radionuclides with half-lives less than 10 years, such as cobalt-60 (half-life of 5.27 years).

S.3.1 End-State Approach

End-state analysis included the review of applicable documents and consultation with the U.S. Department of Energy's (DOE's) Office of River Protection (ORP) and Richland Operations Office (RL). The end states for all waste sites were reviewed and concurred upon by each responsible ORP and DOE-RL manager to ensure accuracy and completeness. The approach for determining which end state to use for each waste site followed specific guidelines. The guidelines for selecting an end state were based on the following broad criteria:

- The end state should represent a reasonably foreseeable outcome for a particular facility or group of facilities. The implementing approach should not assume excessive research and development or reliance on undeveloped technology.

- The end state should comply with current regulations and agreements where applicable, based on the following hierarchy:

  - Environmental documents submitted to or approved by regulatory agencies (e.g., remedial investigations/feasibility studies, interim Records of Decision, Resource Conservation and Recovery Act closure plans) (SAIC 2006)

  - Milestones stipulated in the Hanford Federal Facility Agreement and Consent Order (also known as the Tri-Party Agreement) (Ecology, EPA, and DOE 1989)

  - Outcomes defined by requests for proposal or contracts (e.g., river corridor)

  - Planning documents (e.g., *Plan for Central Plateau Closure* [Fluor Hanford 2004])

- End states should represent a consistent application of DOE policies and procedures. Exceptions have to be documented to support a reason for a policy change.

- If a different end state is proposed than those identified above, the end states must be in a publicly available, referenced document.

The end states identified using the approach described above are current through October 2006, when the cumulative impacts groundwater inventory was completed. Since that time, additional or different decisions on end states may have been made, and it is quite possible that other decisions may be made as DOE progresses through the closure and cleanup process at Hanford. However, to complete the groundwater analysis for cumulative impacts in this *TC & WM EIS*, a cutoff date had to be determined. Appendix U of this *TC & WM EIS* provides a description of the overall process for making cleanup decisions, cleanup requirements, and goals that have been set and are likely to be set at Hanford.

S.3.2 Independent Review and Verification (Quality Assurance) Process

Following each step of the cumulative impacts inventory development process (i.e., screening steps 1, 2, 3, and 4 and the "marriage" of the WIDS screen and the TBR), an independent quality assurance review was conducted to ensure data accuracy and integrity. This included verification that the data are traceable to the source document and verification of radionuclide and chemical inventory values. These reviews also verified that the inventory development process was consistently applied in the preparation of the Excel Sites and Inventory worksheets for each Hanford area.

S.3.3 Emerging Data

As new and emerging data were identified, the Excel Workbooks Sites and Inventory worksheets were revised and updated as necessary. For example, the latest version of SIM [the Hanford Soil Inventory Model] (Corbin et al. 2005) was obtained and reviewed to determine applicability. The updated data from this document were incorporated into the Sites and Inventory worksheets. This included adding individual worksheets for each waste site provided by Revision 1 of SIM.

Since publication of the *Draft TC & WM EIS*, additional revisions were made to the inventory database based on comments received on the draft EIS and additional references or corrections to the source documents (SAIC 2011). These revisions include the following sites:

- T Plant complex (including 221-T Canyon Building) – Inventories for all isotopes, except plutonium isotopes, were reduced by a factor of 1/10,000 to be consistent with the footnote provided in the original reference used for this site's inventory and to reduce conservatism (Bushore 2002: Table 2). The footnote states: "Isotopes from tank 15-1 samples, 1989 through 1993, except for plutonium isotopes, multiplied by 10,000 for conservatism."

- Z Area cribs and trenches (ditches) – Based on a 2007 report (Teal 2007), the inventories for mercury were incorrectly reported as inventories for magnesium for several Z Area cribs and trenches (ditches) in SIM (Corbin et al. 2005). These corrections are reflected in the final inventory database.

- Greater-Than-Class C (GTCC) waste disposal site – Since publication of the *Draft TC & WM EIS*, inventories for the proposed disposal site have been estimated. This site has been included in the final inventory database.

- Environmental Restoration Disposal Facility (ERDF) – Inventories for the ERDF have been revised to reflect the current reporting of inventories disposed of at the ERDF through March 2010. No radionuclide inventory projections beyond March 2010 were available and, therefore, were not included in the final inventory database.

- Sites without reported total uranium inventories (e.g., burial grounds, the US Ecology Commercial Low-Level Radioactive Waste Disposal Site) – Several sites located primarily in the 100 Areas and burial grounds in the 200 Areas did not have inventories reported for total uranium in the source documents used to develop the inventory database used for the *Draft TC & WM EIS*.

Based on comments and concerns expressed regarding these potentially "missing" inventories, total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

- Sites with carbon tetrachloride inventories – Although a site may have a carbon tetrachloride inventory identified, the individual site inventory may not have been included in the modeling for this *Final TC & WM EIS*. To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. These sites are noted in the following tables (Nelson and Preston 2010).
- 300 Area Process Ponds and Trenches (WIDS Identifiers 316-1, 316-2, and 316-5) – The radionuclide inventories for the 300 Area Process Ponds and Trenches were determined to be overly conservative as reported in SIM (Corbin et al. 2005), which relied upon a surrogate waste stream from the PUREX [plutonium-uranium extraction] process cooling-water/steam condensate. This approach resulted in a significant overestimation of the radionuclide inventory based on analytical data and process knowledge. The inventories for plutonium only have been revised to account for this overestimation (Mehta 2011; Harrington 2011).

S.3.4 Results of Initial Screening

Based on the screening approach discussed above, over 2,300 sites and sources were documented. These sites were identified for 18 geographical areas. Of this total, 383 sites were identified as sites with referenceable inventories containing radioactive or chemical constituents of potential concern (COPCs) above *de minimis* contamination levels. Approximately 403 sites were identified as sites expected to contain a radioactive or chemical COPC inventory above *de minimis*, but no referenceable inventory information was available. A total of 1,429 sites were identified as sites for which process knowledge indicates a lack of contamination or sites containing radioactive or chemical COPCs below *de minimis* contamination levels as defined in the Screen 4 rule; approximately 106 were identified as non-liquid-waste sites where the contamination would be removed and thus would not contribute to groundwater contamination.

S.3.5 Analysis of Sites with Missing Inventory

As previously discussed, the cumulative impacts analysis inventory looked at a total of 2,321 sites. The 403 sites identified as having unknown inventory expected to contain radioactive or chemical COPCs represent about 17 percent of the total. The remainder (1,918 sites, or 83 percent of the total) have known inventory. The percentage of sites with unknown inventory varies by area, as shown in Table S–6.

Table S–6. Unknown-Inventory Sites per Area at the Hanford Site

Area	Total Sites	Unknown-Inventory Sites	Percentage of Unknown-Inventory Sites
100 Areas	808	132	16
200 Areas	957	194	20
300 Area	440	66	15
400 Area	76	1	1
Permitted facilities	2	0	0
Other sites	38	10	26
Total	**2,321**	**403**	**17**

In the core of the production area at Hanford (100, 200, and 300 Areas), characterization is most advanced for the 100 and 300 Areas. Therefore, the 100 and 300 Areas have corresponding lower percentages of unknown-inventory sites.

The simplest inference that can be drawn from these initial observations is that the cumulative impacts analysis inventory might be about 17 percent low because data are missing for about 17 percent of the sites. This inference is based on the assumption that each of the sites with unknown inventory actually has inventory equal to the average of the sites with known inventory.

The cumulative impacts analysis inventory additionally categorized the sites with known inventory into three groups, as follows:

1 Sites with inventories that would be released into the environment at their original disposal locations

2 Sites with inventories that would be removed, treated, and disposed of in permitted facilities

3 Sites with inventories that are essentially zero (*de minimis*)

Another assumption is that the sites with unknown inventory behave similarly (statistically) to the sites with known inventory (this assumption is examined in more detail below). The COPCs at 293 sites with known inventories are not negligible and, based on the end-state information, would not be removed, treated, and disposed of in permitted facilities. These sites represent about 15 percent of the 1,918 sites with known inventory. If the sites with unknown inventory have a similar COPC population to the sites with known inventory, then it may be expected that about 15 percent of the 403 sites with unknown inventory, or about 65 sites, actually contain non-negligible amounts of inventory that will be released to the environment outside of permitted facilities. The missing inventory (estimated to be about 17 percent of the total inventory) might be contained in only 15 percent of the sites with unknown inventory. This observation suggests that it might be useful to examine the sites with unknown inventory individually to try to identify the 15 percent of the unknown-inventory sites that are significant to the total inventory.

To follow this thought, a third analysis of the sites with unknown inventory was performed to evaluate their significance. A weight-of-evidence approach was used by reviewing the WIDS description (and technical baseline documents where necessary) to categorize the unknown-inventory sites into three groups, as follows:

1 Sites that most likely have significant inventory
2 Sites that most likely have insignificant inventory
3 Sites where no judgment of significance could be made

As shown in Figures S–1 through S–3, the 200-B Area has a rather high percentage of unknown-inventory sites and was selected as an area in which to evaluate the utility of the weight-of-evidence approach. Three independent teams performed this evaluation. The independent teams each reviewed the 37 sites with unknown inventory in the 200-B Area.

All three teams concluded that the missing inventory is probably not spread evenly over the 37 sites with unknown inventory in the 200-B Area. The teams concluded that the unknown-inventory sites likely had a higher proportion of significant sites than the 15 percent observed in the known-inventory population. A conservative estimate is that the percentage of unknown-inventory sites that are most likely to be significant in the 200-B Area is about 50 percent. This suggests that about half of the 403 unknown-inventory sites in the total population, about 202, are most likely to be insignificant to the analysis if the other areas are similar to the 200-B Area. The missing inventory is currently estimated to be 17 percent of the known inventory.

The significance of the missing inventory should be considered in the context of the inventory for the alternatives impacts analysis. If the inventory for the cumulative impacts analysis is smaller than that for the alternatives impacts analysis, then it would be expected that uncertainties in the sum of both inventories would be dominated by uncertainties in the alternatives impacts analysis. Similarly, if the inventory for the cumulative impacts analysis is larger than that for the alternatives impacts analysis, then it would be expected that uncertainties in the sum of both inventories would be dominated by uncertainties in the cumulative impacts analysis. If the uncertainties in the two inventories are of the same order of magnitude, then uncertainties in both inventories contribute to the overall uncertainty.

Reflected in Table S–7 is the relative uncertainty of the two inventories. For example, technetium-99 has an alternatives inventory of 29,700 curies in tanks (DOE 2003), 312 curies in past leaks (CH2M HILL 2002; Jones et al. 2000, 2001; Myers 2005; Wood and Jones 2003; Wood et al. 2003), and 142 curies disposed of in cribs and trenches (ditches) (Corbin et al. 2005), for a total of 30,154 curies. The spreadsheets of the October 2006, Revision 4, Cumulative Impacts Analysis reflect a cumulative inventory of 762 curies for technetium-99 (SAIC 2006). Thus, missing inventory is expected because data incompleteness in the cumulative inventory of about 17 percent would be dominated by uncertainty in the alternatives inventory. It can be concluded that the effects of potentially missing inventory in the cumulative impacts inventory would not be an important factor in evaluating the sum of the alternatives and cumulative inventories.

Table S–7. Uncertainty of Alternatives and Cumulative Radionuclide Inventories at the Hanford Site

Constituent	Alternatives Inventory[a]	Known Cumulative Inventory[b]	Uncertainties Dominating Overall Uncertainty
Technetium-99	30,200	762	Alternatives inventory
Iodine-129	49	25	Alternatives inventory
Uranium-238	964	3,220	Cumulative inventory
Strontium-90	50,900,000	2,100,000	Alternatives inventory
Cesium-137	47,100,000	2,430,000	Alternatives inventory
Hydrogen-3 (tritium)	19,700	1,500,000	Cumulative inventory
Carbon-14	3,180	43,500	Cumulative inventory

[a] CH2M HILL 2002; Corbin et al. 2005; DOE 2003; Field 2003; Jones et al. 2000, 2001; Myers 2005; Wood and Jones 2003; Wood et al. 2003.
[b] SAIC 2006.

Similarly, these data suggest that missing inventory in the cumulative impacts analysis because of data incompleteness for strontium-90 and cesium-137 is not a driver of the uncertainty in the total inventory for the same reasons given above for technetium-99.

For iodine-129, missing cumulative impacts analysis inventory is considered a minor issue. The Inventory Data Package suggested that the uncertainty in the iodine-129 inventory (49 curies) for the alternatives impacts analysis is ± 21 curies. This suggests that the inventory for the alternatives impacts analysis will be between 28 curies and 70 curies. The October 2, 2006, spreadsheets show an inventory for the cumulative impacts analysis of 25 curies for iodine-129, and the inference is that 17 percent of that inventory (about 4 curies) may be missing because of data incompleteness. The expected value for the total inventory is about 74 curies, with an uncertainty of ± 21 curies in the portion of the inventory reflected in the alternatives impacts analysis, and an estimated 4 curies missing because of data incompleteness. The uncertainty of the iodine-129 inventory in the alternatives impacts analysis is thus five times greater than that in the cumulative impacts analysis inventory.

For uranium-238, hydrogen-3 (tritium), and carbon-14, missing inventory plays a potentially important role in the uncertainty of the total inventory.

Presented as Figures S–1, S–2, and S–3 are the proportions of known and unknown inventory for the various areas, sites, and facilities at Hanford. The figures suggest rather even proportions of unknown inventory for the subareas of the 100 Areas (see Figure S–1). Those proportions are more variable, however, within the 200 Areas (see Figure S–2); unknown inventory is proportionally high for the B Area, the PUREX [Plutonium-Uranium Extraction] Plant, S Area, T Area, and U Area relative to that for B Pond, Gable North, Nonradioactive Dangerous Waste Landfill, and Z Area. Substantial disparity in the proportion of unknown inventory is evident for the other Hanford areas, sites, and facilities (see Figure S–3).

Figure S–1. Known and Unknown Inventory in Hanford Site 100 Areas

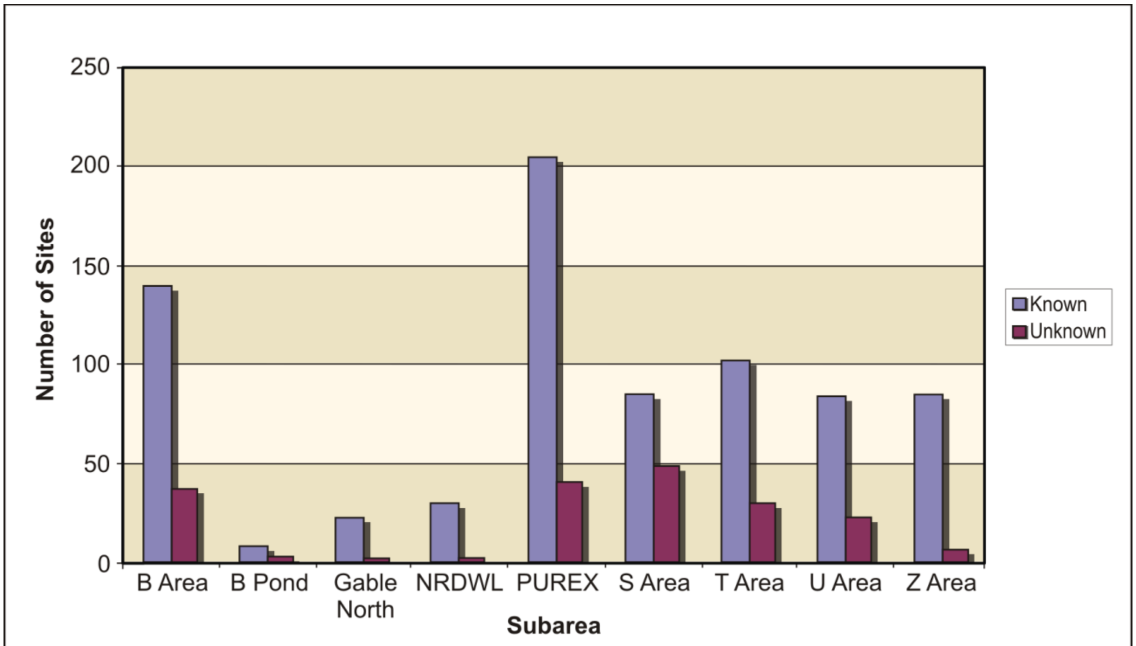


Figure S–2. Known and Unknown Inventory in Hanford Site 200 Areas

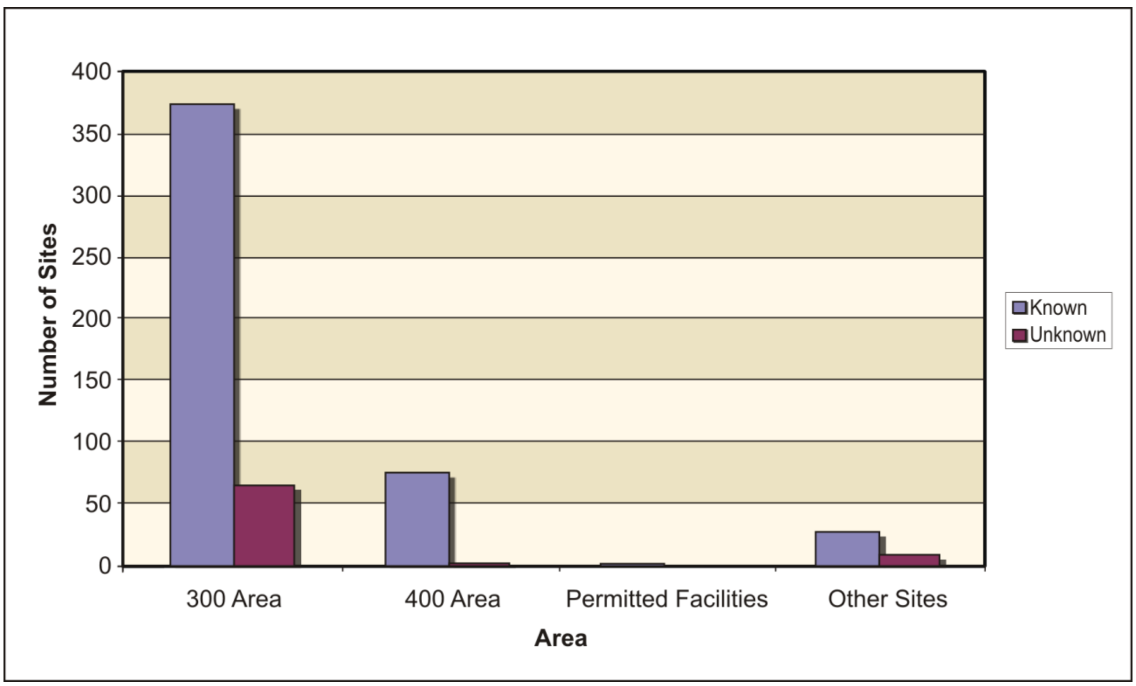


Figure S–3. Known and Unknown Inventory in Hanford Site 300 Area, 400 Area, Permitted Facilities, and Other Sites

S.3.6 Determination of Final Inventory Used for Cumulative Analysis

The initial list of radionuclides included those with half-lives greater than 10 years, and the initial list of chemicals included those with a health risk from ingestion—that is, they have maximum contaminant levels or are listed in the Integrated Risk Information System as having health-based ingestion standards. Not all the radioactive and chemical constituents on the initial list are important in exposure scenarios used to assess cumulative impacts in this *TC & WM EIS*. Therefore, to focus attention on constituents that control impacts, an additional screening analysis was performed. The primary focus of that analysis was to consider groundwater release scenarios for cumulative impacts analysis sources and to ensure consistency with the screening done for the alternatives analysis, allowing for cumulative impacts to be added to the alternatives impacts. For radionuclides, only groundwater consumption was considered, release was assumed to be partition limited, and decay during transport was considered. For analysis purposes, estimation of relative impacts was based on the distribution of radionuclides in the cumulative impacts inventory. Radionuclides contributing less than 1 percent of impacts under well scenarios were eliminated from the detailed analysis. To screen for hazardous chemicals, reported chemical inventories for the cumulative impacts sites were compared with health-based limits. Chemicals present in the inventories at levels above health-based limits were selected for detailed analysis. As indicated in Table S–8, the screening resulted in reduction of the original set of radioactive and chemical constituents to a final set of 14 radioactive and 26 chemical constituents, which includes those constituents also identified for the alternatives impacts analysis. Appendix Q of this *TC & WM EIS* provides further description of the screening process for the radioactive and chemical constituents identified for the groundwater analysis. The final list of cumulative impact waste inventories, waste sites, and end states was provided to DOE-RL and ORP responsible managers for review and concurrence to ensure accuracy and completeness.

Table S–8. Radioactive and Chemical Constituents

Radionuclides	Chemicals	
Hydrogen-3 (tritium)	1,2-Dichloroethane	Lead
Carbon-14	1,4-Dioxane	Manganese
Potassium-40	1-Butanol	Mercury
Strontium-90	2,4,6-Trichlorophenol	Molybdenum
Zirconium-93	Acetonitrile	Nickel (soluble salts)
Technetium-99	Arsenic, inorganic	Nitrate
Iodine-129	Benzene	Polychlorinated biphenyls
Cesium-137	Boron and compounds	Silver
Gadolinium-152	Cadmium	Strontium (stable)
Thorium-232	Carbon tetrachloride	Total uranium
Uranium isotopes (includes uranium-233, -234, -235, -238)	Chromium[a]	Trichloroethylene
Neptunium-237	Dichloromethane	Vinyl chloride
Plutonium isotopes (includes plutonium-239, -240)	Fluoride	
Americium-241	Hydrazine/hydrazine sulfate	

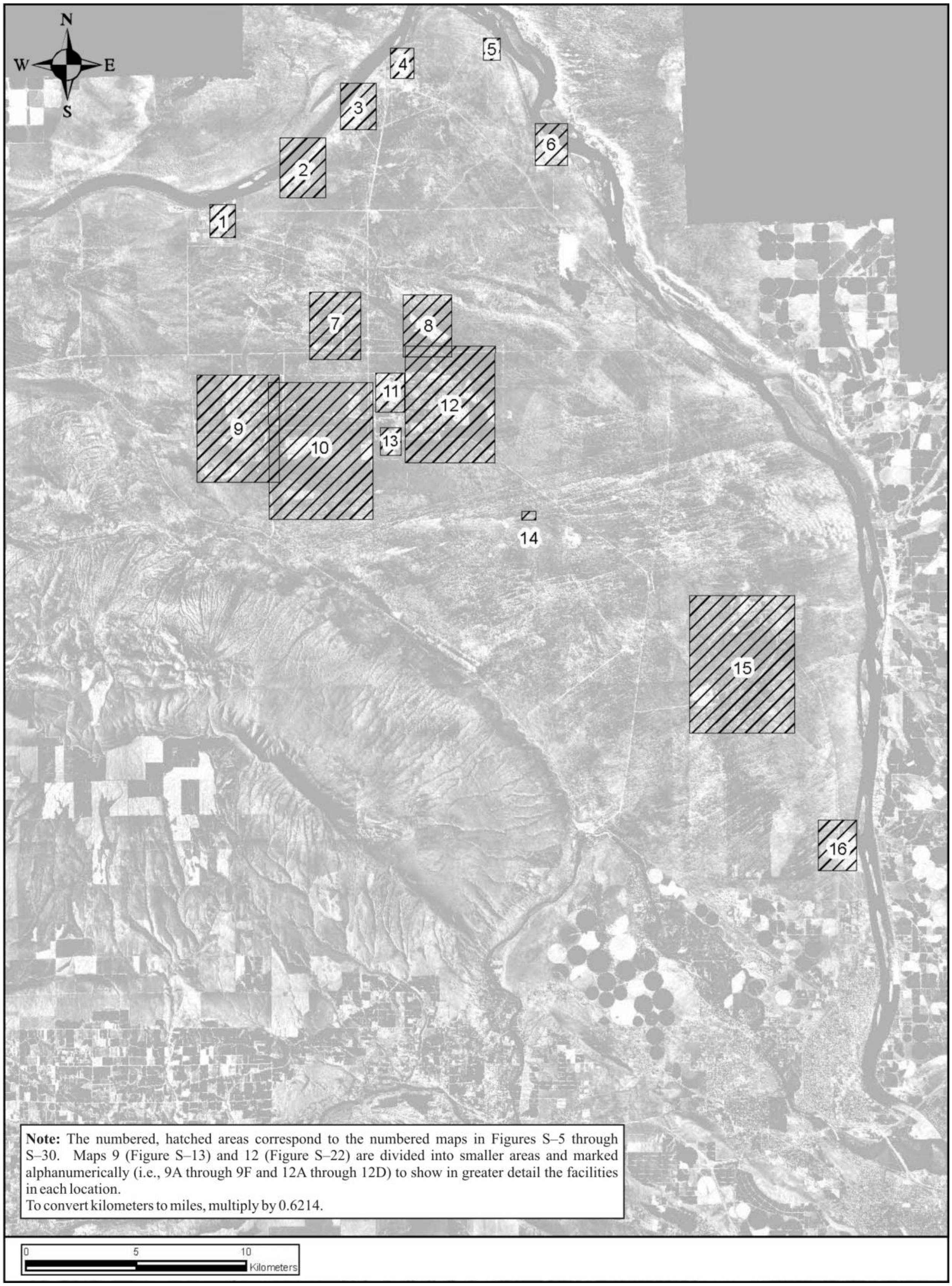
[a] For purposes of long-term impacts, it was assumed that this is hexavalent chromium.

Locations of the sites of the WIDS screening and the TBR are depicted in the maps provided as Figures S–4 through S–30. The final results of the WIDS screening, the TBR, the marriage of these two approaches, and the additional screening process are provided in Tables S–9 through S–34. The radionuclide inventories for the sites listed in these tables are provided in Tables S–35 through S–60 and the chemical inventories, in Tables S–61 through S–86.

As discussed in Chapter 1, DOE has prepared the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (GTCC EIS)* (DOE 2011), which addresses the disposal of low-level radioactive waste (LLW) generated by activities licensed by the U.S. Nuclear Regulatory Commission or an agreement state that contains radionuclides in concentrations exceeding Class C limits (10 CFR 61). The *GTCC EIS* also addresses DOE LLW and non-defense-generated transuranic waste, which have characteristics similar to GTCC LLW and for which there may be no path for disposal.

Hanford is being considered as a candidate location for a new GTCC waste disposal facility in the *Draft GTCC EIS*. Such a facility is not expected to be operational until after 2019. In addition, DOE estimates there are about12,000 cubic meters (420,000 cubic feet) of GTCC LLW and similar DOE waste (DOE 2011) already in storage or projected to be generated from existing facilities or that may be generated in the future as a result of actions proposed by DOE or commercial entities. Detailed information on this waste is provided in the *Draft GTCC EIS* (DOE 2011).

If Hanford were selected to host a GTCC disposal facility pursuant to the *Final GTCC EIS*, DOE would conduct an appropriate project-specific National Environmental Policy Act review, including a cumulative impacts analysis. These offsite inventories have been estimated since publication of the *Draft TC & WM EIS* and are included in the groundwater analysis for this *TC & WM EIS*.



Note: The numbered, hatched areas correspond to the numbered maps in Figures S–5 through S–30. Maps 9 (Figure S–13) and 12 (Figure S–22) are divided into smaller areas and marked alphanumerically (i.e., 9A through 9F and 12A through 12D) to show in greater detail the facilities in each location.
To convert kilometers to miles, multiply by 0.6214.

Figure S–4. Alternatives and Cumulative Impact Sites Index Map

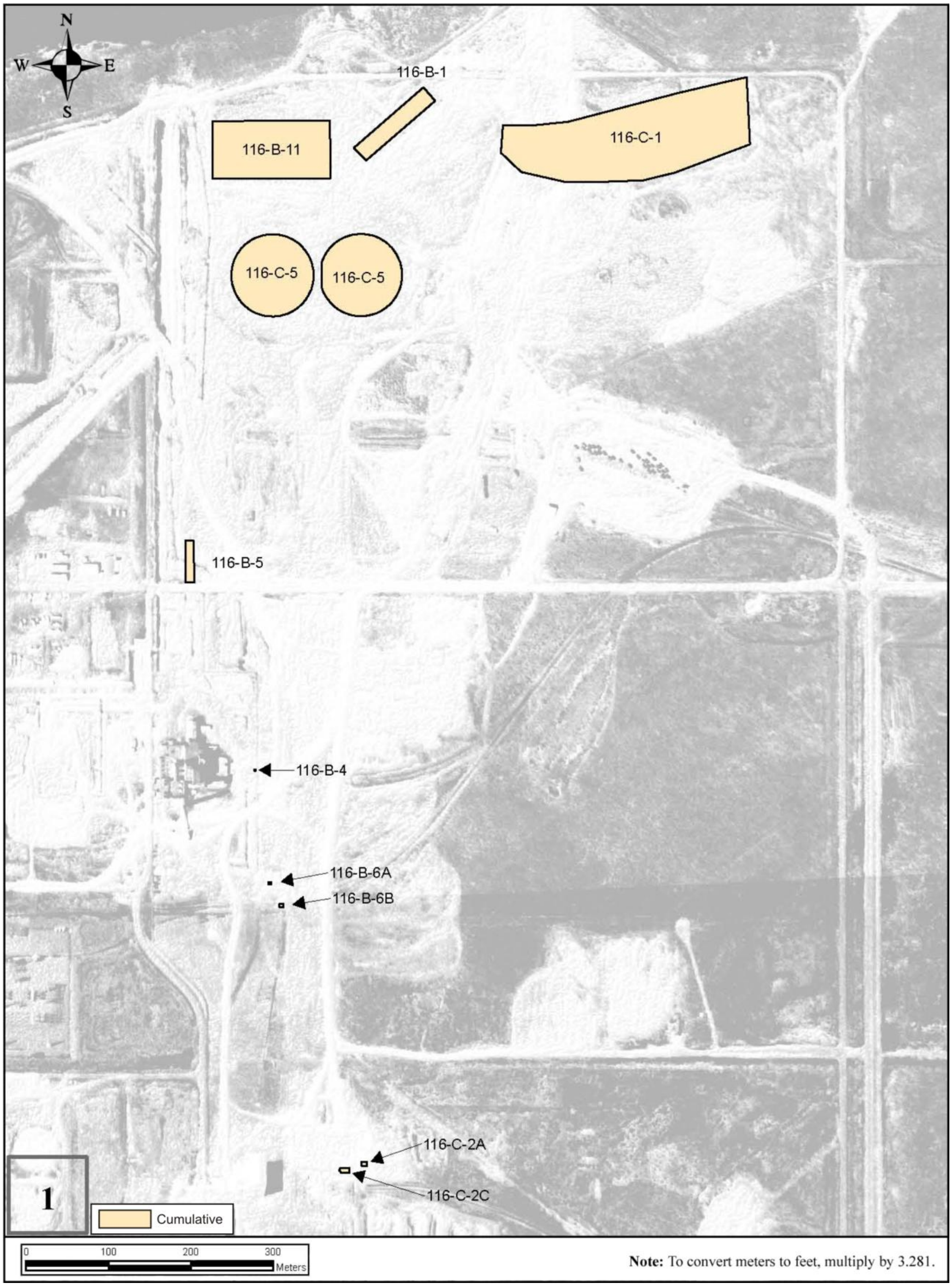


Figure S–5. Map 1: Cumulative Impact Sites in the 100-B and -C Areas

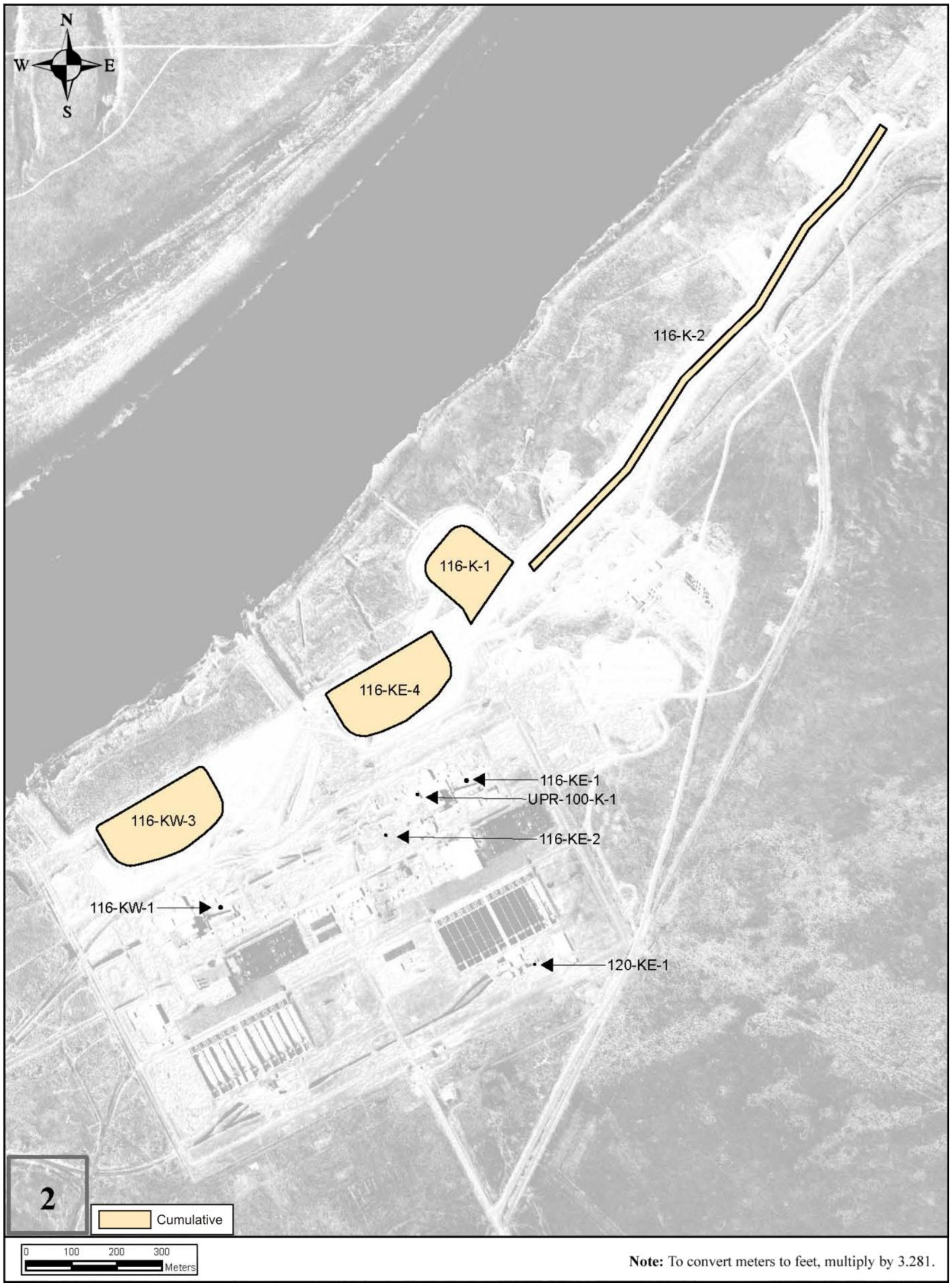


Figure S–6. Map 2: Cumulative Impact Sites in the 100-K Area

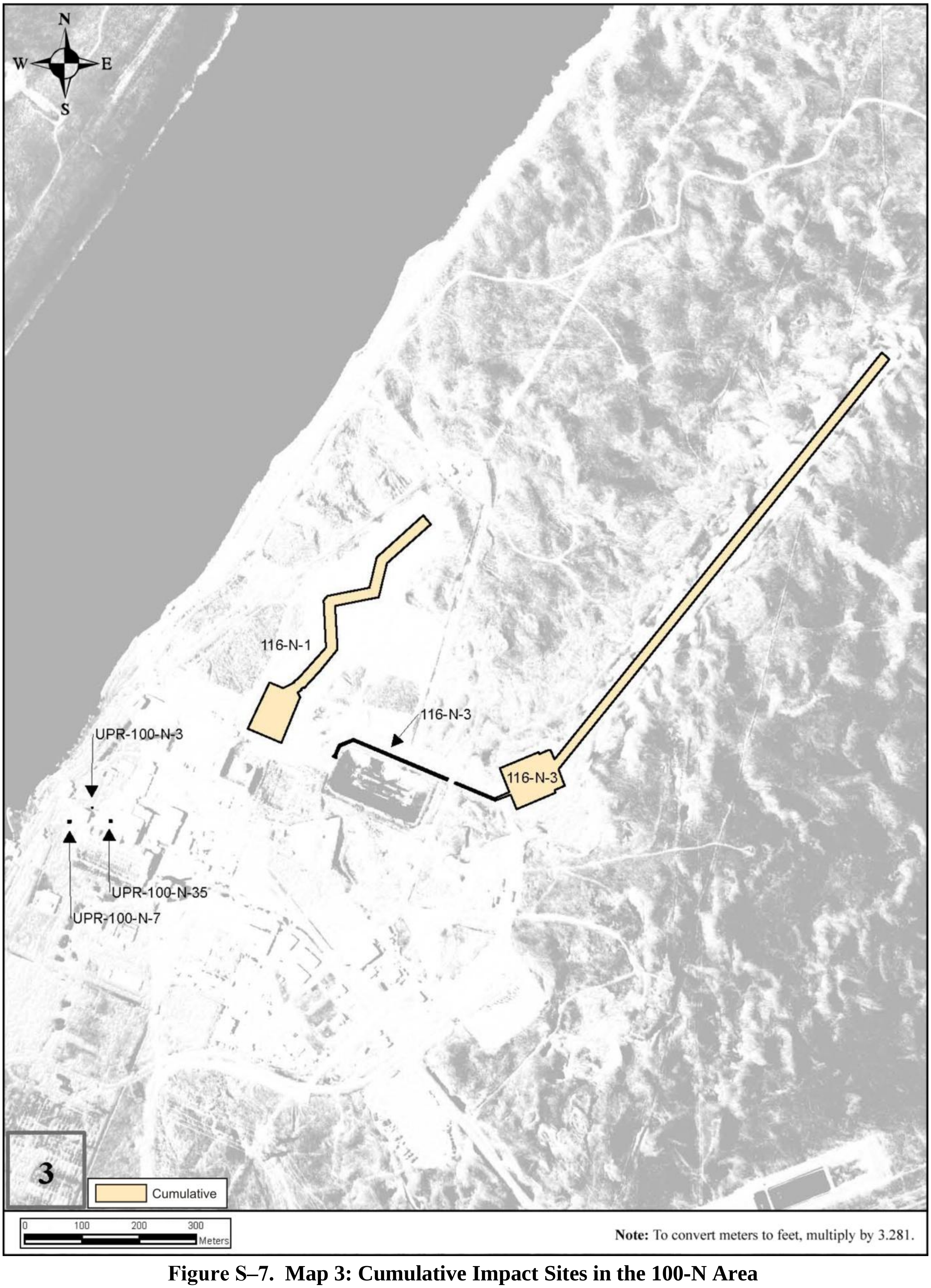


Figure S–7. Map 3: Cumulative Impact Sites in the 100-N Area

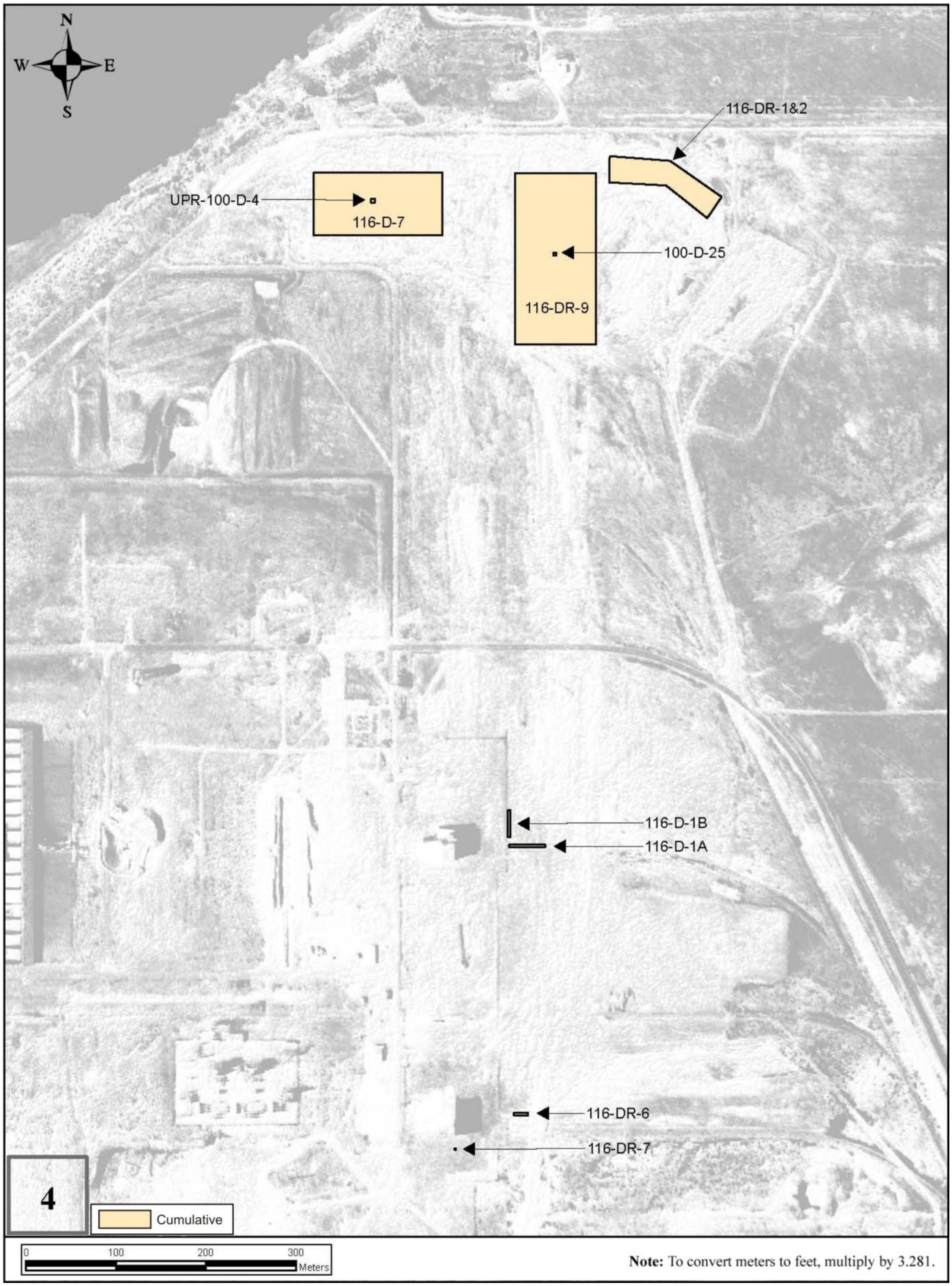


Figure S–8. Map 4: Cumulative Impact Sites in the 100-D Area

Figure S–9. Map 5: Cumulative Impact Sites in the 100-H Area

Figure S–10. Map 6: Cumulative Impact Sites in the 100-F Area

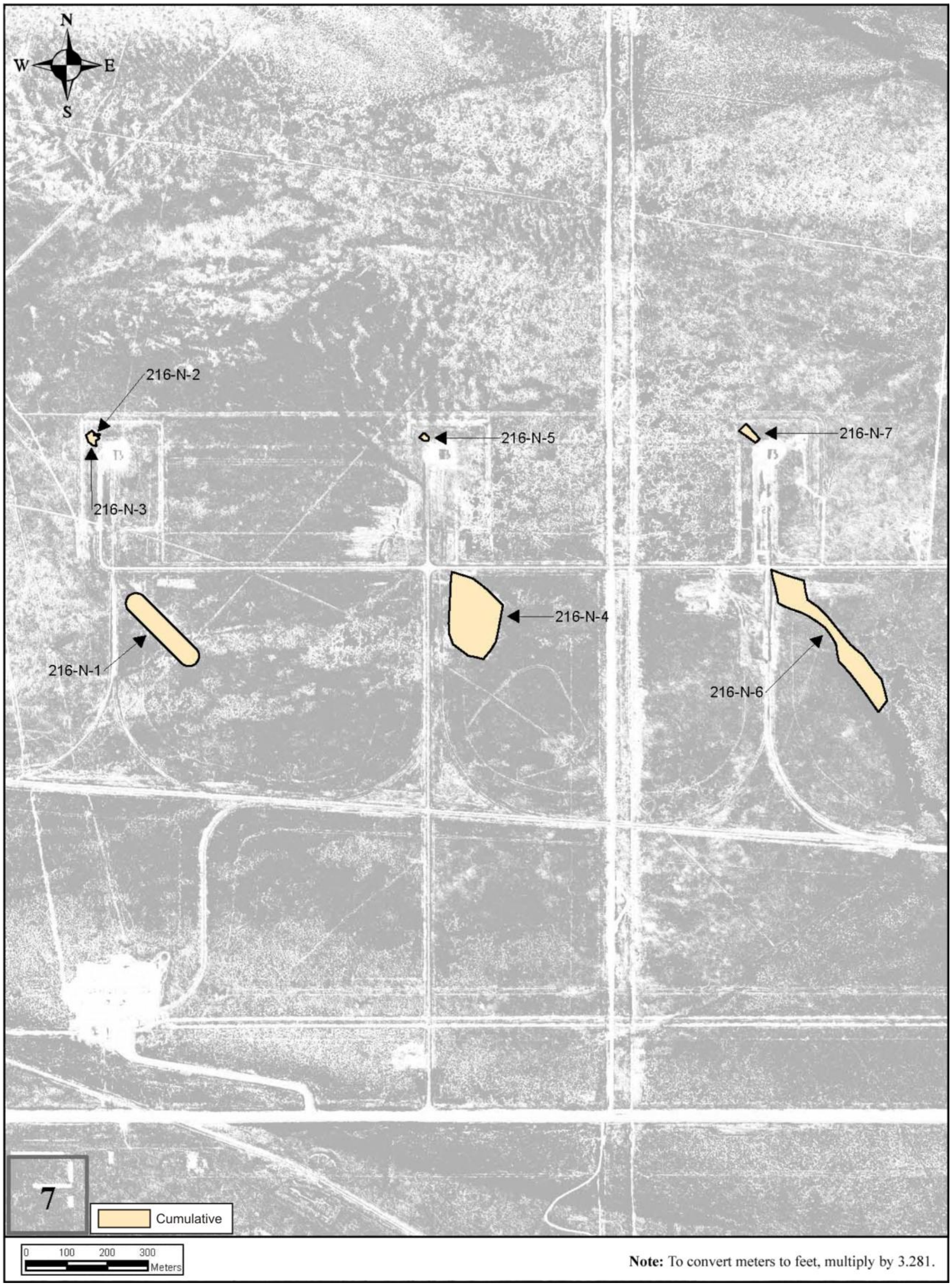


Figure S–11. Map 7: Cumulative Impact Sites in the 216-N Area

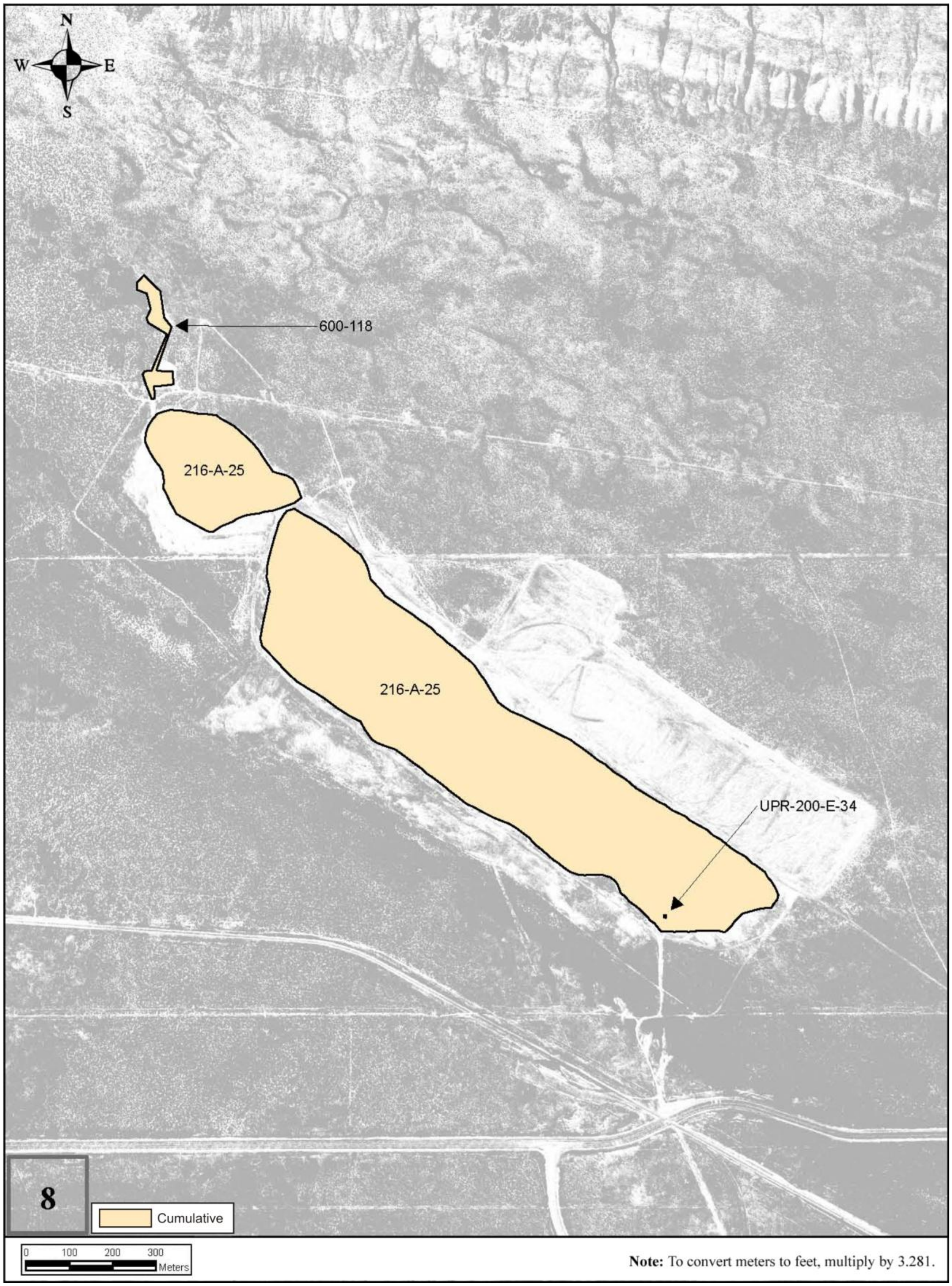


Figure S–12. Map 8: Cumulative Impact Sites in the Gable Mountain Pond Area

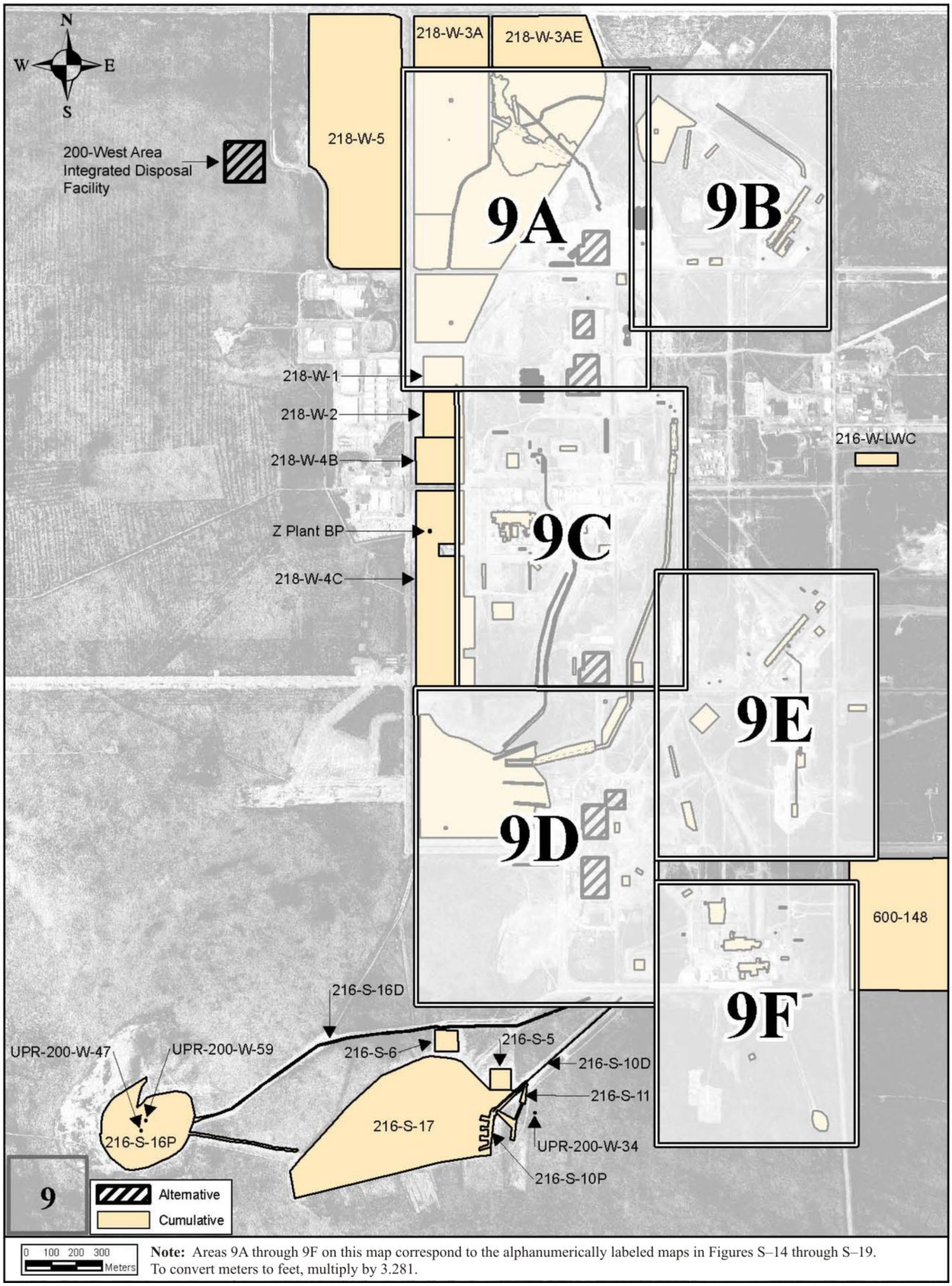


Figure S–13. Map 9: Alternatives and Cumulative Impact Sites in the 200-West Area

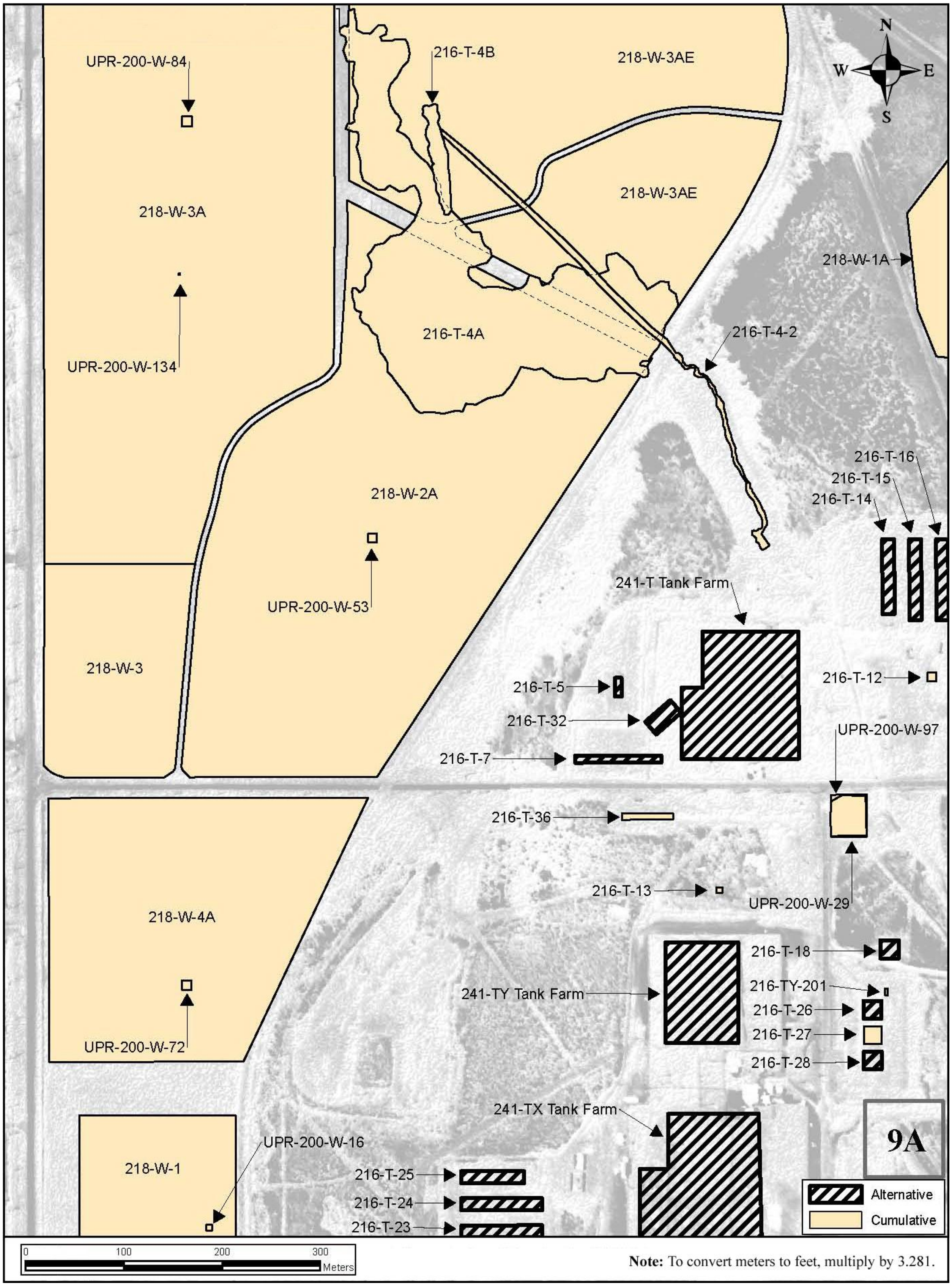
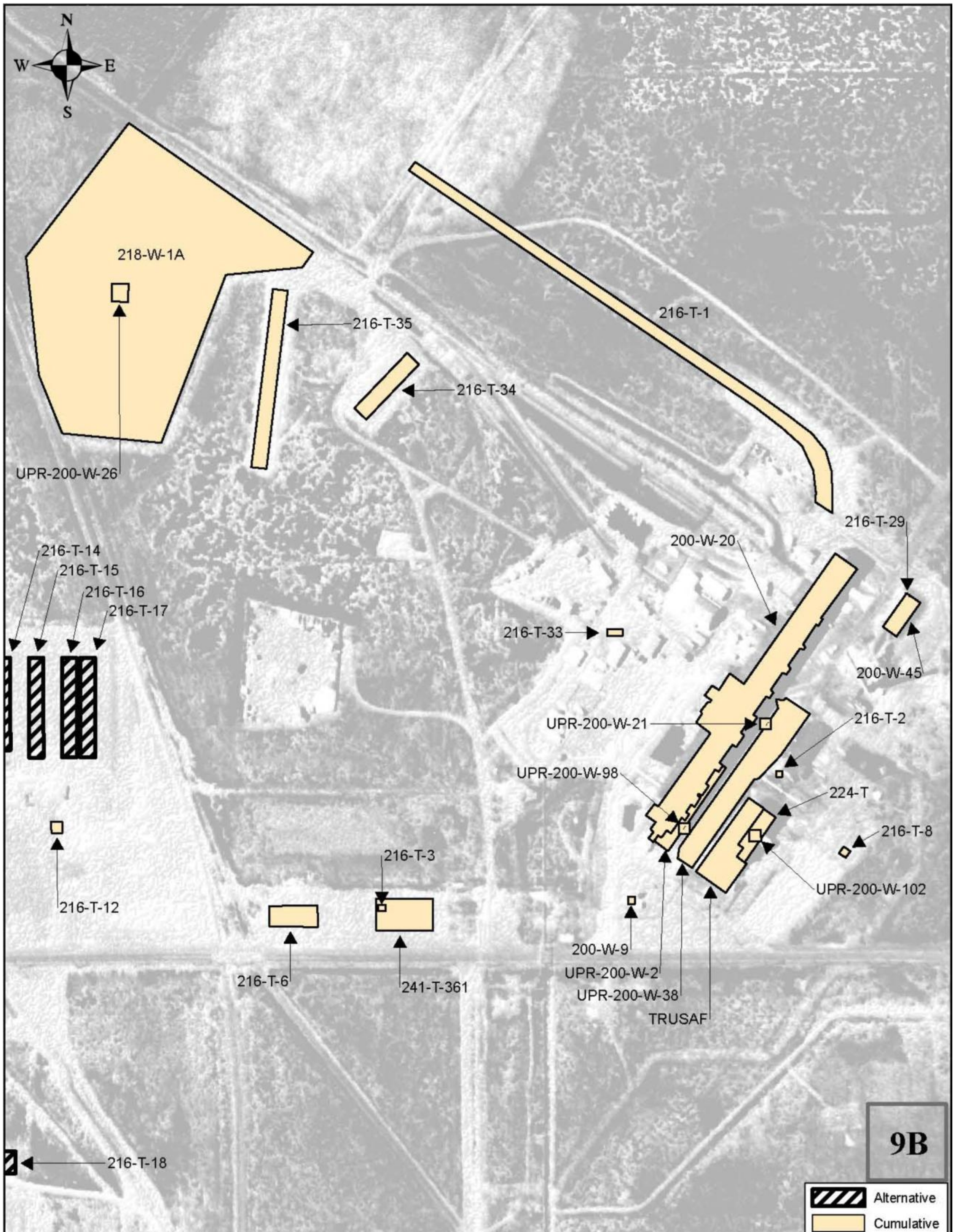


Figure S–14. Map 9A: Alternatives and Cumulative Impact Sites in the 200-West Area



Note: To convert meters to feet, multiply by 3.281.
Key: TRUSAF=Transuranic Waste Storage and Assay Facility.

Figure S–15. Map 9B: Alternatives and Cumulative Impact Sites in the 200-West Area

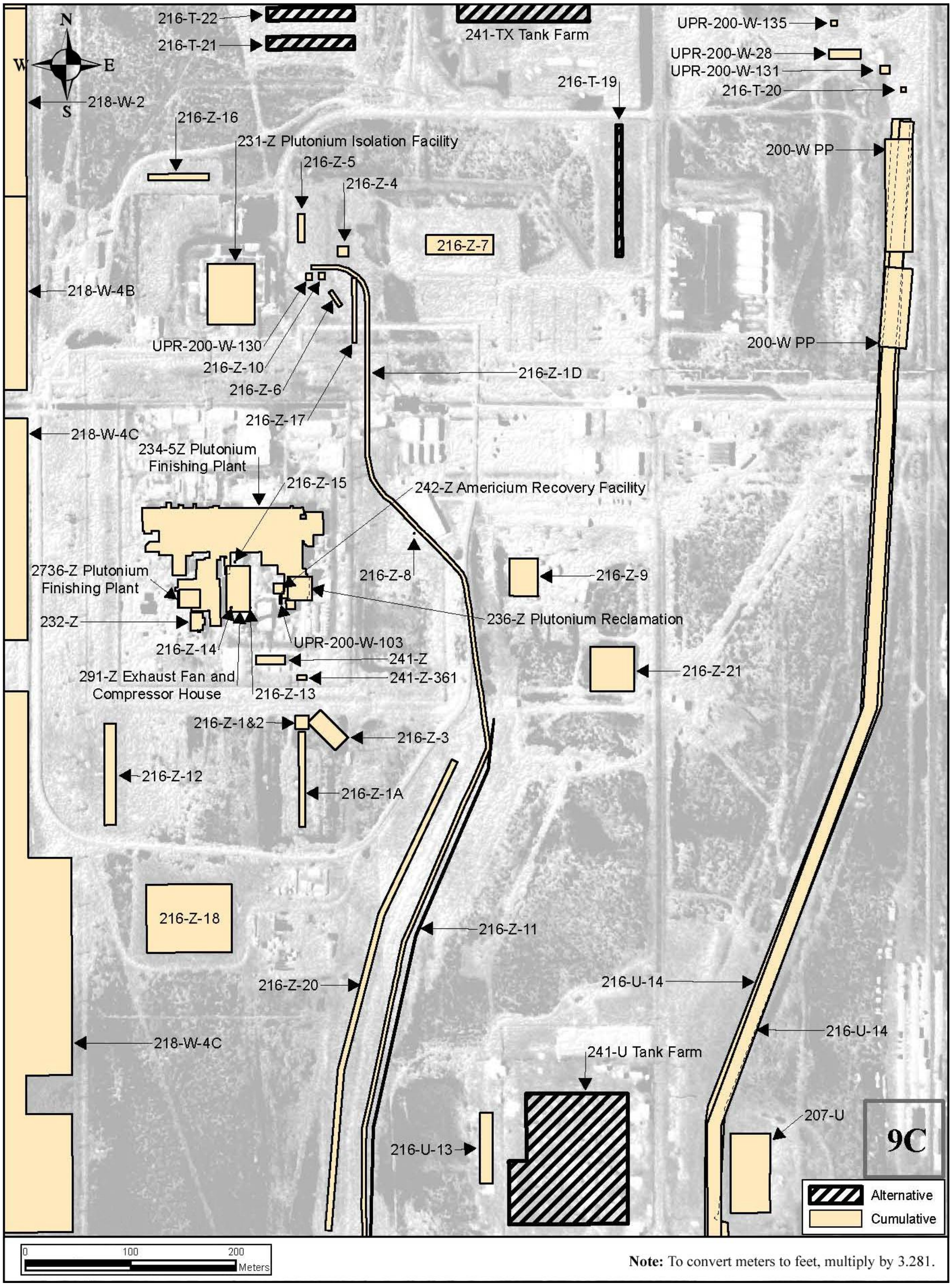


Figure S–16. Map 9C: Alternatives and Cumulative Impact Sites in the 200-West Area

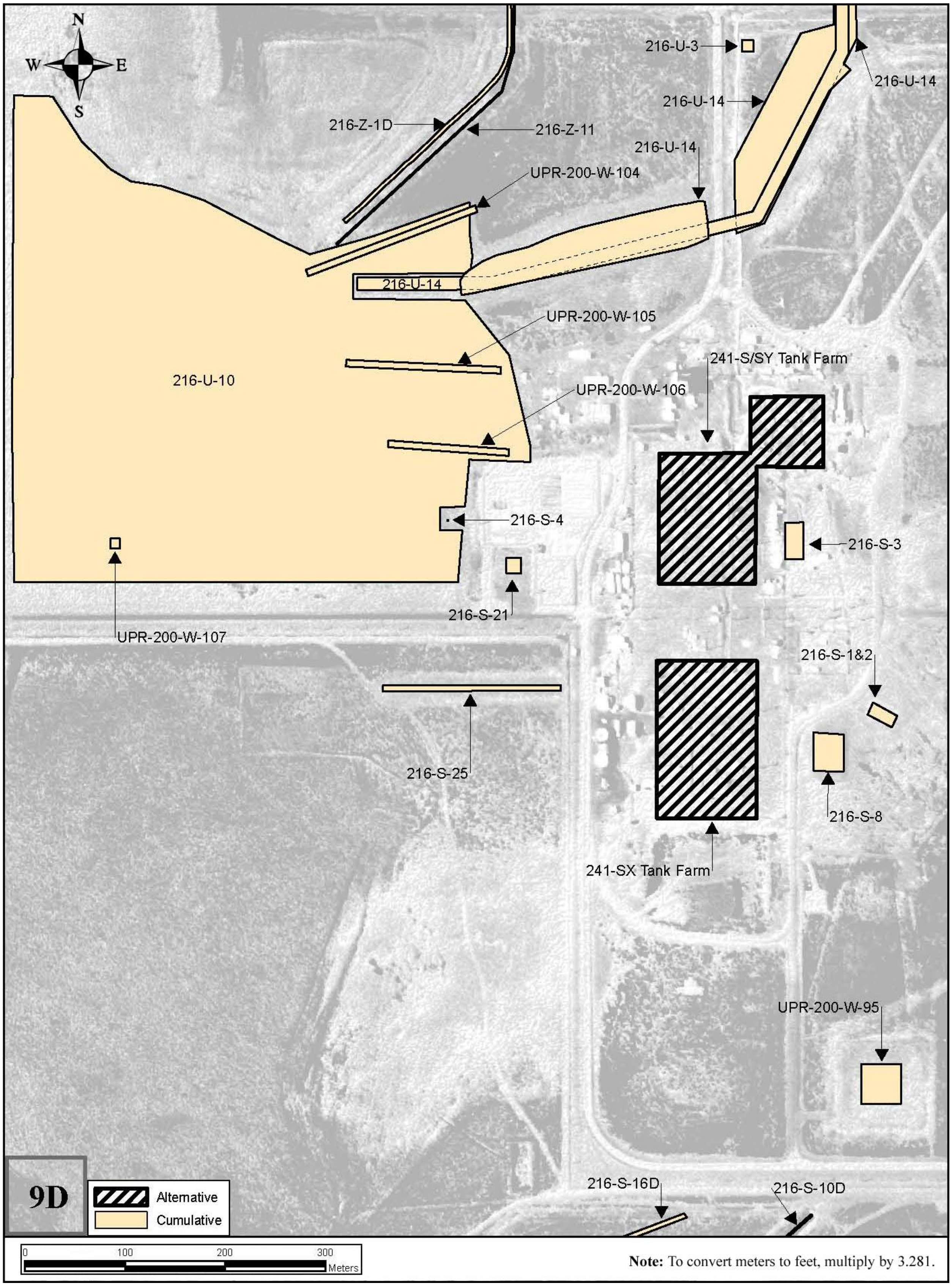


Figure S–17. Map 9D: Alternatives and Cumulative Impact Sites in the 200-West Area

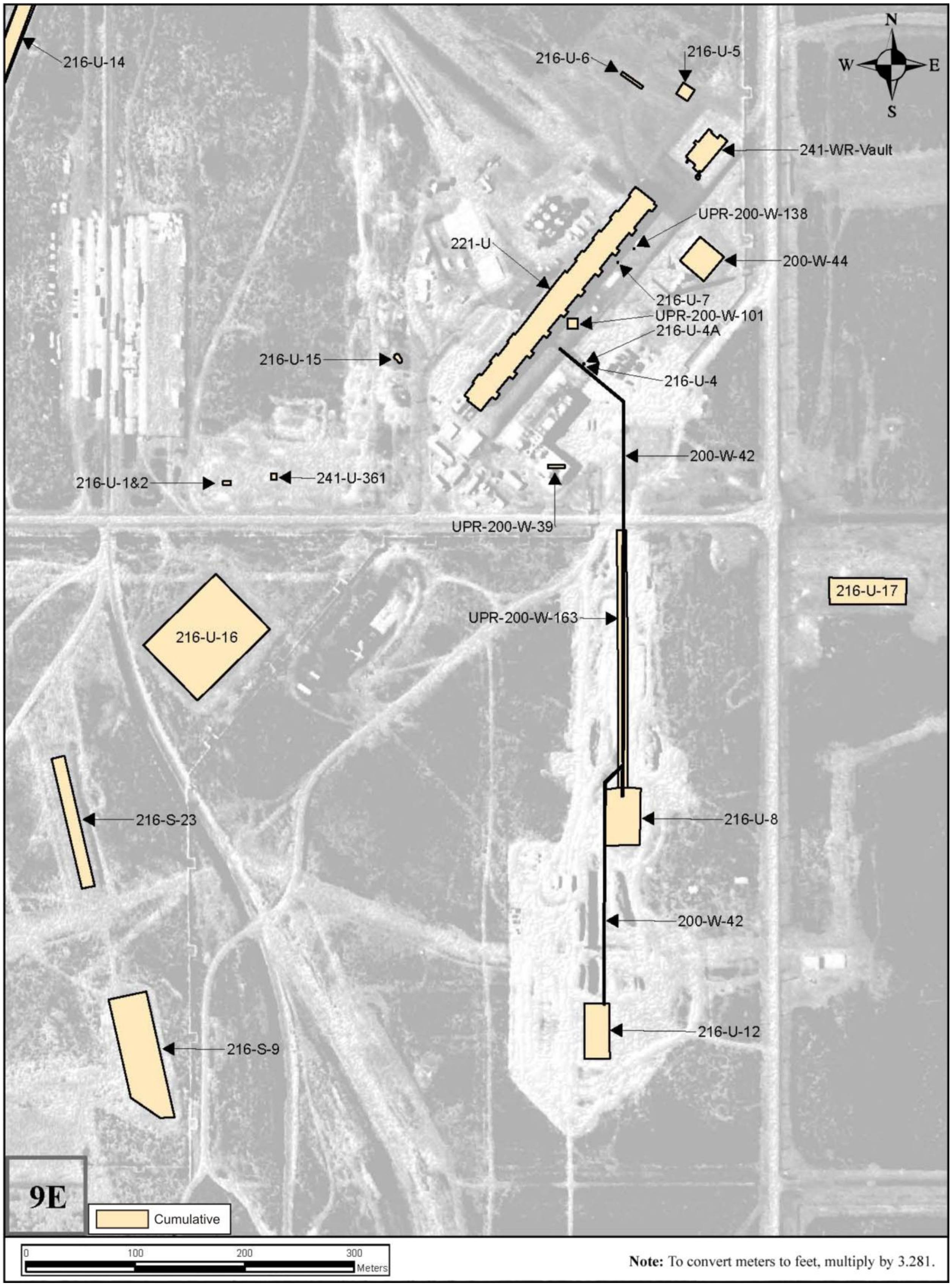


Figure S–18. Map 9E: Cumulative Impact Sites in the 200-West Area

Figure S–19. Map 9F: Cumulative Impact Sites in the 200-West Area

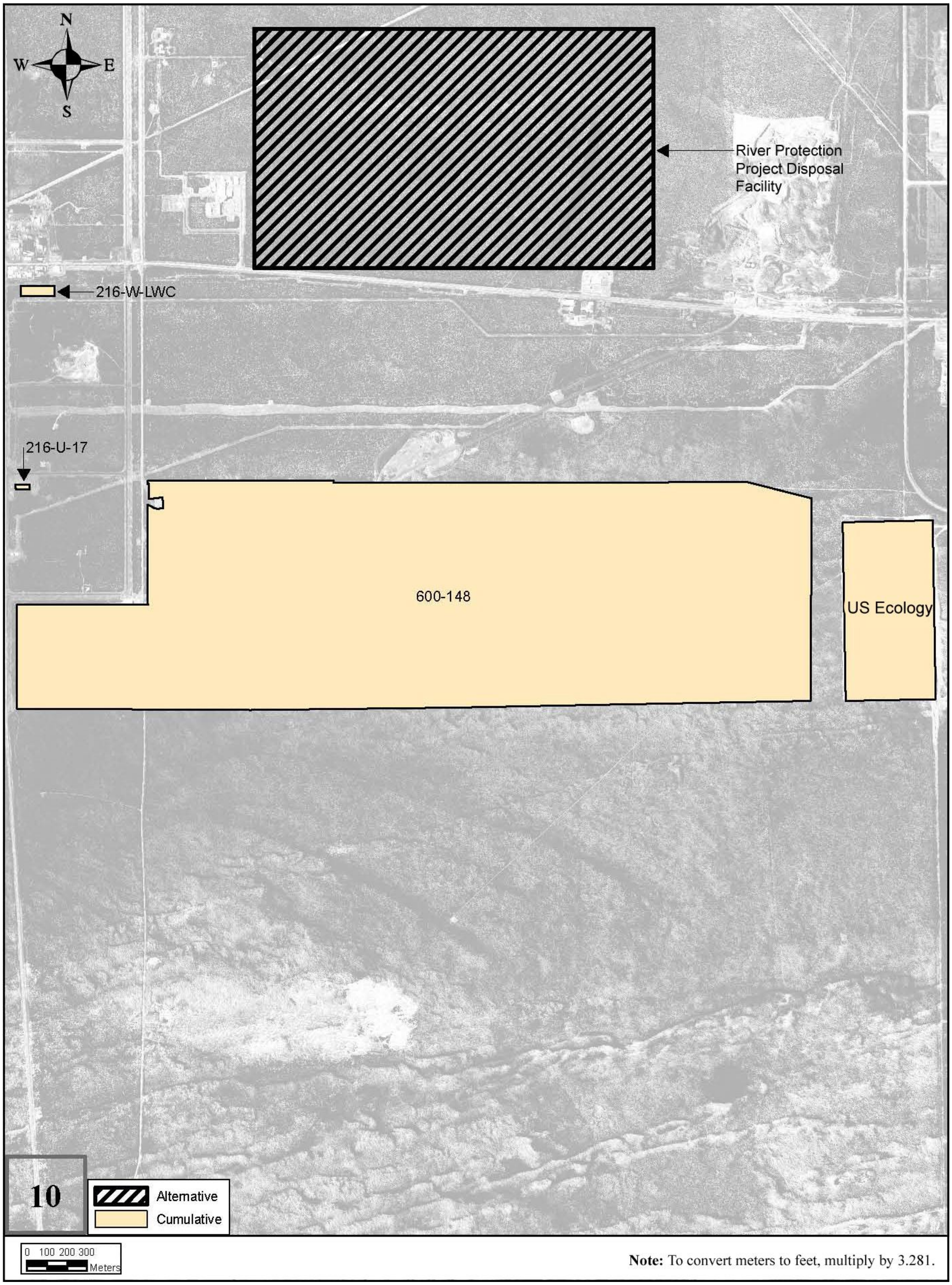
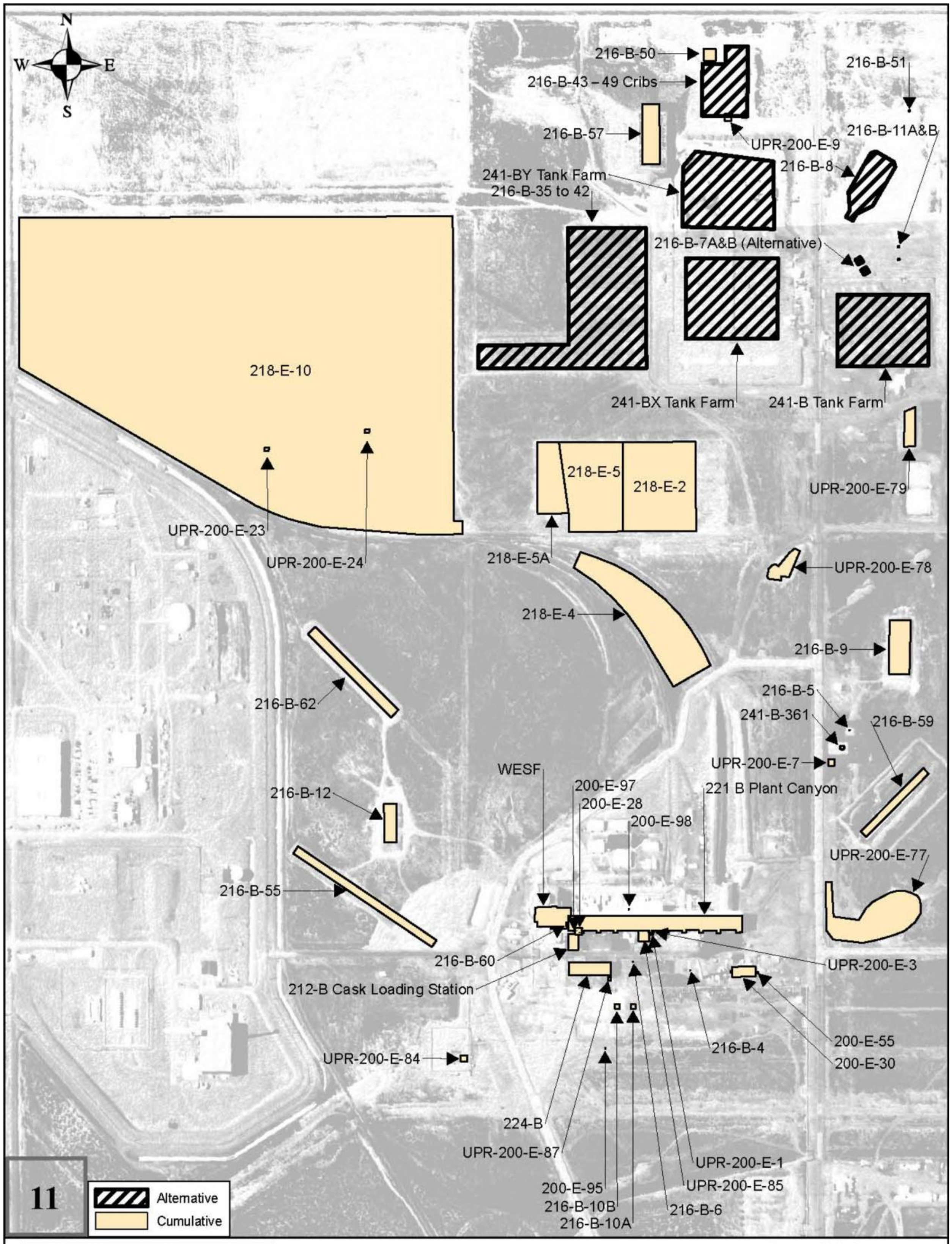


Figure S–20. Map 10: Alternatives and Cumulative Impact Sites in the Environmental Restoration Disposal Facility Area



Note: To convert meters to feet, multiply by 3.281.
Key: WESF=Waste Encapsulation and Storage Facility.

Figure S–21. Map 11: Alternatives and Cumulative Impact Sites in the 200-East Area

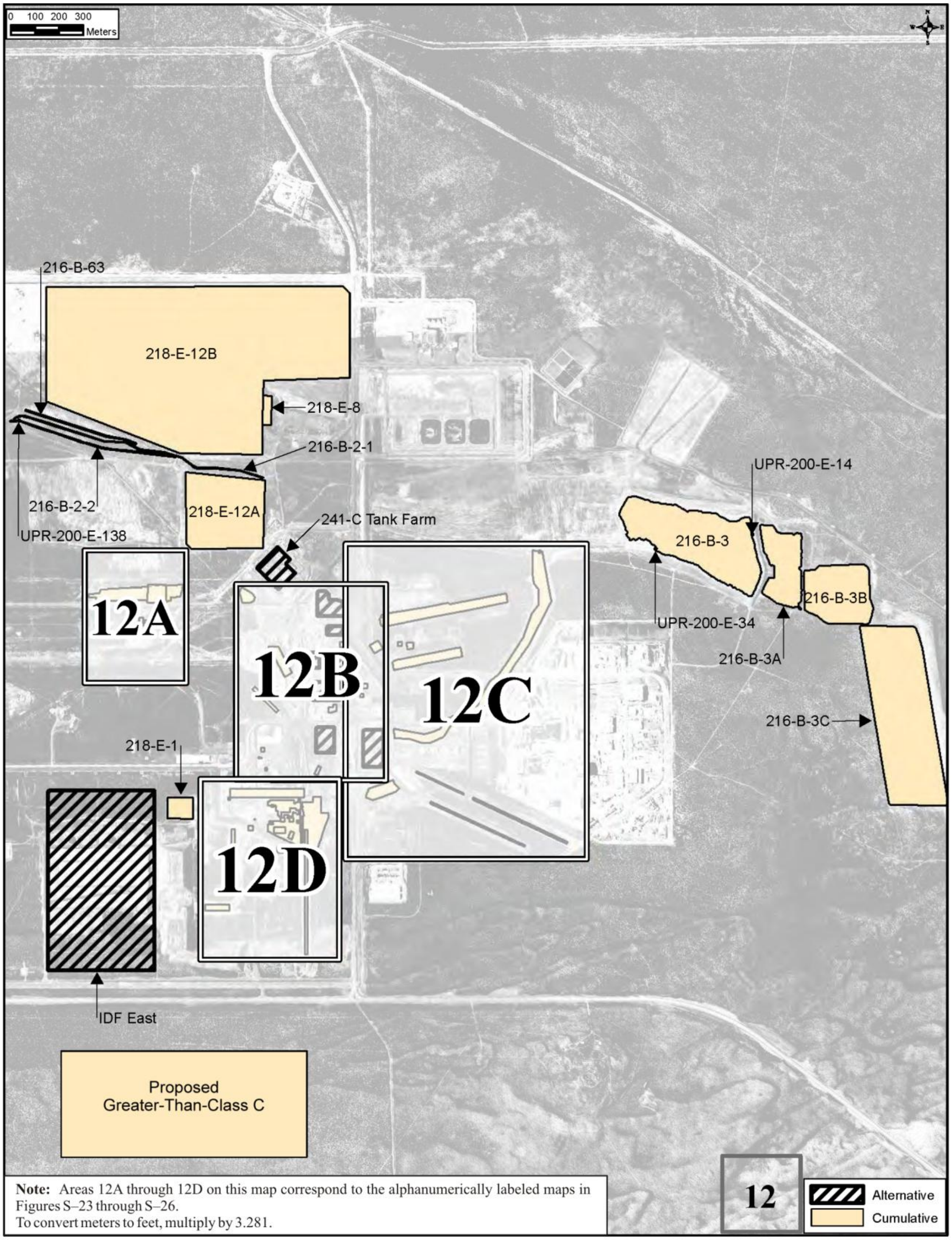


Figure S–22. Map 12: Alternatives and Cumulative Impact Sites in the 200-East Area

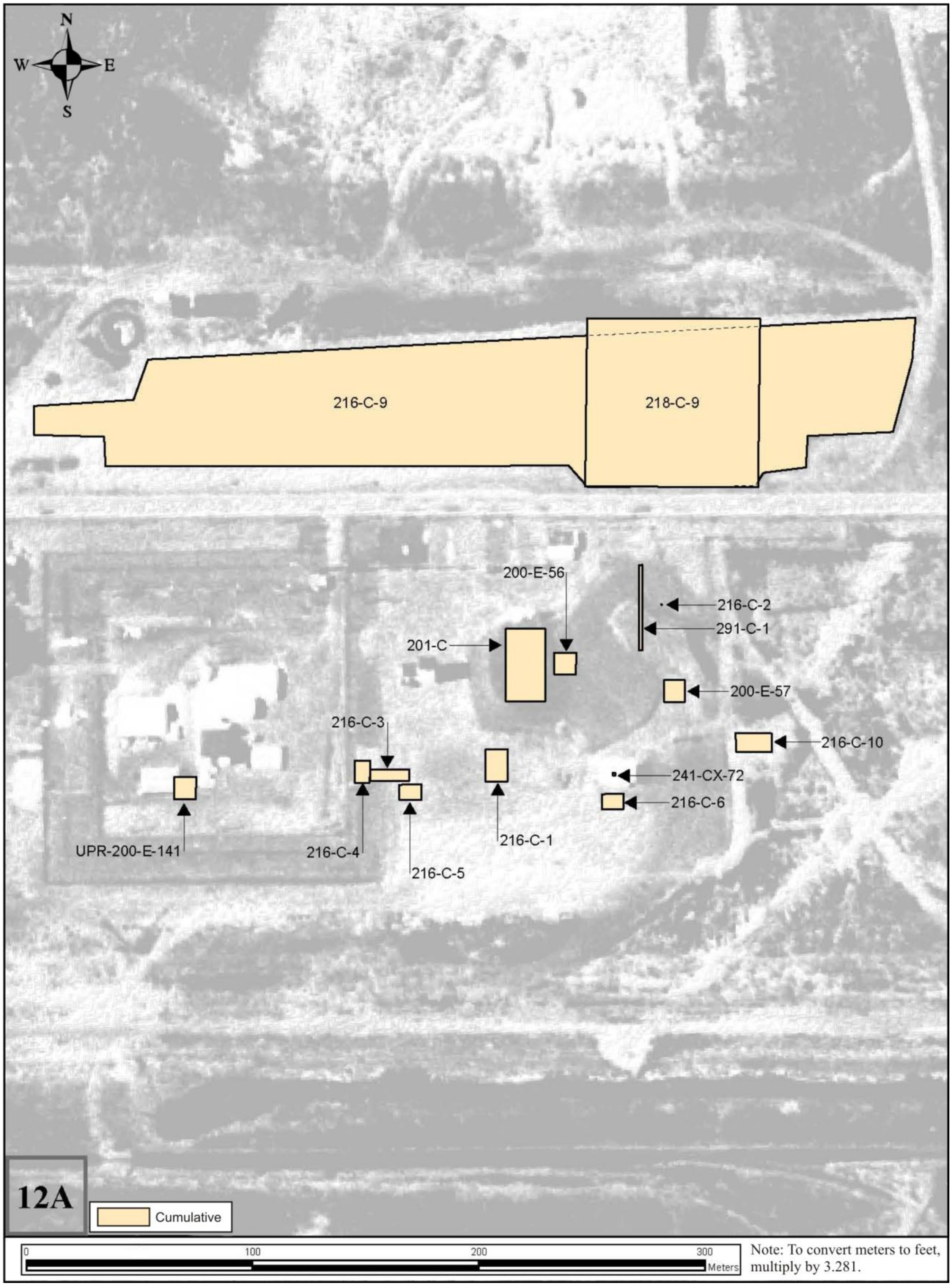


Figure S–23. Map 12A: Cumulative Impact Sites in the 200-East Area

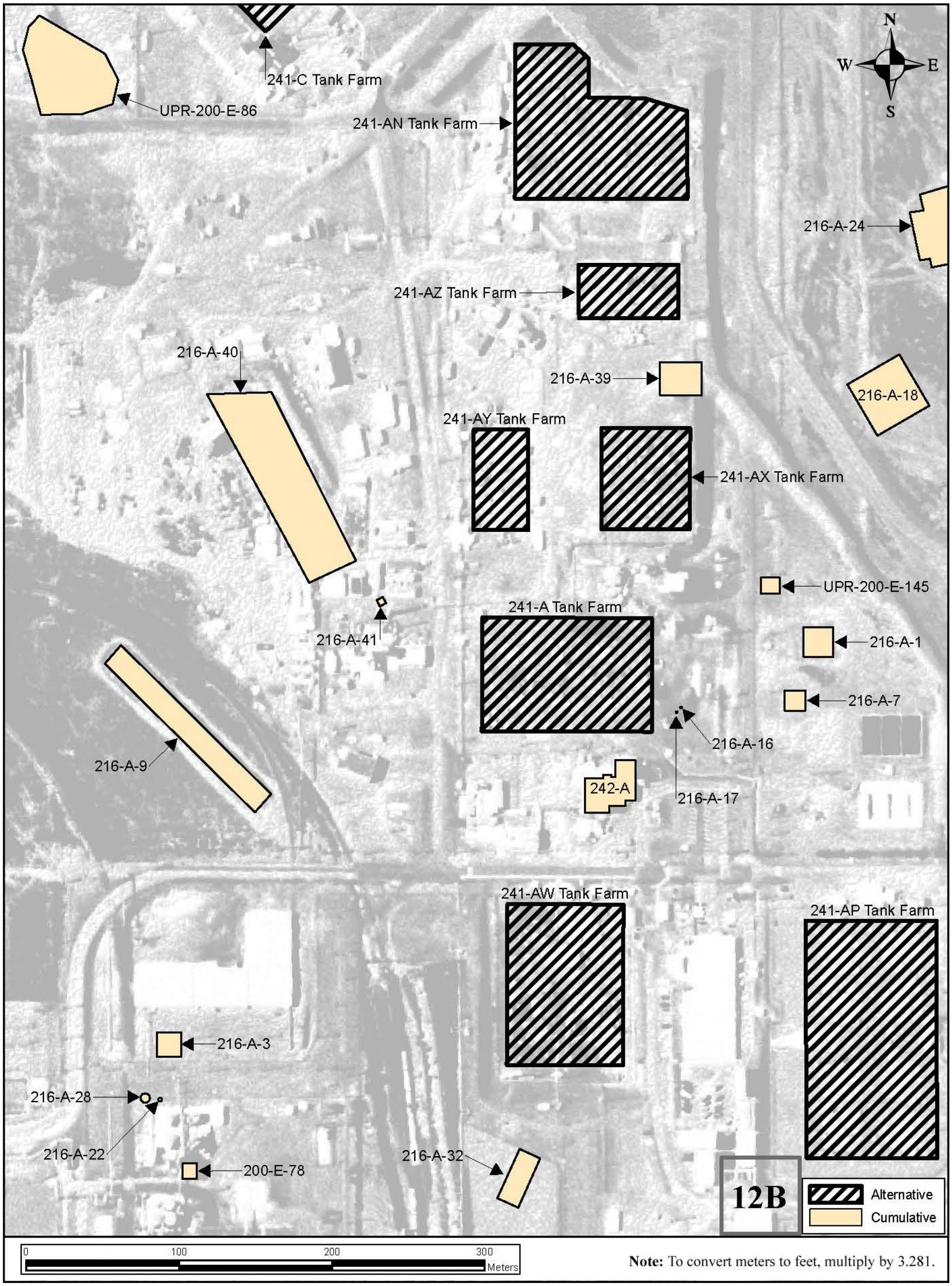
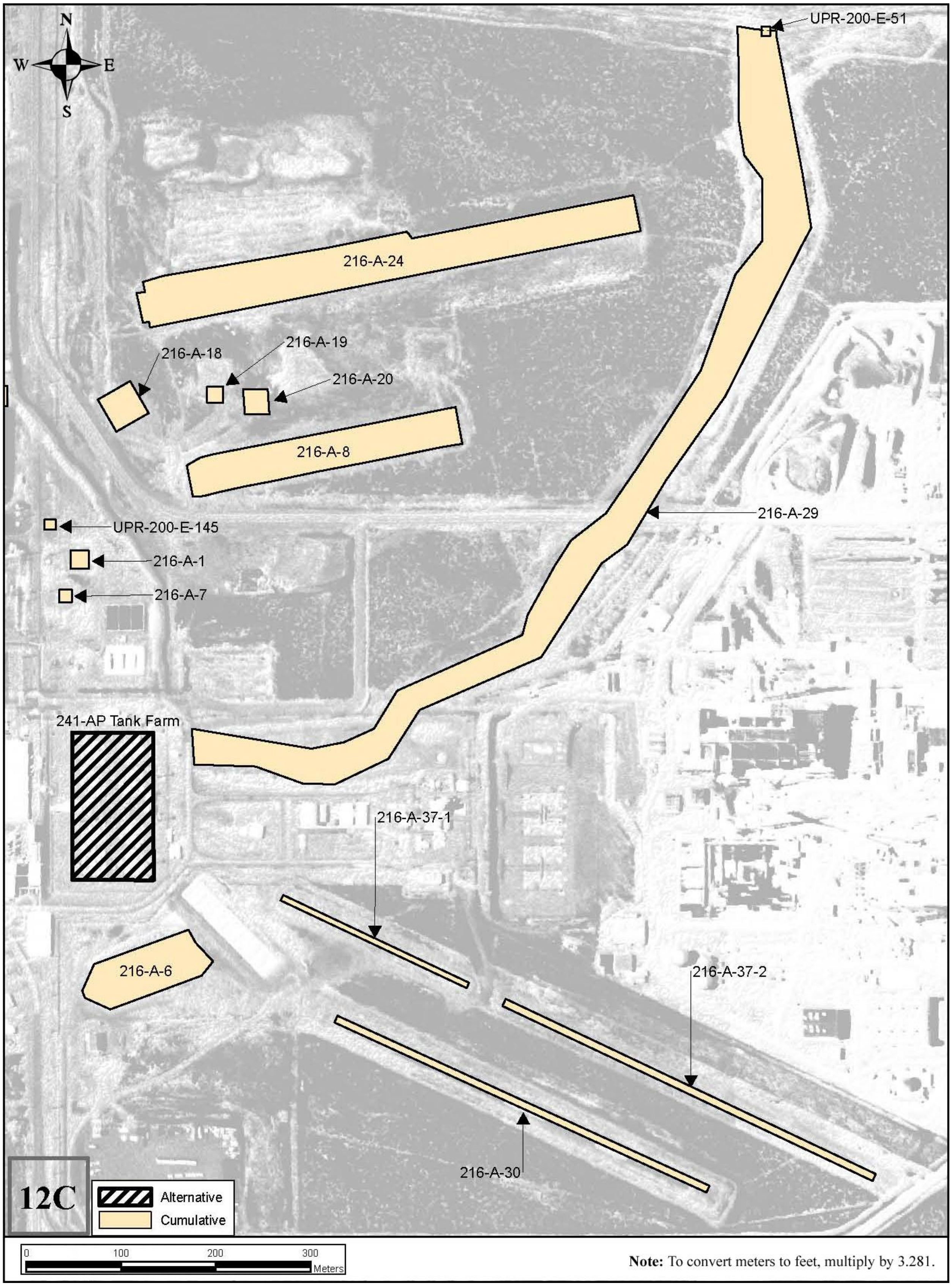


Figure S–24. Map 12B: Alternatives and Cumulative Impact Sites in the 200-East Area



Note: To convert meters to feet, multiply by 3.281.

Figure S–25. Map 12C: Alternatives and Cumulative Impact Sites in the 200-East Area

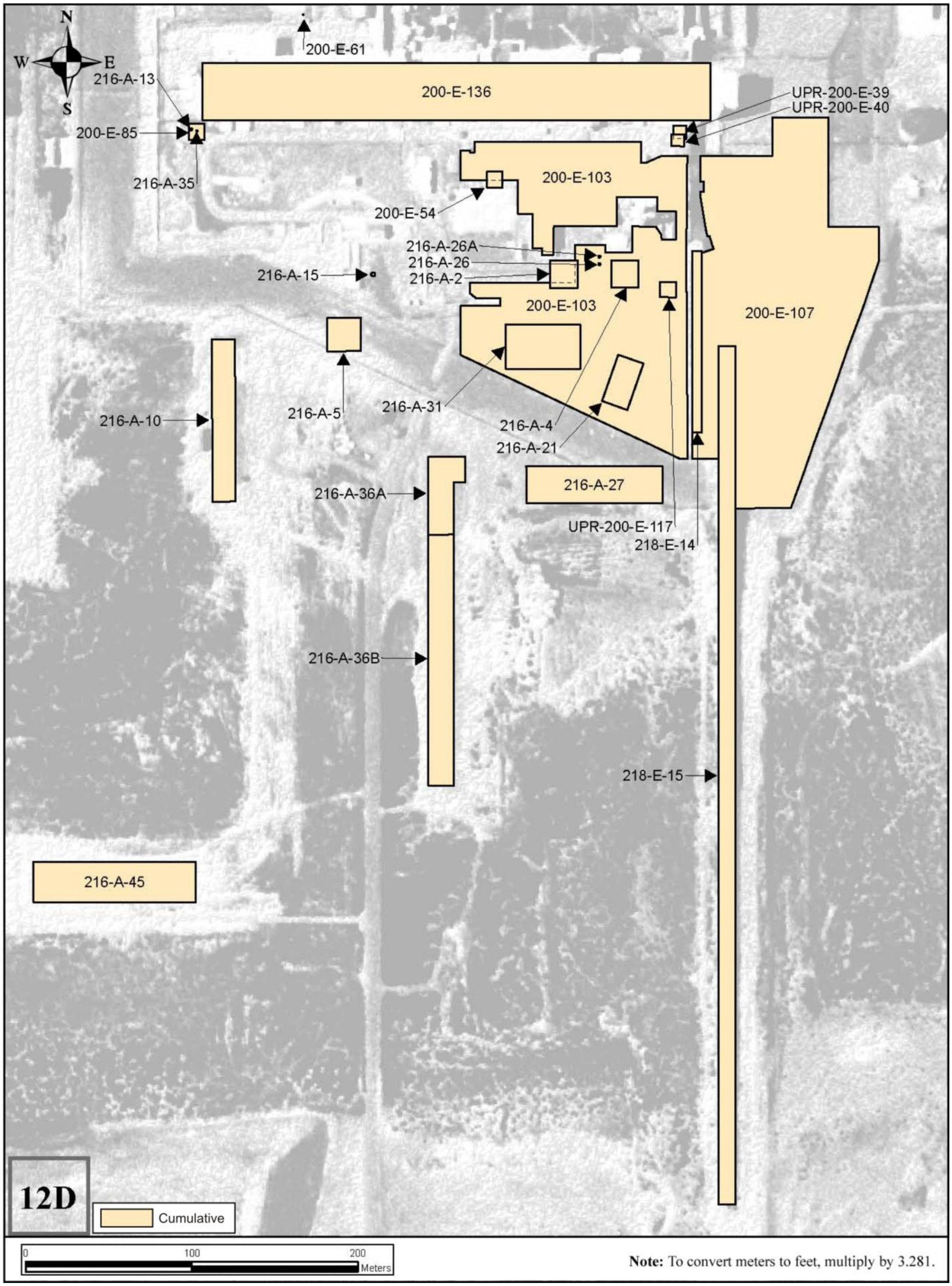


Figure S–26. Map 12D: Cumulative Impact Sites in the 200-East Area

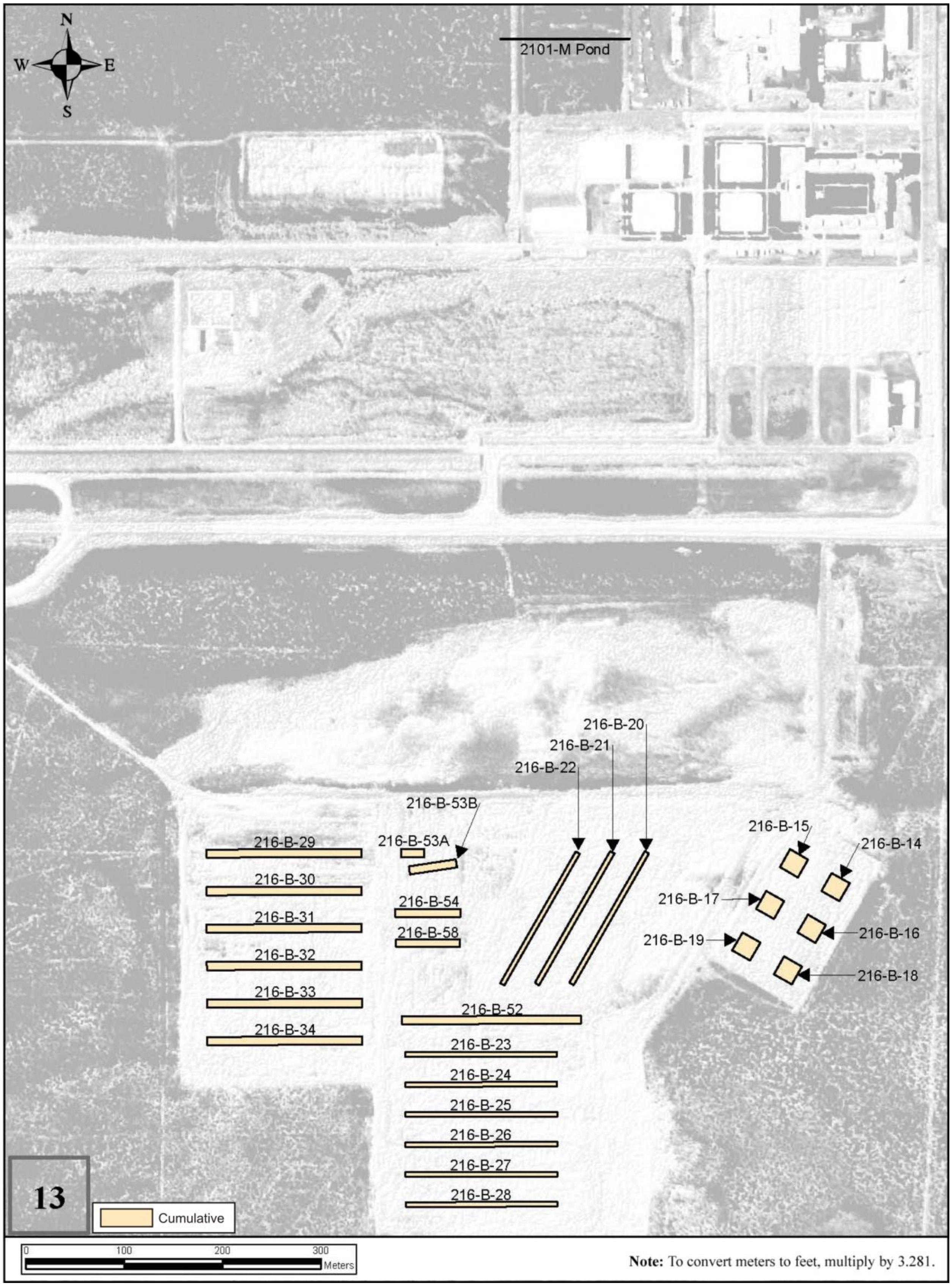


Figure S–27. Map 13: Cumulative Impact Sites in the 200-East Area

Figure S–28. Map 14: Cumulative Impact Sites in the 600 Area

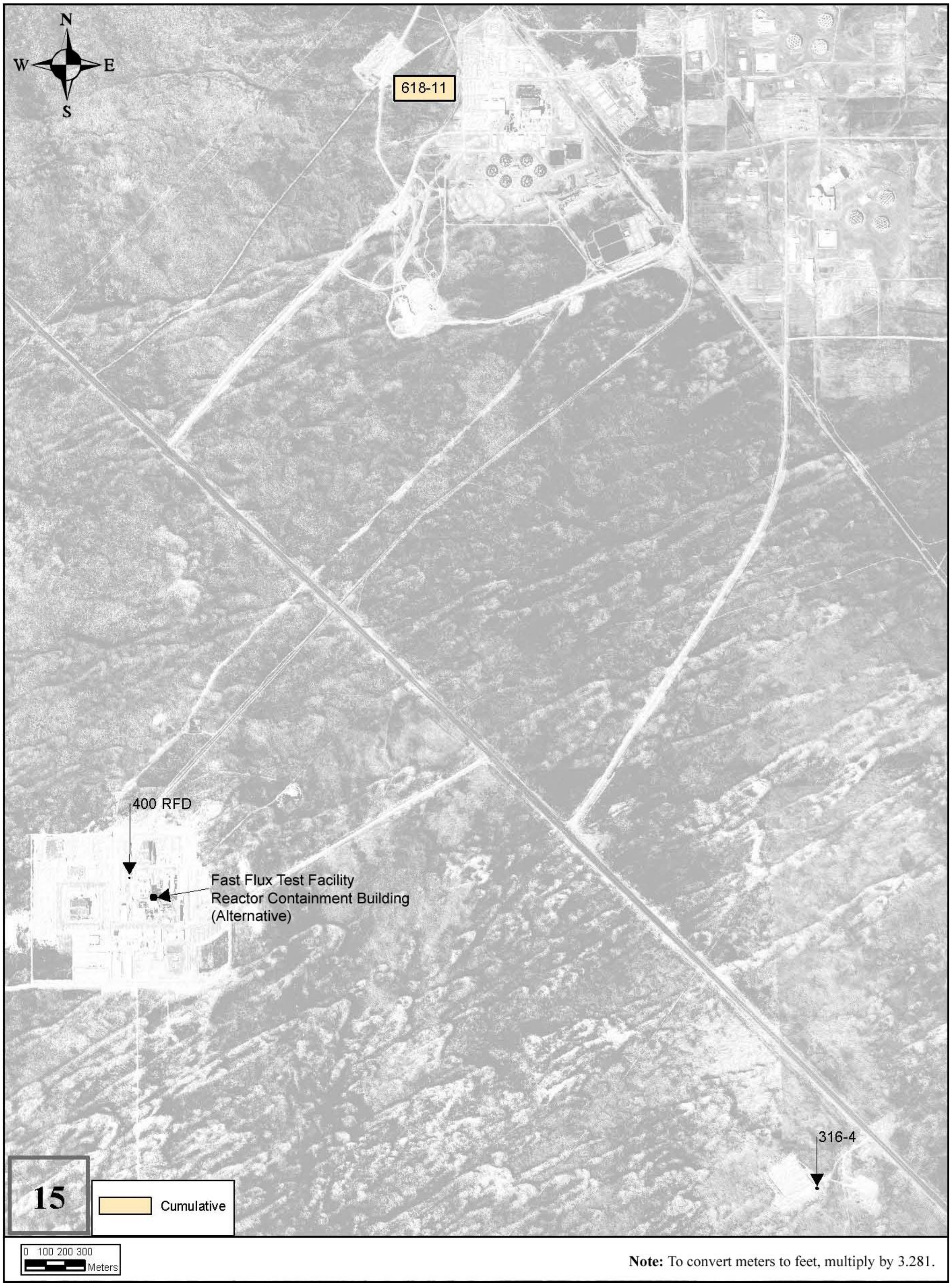


Figure S–29. Map 15: Alternatives and Cumulative Impact Sites in Vicinity of the 300 and 400 Areas

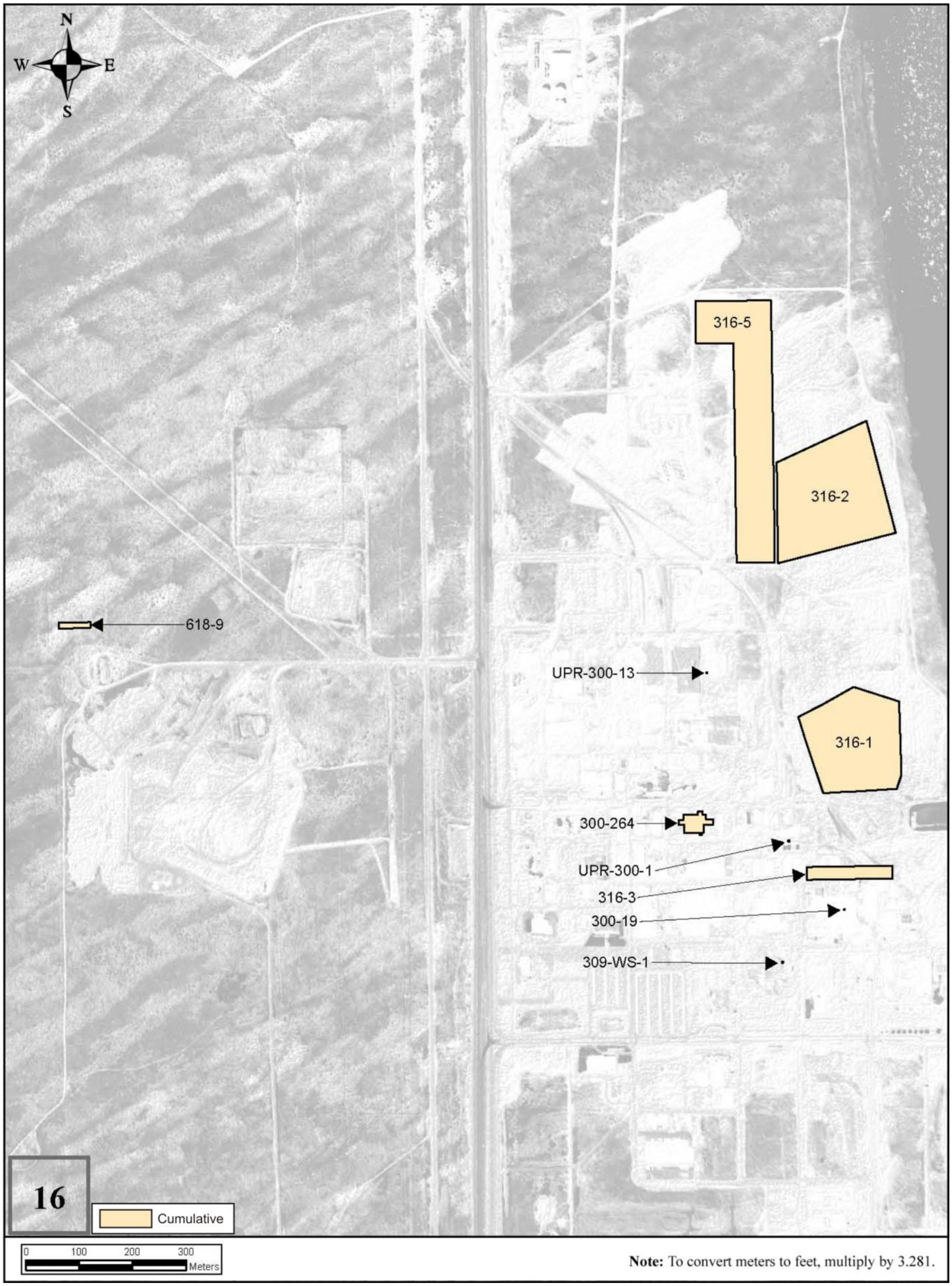


Figure S–30. Map 16: Cumulative Impact Sites in the 300 Area

Table S–9. Cumulative Impacts Sites for Map 1

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
116-B-1	107-B Liquid Waste Disposal Trench	Trench	Liquid	6.0×10^{7}	–	1950	1968	Remediated and closed out in 1999
116-B-4	105-B Dummy Decontamination French Drain	French drain	Liquid	3.0×10^{5}	–	1957	1968	Remediated and closed out in 2000
116-B-5	108-B Crib (116-B-5 Crib)	Crib	Liquid	1.0×10^{7}	–	1950	1968	Site excavated in 1995 and contaminated soil disposed of in ERDF
116-B-6A	116-B-6-1 Crib	Crib	Liquid	5.0×10^{3}	–	1951	1968	Excavated and remediated in 1999
116-B-6B	116-B-6-2 Crib	Crib	Liquid	1.0×10^{4}	–	1950	1953	Excavated and remediated in 1999
116-B-11	107-B Retention Basins	Retention basin	Liquid	Unknown	–	1944	1968	Excavated and remediated in 1999
116-C-5	107-C Retention Basins	Retention basin	Liquid	Unknown	–	1952	1969	Tanks excavated, remediated, and closed out in 1999
116-C-1	107-C Liquid Waste Disposal Trench	Trench	Liquid	1.0×10^{8}	–	1952	1968	Tanks excavated, remediated, and closed out in 1999
116-C-2A	105-C Pluto Crib	Crib	Liquid	3.50×10^{6}	–	1952	1968	Backfilled with 4.6 meters (15 feet) of soil in 1968; area excavated and contaminated soil removed to ERDF in 1999
116-C-2C	105-C Pluto Crib Sand Filter	Crib/ sand filter	Liquid	3.50×10^{6}	–	1952	1969	Site excavated and removed to ERDF in 1999

Note: To convert liters to gallons, multiply by 0.26417.

Key: Dash (–)=not applicable; ERDF=Environmental Restoration Disposal Facility; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–10. Cumulative Impacts Sites for Map 2

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
116-K-1	100-K Crib	Crib	Liquid	4.00×10^{7}	–	1955	1971	Contaminated soil removed and disposed of in ERDF in 2003
116-K-2	100-K Mile Long Trench	Trench	Liquid	3.00×10^{11}	–	1955	1971	Contaminated soil removed in 1996; site backfilled and stabilized
116-KE-4	107-KE Retention Basins	Retention basin	Liquid	Unknown	–	1955	1971	Steel walls of tanks removed, site interim-stabilized, and bottoms of tanks left in place and backfilled in 1995; large pieces of contaminated effluent piping and scrap metal removed and taken to ERDF in 1999
116-KW-3	107-KW Retention Basin	Retention basin	Liquid	Unknown	–	1955	1970	Steel walls of tanks removed, site interim-stabilized, bottoms of tanks left in place, and site backfilled in 1995; large pieces of contaminated effluent piping and scrap metal removed and taken to ERDF in 1999
116-KE-1	115-KE Condensate Crib	Crib	Liquid	8.00×10^{5}	–	1955	1971	Crib and pipeline removed to ERDF and site covered with clean backfill
116-KE-2	1706-KER Waste Crib	Crib	Liquid	3.00×10^{6}	–	1955	1971	Inactive; site retired in 1971
116-KW-1	115-KW Condensate Crib	Crib	Liquid	8.00×10^{5}	–	1955	1971	Crib and pipeline removed to ERDF and site covered with clean backfill in 2004
UPR-100-K-1	100-KE Fuel Storage Basin Leak	Unplanned release	Liquid	Unknown	–	1974	1979	Inactive
120-KE-1	183-KE Filter Waste Facility Drywell	Sump	Liquid/ solid	Unknown	–	1955	1971	Drain backfilled and surface stabilized in August 2000

Note: To convert liters to gallons, multiply by 0.26417.

Key: Dash (–)=not applicable; ERDF=Environmental Restoration Disposal Facility; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–11. Cumulative Impacts Sites for Map 3

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
116-N-1	1301-N Liquid Waste Disposal Facility	Crib	Liquid	8.37×10^{10}	–	1964	1985	Inactive; crib stabilized and trench backfilled
116-N-3	1325-N Liquid Waste Disposal Facility	Crib	Liquid	7.61×10^{9}	–	1983	1991	Remediated and closed out
UPR-100-N-3	Spacer Disposal System Transport Line Leak	Unplanned release	Liquid	1.36×10^{6}	–	1978	1978	Line repaired, contaminated soil removed, and sinkhole backfilled
UPR-100-N-7	Rad Line Leak	Unplanned release	Liquid	1.91×10^{6}	–	1985	1985	Inactive; no remediation action reported
UPR-100-N-35	100-N Fuel Storage Basin Drainage System Leak	Unplanned release	Liquid	Unknown	–	1986	1986	Inactive; no remediation action reported

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–12. Cumulative Impacts Sites for Map 4

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
116-D-1A	105-D Storage Basin Trenches 1	Trench	Liquid	2.00×10^{5}	–	1947	1952	Site excavated and contaminated soil disposed of in ERDF; backfilled with clean soil in 2000
116-D-1B	105-D Storage Basin Trenches 2	Trench	Liquid	8.00×10^{6}	–	1953	1967	Site excavated and contaminated soil disposed of in ERDF; backfilled with clean soil in 2000
116-D-7	107-D Retention Basin	Retention basin	Liquid	Unknown	–	1944	1967	Site excavated and contaminated soil disposed of in ERDF in 1997; closed out in 2000
116-DR-9	107-DR Retention Basin	Retention basin	Liquid	Unknown	–	1950	1967	Site excavated and contaminated soil disposed of in ERDF; closed out in 1999
100-D-25	107-DR Basin Leaks	Unplanned release	Liquid	Unknown	–	1951	Unknown	Site excavated and contaminated soil disposed of in ERDF; closed out in 1999
UPR-100-D-4	107-D Basin Leaks	Unplanned release	Liquid	Unknown	–	1950	Unknown	Site excavated and contaminated soil disposed of in ERDF in 1997; closed out in 2000
116-DR-1&2	107-DR Liquid Waste Disposal Trenches	Trench	Liquid	8.00×10^{7}	–	1951	1967	Site excavated and contaminated soil disposed of in ERDF in 1997; closed out in 2000
116-DR-6	1608-DR Liquid Disposal Trench	Trench	Liquid	7.00×10^{6}	–	1953	1965	Site excavated and contaminated soil disposed of in ERDF in 1997; closed out in 2000
116-DR-7	105-DR Inkwell Crib	Crib	Liquid	4.00×10^{3}	–	1953	1953	Site excavated and contaminated soil disposed of in ERDF in 1999

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ERDF=Environmental Restoration Disposal Facility; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–13. Cumulative Impacts Sites for Map 5

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
100-H-33	183-H Solar Evaporation Basins Radionuclide Components	Retention basin	Liquid	9.63×10^{6}	–	1949	1985	Remediated in 1985 and 1996 and closed out in 1997
116-H-6	183-H Solar Evaporation Basins	Retention basin	Liquid	See 100-H-33	–	1949	1985	Remediated in 1985 and 1996 and closed out in 1997
116-H-1	107-H Liquid Disposal Trench	Trench	Liquid	9.00×10^{7}	–	1952	1965	Contaminated soil removed and disposed of in ERDF in 2000
116-H-2	1608-H Liquid Waste Disposal Trench	Trench	Liquid	6.00×10^{9}	–	1953	1965	Contaminated soil removed and disposed of in ERDF in 2001
116-H-4	105-H Pluto Crib	Crib	Liquid	1.00×10^{3}	–	1950	1952	Contaminated material moved in 1960 and placed in 118-H-5 burial ground
116-H-7	107-H Retention Basin	Retention basin	Liquid	Unknown	–	1949	1965	Contaminated soil removed and disposed of in ERDF in 2001
116-H-3	105-H Dummy Decontamination French Drain	French drain	Liquid	4.00×10^{5}	–	1950	1965	Contaminated soil removed and disposed of in ERDF in 2000

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ERDF=Environmental Restoration Disposal Facility; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–14. Cumulative Impacts Sites for Map 6

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
116-F-1	Lewis Canal	Trench	Liquid	$1.00{\times}10^{8}$	–	1953	1965	Soil and debris removed and disposed of in ERDF in 2002; backfilled to grade with clean soil
116-F-2	107-F Liquid Waste Disposal Trench	Trench	Liquid	$6.00{\times}10^{7}$	–	1950	1965	Soil and debris removed and disposed of in ERDF in 2002; backfilled to grade with clean soil
116-F-9	Animal Waste Leaching Trench	Trench	Liquid	$3.00{\times}10^{8}$	–	1963	1976	Soil and debris removed and disposed of in ERDF in 2002; backfilled to grade with clean soil
116-F-3	105-F Storage Basin Trench	Trench	Liquid	$4.00{\times}10^{6}$	–	1949	1951	Contaminated soil removed and disposed of in ERDF in 2003
116-F-6	105-F Cooling Water Trench	Trench	Liquid	$1.00{\times}10^{5}$	–	1952	1965	Contaminated soil removed and disposed of in ERDF in 2002
116-F-4	105-F Pluto Crib	Crib	Liquid	$4.00{\times}10^{3}$	–	1950	1956	Contaminated soil removed and disposed of in ERDF in 1993
116-F-10	105-F Dummy Decontamination French Drain	French drain	Liquid	$4.00{\times}10^{8}$	–	1953	1965	Contaminated soil removed and disposed of in ERDF in 2003
116-F-14	107-F Retention Basin	Retention basin	Liquid	–	–	1945	1965	Decommissioned in stages from 1965 to 1999; excavation and disposal in ERDF completed in 2002

Note: To convert liters to gallons, multiply by 0.26417.

Key: Dash (–)=not applicable; ERDF=Environmental Restoration Disposal Facility; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–15. Cumulative Impacts Sites for Map 7

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-N-1	216-N-1 Pond	Pond	Liquid	9.47×10^8	–	1944	1952	Deactivated and backfilled; removal, treatment, and disposal planned
216-N-2	216-N-2 Trench	Trench	Liquid	7.57×10^6	–	1947	1947	Deactivated and backfilled; removal, treatment, and disposal planned
216-N-3	216-N-3 Trench	Trench	Liquid	7.57×10^6	–	1952	1952	Deactivated and backfilled; removal, treatment, and disposal planned
216-N-4	216-N-4 Pond	Pond	Liquid	9.47×10^8	–	1944	1952	Deactivated and backfilled; removal, treatment, and disposal planned
216-N-5	216-N-5 Trench	Trench	Liquid	7.57×10^6	–	1952	1952	Deactivated and backfilled; removal, treatment, and disposal planned
216-N-6	216-N-6 Pond	Pond	Liquid	9.47×10^8	–	1944	1952	Deactivated in 1952 and backfilled; removal, treatment, and disposal planned
216-N-7	216-N-7 Trench	Trench	Liquid	7.57×10^6	–	1952	1952	Deactivated and backfilled; removal, treatment, and disposal planned

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–16. Cumulative Impacts Sites for Map 8

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-A-25	216-A-25 Gable Mountain Pond	Pond	Liquid	2.94×10^{11}	–	1957	1985	Backfilled in 1988; surface stabilized in 1997
UPR-200-E-34	UPR-200-E-34	Contaminated soil	Liquid	Unknown	–	1964	1964	Surface stabilized
600-118	600-118 Ditch	Soil	Liquid	Unknown	–	Unknown	Unknown	Backfilled with clean soil

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–17. Cumulative Impacts Sites for Map 9

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-S-5	216-S-5 Crib	Crib	Liquid	4.08×10^{9}	–	1954	1957	Surface stabilized in 1990; landfill closure planned
216-S-6	216-S-6 Crib	Crib	Liquid	4.44×10^{9}	–	1954	1972	Surface stabilized in 1990; landfill closure planned
216-S-10D	216-S-10D Ditch	Ditch	Liquid	4.66×10^{9}	–	1954	1991	Portion backfilled and stabilized in 1984
216-S-10P	216-S-10P Pond	Pond	Liquid	6.73×10^{9}	–	1951	1991	Backfilled and stabilized in 1984; landfill closure planned
216-S-11	216-S-11 Pond	Pond	Liquid	2.23×10^{9}	–	1954	1965	Interim-stabilized in 1983; landfill closure planned
216-S-16D	216-S-16D Ditch	Ditch	Liquid	4.00×10^{8}	–	1957	1975	Backfilled and surface stabilized
216-S-16P	216-S-16P Pond	Pond	Liquid	4.07×10^{10}	–	1957	1972	Surface stabilized with additional backfill in 1984; landfill closure planned
216-S-17	216-S-17 Pond	Pond	Liquid	6.44×10^{9}	–	1951	1954	Backfilled in 1954; surface stabilized with additional backfill in 1984; landfill closure planned
UPR-200-W-47	UPR-200-W-47	Contaminated soil	Liquid	Unknown	–	1958	1959	Surface stabilized in 1984; landfill closure planned
UPR-200-W-59	UPR-200-W-59	Pond	Liquid	Unknown	–	1965	1965	Landfill closure planned
UPR-200-W-34	UPR-200-W-34	Contaminated soil	Liquid	Unknown	–	1955	1955	Stabilized in 1984
218-W-1	218-W-1 Burial Ground	Burial ground	Solid	–	7.0×10^{3}	1944	1953	Surface stabilized in 1983; landfill closure planned
218-W-2	218-W-2 Burial Ground	Burial ground	Solid	–	8.2×10^{3}	1953	1956	Surface stabilized in 1983; landfill closure planned
218-W-4B	218-W-4B Burial Ground	Burial ground	Solid	–	1.0×10^{4}	1967	1990	Trenches 1–7 stabilized in 1983; remaining trenches stabilized in 1995; landfill closure planned
218-W-4C	218-W-4C Burial Ground	Burial ground	Solid	–	1.6×10^{4}	1978	Active	Landfill closure planned
218-W-5	218-W-5 Burial Ground	Burial ground	Solid	–	3.6×10^{4}	1986	Active	Landfill closure planned
218-W-3AE	218-W-3AE Burial Ground	Burial ground	Solid	–	2.2×10^{4}	1981	Active	Landfill closure planned
218-W-3A	218-W-3A Burial Ground	Burial ground	Solid	–	1.0×10^{5}	1970	Active	Landfill closure planned
Z Plant BP	Z Plant Burning Pit	Burning pit	Solid	–	Unknown	1950	1960	Landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–18. Cumulative Impacts Sites for Map 9A

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
218-W-3	218-W-3 Burial Ground	Burial ground	Solid	–	1.1×10^4	1957	1961	Surface stabilized in 1983; landfill closure planned
218-W-4A	218-W-4A Burial Ground	Burial ground	Solid	–	1.8×10^4	1959	1968	Surface stabilized in 1983; landfill closure planned
218-W-2A	218-W-2A Burial Ground	Burial ground	Solid	–	2.5×10^4	1954	1985	Backfilled and stabilized in 1980; landfill closure planned
UPR-200-W-84	UPR-200-W-84	Contaminated soil	Liquid	Unknown	–	1980	1980	Landfill closure planned
UPR-200-W-134	UPR-200-W-134	Contaminated soil	Solid	–	Unknown	1975	1975	Landfill closure planned
UPR-200-W-53	UPR-200-W-53	Contaminated soil	Liquid	Unknown	–	1959	1959	Backfilled and stabilized
UPR-200-W-72	UPR-200-W-72	Contaminated soil	Solid	–	Unknown	1975	1975	Stabilized in 1975; landfill closure planned
UPR-200-W-16	UPR-200-W-16	Contaminated soil	Solid	–	Unknown	1952	1952	Landfill closure planned
216-T-4A	216-T-4A Pond	Pond	Liquid	4.28×10^{10}	–	1944	1995	Interim-stabilized in 1995; landfill closure planned
216-T-4B	216-T-4B Pond	Pond	Liquid	Included in 216-T-4A	–	1972	1995	Landfill closure planned
216-T-36	216-T-36 Crib	Crib	Liquid	5.09×10^5	–	1967	1969	Surface stabilized in 2000; removal, treatment, and disposal planned
216-T-4-2	216-T-4-2 Ditch	Ditch	Liquid	Unknown	–	1972	1995	Backfilled and stabilized in 1995; removal, treatment, and disposal planned
UPR-200-W-97	UPR-200-W-97 Unplanned Release	Contaminated soil	Liquid	2.00×10^3	–	1966	1966	Partial soil removal in 1966; surface stabilized in 1978; landfill closure planned
UPR-200-W-29	UPR-200-W-29 Unplanned Release	Contaminated soil	Liquid	3.79×10^3	–	1954	1954	Backfilled and covered with gravel; landfill closure planned
216-T-13	216-T-13 Trench	Trench	Liquid	9.84×10^4	–	1954	1964	Soil excavated and removed in 1972; landfill closure planned
216-T-27	216-T-27 Crib	Crib	Liquid	7.19×10^6	–	1965	1965	Surface stabilized in 1990; landfill closure planned
216-TY-201	216-TY-201 Settling Tank	Tank	Liquid	2.40×10^4	–	1953	1966	Isolated in 1981; surface stabilized in 1990; landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–19. Cumulative Impacts Sites for Map 9B

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-T-12	216-T-12 Trench	Trench	Liquid	5.01×10^{6}	–	1954	1954	Site backfilled and surface stabilized; landfill closure planned
218-W-1A	218-W-1A Burial Ground	Burial ground	Solid	–	1.4×10^{4}	1944	1960	Site backfilled and surface stabilized in 1983; landfill closure planned
UPR-200-W-26	UPR-200-W-26	Contaminated soil	Solid	–	Unknown	1953	1953	Landfill closure planned
216-T-29	216-T-29 Crib	Crib	Liquid	7.40×10^{4}	–	1949	1964	Deactivated; landfill closure planned
216-T-33	216-T-33 Crib	Crib	Liquid	1.90×10^{6}	–	1963	1963	Surface stabilized in 1991; landfill closure planned
216-T-34	216-T-34 Crib	Crib	Liquid	1.73×10^{7}	–	1966	1967	Interim-stabilized in 1990; landfill closure planned
216-T-35	216-T-35 Crib	Crib	Liquid	5.73×10^{6}	–	1967	1968	Surface stabilized in 1990; landfill closure planned
216-T-1	216-T-1 Ditch (221-T Ditch)	Ditch	Liquid	2.75×10^{8}	–	1945 1964	1956 1995	Backfilled and stabilized in 1995; landfill closure planned
216-T-2	216-T-2 Reverse Well	French drain	Liquid	6.01×10^{6}	–	1945	1950	Surface stabilized
216-T-3	216-T-3 Reverse Well	French drain	Liquid	1.13×10^{7}	–	1945	1946	Surface stabilized in 1993
216-T-6	216-T-6 Cribs	Crib	Liquid	4.50×10^{7}	–	1946	1947	Surface stabilized in 1993; landfill closure planned
216-T-8	216-T-8 Crib	Crib	Liquid	5.00×10^{5}	–	1950	1951	Stabilized in 1981; landfill closure planned
200-W-45	200-W-45 Sand Filter	Sand filter	Solid	–	Unknown	1949	1979	Inactive
200-W-20	2706-T Equipment Decontamination Building	Building	Solid	–	Unknown	1944	Unknown	Landfill closure planned
200-W-20	T Plant Complex (including 221-T Canyon)	Building	Solid	–	Unknown	1944	Unknown	Landfill closure planned
224-T	224-T Canyon	Building	Liquid/ solid	Unknown	–	1944	1956	Landfill closure planned
200-W-9	200-W-9 Unplanned Release	Contaminated soil	Liquid	1.36×10^{5}	–	1994	1994	Landfill closure planned
UPR-200-W-2	UPR-200-W-2 Unplanned Release	Contaminated soil	Liquid	1.23×10^{4}	–	1947	1947	Landfill closure planned
UPR-200-W-21	UPR-200-W-21	Contaminated soil	Liquid	1.11×10^{4}	–	1953	1953	Covered with blacktop; entire area covered with shotcrete in 1991; landfill closure planned
UPR-200-W-38	UPR-200-W-38 Unplanned Release	Contaminated soil	Liquid	7.70×10^{3}	–	1955	1955	Backfilled with soil in 1955; surface stabilized in 1991; landfill closure planned
UPR-200-W-98	UPR-200-W-98 Unplanned Release	Contaminated soil	Liquid	3.30×10^{2}	–	1945	1945	Covered with 1.2 meters of soil in 1945; currently located under blacktop road; landfill closure planned

Table S–19. Cumulative Impacts Sites for Map 9B *(continued)*

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
UPR-200-W-102	UPR-200-W-102 Unplanned Release	Contaminated soil	Liquid	2.88×10^4	–	1972	1972	Landfill closure planned
TRUSAF	TRUSAF (in 224-T Canyon)	Building	Liquid/ solid	Unknown	Unknown	1944	Standby	Landfill closure planned
241-T-361	241-T-361 Settling Tank	Tank	Liquid/ solid	1.06×10^5	–	1944	1951	Liquids pumped out and isolated in 1985; surface stabilized in 1993; landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417; meters to feet, by 3.281.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–20. Cumulative Impacts Sites for Map 9C

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-Z-16	216-Z-16 Crib	Crib	Liquid	1.02×10^8	–	1968	1977	Landfill closure planned
231-Z	231-Z Plutonium Isolation Facility	Building	Solid		Unknown	1945	1975	Partially cleaned out and decontaminated after 1975; landfill closure planned
216-Z-4	216-Z-4 Trench	Trench	Liquid	1.10×10^4	–	1945	1945	Deactivated and backfilled in 1945; interim-stabilized in 1990; landfill closure planned
216-Z-5	216-Z-5 Crib	Crib	Liquid	3.10×10^7	–	1945	1947	Deactivated in 1947; surface stabilized in 1990; landfill closure planned
216-Z-6	216-Z-6 Crib	Crib	Liquid	9.80×10^4	–	1945	1945	Surface stabilized in 1990; landfill closure planned
216-Z-7	216-Z-7 Crib	Crib	Liquid	7.99×10^7	–	1947 1965	1957 1966	Backfilled in 1967; interim-stabilized in 1990; landfill closure planned
216-Z-8	216-Z-8 Trench	French drain	Liquid	1.04×10^4	–	1957	1961	Landfill closure planned
216-Z-9	216-Z-9 Trench	Trench	Liquid	4.09×10^6	–	1955	1962	Gravel biobarrier placed in 1999; landfill closure planned
216-Z-10	216-Z-10 Reverse Well	Reverse well	Liquid	1.00×10^6	–	1945	1945	Interim-stabilized in 1990; landfill closure planned
UPR-200-W-130	UPR-200-W-130	Contaminated soil	Liquid	3.30×10^2	–	1967	1967	Covered with clean soil; landfill closure planned
216-Z-17	216-Z-17 Trench	Trench	Liquid	3.68×10^7	–	1967	1968	Backfilled in 1975; surface stabilized in 1990; landfill closure planned
216-Z-15	216-Z-15 French Drain	French drain	Liquid	4.81×10^7	–	1949	1997	Landfill closure planned
234-5Z	234-5Z Plutonium Finishing Plant	Building	Solid	–	Unknown	1949	1988	Landfill closure planned
2736-Z	2736-Z Plutonium Finishing Plant	Building	Liquid/ solid	Unknown	Unknown	1971	Active	Landfill closure planned
242-Z	242-Z Americium Recovery Facility	Building	Solid	–	Unknown	1964	1976	Landfill closure planned

Table S–20. Cumulative Impacts Sites for Map 9C *(continued)*

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-Z-1D	216-Z-1(D) Ditch	Ditch	Liquid	1.00×10^6	–	1944	1959	Backfilled in 1959; landfill closure planned
236-Z	236-Z Plutonium Reclamation Facility	Building	Solid	–	Unknown	1964	1991	Landfill closure planned
216-Z-14	216-Z-14 French Drain	French drain	Liquid	5.18×10^7	–	1949	2001	Landfill closure planned
291-Z	291-Z Exhaust Fan and Compressor House	Building	Solid	–	Unknown	1949	Active	Landfill closure planned
UPR-200-W-103	UPR-200-W-103	Contaminated soil	Liquid	2.97×10^2	–	1971	1971	Part of soil removed; landfill closure planned
241-Z	241-Z Treatment Tank	Tank	Liquid	Unknown	–	1948	Active	Landfill closure planned
241-Z-361	241-Z-361 Settling Tank	Tank	Liquid	7.50×10^2	7.60×10^1	1949	1976	Landfill closure planned
216-Z-13	216-Z-13 French Drain	French drain	Liquid	4.98×10^7	–	1949	1999	Active
216-Z-1&2	216-Z-1 & 2 Cribs	Crib	Liquid	3.37×10^7	–	1949 1966	1952 1969	Landfill closure planned
216-Z-3	216-Z-3 Crib	Crib	Liquid	1.78×10^8	–	1952	1959	Landfill closure planned
216-Z-12	216-Z-12 Crib	Crib	Liquid	2.72×10^8	–	1959	1973	Landfill closure planned
216-Z-1A	216-Z-1A Tile Field	Tile field	Liquid	6.21×10^6	–	1949 1964	1959 1969	Deactivated in 1969; landfill closure planned
216-Z-18	216-Z-18 Crib	Crib	Liquid	3.86×10^6	–	1969	1973	Landfill closure planned
216-Z-20	216-Z-20 Crib	Crib	Liquid	4.19×10^9	–	1981	1995	Backfilled and isolated; landfill closure planned
216-Z-21	216-Z-21 Seepage Basin	Pond	Liquid	1.57×10^9	–	1980	1995	Landfill closure planned
216-Z-11	216-Z-11 Ditch	Ditch	Liquid	Unknown	–	1959	1971	Backfilled in 1981; landfill closure planned
216-U-13	216-U-13 Trench	Trench	Liquid	1.14×10^4	–	1952	1956	Contaminated soil removed in 1956; landfill closure planned
216-U-14	216-U-14 Ditch	Ditch	Liquid	4.88×10^9	–	1944	1994	Stabilized in 1995
207-U	207-U Retention Basin	Basin	Liquid	1.30×10^4	–	1952	Unknown	Converted into active stormwater basin; stabilization planned
UPR-200-W-135	UPR-200-W-135 Unplanned Release	Contaminated soil	Liquid	3.79×10^3	–	1954	1954	Stabilized with soil in 1990; landfill closure planned
UPR-200-W-28	UPR-200-W-28	Contaminated soil	Liquid	2.31×10^3	–	1954	1954	Covered with clean soil; landfill closure planned
UPR-200-W-131	UPR-200-W-131	Contaminated soil	Liquid	1.51×10^1	–	1953	1953	Covered with clean gravel in 2002; landfill closure planned

Table S–20. Cumulative Impacts Sites for Map 9C *(continued)*

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
200-W PP	200-W PP Powerhouse Pond	Pond	Liquid	3.41×10^{9}	–	1984	1995	Stabilized in 1995
216-T-20	216-T-20 Trench	Trench	Liquid	1.89×10^{4}	–	1952	1952	Deactivated and backfilled; landfill closure planned
232-Z	232-Z Waste Incinerator	Building	Solid	–	Unknown	1959	1976	Isolated and stabilized; landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–21. Cumulative Impacts Sites for Map 9D

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-U-10	216-U-10 Pond	Pond	Liquid	1.60×10^{11}	–	1944	1994	Backfilled and stabilized; landfill closure planned
216-U-3	216-U-3 French Drain	Crib	Liquid	7.91×10^{5}	–	1954	1955	Landfill closure planned
UPR-200-W-104	UPR-200-W-104	Contaminated soil	Liquid	Unknown	–	Unknown	Unknown	Stabilized in 1985; landfill closure planned
UPR-200-W-105	UPR-200-W-105	Contaminated soil	Liquid	Unknown	–	Unknown	Unknown	Stabilized in 1985; landfill closure planned
UPR-200-W-106	UPR-200-W-106	Contaminated soil	Liquid	Unknown	–	Unknown	Unknown	Stabilized in 1985; landfill closure planned
216-S-4	216-S-4 French Drain	French drain	Liquid	9.99×10^{5}	–	1953	1956	Stabilized; landfill closure planned
216-S-3	216-S-3 Crib	Crib	Liquid	4.20×10^{6}	–	1953	1956	Landfill closure planned
216-S-21	216-S-21 Crib	Crib	Liquid	8.71×10^{7}	–	1954	1969	Interim-stabilized in 1990; landfill closure planned
UPR-200-W-107	UPR-200-W-107	Contaminated soil	Liquid	Unknown	–	1952	1957	Stabilized in 1985; landfill closure planned
216-S-25	216-S-25 Crib	Crib	Liquid	2.88×10^{8}	–	1973 1985	1980 1985	Landfill closure planned
216-S-1&2	216-S-1 and 216-S-2 Cribs	Cribs	Liquid	1.60×10^{8}	–	1952	1956	Surface stabilized in 1994; landfill closure planned
216-S-8	216-S-8 Trench	Trench	Liquid	1.00×10^{7}	–	1951	1952	Backfilled and surface stabilized in 1994; landfill closure planned
UPR-200-W-95	UPR-200-W-95	Contaminated soil	Liquid	3.97×10^{1}	–	1951	1954	Lined basin covered with clean soil in 1984

Note: To convert liters to gallons, by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–22. Cumulative Impacts Sites for Map 9E

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-U-5	216-U-5 Trench	Trench	Liquid	$2.25{\times}10^6$	–	1952	1952	Backfilled in 1952; surface stabilized in 1994; removal, treatment, and disposal planned
216-U-6	216-U-6 Trench	Trench	Liquid	$2.25{\times}10^6$	–	1952	1952	Backfilled in 1952; surface stabilized in 1994; removal, treatment, and disposal planned
221-U	221-U Process Canyon	Building	Liquid/ solid	Unknown	Unknown	1945	1961	Landfill closure planned
241-WR-Vault	241-WR Vault	Building	Liquid	Unknown	–	1952	1976	Covered with plastic; landfill closure planned
216-U-15	216-U-15 Trench	Trench	Liquid	$6.81{\times}10^4$	–	1957	1957	Backfilled in 1957; removal, treatment, and disposal planned
UPR-200-W-138	UPR-200-W-138	Contaminated soil	Liquid	$1.49{\times}10^4$	–	1953	1953	Covered with clean soil 1998; landfill closure planned
200-W-44	200-W-44 Sand Filter	Sand filter	Solid	–	Unknown	1948	Active	Active
216-U-7	216-U-7 French Drain	French drain	Liquid	$7.00{\times}10^3$	–	1952	1957	Surface stabilized in 1998; landfill closure planned
UPR-200-W-101	UPR-200-W-101 Unplanned Release	Contaminated soil	Liquid	$4.50{\times}10^3$	–	1957	1957	Covered with clean backfill in 1998; landfill closure planned
216-U-4	216-U-4 Reverse Well	Reverse well	Liquid	$3.00{\times}10^5$	–	1947	1955	Landfill closure planned
216-U-4A	216-U-4A French Drain	French drain	Liquid	$5.45{\times}10^5$	–	1955 1965	1961 1970	Landfill closure planned
216-U-1&2	216-U-1 and 2 Cribs	Crib	Liquid	$1.59{\times}10^7$	–	1951 1958 1966	1956 1960 1967	Landfill closure planned
241-U-361	241-U-361 Settling Tank	Tank	Liquid	$1.04{\times}10^5$	–	1951	1967	Interim-stabilized in 1985; surface stabilized in 1992; landfill closure planned
UPR-200-W-39	UPR-200-W-39 Unplanned Release	Contaminated soil	Liquid	$3.85{\times}10^2$	–	1954	1954	Covered with clean soil and building; landfill closure planned
200-W-42	200-W-42 Process Sewer	Process sewer	Liquid	$1.11{\times}10^4$	–	1952	1988	Portions stabilized with gravel in 1995 and 2001; removal, treatment, and disposal planned
UPR-200-W-163	UPR-200-W-163 Unplanned Release	Contaminated vegetation	Liquid	$3.35{\times}10^4$	–	1952	1988	Partially stabilized
216-U-16	216-U-16 Crib	Crib	Liquid	$4.09{\times}10^8$	–	1984	1985	Backfilled in 2000
216-S-9	216-S-9 Crib	Crib	Liquid	$4.96{\times}10^7$	–	1965	1969	Surface stabilized in 1995; landfill closure planned
216-S-23	216-S-23 Crib	Crib	Liquid	$3.41{\times}10^7$	–	1969	1972	Interim-stabilized in 1985; landfill closure planned
216-U-8	216-U-8 Crib	Crib	Liquid	$3.75{\times}10^8$	–	1952	1960	Interim-stabilized in 1995; landfill closure planned
216-U-12	216-U-12 Crib	Crib	Liquid	$1.49{\times}10^8$	–	1960 1981	1972 1988	Landfill closure planned

Note: To convert liters to gallons, by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–23. Cumulative Impacts Sites for Map 9F

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-S-19	216-S-19 Pond	Pond	Liquid	1.30×10^{9}	–	1952	1984	Stabilized in 1984; removal, treatment, and disposal planned
216-S-14	216-S-14 Trench	Trench	Liquid	7.60×10^{4}	–	1952	1952	Backfilled; removal, treatment, and disposal planned
216-S-7	216-S-7 Crib	Crib	Liquid	3.90×10^{8}	–	1956	1965	Surface stabilized in 1992; landfill closure planned
UPR-200-W-32	UPR-200-W-32	Contaminated soil	Liquid	3.30×10^{2}	–	1954	1954	Contaminated soil covered with clean soil in 1954; removal, treatment, and disposal planned
216-S-13	216-S-13 Crib	Crib	Liquid	5.00×10^{6}	–	1951	1966	Interim-stabilized in 1991; landfill closure planned
216-S-12	216-S-12 Trench	Trench	Liquid	7.48×10^{4}	–	1954	1954	Landfill closure planned
200-W-22	200-W-22 Unplanned Release	Contaminated soil	Liquid	3.20×10^{1}	–	1952	1983	Aboveground contamination removed; removal, treatment, and disposal planned
233-S	233-S Plutonium Concentration Facility	Building	Solid	Unknown	–	1952	1967	Demolished in 2004; concrete cap placed over foundation
200-W-69	200-W-69 Lab Complex (includes 222-S Lab, 222-S DMWSA, 219-S, 222-SA, 296-S-21, 296-S-16, 296-S-23, 296-S-13)	Chemicals	Liquid/ solid	Unknown	–	1951	Active	Landfill closure planned
UPR-200-W-61	UPR-200-W-61	Contaminated soil	Liquid	9.24×10^{2}	–	1966	1966	Landfill closure planned
202-S	202-S (REDOX)	Building	Solid	Unknown	–	1952	1967	Landfill closure planned
291-S	291-S Sand Filter	Sand filter/ equipment	Solid	Unknown	–	1952	Active	Active
216-S-20	216-S-20 Crib	Crib	Liquid	1.35×10^{8}	–	1952 1972	1969 1973	Deactivated in 1974; sinkholes backfilled; removal, treatment, and disposal planned
216-S-22	216-S-22 Crib	Crib	Liquid	9.83×10^{4}	–	1957	1959	Landfill closure planned
216-S-26	216-S-26 Crib	Crib	Liquid	2.19×10^{8}	–	1984	1995	Isolated; manhole filled with concrete; removal, treatment, and disposal planned
218-W-7	218-W-7 Burial Ground (222-S Vault)	Burial ground	Solid	–	1.59×10^{2}	1952	1960	Landfill closure planned

Note: To convert liters to gallons, by 0.26417.

Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; REDOX=Reduction-Oxidation (Facility); WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–24. Cumulative Impacts Sites for Map 10

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
600-148	Environmental Restoration Disposal Facility	Disposal facility	Solid	–	2.14×10^{7}	1996	2031	Disposal operations to be completed in 2031; barrier construction to be completed in 2033
N/A	US Ecology	Disposal facility	Solid	–	7.08×10^{5}	1965	2056	Operations assumed to end in 2056; barrier placed in stages
216-W-LWC	216-W-LWC Crib	Crib	Liquid	9.99×10^{8}	–	1981	1993	Isolated in 1994; landfill closure planned
216-U-17	216-U-17 Crib	Crib	Liquid	5.93×10^{6}	–	1988 1992	1989 1994	Stabilized

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels, to convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.

Key: ID=identifier; L=liters; m^3=cubic meters; N/A=not applicable; US Ecology=US Ecology Commercial Low-Level Radioactive Waste Disposal Site; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–25. Cumulative Impacts Sites for Map 11

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
218-E-10	218-E-10 Trench	Burial ground	Solid	–	2.18×10^{4}	1960	Unknown	Active; partially stabilized in 1980; landfill closure planned
UPR-200-E-23	UPR-200-E-23	Contaminated soil	Solid	Unknown	–	Unknown	Unknown	Addressed in 218-E-10
UPR-200-E-24	UPR-200-E-24	Contaminated soil	Solid	Unknown	–	Unknown	Unknown	Addressed in 218-E-10
216-B-50	216-B-50 Crib	Crib	Liquid	5.47×10^{7}	–	1965	1974	Interim-stabilized in 1991; landfill closure planned
216-B-57	216-B-57 Crib	Crib	Liquid	8.43×10^{7}	–	1968	1973	Surface stabilized in 1991; covered with Hanford prototype barrier in 1994; landfill closure planned
UPR-200-E-9	UPR-200-E-9	Contaminated soil	Liquid	4.16×10^{4}	–	1955	1955	Most contaminated soil removed; remainder stabilized in 1955; landfill closure planned
216-B-11A & B	216-B-11A and B	Reverse well	Liquid	2.96×10^{7}	–	1952	1954	Backfilled in 1992; landfill closure planned
216-B-51	216-B-51 French Drain	French drain	Liquid	1.00×10^{3}	–	1956	1958	Stabilized in 1992
218-E-5	218-E-5 Burial Ground	Burial ground	Solid	–	3.17×10^{3}	1954	1956	Surface stabilized in 1980; landfill closure planned
218-E-5A	218-E-5A Burial Ground	Burial ground	Solid	–	6.17×10^{3}	1956	1959	Surface stabilized in 1980; landfill closure planned
218-E-2	218-E-2 Burial Ground	Burial ground	Solid	–	9.03×10^{3}	1945	1953	Backfilled and stabilized in 1979; landfill closure planned
UPR-200-E-79	UPR-200-E-79 Unplanned Release	Contaminated soil	Liquid	3.85×10^{3}	–	1953	1953	Contaminated soil covered with soil

Table S–25. Cumulative Impacts Sites for Map 11 *(continued)*

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
UPR-200-E-78	UPR-200-E-78 Unplanned Release	Contaminated soil	Liquid	1.54×10^{2}	–	1955	1955	Covered with clean soil; landfill closure planned
218-E-4	218-E-4 Burial Ground	Burial ground	Solid	–	1.59×10^{3}	1955	1956	Surface stabilized in 1980; landfill closure planned
216-B-5	216-B-5 Reverse Well	Reverse well	Liquid	3.21×10^{7}	–	1945	1947	Interim-stabilized in 1994
216-B-9	216-B-9 Crib	Crib	Liquid	3.60×10^{7}	–	1948	1951	Inactive; surface stabilized; landfill closure planned
216-B-59	216-B-59 Trench	Trench	Liquid	4.77×10^{5}	–	1968	1968	Inactive; removal, treatment, and disposal planned
241-B-361	241-B-361 Settling Tank	Tank	Liquid	–	8.30×10^{1}	1945	1947	Interim-stabilized in 1985; landfill closure planned
UPR-200-E-7	UPR-200-E-7 Unplanned Release	Contaminated soil	Liquid	1.89×10^{4}	–	1954	1954	Stabilized; removal, treatment, and disposal planned
221-B	221-B B Plant/Canyon	Building	Solid	–	Unknown	1945	1984	Deactivated in 1998; landfill closure planned
200-E-28	200-E-28 UPR	Steam condensate	Liquid	5.86×10^{5}	–	1990	1990	Closed out as part of completion of 221-B
200-E-97	200-E-97 French Drain	French drain	Liquid	2.32×10^{5}	–	1945	1997	Inactive
200-E-98	200-E-98 French Drain	French drain	Liquid	1.92×10^{5}	–	1945	1997	Inactive
WESF	WESF (Building 225-B)	Waste storage	Solid	Unknown	–	1974	Active	Cesium and strontium capsules to be removed; landfill closure planned
216-B-62	216-B-62 Crib	Crib	Liquid	2.80×10^{8}	–	1973	1986	Inactive; isolated; landfill closure planned
216-B-12	216-B-12 Crib	Crib	Liquid	5.20×10^{8}	–	1952 1967	1957 1973	Inactive; stabilized in 1993; landfill closure planned
216-B-55	216-B-55 Crib	Crib	Liquid	1.20×10^{9}	–	1967 1988	1986 1990	Inactive; isolated; landfill closure planned
212-B	212-B Cask Loading Station	Building	Solid	–	Unknown	Unknown	Unknown	Deactivated; landfill closure planned
216-B-60	216-B-60 Crib	Crib	Liquid	1.89×10^{4}	–	1968	1968	Inactive; landfill closure planned
UPR-200-E-84	UPR-200-E-84 Unplanned Release	Contaminated soil	Liquid	6.43×10^{3}	–	1953	1953	Landfill closure planned
224-B	224-B Plutonium Concentration Facility	Equipment	Solid	–	Unknown	1945	1976	Landfill closure planned
UPR-200-E-87	UPR-200-E-87 Unplanned Release	Contaminated soil	Liquid	2.88×10^{4}	–	1949	1949	Landfill closure planned
UPR-200-E-1	UPR-200-E-1 Unplanned Release	Contaminated soil	Liquid	2.04×10^{4}	–	1946	1946	Area covered; landfill closure planned
UPR-200-E-3	UPR-200-E-3 Unplanned Release	Contaminated soil	Liquid	3.30×10^{2}	–	1951	1951	Cleanup of highly radioactive areas prohibited; landfill closure planned

Table S–25. Cumulative Impacts Sites for Map 11 *(continued)*

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
UPR-200-E-85	UPR-200-E-85 Unplanned Release	Contaminated soil	Liquid	2.48×10^{3}	–	1972	1972	Stabilized in 1984; landfill closure planned
216-B-4	216-B-4 Reverse Well	Reverse well	Liquid	1.00×10^{4}	–	1945	1949	Inactive; landfill closure planned
216-B-6	216-B-6 Reverse Well	Reverse well	Liquid	6.00×10^{6}	–	1945	1949	Inactive; landfill closure planned
200-E-30	200-E-30 Sand Filter (291-B Sand Filter)	Soil	Solid	Unknown	–	1948	1997	Inactive; deactivated
200-E-55	200-E-55 French Drain	French drain	Liquid	2.31×10^{5}	–	1945	1997	Landfill closure planned
200-E-95	200-E-95 French Drain	French drain	Liquid	2.19×10^{5}	–	1945	1994	Inactive
216-B-10A	216-B-10A Crib	Crib	Liquid	9.98×10^{6}	–	1949	1952	Stabilized in 1983; removal, treatment, and disposal planned
216-B-10B	216-B-10B Crib	Crib	Liquid	2.80×10^{4}	–	1969	1973	Stabilized in 1983; removal, treatment, and disposal planned
UPR-200-E-77	UPR-200-E-77 Unplanned Release	Contaminated soil	Liquid	3.47×10^{1}	–	1946	1946	Stabilized in 1946; landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–26. Cumulative Impacts Sites for Map 12

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
218-E-12B	218-E-12B Burial Ground	Burial ground	Solid	–	7.3×10^{4}	1967	Unknown	Seventeen trenches stabilized in 1981; landfill closure planned
218-E-12A	218-E-12A Burial Ground	Burial ground	Solid	–	1.5×10^{4}	1953	1967	Surface stabilized in 1980 and 1994; landfill closure planned
216-B-63	216-B-63 Ditch	Ditch	Liquid	7.98×10^{9}	–	1970	1992	Inactive; backfilled and stabilized; removal, treatment, and disposal planned
216-B-2-2	216-B-2-2 Ditch	Ditch	Liquid	1.49×10^{11}	–	1963	1970	Inactive; backfilled in 1970; surface stabilized in 1987; removal, treatment, and disposal planned
216-B-2-1	216-B-2-1 Ditch	Ditch	Liquid	1.49×10^{11}	–	1945	1963	Backfilled and stabilized; removal, treatment, and disposal planned
UPR-200-E-138	UPR-200-E-138 Unplanned Release	Contaminated soil	Liquid	Unknown	–	1970	1970	Surface stabilized in 1987
218-E-8	218-E-8 Burial Ground	Burial ground	Solid	–	2.3×10^{3}	1958	1959	Surface stabilized in 1980; landfill closure planned
218-E-1	218-E-1 Burial Ground	Burial ground	Solid	–	3.0×10^{3}	1945	1953	Surface stabilized in 1981; landfill closure planned
216-B-3	216-B-3 Pond	Pond	Liquid	2.83×10^{11}	–	1945	1997	Pond backfilled and surface stabilized in 1994
216-B-3A Pond / 216-B-3A RAD	216-B-3A Pond / 216-B-3A RAD	Pond	Liquid	Unknown	–	1983	1984	Closed as an RCRA TSD site in 1995; interim-stabilized with B Pond
216-B-3B Pond / 216-B-3B-RAD	216-B-3B Pond / 216-B-3B-RAD	Pond	Liquid	Unknown	–	1984	1985	Closed as an RCRA TSD site in 1995; interim-stabilized with B Pond
216-B-3C Pond / 216-B-3C RAD	216-B-3C Pond / 216-B-3C RAD	Pond	Liquid	Unknown	–	1985	1997	Backfilled in 1997; clean-closed under RCRA in 1995
UPR-200-E-14	Unplanned Release UPR-200-E-14	Contaminated soil	Liquid	Unknown	–	1958	1958	Released from radiation zone status in 1970; covered by 216-B-3A Pond Lobe in 1983; contaminated zone covered with clean soil
UPR-200-E-34	Unplanned Release UPR-200-E-34	Pond	Liquid	Unknown	–	1964	1964	Surface stabilized
N/A	Greater-Than-Class C Proposed Disposal Facility	Disposal facility	Solid	–	1.17×10^{4}	2019	2038	Possible facility; assumed borehole disposal; engineered barrier covered with backfill, concrete, and lockable steel lid

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.
Key: ID=identifier; L=liters; m^3=cubic meters; N/A=not applicable; RCRA=Resource Conservation and Recovery Act; TSD=treatment, storage, and disposal; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–27. Cumulative Impacts Sites for Map 12A

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-C-9	216-C-9 Swamp	Pond	Liquid	1.04×10^{9}	–	1953	1985	Backfilled and interim-stabilized in 1989
218-C-9	218-C-9 Burial Ground	Burial ground	Solid	–	2.27×10^{3}	1985	1989	Backfilled and stabilized in 1989; landfill closure planned
UPR-200-E-141	UPR-200-E-141	Contaminated soil	Liquid	2.08×10^{2}	–	1984	1984	Contamination cleaned up
200-E-56	200-E-56 Unplanned Release	Contaminated soil	Liquid	7.55×10^{4}	–	1957	1957	Landfill closure planned
201-C	201-C Process Building	Buildings	Liquid/ solid	Unknown	Unknown	1949	1967	Core entombed in 1986; area covered with 3 meters of ash in 1992; landfill closure planned
216-C-1	216-C-1 Hot Semi Work Crib	Crib	Liquid	2.34×10^{7}	–	1952	1957	Stabilized in 1979; entombed in concrete in 1986; landfill closure planned
216-C-3	216-C-3 Hot Semi Work Crib	Crib	Liquid	5.00×10^{6}	–	1953	1954	Stabilized in 1979; landfill closure planned
216-C-4	216-C-4 Hot Semi Work Crib	Crib	Liquid	1.70×10^{5}	–	1955 1962	1957 1964	Stabilized and backfilled in 2000; landfill closure planned
216-C-5	216-C-5 Hot Semi Work Crib	Crib	Liquid	3.89×10^{4}	–	1955	1955	Stabilized in 1979; landfill closure planned
216-C-6	216-C-6 Hot Semi Work Crib	Crib	Liquid	5.31×10^{5}	–	1955 1962	1957 1964	Deactivated in 1964; landfill closure planned
216-C-10	216-C-10 Hot Semi Work Crib	Crib	Liquid	8.97×10^{5}	–	1964	1967	Surface stabilized in 1989; landfill closure planned
216-C-2	216-C-2 Semi Works Reverse Well	Reverse well	Liquid	3.15×10^{6}	–	1953	1988	Sealed with concrete in 1988; landfill closure planned
200-E-57	200-E-57 Unplanned Release	Contaminated soil	Liquid	1.13×10^{5}	–	1957	1957	Some soil removed; removal, treatment, and disposal planned
241-CX-72	241-CX-72 Storage Tank and Vault	Equipment	Liquid/ solid	Unknown	1.26×10^{2}	1957	1976	Filled with grout in 1986; landfill closure planned
291-C-1	291-C-1 Burial Ground	Burial ground	Solid	–	Unknown	1949	1987	Surface stabilized; landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417; meters to feet, by 3.281.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–28. Cumulative Impacts Sites for Map 12B

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
UPR-200-E-86	UPR-200-E-86	Contaminated soil	Liquid	7.00×10^4	–	1971	1971	Surface covered with shotcrete in 1995; landfill closure planned
216-A-40	216-A-40 Trench	Trench	Liquid	9.46×10^5	–	1968	1979	Backfilled with soil in 1994; removal, treatment, and disposal planned
216-A-41	216-A-41 Crib	Crib	Liquid	1.00×10^4	–	1968	1974	Removal, treatment, and disposal planned
216-A-9	216-A-9 Crib	Crib	Liquid	9.81×10^8	–	1956 1966	1958 1967	Surface stabilized; removal, treatment, and disposal planned
216-A-3	216-A-3 Crib	Crib	Liquid	3.05×10^6	–	1956 1976	1966 1981	Backfilled with gravel; removal, treatment, and disposal planned
216-A-39	216-A-39 Crib	Trench	Liquid	2.00×10^1	–	1966	1966	Landfill closure planned
216-A-18	216-A-18 Trench	Trench	Liquid	4.88×10^5	–	1955	1955	Surface stabilized in 1990; landfill closure planned
216-A-1	216-A-1 Crib	Crib	Liquid	9.84×10^4	–	1955	1955	Backfilled in 1992; landfill closure planned
216-A-7	216-A-7 Crib	Crib	Liquid	3.27×10^5	–	1955 1966	1956 1966	Backfilled in 1992; landfill closure planned
UPR-200-E-145	UPR-200-E-145	Contaminated soil	Liquid	6.25×10^3	–	1993	1993	Covered with clean soil in 2003
216-A-16	216-A-16 French Drain	French drain	Liquid	1.22×10^5	–	1956	1969	Landfill closure planned
216-A-17	216-A-17 French Drain	French drain	Liquid	6.00×10^4	–	1956	1969	Landfill closure planned
242-A	242-A Evaporator	Equipment	Liquid	Unknown	–	1977	Active	Landfill closure planned
216-A-22	216-A-22 Crib (French Drain)	Crib	Liquid	9.99×10^3	–	1956	1959	Surface stabilized; removal, treatment, and disposal planned
216-A-28	216-A-28 French Drain	French drain	Liquid	3.00×10^4	–	1960	1960	Excavated in 1981; removal, treatment, and disposal planned
216-A-32	216-A-32 Crib	Crib	Liquid	4.00×10^3	–	1959	1972	Surface stabilized in 2001
200-E-78	200-E-78 Reverse Well	Reverse well	Liquid	1.84×10^5	–	1955	1996	Inactive

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–29. Cumulative Impacts Sites for Map 12C

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
UPR-200-E-51	UPR-200-E-51	Chemicals	Liquid	Unknown	–	1977	1977	Backfilled
216-A-24	216-A-24 Crib	Crib	Liquid	8.21×10^{8}	–	1958 1971 1978	1967 1976 1978	Surface stabilized in 1988; landfill closure planned
216-A-6	216-A-6 Crib	Crib	Liquid	3.36×10^{9}	–	1955 1966	1961 1970	Surface stabilized with sand and plastic sheeting in 1972 and 1993; landfill closure planned
216-A-19	216-A-19 Trench	Trench	Liquid	1.10×10^{6}	–	1955	1955	Surface stabilized in 1990; landfill closure planned
216-A-20	216-A-20 Trench	Trench	Liquid	9.61×10^{5}	–	1955	1955	Surface stabilized in 1990; landfill closure planned
216-A-8	216-A-8 Crib	Crib	Liquid	1.15×10^{9}	–	1955 1966 1978 1983	1958 1976 1978 1985	Surface stabilized in 1990; landfill closure planned
216-A-29	216-A-29 Ditch	Ditch	Liquid	Unknown	–	1955	1991	Surface stabilized in 1991
216-A-30	216-A-30 Crib	Crib	Liquid	7.64×10^{9}	–	1961 1976	1973 1991	Backfilled with gravel in 2001; landfill closure planned
216-A-37-1	216-A-37-1 Crib	Crib	Liquid	3.68×10^{8}	–	1977	1989	Landfill closure planned
216-A-37-2	216-A-37-2 Crib	Crib	Liquid	1.10×10^{9}	–	1984 1988	1986 1991	Landfill closure planned

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–30. Cumulative Impacts Sites for Map 12D

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
216-A-13	216-A-13 French Drain	French drain	Liquid	1.00×10^{4}	–	1956	1962	Landfill closure planned
200-E-61	200-E-61 Reverse Well	Reverse well	Liquid	1.80×10^{6}	–	1955	2001	Landfill closure planned
200-E-136	200-E-136 PUREX Plant (202-A and others)	Building	Solid	–	Unknown	1956	1990	Landfill closure planned
UPR-200-E-39	UPR-200-E-39 (at 216-A-36B)	Contaminated soil	Liquid	1.52×10^{3}	–	1968	1968	Inactive
UPR-200-E-40	UPR-200-E-40	Contaminated soil	Liquid	1.17×10^{2}	–	1968	1968	Contaminated blacktop removed in 1968; covered with clean gravel in 1999; landfill closure planned
200-E-85	200-E-85 Reverse Well	Reverse well	Liquid	1.43×10^{6}	–	1955	1997	Landfill closure planned
216-A-35	216-A-35 French Drain	French drain	Liquid	1.00×10^{4}	–	1963	1966	Landfill closure planned

Table S–30. Cumulative Impacts Sites for Map 12D *(continued)*

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
200-E-54	200-E-54 Unplanned Release	Contaminated soil	Liquid	2.01×10^{5}	–	1991	1991	Inactive
200-E-103	200-E-103 PUREX Stabilized Area	Contaminated soil	Liquid	4.00×10^{3}	–	1960	1960	Interim-stabilized in 1999; landfill closure planned
UPR-200-E-117	UPR-200-E-117	Contaminated soil	Liquid	3.30×10^{2}	–	1972	1972	Covered with clean backfill in 1999; landfill closure planned
216-A-2	216-A-2 Crib	Crib	Liquid	2.30×10^{5}	–	1956	1960	Landfill closure planned
216-A-26	216-A-26 French Drain	French drain	Liquid	3.86×10^{3}	–	1965	1991	Inactive
216-A-26A	216-A-26A French Drain	French drain	Liquid	1.00×10^{3}	–	1959	1965	Landfill closure planned
216-A-15	216-A-15 French Drain	French drain	Liquid	1.00×10^{7}	–	1955	1972	Landfill closure planned
200-E-107	200-E-107 Unplanned Release	Contaminated soil	Liquid	4.00×10^{3}	–	2000	2000	Surface stabilized with clean soil in 2001; landfill closure planned
218-E-14	218-E-14 PUREX Tunnel 1	Equipment	Solid	–	5.67×10^{2}	1960	1965	Landfill closure planned
218-E-15	218-E-15 PUREX Tunnel 2	Equipment	Solid	–	Unknown	1967	1996	Landfill closure planned
216-A-4	216-A-4 Crib	Crib	Liquid	6.21×10^{6}	–	1955	1958	Surface stabilized in 1999; landfill closure planned
216-A-5	216-A-5 Crib	Crib	Liquid	1.63×10^{9}	–	1955 1966	1961 1966	Surface stabilized in 1983; landfill closure planned
216-A-10	216-A-10 Crib	Crib	Liquid	3.16×10^{9}	–	1956 1961 1977 1981	1956 1973 1978 1987	Deactivated in 1987; landfill closure planned
216-A-21	216-A-21 Crib	Crib	Liquid	7.79×10^{7}	–	1957	1965	Surface stabilized in 1999; landfill closure planned
216-A-27	216-A-27 Crib	Crib	Liquid	2.32×10^{7}	–	1965	1970	Backfilled; landfill closure planned
216-A-31	216-A-31 Crib	Crib	Liquid	3.05×10^{4}	–	1964 1966	1964 1966	Landfill closure planned
216-A-36-A	216-A-36A Crib	Crib	Liquid	1.07×10^{6}	–	1965	1966	Landfill closure planned
216-A-36-B	216-A-36B Crib	Crib	Liquid	3.15×10^{8}	–	1966 1982	1972 1987	Landfill closure planned
216-A-45	216-A-45 Crib	Crib	Liquid	1.03×10^{8}	–	1987	1989	Landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315; liters to gallons, by 0.26417.

Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; PUREX=Plutonium-Uranium Extraction; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–31. Cumulative Impacts Sites for Map 13

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
2101-M Pond	2101-M Pond	Pond	Liquid	1.11×10^{9}	–	1953	1995	Inactive
216-B-54	216-B-54 Trench	Trench	Liquid	9.99×10^{5}	–	1963	1965	Surface of backfilled trenches stabilized in 1982; removal, treatment, and disposal planned
216-B-14	216-B-14 Crib	Crib	Liquid	8.67×10^{6}	–	1956	1956	Stabilized in 1981; landfill closure planned
216-B-15	216-B-15 Crib	Crib	Liquid	6.32×10^{6}	–	1956	1957	Stabilized in 1981; landfill closure planned
216-B-16	216-B-16 Crib	Crib	Liquid	5.60×10^{6}	–	1956	1956	Stabilized in 1981; landfill closure planned
216-B-17	216-B-17 Crib	Crib	Liquid	3.41×10^{6}	–	1956	1956	Stabilized in 1981; landfill closure planned
216-B-18	216-B-18 Crib	Crib	Liquid	8.52×10^{6}	–	1956	1956	Stabilized in 1981; landfill closure planned
216-B-19	216-B-19 Crib	Crib	Liquid	6.35×10^{6}	–	1957	1957	Stabilized in 1981; landfill closure planned
216-B-20	216-B-20 Trench	Trench	Liquid	4.68×10^{6}	–	1956	1956	Stabilized in 1982; landfill closure planned
216-B-21	216-B-21 Trench	Trench	Liquid	4.67×10^{6}	–	1956	1956	Stabilized in 1982; landfill closure planned
216-B-22	216-B-22 Trench	Trench	Liquid	4.74×10^{6}	–	1956	1956	Stabilized in 1982; landfill closure planned
216-B-23	216-B-23 Trench	Trench	Liquid	4.52×10^{6}	–	1956	1956	Stabilized in 1982; landfill closure planned
216-B-24	216-B-24 Trench	Trench	Liquid	4.87×10^{6}	–	1956	1956	Stabilized in 1982; landfill closure planned
216-B-25	216-B-25 Trench	Trench	Liquid	4.91×10^{6}	–	1956	1956	Stabilized in 1982; landfill closure planned
216-B-26	216-B-26 Trench	Trench	Liquid	4.75×10^{6}	–	1956	1957	Stabilized in 1982; landfill closure planned
216-B-27	216-B-27 Trench	Trench	Liquid	4.42×10^{6}	–	1957	1957	Stabilized in 1982; landfill closure planned
216-B-28	216-B-28 Trench	Trench	Liquid	5.05×10^{6}	–	1957	1957	Stabilized in 1982; landfill closure planned
216-B-29	216-B-29 Trench	Trench	Liquid	4.83×10^{6}	–	1957	1957	Stabilized in 1982; landfill closure planned
216-B-30	216-B-30 Trench	Trench	Liquid	4.78×10^{6}	–	1957	1957	Stabilized in 1982; landfill closure planned
216-B-31	216-B-31 Trench	Trench	Liquid	4.85×10^{6}	–	1957	1957	Stabilized in 1982; landfill closure planned
216-B-32	216-B-32 Trench	Trench	Liquid	4.75×10^{6}	–	1956	1957	Stabilized in 1982; landfill closure planned
216-B-33	216-B-33 Trench	Trench	Liquid	4.75×10^{6}	–	1956	1957	Stabilized in 1982; landfill closure planned
216-B-34	216-B-34 Trench	Trench	Liquid	4.88×10^{6}	–	1956	1957	Stabilized in 1982; landfill closure planned
216-B-52	216-B-52 Trench	Trench	Liquid	8.53×10^{6}	–	1957	1958	Stabilized in 1982; landfill closure planned
216-B-53A	216-B-53A Trench	Trench	Liquid	5.49×10^{5}	–	1965	1965	Stabilized in 1982; removal, treatment, and disposal planned
216-B-53B	216-B-53B Trench	Trench	Liquid	2.01×10^{4}	–	1962	1963	Stabilized in 1982; removal, treatment, and disposal planned
216-B-58	216-B-58 Trench	Trench	Liquid	4.17×10^{5}	–	1965	1967	Stabilized in 1982; removal, treatment, and disposal planned

Note: To convert liters to gallons, multiply by 0.26417.
Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–32. Cumulative Impacts Sites for Map 14

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
600 NRDWL	600 Nonrad Dangerous Waste Landfill	Landfill	Solid	Unknown	1.41×10^5	1975	1985	Backfilled and covered; landfill closure planned

Note: To convert cubic meters to cubic feet, multiply by 35.315.

Key: ID=identifier; L=liters; m^3=cubic meters; Nonrad=nonradioactive; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–33. Cumulative Impacts Sites for Map 15

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
618-11	300 Wye Burial Ground	Burial ground	Solid	–	Unknown	1962	1967	Surface stabilized in 1987; removal, treatment, and disposal planned
400 RFD	400 Area Retired French Drains	French drain	Liquid	Unknown	–	Unknown	Unknown	Inactive
316-4	300 North Cribs, 321 Cribs	Crib	Liquid	2.00×10^5	–	1948	1955	Remedial excavation work begun in 2004; removal, treatment, and disposal planned

Note: To convert liters to gallons, multiply by 0.26417.

Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–34. Cumulative Impacts Sites for Map 16

WIDS ID/ Building Number	Common Site Name	Site Type	Source Type	Liquid Volume (L)	Solid Volume (m^3)	Time Start	Time Stop	Status/Future End State
618-9	300 West Burial Ground	Burial ground	Solid	–	Unknown	1950	1956	Remediated in 1991; site exhumed and all waste removed
316-1	300 Area South Process Ponds	Pond	Liquid	5.11×10^{10}	–	1944	1975	Remediated and closed out; removal, treatment, and disposal planned
316-2	300 Area North Process Ponds	Pond	Liquid	3.73×10^{10}	–	1949	1975	Remediated and closed out; removal, treatment, and disposal planned
316-5	300 Area Process Trenches	Trench	Liquid	3.63×10^{10}	–	1975	1985	Remediated and closed out; removal, treatment, and disposal planned
UPR-300-1	307-340 Waste Line Leak	Unplanned release	Liquid	Unknown	–	1969	1969	Top 0.6 meters of contaminated soil removed and disposed of in 200 Areas; removal, treatment, and disposal planned
300-19	324 Sodium Removal Pilot Plant	Process unit/plant	Liquid	Unknown	–	1979	1987	Reaction vessel decommissioned and removed in 1991
UPR-300-13	Acid Neutralization Tank Leak East of 333 Building	Unplanned release	Liquid	4.93×10^{3}	–	1973	1973	Tank and contaminated soil removed
300-264	327 Building, Postirradiation Testing Laboratory	Laboratory	Liquid	Unknown	–	1953	1996	Currently in stabilization and deactivation stage
309-WS-1	309 Plutonium Recycle Test Reactor Ion Exchange Vault	Process unit/plant	Liquid	Unknown	–	1961	1969	Deactivated in 1995; vault decontaminated and residual contamination stabilized
316-3	307 Disposal Trenches	Trench	Liquid	1.00×10^{9}	–	1953	1963	Contaminated sediments excavated and removed in 1963; trench backfilled in 1965; removal, treatment, and disposal planned

Note: To convert liters to gallons, multiply by 0.26417.

Key: Dash (–)=not applicable; ID=identifier; L=liters; m^3=cubic meters; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–35a. Map 1: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
116-B-1	107-B Liquid Waste Disposal Trench	Liquid	1998	2.51×10^{-2}	–	–	4.98×10^{-2}	–	–	–
116-B-4	105-B Dummy Decontamination French Drain	Liquid	1998	–	–	–	–	–	–	–
116-B-5	108-B Crib	Liquid	1998	8.29×10^{1}	–	–	8.10×10^{-4}	–	–	–
116-B-6A	116-B-6-1 Crib	Liquid	1998	–	–	–	6.37×10^{-1}	–	–	–
116-B-6B	116-B-6-2 Crib	Liquid	1998	3.31×10^{-3}	–	–	1.33×10^{-4}	–	–	–
116-B-11	107-B Retention Basins	Liquid	1998	1.82	–	–	6.58×10^{-1}	–	–	–
116-C-5	107-C Retention Basins	Liquid	1998	3.68×10^{-1}	–	–	1.70	–	–	–
116-C-1	107-C Liquid Waste Disposal Trench	Liquid	1998	3.87×10^{-1}	–	–	1.16	–	–	–
116-C-2A	105-C Pluto Crib	Liquid	1998	1.38×10^{-1}	–	–	6.94×10^{-1}	–	–	–
116-C-2C	105-C Pluto Crib Sand Filter	Liquid	1998	1.24×10^{-1}	–	–	1.27	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–35b. Map 1: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
116-B-1	107-B Liquid Waste Disposal Trench	Liquid	1998	2.17×10^{-1}	–	–	6.15×10^{-9}	–	8.18×10^{-3}	–
116-B-4	105-B Dummy Decontamination French Drain	Liquid	1998	–	–	–	–	–	–	–
116-B-5	108-B Crib	Liquid	1998	1.46×10^{-3}	–	–	–	–	–	–
116-B-6A	116-B-6-1 Crib	Liquid	1998	1.05×10^{-1}	–	–	4.53×10^{-11}	–	2.00×10^{-3}	–
116-B-6B	116-B-6-2 Crib	Liquid	1998	1.46×10^{-4}	–	–	–	–	–	–
116-B-11	107-B Retention Basins	Liquid	1998	5.24	–	–	1.09×10^{-6}	–	9.13×10^{-1}	–
116-C-5	107-C Retention Basins	Liquid	1998	8.78×10^{-1}	–	–	6.06×10^{-7}	–	2.94×10^{-1}	–
116-C-1	107-C Liquid Waste Disposal Trench	Liquid	1998	4.10	–	–	2.94×10^{-9}	–	1.30×10^{-1}	–
116-C-2A	105-C Pluto Crib	Liquid	1998	5.86×10^{-4}	–	–	–	–	–	–
116-C-2C	105-C Pluto Crib Sand Filter	Liquid	1998	5.86	–	–	7.15×10^{-6}	–	1.20×10^{-1}	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–36a. Map 2: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
116-K-1	100-K Crib	Liquid	1998	–	–	–	4.39×10^{-1}	–	–	–
116-K-2	100-K Mile Long Trench	Liquid	1998	1.44×10^{1}	–	–	1.08×10^{1}	–	–	–
116-KE-4	107-KE Retention Basins	Liquid	1998	3.61×10^{-2}	–	–	9.40×10^{-2}	–	–	–
116-KW-3	107-KW Retention Basin	Liquid	1998	1.38×10^{-1}	–	–	4.65×10^{-2}	–	–	–
116-KE-1	115-KE Condensate Crib	Liquid	1986	5.65×10^{1}	1.10×10^{2}	–	–	–	–	–
116-KE-2	1706-KER Waste Crib	Liquid	–	–	–	–	–	–	–	–
116-KW-1	115-KW Condensate Crib	Liquid	1998	3.59×10^{1}	–	–	4.40×10^{-3}	–	–	–
UPR-100-K-1[b]	100-KE Fuel Storage Basin Leak	Liquid	Unknown	–	–	–	–	–	–	–
120-KE-1	183-KE Filter Waste Facility Drywell	Liquid/solid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–36b. Map 2: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
116-K-1	100-K Crib	Liquid	1998	1.29×10^{1}	–	–	8.38×10^{-7}	–	1.41×10^{-1}	–
116-K-2	100-K Mile Long Trench	Liquid	1998	1.06×10^{2}	–	–	1.14×10^{-5}	–	4.99	–
116-KE-4	107-KE Retention Basins	Liquid	1998	9.97×10^{-1}	–	–	1.26×10^{-9}	–	5.38×10^{-4}	–
116-KW-3	107-KW Retention Basin	Liquid	1998	3.02×10^{-1}	–	–	8.19×10^{-11}	–	3.61×10^{-3}	–
116-KE-1	115-KE Condensate Crib	Liquid	1986	–	–	–	–	–	–	–
116-KE-2	1706-KER Waste Crib	Liquid	–	–	–	–	–	–	–	–
116-KW-1	115-KW Condensate Crib	Liquid	1998	2.58×10^{-3}	–	–	–	–	–	–
UPR-100-K-1[b]	100-KE Fuel Storage Basin Leak	Liquid	Unknown	–	–	–	–	–	1.30	–
120-KE-1	183-KE Filter Waste Facility Drywell	Liquid/solid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–37a. Map 3: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
116-N-1	1301-N Liquid Waste Disposal Facility	Liquid	1998	5.29×10^{3}	–	–	1.61×10^{3}	–	–	–
116-N-3	1325-N Liquid Waste Disposal Facility	Liquid	1998	3.23×10^{2}	–	–	1.61×10^{2}	–	–	–
UPR-100-N-3	Spacer Disposal System Transport Line Leak	Liquid	1978	1.00	–	–	8.00×10^{-1}	–	–	–
UPR-100-N-7	Rad Line Leak	Liquid	1985	–	–	–	–	–	8.00×10^{-1}	–
UPR-100-N-35[b]	100-N Fuel Storage Basin Drainage System Leak	Liquid	1986	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–37b. Map 3: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
116-N-1	1301-N Liquid Waste Disposal Facility	Liquid	1998	2.11×10^{3}	–	–	2.72×10^{-7}	–	2.30×10^{1}	–
116-N-3	1325-N Liquid Waste Disposal Facility	Liquid	1998	2.92×10^{2}	–	–	5.49×10^{-2}	–	2.80	–
UPR-100-N-3	Spacer Disposal System Transport Line Leak	Liquid	1978	2.50×10^{-1}	–	–	–	–	4.00×10^{-4}	–
UPR-100-N-7	Rad Line Leak	Liquid	1985	–	–	–	–	–	–	–
UPR-100-N-35[b]	100-N Fuel Storage Basin Drainage System Leak	Liquid	1986	4.00×10^{-1}	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–38a. Map 4: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
116-D-1A	105-D Storage Basin Trenches 1	Liquid	1998	3.87×10^{-1}	–	–	8.68×10^{-2}	–	–	–
116-D-1B	105-D Storage Basin Trenches 2	Liquid	1998	5.52×10^{-2}	–	–	1.16×10^{-1}	–	–	–
116-D-7	107-D Retention Basin	Liquid	1998	2.49×10^{-1}	–	–	1.62×10^{-1}	–	–	–
116-DR-9	107-DR Retention Basin	Liquid	1998	9.39×10^{-3}	–	–	1.43×10^{-1}	–	–	–
100-D-25[b]	107-DR Basin Leaks	Liquid	1998	1.52×10^{-1}	–	–	2.20×10^{-1}	–	–	–
UPR-100-D-4[b]	107-D Basin Leaks	Liquid	1998	4.06×10^{-1}	–	–	1.12×10^{-1}	–	–	–
116-DR-1&2	107-DR Liquid Waste Disposal Trenches	Liquid	1998	1.96×10^{-1}	–	–	2.14×10^{-1}	–	–	–
116-DR-6	1608-DR Liquid Disposal Trench	Liquid	N/A	–	–	–	–	–	–	–
116-DR-7	105-DR Inkwell Crib	Liquid	1986	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–38b. Map 4: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
116-D-1A	105-D Storage Basin Trenches 1	Liquid	1998	7.61×10^{-1}	–	–	4.53×10^{-10}	–	2.00×10^{-2}	–
116-D-1B	105-D Storage Basin Trenches 2	Liquid	1998	3.63×10^{-1}	–	–	1.52×10^{-10}	–	–	–
116-D-7	107-D Retention Basin	Liquid	1998	1.68	–	–	6.17×10^{-7}	–	1.40×10^{-1}	–
116-DR-9	107-DR Retention Basin	Liquid	1998	2.68	–	–	9.32×10^{-8}	–	6.86×10^{-2}	–
100-D-25[b]	107-DR Basin Leaks	Liquid	1998	3.29	–	–	9.85×10^{-10}	–	4.34×10^{-2}	–
UPR-100-D-4[b]	107-D Basin Leaks	Liquid	1998	2.17	–	–	6.72×10^{-8}	–	6.99×10^{-2}	–
116-DR-1&2	107-DR Liquid Waste Disposal Trenches	Liquid	1998	9.37	–	–	7.92×10^{-10}	–	3.49×10^{-2}	–
116-DR-6	1608-DR Liquid Disposal Trench	Liquid	N/A	–	–	–	–	–	–	–
116-DR-7	105-DR Inkwell Crib	Liquid	1986	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–39a. Map 5: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
100-H-33	183-H Solar Evaporation Basins Radionuclide Components	Liquid	N/A	–	–	–	–	–	–	–
116-H-6	183-H Solar Evaporation Basins	Liquid	N/A	Site consolidated with Site WIDS ID 100-H-33						
116-H-1	107-H Liquid Disposal Trench	Liquid	1998	1.35×10^{-2}	–	–	5.32×10^{-1}	–	–	–
116-H-2	1608-H Liquid Waste Disposal Trench	Liquid	1998	–	–	–	–	–	–	–
116-H-4	105-H Pluto Crib	Liquid	N/A	–	–	–	–	–	–	–
116-H-7	107-H Retention Basin	Liquid	1998	4.27×10^{-1}	–	–	5.76×10^{-1}	–	–	–
116-H-3	105-H Dummy Decontamination French Drain	Liquid	1998	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–39b. Map 5: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
100-H-33	183-H Solar Evaporation Basins Radionuclide Components	Liquid	N/A	–	–	–	–	–	–	–
116-H-6	183-H Solar Evaporation Basins	Liquid	N/A	Site consolidated with Site WIDS ID 100-H-33						
116-H-1	107-H Liquid Disposal Trench	Liquid	1998	2.69	–	–	1.99×10^{-7}	–	6.68×10^{-2}	–
116-H-2	1608-H Liquid Waste Disposal Trench	Liquid	1998	–	–	–	–	–	–	–
116-H-4	105-H Pluto Crib	Liquid	N/A	–	–	–	–	–	–	–
116-H-7	107-H Retention Basin	Liquid	1998	6.43	–	–	3.46×10^{-7}	–	2.36×10^{-1}	–
116-H-3	105-H Dummy Decontamination French Drain	Liquid	1998	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–40a. Map 6: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
116-F-1[b]	Lewis Canal	Liquid	1998	8.84×10^{-2}	–	–	3.65×10^{-2}	–	–	–
116-F-2	107-F Liquid Waste Disposal Trench	Liquid	1998	1.64×10^{-1}	–	–	4.92×10^{-2}	–	–	–
116-F-9	Animal Waste Leaching Trench	Liquid	1986	–	–	–	1.96	–	–	–
116-F-3	105-F Storage Basin Trench	Liquid	1998	–	–	–	–	–	–	–
116-F-6	105-F Cooling Water Trench	Liquid	1998	6.35×10^{-1}	–	–	1.22×10^{-1}	–	–	–
116-F-4	105-F Pluto Crib	Liquid	1998	4.70×10^{-3}	–	–	7.52×10^{-1}	–	–	–
116-F-10	105-F Dummy Decontamination French Drain	Liquid	N/A	–	–	–	–	–	–	–
116-F-14	107-F Retention Basin	Liquid	1998	1.96×10^{-1}	–	–	1.19×10^{-1}	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because it emptied directly into the Columbia River.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–40b. Map 6: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
116-F-1[b]	Lewis Canal	Liquid	1998	6.44×10^{-1}	–	–	1.49×10^{-10}	–	6.58×10^{-3}	–
116-F-2	107-F Liquid Waste Disposal Trench	Liquid	1998	5.39×10^{-1}	–	–	1.85×10^{-10}	–	8.18×10^{-3}	–
116-F-9	Animal Waste Leaching Trench	Liquid	1986	9.10×10^{-2}	–	–	–	–	7.00×10^{-3}	–
116-F-3	105-F Storage Basin Trench	Liquid	1998	–	–	–	–	–	–	–
116-F-6	105-F Cooling Water Trench	Liquid	1998	3.86×10^{-1}	–	–	2.22×10^{-10}	–	9.78×10^{-3}	–
116-F-4	105-F Pluto Crib	Liquid	1998	1.11	–	–	3.44×10^{-8}	–	4.19×10^{-2}	–
116-F-10	105-F Dummy Decontamination French Drain	Liquid	N/A	–	–	–	–	–	–	–
116-F-14	107-F Retention Basin	Liquid	1998	1.48	–	–	1.79×10^{-9}	–	7.91×10^{-2}	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because it emptied directly into the Columbia River.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–41a. Map 7: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-N-1	216-N-1 Pond	Liquid	2001	–	–	–	–	–	–	–
216-N-2	216-N-2 Trench	Liquid	2001	4.27×10^{-4}	8.26×10^{-6}	–	4.74×10^{-2}	1.94×10^{-5}	1.76×10^{-4}	1.76×10^{-7}
216-N-3	216-N-3 Trench	Liquid	2001	4.27×10^{-4}	8.26×10^{-6}	–	4.74×10^{-2}	1.94×10^{-5}	1.76×10^{-4}	1.76×10^{-7}
216-N-4	216-N-4 Pond	Liquid	2001	4.28×10^{-4}	8.27×10^{-6}	–	4.75×10^{-2}	1.94×10^{-5}	1.76×10^{-4}	1.76×10^{-7}
216-N-5	216-N-5 Trench	Liquid	2001	4.27×10^{-4}	8.25×10^{-6}	–	4.74×10^{-2}	1.94×10^{-5}	1.76×10^{-4}	1.76×10^{-7}
216-N-6	216-N-6 Pond	Liquid	2001	4.28×10^{-4}	8.27×10^{-6}	–	4.75×10^{-2}	1.94×10^{-5}	1.76×10^{-4}	1.76×10^{-7}
216-N-7	216-N-7 Trench	Liquid	2001	4.27×10^{-4}	8.25×10^{-6}	–	4.74×10^{-2}	1.94×10^{-5}	1.76×10^{-4}	1.76×10^{-7}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–41b. Map 7: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-N-1	216-N-1 Pond	Liquid	2001	–	–	5.02×10^{-15}	3.90×10^{-4}	4.78×10^{-8}	3.17×10^{-5}	–
216-N-2	216-N-2 Trench	Liquid	2001	3.89×10^{-1}	–	1.05×10^{-14}	1.51×10^{-5}	1.09×10^{-6}	2.22×10^{-4}	6.18×10^{-5}
216-N-3	216-N-3 Trench	Liquid	2001	3.89×10^{-1}	–	1.05×10^{-14}	1.51×10^{-5}	1.09×10^{-6}	2.22×10^{-4}	6.18×10^{-5}
216-N-4	216-N-4 Pond	Liquid	2001	3.90×10^{-1}	–	1.57×10^{-14}	4.02×10^{-4}	1.14×10^{-6}	2.54×10^{-4}	6.18×10^{-5}
216-N-5	216-N-5 Trench	Liquid	2001	3.90×10^{-1}	–	1.05×10^{-14}	1.50×10^{-5}	1.09×10^{-6}	2.22×10^{-4}	6.18×10^{-5}
216-N-6	216-N-6 Pond	Liquid	2001	3.90×10^{-1}	–	1.55×10^{-14}	4.02×10^{-4}	1.14×10^{-6}	2.53×10^{-4}	6.18×10^{-5}
216-N-7	216-N-7 Trench	Liquid	2001	3.90×10^{-1}	–	1.05×10^{-14}	1.51×10^{-5}	1.09×10^{-6}	2.22×10^{-4}	6.18×10^{-5}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–42a. Map 8: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-A-25	216-A-25 Gable Mountain Pond	Liquid	2001	8.75×10^{2}	3.49×10^{1}	–	1.83×10^{2}	3.26×10^{-1}	1.71	1.40×10^{-2}
UPR-200-E-34	UPR-200-E-34	Liquid	N/A	Site consolidated with Site WIDS ID 216-A-25						
600-118	600-118 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-A-25						

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–42b. Map 8: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-A-25	216-A-25 Gable Mountain Pond	Liquid	2001	7.26×10^{3}	–	4.91×10^{-9}	9.23	1.17×10^{-1}	3.76×10^{1}	2.84
UPR-200-E-34	UPR-200-E-34	Liquid	N/A	Site consolidated with Site WIDS ID 216-A-25						
600-118	600-118 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-A-25						

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–43a. Map 9: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-S-5	216-S-5 Crib	Liquid	2001	3.30	1.08×10^{-3}	–	3.14×10^{1}	3.11×10^{-3}	2.59×10^{-2}	3.15×10^{-5}
216-S-6	216-S-6 Crib	Liquid	2001	3.55	9.23×10^{-5}	–	5.83	2.37×10^{-3}	1.60×10^{-2}	2.80×10^{-3}
216-S-10D[b]	216-S-10D Ditch	Liquid	1998	–	–	–	8.67×10^{-1}	–	–	–
216-S-10P	216-S-10P Pond	Liquid	2001	1.05	2.55	–	8.28×10^{-1}	1.83×10^{-3}	1.15×10^{-2}	1.81×10^{-5}
216-S-11	216-S-11P Pond	Liquid	1998	–	–	–	6.57×10^{-1}	2.24×10^{-5}	9.95×10^{-5}	–
216-S-16D[b]	216-S-16D Ditch	Liquid	N/A	–	–	–	–	–	–	–
216-S-16P	216-S-16P Pond	Liquid	2001	2.60	8.47×10^{-4}	–	1.37	3.75×10^{-3}	2.88×10^{-2}	3.50×10^{-5}
216-S-17	216-S-17 Pond	Liquid	2001	7.31×10^{-1}	1.62×10^{-3}	–	7.13	4.65×10^{-3}	2.95×10^{-2}	4.71×10^{-5}
UPR-200-W-47	UPR-200-W-47	Liquid	N/A	Site consolidated with Site WIDS ID 216-S-16P						
UPR-200-W-59	UPR-200-W-59	Liquid	N/A	Site consolidated with Site WIDS ID 216-S-16P						
UPR-200-W-34	UPR-200-W-34	Liquid	N/A	Site consolidated with Site WIDS ID 216-S-10D						
218-W-1	218-W-1 Burial Ground	Solid	1986	–	–	–	3.88	–	–	–
218-W-2	218-W-2 Burial Ground	Solid	1986	–	–	–	9.70	–	–	–
218-W-4B	218-W-4B Burial Ground	Solid	1995	5.23×10^{4}	1.14×10^{1}	–	1.48×10^{4}	–	–	5.00×10^{-1}
218-W-4C	218-W-4C Burial Ground	Solid	1995	3.29×10^{4}	2.63	2.00×10^{-4}	7.33×10^{3}	5.70×10^{-4}	1.64×10^{1}	1.46×10^{-3}
218-W-5	218-W-5 Burial Ground	Solid	1995	5.82×10^{4}	5.33	5.42×10^{-2}	1.05×10^{5}	1.03×10^{-3}	1.42×10^{2}	3.66×10^{-2}
218-W-3AE	218-W-3AE Burial Ground	Solid	1995	7.03×10^{4}	1.46×10^{1}	6.24×10^{-2}	8.65×10^{4}	7.84	3.50×10^{1}	4.46×10^{-4}
218-W-3A	218-W-3A Burial Ground	Solid	1995	1.35×10^{5}	2.91×10^{2}	1.25×10^{-4}	9.85×10^{4}	1.83×10^{-5}	2.54×10^{-1}	1.44×10^{-2}
Z Plant BP	Z Plant Burning Pit	Solid	N/A	Site consolidated with Site WIDS ID 218-W-4C						

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.
[b] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–43b. Map 9: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-S-5	216-S-5 Crib	Liquid	2001	5.63×10^{1}	–	1.89×10^{-14}	7.42×10^{-1}	1.37×10^{-4}	1.73×10^{-2}	1.02×10^{-2}
216-S-6	216-S-6 Crib	Liquid	2001	1.13×10^{1}	–	3.26×10^{-12}	5.77×10^{-1}	1.74×10^{-3}	2.98×10^{-1}	5.49×10^{-2}
216-S-10D[b]	216-S-10D Ditch	Liquid	1998	1.02	–	2.52×10^{-14}	6.91×10^{-11}	–	8.17×10^{-3}	1.87×10^{-2}
216-S-10P	216-S-10P Pond	Liquid	2001	3.76×10^{1}	–	2.56×10^{-10}	4.15×10^{-1}	4.60×10^{-2}	1.97×10^{1}	5.31×10^{1}
216-S-11	216-S-11 Pond	Liquid	1998	6.65×10^{-1}	–	2.57×10^{-15}	–	–	–	–
216-S-16D[b]	216-S-16D Ditch	Liquid	N/A	–	–	–	–	–	–	–
216-S-16P	216-S-16P Pond	Liquid	2001	7.07×10^{1}	–	2.96×10^{-14}	4.44×10^{-1}	1.37×10^{-4}	6.14×10^{-3}	6.68×10^{-3}
216-S-17	216-S-17 Pond	Liquid	2001	8.41×10^{1}	–	2.81×10^{-14}	2.39×10^{-3}	2.07×10^{-4}	8.55×10^{-3}	8.08×10^{-3}
UPR-200-W-47	UPR-200-W-47	Liquid	N/A	Site consolidated with Site WIDS ID 216-S-16P						
UPR-200-W-59	UPR-200-W-59	Liquid	N/A	Site consolidated with Site WIDS ID 216-S-16P						
UPR-200-W-34	UPR-200-W-34	Liquid	N/A	Site consolidated with Site WIDS ID 216-S-10D						
218-W-1	218-W-1 Burial Ground	Solid	1986	4.15	–	–	2.35×10^{-2}	–	6.82×10^{3}	–
218-W-2	218-W-2 Burial Ground	Solid	1986	1.04×10^{1}	–	–	4.69×10^{-1}	–	9.13×10^{3}	–
218-W-4B	218-W-4B Burial Ground	Solid	1995	1.63×10^{4}	–	–	–	–	–	–
218-W-4C	218-W-4C Burial Ground	Solid	1995	5.75×10^{4}	–	–	7.28×10^{1}	8.26×10^{-3}	1.73×10^{4}	1.61×10^{4}
218-W-5	218-W-5 Burial Ground	Solid	1995	3.25×10^{3}	–	–	6.54×10^{2}	3.47×10^{-2}	1.46×10^{2}	3.86
218-W-3AE	218-W-3AE Burial Ground	Solid	1995	1.29×10^{5}	–	–	1.85×10^{2}	6.79×10^{-2}	3.69×10^{1}	1.11×10^{2}
218-W-3A	218-W-3A Burial Ground	Solid	1995	2.70×10^{5}	3.39×10^{-3}	–	–	–	–	–
Z Plant BP	Z Plant Burning Pit	Solid	N/A	Site consolidated with Site WIDS ID 218-W-4C						

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–44a. Map 9A: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
218-W-3	218-W-3 Burial Ground	Solid	Varies based on time of disposal	–	–	–	1.75×10^{1}	–	–	–
218-W-4A	218-W-4A Burial Ground	Solid	1986	–	–	–	5.84×10^{1}	–	–	–
218-W-2A	218-W-2A Burial Ground	Solid	Varies based on time of disposal	–	–	–	2.98×10^{3}	–	–	–
UPR-200-W-84	UPR-200-W-84	Liquid	N/A	Site consolidated with Site WIDS ID 218-W-3A						
UPR-200-W-134	UPR-200-W-134	Solid	N/A	Site consolidated with Site WIDS ID 218-W-3A						
UPR-200-W-53	UPR-200-W-53	Liquid	N/A	Site consolidated with Site WIDS ID 218-W-2A						
UPR-200-W-72	UPR-200-W-72	Solid	N/A	Site consolidated with Site WIDS ID 218-W-4A						
UPR-200-W-16	UPR-200-W-16	Solid	N/A	Site consolidated with Site WIDS ID 218-W-1						
216-T-4A	216-T-4A Pond	Liquid	2001	1.25×10^{3}	1.11×10^{-4}	–	2.87	2.60×10^{-4}	6.68×10^{-2}	4.36×10^{-4}
216-T-4B	216-T-4B Pond	Liquid	N/A	Site consolidated with Site WIDS ID 216-T-4A						
216-T-36	216-T-36 Crib	Liquid	2001	1.24×10^{-3}	1.19×10^{-5}	–	6.16×10^{-1}	2.96×10^{-5}	2.15×10^{-4}	2.98×10^{-4}
216-T-4-2	216-T-4-2 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-T-4A						
UPR-200-W-97	UPR-200-W-97 Unplanned Release	Liquid	2001	5.57×10^{-6}	1.76×10^{-5}	–	1.87×10^{-2}	4.78×10^{-4}	9.49×10^{-6}	–
UPR-200-W-29	UPR-200-W-29 Unplanned Release	Liquid	2001	2.31×10^{-2}	3.06×10^{-4}	–	2.54×10^{-1}	4.67×10^{-3}	7.66×10^{-4}	6.68×10^{-6}
216-T-13	216-T-13 Trench	Liquid	1972	–	–	–	1.00×10^{-1}	–	–	–
216-T-27	216-T-27 Crib	Liquid	2001	8.35×10^{-3}	1.10×10^{-1}	–	4.15	2.00×10^{-4}	1.43×10^{-3}	–
216-TY-201	216-TY-201 Settling Tank	Liquid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–44b. Map 9A: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
218-W-3	218-W-3 Burial Ground	Solid	Varies based on time of disposal	1.87×10^{1}	–	–	2.35×10^{1}	–	4.93×10^{3}	–
218-W-4A	218-W-4A Burial Ground	Solid	1986	6.25×10^{1}	–	–	1.32×10^{2}	–	2.57×10^{3}	–
218-W-2A	218-W-2A Burial Ground	Solid	Varies based on time of disposal	3.18×10^{3}	–	–	–	–	–	–
UPR-200-W-84	UPR-200-W-84	Liquid	N/A	Site consolidated with Site WIDS ID 218-W-3A						
UPR-200-W-134	UPR-200-W-134	Solid	N/A	Site consolidated with Site WIDS ID 218-W-3A						
UPR-200-W-53	UPR-200-W-53	Liquid	N/A	Site consolidated with Site WIDS ID 218-W-2A						
UPR-200-W-72	UPR-200-W-72	Solid	N/A	Site consolidated with Site WIDS ID 218-W-4A						
UPR-200-W-16	UPR-200-W-16	Solid	N/A	Site consolidated with Site WIDS ID 218-W-1						
216-T-4A	216-T-4A Pond	Liquid	2001	5.50	–	5.15×10^{-11}	4.12×10^{-1}	1.63×10^{-4}	6.26×10^{-2}	8.30×10^{-4}
216-T-4B	216-T-4B Pond	Liquid	N/A	Site consolidated with Site WIDS ID 216-T-4A						
216-T-36	216-T-36 Crib	Liquid	2001	7.26×10^{-1}	–	3.46×10^{-8}	1.32	4.52×10^{-7}	2.28×10^{1}	7.96×10^{-4}
216-T-4-2	216-T-4-2 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-T-4A						
UPR-200-W-97	UPR-200-W-97 Unplanned Release	Liquid	2001	2.18×10^{-2}	–	2.87×10^{-13}	1.04×10^{-5}	3.93×10^{-6}	1.13×10^{-2}	2.76×10^{-4}
UPR-200-W-29	UPR-200-W-29 Unplanned Release	Liquid	2001	1.73	–	1.26×10^{-12}	7.92×10^{-5}	1.76×10^{-5}	2.13×10^{-4}	1.97×10^{-3}
216-T-13	216-T-13 Trench	Liquid	1972	1.00×10^{-1}	–	–	–	–	–	–
216-T-27	216-T-27 Crib	Liquid	2001	4.94	–	2.33×10^{-7}	8.17×10^{-2}	3.33×10^{-3}	1.98	2.30
216-TY-201	216-TY-201 Settling Tank	Liquid	N/A		–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–45a. Map 9B: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-T-12	216-T-12 Trench	Liquid	2001	7.92×10^{1}	4.04×10^{-4}	–	3.60×10^{-1}	6.18×10^{-3}	8.43×10^{-3}	8.82×10^{-6}
218-W-1A	218-W-1A Burial Ground	Solid	Varies based on time of disposal	–	–	–	9.32×10^{2}	–	–	–
UPR-200-W-26	UPR-200-W-26	Solid	N/A	Site consolidated with Site WIDS ID 218-W-1A						
216-T-29	216-T-29 Crib	Liquid	2001	4.57×10^{-5}	8.83×10^{-7}	–	5.07×10^{-3}	2.07×10^{-6}	1.88×10^{-5}	1.88×10^{-8}
216-T-33	216-T-33 Crib	Liquid	2001	7.66×10^{-1}	1.21×10^{-6}	–	6.03×10^{-2}	3.01×10^{-6}	4.13×10^{-3}	2.93×10^{-5}
216-T-34	216-T-34 Crib	Liquid	2001	3.68×10^{-4}	8.66×10^{-2}	–	1.74×10^{-1}	1.11×10^{-5}	7.37×10^{-5}	8.21×10^{-3}
216-T-35	216-T-35 Crib	Liquid	2001	–	1.50×10^{-1}	–	7.13×10^{-3}	–	–	–
216-T-1	216-T-1 Ditch (221-T Ditch)	Liquid	2001	4.23×10^{-2}	6.27×10^{-4}	–	2.70	1.06×10^{-4}	9.66×10^{-4}	9.63×10^{-7}
216-T-2	216-T-2 Reverse Well	Liquid	2001	7.14×10^{-3}	1.38×10^{-4}	–	7.92×10^{-1}	3.24×10^{-4}	2.94×10^{-3}	2.94×10^{-6}
216-T-3	216-T-3 Reverse Well	Liquid	2001	2.02×10^{-5}	4.14×10^{-3}	–	1.70	3.57×10^{-2}	9.57×10^{-4}	4.24×10^{-7}
216-T-6	216-T-6 Cribs	Liquid	2001	2.13×10^{-4}	1.48×10^{-2}	–	1.40×10^{1}	4.01×10^{-1}	7.87×10^{-3}	3.49×10^{-6}
216-T-8	216-T-8 Crib	Liquid	2001	4.38×10^{-4}	7.87×10^{-5}	–	1.52×10^{1}	2.80×10^{-6}	1.94×10^{-4}	2.17×10^{-7}
200-W-45	200-W-45 Sand Filter	Solid	1994	–	–	–	2.90×10^{1}	–	–	–
200-W-20	2706-T Equipment Decontamination Building	Solid	1994	–	–	–	1.50×10^{1}	–	–	–
200-W-20[b]	T Plant Complex (including 221-T Canyon)	Solid	1994	–	6.66×10^{-3}	–	1.66	–	4.03×10^{-3}	1.40×10^{-3}
224-T	224-T Canyon	Liquid/ solid	2003	–	–	–	–	–	–	–
200-W-9	200-W-9 Unplanned Release	Liquid	2001	1.61×10^{-4}	3.12×10^{-6}	–	1.79×10^{-2}	7.33×10^{-6}	6.66×10^{-5}	6.64×10^{-8}
UPR-200-W-2[c]	UPR-200-W-2 Unplanned Release	Liquid	2001	1.43×10^{-1}	3.80×10^{-3}	–	3.04×10^{1}	4.73×10^{-5}	8.43×10^{-2}	3.72×10^{-5}
UPR-200-W-21	UPR-200-W-21	Liquid	2001	2.87×10^{-1}	4.77×10^{-3}	–	2.75×10^{1}	7.08×10^{-5}	1.28×10^{-1}	1.46×10^{-4}
UPR-200-W-38	UPR-200-W-38 Unplanned Release	Liquid	2001	1.99×10^{-1}	3.31×10^{-3}	–	1.91×10^{1}	4.89×10^{-5}	8.87×10^{-2}	1.01×10^{-4}
UPR-200-W-98[c]	UPR-200-W-98 Unplanned Release	Liquid	2001	3.84×10^{-3}	1.03×10^{-4}	–	8.14×10^{-1}	1.26×10^{-6}	2.27×10^{-3}	1.01×10^{-6}
UPR-200-W-102	UPR-200-W-102 Unplanned Release	Liquid	2001	3.98×10^{-7}	1.65×10^{-5}	–	2.96×10^{-3}	–	1.51×10^{-6}	–
TRUSAF	TRUSAF (in 224-T Canyon)	Liquid/ solid	1985	–	–	–	2.20×10^{1}	–	–	–
241-T-361	241-T-361 Settling Tank	Liquid/ solid	Unknown	–	–	–	8.72×10^{2}	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] Inventories for all isotopes, except plutonium isotopes, were reduced by a factor of 1/10,000 to reduce conservatism.

[c] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–45b. Map 9B: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-T-12	216-T-12 Trench	Liquid	2001	2.29	–	1.67×10^{-12}	1.46×10^{-1}	2.42×10^{-5}	2.47×10^{-3}	2.60×10^{-3}
218-W-1A	218-W-1A Burial Ground	Solid	Varies based on time of disposal	9.97×10^{2}	–	–	3.02×10^{-1}	–	1.45×10^{2}	–
UPR-200-W-26	UPR-200-W-26	Solid	N/A	Site consolidated with Site WIDS ID 218-W-1A						
216-T-29	216-T-29 Crib	Liquid	2001	4.17×10^{-2}	–	1.12×10^{-15}	1.29×10^{-6}	1.16×10^{-7}	2.37×10^{-5}	6.60×10^{-6}
216-T-33	216-T-33 Crib	Liquid	2001	7.34×10^{-2}	–	3.37×10^{-9}	1.57×10^{-1}	4.95×10^{-8}	2.24	7.86×10^{-5}
216-T-34	216-T-34 Crib	Liquid	2001	3.08×10^{-1}	–	9.51×10^{-9}	3.73×10^{-1}	1.21×10^{-3}	6.99	1.81
216-T-35	216-T-35 Crib	Liquid	2001	7.71×10^{-2}	–	9.44×10^{-12}	2.39×10^{-2}	2.10×10^{-3}	1.19	3.14
216-T-1	216-T-1 Ditch (221-T Ditch)	Liquid	2001	2.42	–	9.30×10^{-14}	1.53×10^{-4}	2.04×10^{-5}	7.17×10^{-3}	3.56×10^{-4}
216-T-2	216-T-2 Reverse Well	Liquid	2001	6.51	–	1.74×10^{-13}	2.02×10^{-4}	1.82×10^{-5}	3.70×10^{-3}	1.03×10^{-3}
216-T-3	216-T-3 Reverse Well	Liquid	2001	1.95	–	2.82×10^{-10}	1.36×10^{-3}	3.35×10^{-3}	1.77×10^{1}	7.26×10^{-2}
216-T-6	216-T-6 Cribs	Liquid	2001	1.60×10^{1}	–	2.78×10^{-10}	1.41×10^{-2}	3.31×10^{-3}	1.61×10^{1}	7.17×10^{-2}
216-T-8	216-T-8 Crib	Liquid	2001	4.41×10^{-1}	–	4.47×10^{-15}	3.21×10^{-2}	1.12×10^{-6}	1.22×10^{-3}	7.64×10^{-5}
200-W-45	200-W-45 Sand Filter	Solid	1994	3.30×10^{1}	–	–	–	–	4.10	–
200-W-20	2706-T Equipment Decontamination Building	Solid	1994	1.50×10^{1}	–	–	–	–	2.50	1.50×10^{-1}
200-W-20[b]	T Plant Complex (including 221-T Canyon)	Solid	1994	5.24	–	–	1.26×10^{-3}	–	7.49×10^{1}	5.49×10^{-3}
224-T	224-T Canyon	Liquid/ solid	2003	–	–	–	–	–	1.70	1.86×10^{1}
200-W-9	200-W-9 Unplanned Release	Liquid	2001	1.47×10^{-1}	–	3.95×10^{-15}	4.57×10^{-6}	4.11×10^{-7}	8.38×10^{-5}	2.34×10^{-5}
UPR-200-W-2[c]	UPR-200-W-2 Unplanned Release	Liquid	2001	1.72×10^{2}	–	1.72×10^{-12}	7.91×10^{-3}	4.77×10^{-4}	5.30×10^{-2}	1.03×10^{-2}
UPR-200-W-21	UPR-200-W-21	Liquid	2001	2.92×10^{2}	–	2.28×10^{-12}	7.12×10^{-3}	7.35×10^{-4}	6.49×10^{-2}	5.14×10^{-2}
UPR-200-W-38	UPR-200-W-38 Unplanned Release	Liquid	2001	2.03×10^{2}	–	1.59×10^{-12}	4.94×10^{-3}	5.09×10^{-4}	4.50×10^{-2}	3.58×10^{-2}
UPR-200-W-98[c]	UPR-200-W-98 Unplanned Release	Liquid	2001	4.59	–	4.61×10^{-14}	2.12×10^{-4}	1.28×10^{-5}	1.41×10^{-3}	2.76×10^{-4}
UPR-200-W-102	UPR-200-W-102 Unplanned Release	Liquid	2001	3.46×10^{-3}	–	1.34×10^{-12}	3.60×10^{-7}	1.84×10^{-5}	4.01	1.29×10^{-3}
TRUSAF	TRUSAF (in 224-T Canyon)	Liquid/ solid	1985	1.10	–	–	–	–	3.10×10^{1}	5.00
241-T-361	241-T-361 Settling Tank	Liquid/ solid	Unknown	4.91×10^{3}	–	–	–	–	1.39×10^{4}	1.60×10^{3}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] Inventories for all isotopes, except plutonium isotopes, were reduced by a factor of 1/10,000 to reduce conservatism.

[c] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–46a. Map 9C: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-Z-16	216-Z-16 Crib	Liquid	2001	–	–	–	4.39×10^{-5}	1.23×10^{-6}	5.45×10^{-6}	–
231-Z	231-Z Plutonium Isolation Facility	Solid	2003	–	–	–	–	–	–	–
216-Z-4	216-Z-4 Trench	Liquid	2001	–	–	–	2.28×10^{-1}	1.00×10^{-6}	4.47×10^{-6}	–
216-Z-5	216-Z-5 Crib	Liquid	2001	–	–	–	3.69	1.62×10^{-5}	7.21×10^{-5}	–
216-Z-6	216-Z-6 Crib	Liquid	2001	–	–	–	4.86×10^{-1}	2.13×10^{-6}	9.50×10^{-6}	–
216-Z-7	216-Z-7 Crib	Liquid	2001	1.55×10^{-3}	1.50×10^{-5}	–	1.54×10^{2}	7.10×10^{-4}	3.26×10^{-3}	3.71×10^{-3}
216-Z-8	216-Z-8 Trench	Liquid	2001	–	–	–	2.95×10^{-12}	–	–	–
216-Z-9	216-Z-9 Trench	Liquid	2001	–	–	–	5.96×10^{-2}	7.87×10^{-6}	3.50×10^{-5}	–
216-Z-10	216-Z-10 Reverse Well	Liquid	2001	–	–	–	4.78	2.10×10^{-5}	9.33×10^{-5}	–
UPR-200-W-130[b]	UPR-200-W-130	Liquid	2001	–	–	–	1.43×10^{-10}	3.91×10^{-12}	1.76×10^{-11}	–
216-Z-17	216-Z-17 Trench	Liquid	2001	–	–	–	1.58×10^{-5}	4.42×10^{-7}	1.97×10^{-6}	–
216-Z-15	216-Z-15 French Drain	Liquid	2001	–	–	–	1.63×10^{-8}	–	–	–
234-5Z[c]	234-5Z Plutonium Finishing Plant	Solid	N/A	–	–	–	–	–	–	–
2736-Z	2736-Z Plutonium Finishing Plant	Liquid/ solid	Unknown	–	–	–	–	–	–	–
242-Z	242-Z Americium Recovery Facility	Solid	Unknown	–	–	–	–	–	–	–
216-Z-1D[d]	216-Z-1(D) Ditch	Liquid	1986	–	–	–	–	–	–	–
236-Z	236-Z Plutonium Reclamation Facility	Solid	Unknown	–	–	–	–	–	–	–
216-Z-14	216-Z-14 French Drain	Liquid	2001	–	–	–	1.57×10^{-8}	–	–	–
291-Z	291-Z Exhaust Fan and Compressor House	Solid	N/A	–	–	–	–	–	–	–
UPR-200-W-103	UPR-200-W-103	Liquid	2001	–	–	–	–	–	–	–
241-Z[c]	241-Z Treatment Tank	Liquid	N/A	–	–	–	–	–	–	–
241-Z-361	241-Z-361 Settling Tank	Liquid	N/A	–	–	–	–	–	–	–
216-Z-13	216-Z-13 French Drain	Liquid	2001	–	–	–	1.51×10^{-8}	–	–	–
216-Z-1&2	216-Z-1 & 2 Cribs	Liquid	2001	–	–	–	1.68×10^{-2}	1.07×10^{-6}	4.77×10^{-6}	–
216-Z-3	216-Z-3 Crib	Liquid	2001	–	–	–	3.20×10^{-1}	1.89×10^{-6}	8.39×10^{-6}	–
216-Z-12	216-Z-12 Crib	Liquid	2001	–	–	–	7.05×10^{-1}	4.75×10^{-5}	2.11×10^{-4}	–
216-Z-1A	216-Z-1A Tile Field	Liquid	2001	–	–	–	9.82×10^{-1}	1.60×10^{-5}	7.10×10^{-5}	–
216-Z-18	216-Z-18 Crib	Liquid	2001	–	–	–	5.68×10^{-2}	7.51×10^{-6}	3.33×10^{-5}	–
216-Z-20	216-Z-20 Crib	Liquid	2001	–	–	–	1.94×10^{-7}	–	–	–
216-Z-21	216-Z-21 Seepage Basin	Liquid	2001	–	–	–	4.82×10^{-7}	–	–	–

Table S–46a. Map 9C: Radionuclide Inventories (curies) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-Z-11	216-Z-11 Ditch	Liquid	1986	–	–	–	–	–	–	–
216-U-13	216-U-13 Trench	Liquid	2001	1.78×10^{-5}	1.14×10^{-6}	–	1.74×10^{-1}	6.13×10^{-7}	7.48×10^{-6}	7.73×10^{-9}
216-U-14[d]	216-U-14 Ditch	Liquid	2001	9.52	7.77×10^{-3}	–	7.52×10^{-2}	1.37×10^{-4}	8.21×10^{-4}	8.23×10^{-3}
207-U	207-U Retention Basin	Liquid	N/A	–	–	–	–	–	–	–
UPR-200-W-135	UPR-200-W-135 Unplanned Release	Liquid	2001	9.80×10^{-2}	1.63×10^{-3}	–	9.38	2.41×10^{-5}	4.36×10^{-2}	4.97×10^{-5}
UPR-200-W-28	UPR-200-W-28	Liquid	2001	1.42×10^{-2}	5.46×10^{-4}	–	5.72	6.65×10^{-6}	8.62×10^{-3}	1.11×10^{-5}
UPR-200-W-131[b]	UPR-200-W-131	Liquid	2001	9.26×10^{-5}	3.59×10^{-6}	–	3.75×10^{-2}	4.36×10^{-8}	5.64×10^{-5}	7.23×10^{-8}
200-W PP	200-W PP Powerhouse Pond	Liquid	2001	–	–	–	–	–	–	–
216-T-20	216-T-20 Trench	Liquid	2001	3.03×10^{-1}	9.23×10^{-6}	–	7.64×10^{-2}	3.33×10^{-5}	1.08×10^{-4}	1.52×10^{-7}
232-Z	232-Z Waste Incinerator	Solid	2002	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

[c] This site had inventories that were in the initial list of constituents, but was screened out during final screening described in Section S.3.6.

[d] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–46b. Map 9C: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-Z-16	216-Z-16 Crib	Liquid	2001	4.84×10^{-5}	–	9.50×10^{-14}	3.09×10^{-4}	1.06×10^{-2}	3.57	2.75
231-Z	231-Z Plutonium Isolation Facility	Solid	2003	–	–	–	–	–	6.85	–
216-Z-4	216-Z-4 Trench	Liquid	2001	2.35×10^{-1}	–	1.05×10^{-16}	9.53×10^{-6}	1.06×10^{-3}	7.06×10^{-1}	7.60
216-Z-5	216-Z-5 Crib	Liquid	2001	3.79	–	1.67×10^{-15}	1.52×10^{-4}	4.76×10^{-2}	3.16×10^{1}	1.18×10^{3}
216-Z-6	216-Z-6 Crib	Liquid	2001	4.99×10^{-1}	–	2.23×10^{-16}	2.03×10^{-5}	2.34×10^{-3}	1.55	1.87×10^{1}
216-Z-7	216-Z-7 Crib	Liquid	2001	1.58×10^{2}	–	4.27×10^{-8}	1.64	7.78×10^{-1}	5.45×10^{2}	7.35×10^{3}
216-Z-8	216-Z-8 Trench	Liquid	2001	6.81×10^{-12}	–	5.83×10^{-20}	3.21×10^{-9}	1.66×10^{-2}	3.28	6.73×10^{-1}
216-Z-9	216-Z-9 Trench	Liquid	2001	6.22×10^{-2}	–	2.87×10^{-16}	1.70×10^{-5}	9.89	2.18×10^{3}	5.65×10^{2}
216-Z-10	216-Z-10 Reverse Well	Liquid	2001	4.90	–	2.19×10^{-15}	1.99×10^{-4}	2.30×10^{-2}	1.53×10^{1}	1.85×10^{2}
UPR-200-W-130[b]	UPR-200-W-130	Liquid	2001	1.57×10^{-10}	–	3.05×10^{-19}	9.96×10^{-10}	3.44×10^{-8}	1.14×10^{-5}	9.15×10^{-6}
216-Z-17	216-Z-17 Trench	Liquid	2001	1.75×10^{-5}	–	3.43×10^{-14}	1.12×10^{-4}	3.84×10^{-3}	1.29	9.91×10^{-1}
216-Z-15	216-Z-15 French Drain	Liquid	2001	3.75×10^{-8}	–	3.52×10^{-15}	1.53×10^{-5}	1.51×10^{-9}	4.88×10^{-7}	6.26×10^{-8}
234-5Z[c]	234-5Z Plutonium Finishing Plant	Solid	N/A	–	–	–	–	–	–	–

Table S–46b. Map 9C: Radionuclide Inventories (curies) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
2736-Z	2736-Z Plutonium Finishing Plant	Liquid/ solid	Unknown	–	–	–	–	–	1.98×10^{2}	1.92×10^{2}
242-Z	242-Z Americium Recovery Facility	Solid	Unknown	–	–	–	–	–	8.57×10^{1}	3.51×10^{3}
216-Z-1D[d]	216-Z-1(D) Ditch	Liquid	1986	–	–	–	–	–	1.74×10^{2}	–
236-Z	236-Z Plutonium Reclamation Facility	Solid	Unknown	–	–	–	–	–	4.72×10^{3}	4.56×10^{3}
216-Z-14	216-Z-14 French Drain	Liquid	2001	3.62×10^{-8}	–	3.53×10^{-15}	1.48×10^{-5}	1.44×10^{-9}	4.72×10^{-7}	6.05×10^{-8}
291-Z	291-Z Exhaust Fan and Compressor House	Solid	N/A	–	–	–	–	–	1.07×10^{1}	1.03×10^{1}
UPR-200-W-103	UPR-200-W-103	Liquid	2001	–	–	7.54×10^{-20}	2.46×10^{-10}	3.87×10^{-3}	1.30	2.42×10^{-1}
241-Z[c]	241-Z Treatment Tank	Liquid	N/A	–	–	–	–	–	–	–
241-Z-361	241-Z-361 Settling Tank	Liquid	N/A	–	–	–	–	–	4.67×10^{3}	–
216-Z-13	216-Z-13 French Drain	Liquid	2001	3.48×10^{-8}	–	3.35×10^{-15}	1.42×10^{-5}	1.38×10^{-9}	4.53×10^{-7}	5.81×10^{-8}
216-Z-1&2	216-Z-1 & 2 Cribs	Liquid	2001	1.07×10^{-2}	–	3.98×10^{-16}	7.13×10^{-6}	4.98×10^{-1}	1.85×10^{2}	1.88×10^{2}
216-Z-3	216-Z-3 Crib	Liquid	2001	3.20×10^{-1}	–	1.56×10^{-16}	1.11×10^{-5}	4.26×10^{-1}	1.35×10^{2}	5.23×10^{3}
216-Z-12	216-Z-12 Crib	Liquid	2001	7.10×10^{-1}	–	4.04×10^{-14}	1.43×10^{-4}	1.08×10^{1}	3.15×10^{3}	8.51×10^{3}
216-Z-1A	216-Z-1A Tile Field	Liquid	2001	1.01	–	9.21×10^{-15}	6.58×10^{-5}	1.23×10^{1}	4.14×10^{3}	3.88×10^{3}
216-Z-18	216-Z-18 Crib	Liquid	2001	5.94×10^{-2}	–	5.48×10^{-15}	1.78×10^{-5}	6.86	2.30×10^{3}	7.55×10^{2}
216-Z-20	216-Z-20 Crib	Liquid	2001	4.47×10^{-7}	–	5.76×10^{-14}	1.88×10^{-4}	8.62×10^{-3}	2.90	5.39×10^{-1}
216-Z-21	216-Z-21 Seepage Basin	Liquid	2001	1.11×10^{-6}	–	1.43×10^{-13}	4.66×10^{-4}	4.48×10^{-8}	1.50×10^{-5}	1.86×10^{-6}
216-Z-11	216-Z-11 Ditch	Liquid	1986	–	–	–	–	–	1.74×10^{2}	–
216-U-13	216-U-13 Trench	Liquid	2001	1.67×10^{-2}	–	3.64×10^{-16}	3.64×10^{-4}	4.53×10^{-8}	2.05×10^{-5}	2.72×10^{-6}
216-U-14[d]	216-U-14 Ditch	Liquid	2001	2.85	–	3.09×10^{-10}	5.71×10^{-2}	1.36×10^{-3}	2.65×10^{-1}	2.32×10^{-3}
207-U	207-U Retention Basin	Liquid	N/A	–	–	–	–	–	–	–
UPR-200-W-135	UPR-200-W-135 Unplanned Release	Liquid	2001	9.98×10^{1}	–	7.80×10^{-13}	2.43×10^{-3}	2.51×10^{-4}	2.22×10^{-2}	1.76×10^{-2}
UPR-200-W-28	UPR-200-W-28	Liquid	2001	2.63×10^{1}	–	2.23×10^{-13}	4.84×10^{-5}	6.84×10^{-5}	7.57×10^{-3}	3.79×10^{-3}
UPR-200-W-131[b]	UPR-200-W-131	Liquid	2001	1.73×10^{-1}	–	1.46×10^{-15}	3.16×10^{-7}	4.49×10^{-7}	4.96×10^{-5}	2.47×10^{-5}
200-W PP	200-W PP Powerhouse Pond	Liquid	2001	–	–	–	–	–	–	–
216-T-20	216-T-20 Trench	Liquid	2001	3.19×10^{-1}	–	1.18×10^{-14}	7.24×10^{-7}	9.37×10^{-7}	1.95×10^{-4}	5.27×10^{-5}
232-Z	232-Z Waste Incinerator	Solid	2002	–	–	–	–	–	4.84×10^{1}	3.46

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.
[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.
[c] This site had inventories that were in the initial list of constituents, but was screened out during final screening described in Section S.3.6.
[d] This site was consolidated with another site for purposes of modeling.
Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.
Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–47a. Map 9D: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-U-10	216-U-10 Pond	Liquid	2001	2.47×10^{2}	2.02×10^{-1}	–	1.96	3.56×10^{-3}	2.13×10^{-2}	2.14×10^{-1}
216-U-3	216-U-3 French Drain	Liquid	2001	2.28×10^{1}	–	–	1.39×10^{-7}	–	5.94×10^{-4}	–
UPR-200-W-104	UPR-200-W-104	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
UPR-200-W-105	UPR-200-W-105	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
UPR-200-W-106	UPR-200-W-106	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
216-S-4	216-S-4 French Drain	Liquid	2001	2.91×10^{1}	–	–	1.81×10^{-7}	–	–	–
216-S-3	216-S-3 Crib	Liquid	2001	1.22×10^{2}	4.06×10^{-4}	–	3.31×10^{-1}	2.28×10^{-3}	1.42×10^{-2}	2.18×10^{-5}
216-S-21	216-S-21 Crib	Liquid	2001	2.54×10^{3}	8.95×10^{-3}	–	6.63	3.38×10^{-2}	2.11×10^{-1}	3.23×10^{-4}
UPR-200-W-107	UPR-200-W-107	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
216-S-25	216-S-25 Crib	Liquid	1998	3.62×10^{3}	4.48×10^{-5}	–	4.85×10^{-5}	–	–	–
216-S-1&2	216-S-1 & 216-S-2 Cribs	Liquid	2001	2.54×10^{3}	–	–	9.59×10^{2}	5.87×10^{-1}	2.60	1.36×10^{-1}
216-S-8	216-S-8 Trench	Liquid	2001	–	–	–	–	–	–	–
UPR-200-W-95	UPR-200-W-95	Liquid	2001	1.10×10^{-3}	5.97×10^{-5}	–	9.82×10^{-2}	1.65×10^{-4}	1.05×10^{-3}	1.68×10^{-6}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–47b. Map 9D: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-U-10	216-U-10 Pond	Liquid	2001	7.41×10^{1}	–	8.03×10^{-9}	1.49	1.21	4.00×10^{2}	1.60×10^{2}
216-U-3	216-U-3 French Drain	Liquid	2001	3.42×10^{-7}	–	9.63×10^{-18}	1.17×10^{-2}	2.93×10^{-6}	4.96×10^{-4}	–
UPR-200-W-104	UPR-200-W-104	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
UPR-200-W-105	UPR-200-W-105	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
UPR-200-W-106	UPR-200-W-106	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
216-S-4	216-S-4 French Drain	Liquid	2001	4.43×10^{-7}	–	1.25×10^{-17}	2.03×10^{-7}	3.80×10^{-6}	6.42×10^{-4}	–
216-S-3	216-S-3 Crib	Liquid	2001	4.21×10^{1}	–	9.21×10^{-10}	1.41×10^{-3}	7.21×10^{-5}	3.53×10^{-3}	8.96×10^{-4}
216-S-21	216-S-21 Crib	Liquid	2001	6.28×10^{2}	–	1.36×10^{-8}	9.49×10^{-5}	1.16×10^{-3}	7.33×10^{-2}	1.79×10^{-2}
UPR-200-W-107	UPR-200-W-107	Liquid	N/A	Site consolidated with Site WIDS ID 216-U-10						
216-S-25	216-S-25 Crib	Liquid	1998	2.30×10^{-5}	–	1.19×10^{-13}	4.87×10^{-4}	9.59×10^{-4}	1.71×10^{-1}	1.35×10^{-5}
216-S-1&2	216-S-1 & 216-S-2 Cribs	Liquid	2001	8.27×10^{2}	–	9.19×10^{-11}	1.50	5.14×10^{-1}	8.70×10^{1}	2.45×10^{1}
216-S-8	216-S-8 Trench	Liquid	2001	–	–	–	2.09×10^{-1}	–	–	–
UPR-200-W-95	UPR-200-W-95	Liquid	2001	2.97	–	9.57×10^{-16}	8.25×10^{-7}	7.66×10^{-6}	2.41×10^{-4}	2.69×10^{-4}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–48a. Map 9E: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-U-5	216-U-5 Trench	Liquid	2001	–	–	–	–	–	–	–
216-U-6	216-U-6 Trench	Liquid	2001	–	–	–	–	–	–	–
221-U	221-U Process Canyon	Liquid/ solid	2001	–	–	–	1.00×10^{5}	–	–	–
241-WR-Vault	241-WR Vault	Liquid	1976	–	–	–	6.00×10^{1}	–	–	–
216-U-15	216-U-15 Trench	Liquid	2001	6.38×10^{-5}	1.51×10^{-6}	–	1.13×10^{-2}	2.25×10^{-6}	3.52×10^{-2}	3.16×10^{-8}
UPR-200-W-138	UPR-200-W-138	Liquid	2001	2.33×10^{-1}	–	–	–	–	4.43×10^{-4}	–
200-W-44	200-W-44 Sand filter	Solid	Active	–	–	–	7.90×10^{2}	–	–	–
216-U-7	216-U-7 French Drain	Liquid	2001	1.90×10^{-8}	4.36×10^{-10}	–	3.87×10^{-7}	2.20×10^{-9}	1.17×10^{-8}	2.24×10^{-11}
UPR-200-W-101	UPR-200-W-101 Unplanned Release	Liquid	2001	7.09×10^{-2}	–	–	–	–	1.34×10^{-4}	–
216-U-4	216-U-4 Reverse Well	Liquid	2001	3.56×10^{-4}	6.99×10^{-6}	–	3.95×10^{-2}	1.61×10^{-5}	1.47×10^{-4}	1.46×10^{-7}
216-U-4A	216-U-4A French Drain	Liquid	2001	5.69×10^{-7}	1.43×10^{-2}	–	7.42×10^{-4}	2.58×10^{-8}	2.35×10^{-7}	2.34×10^{-10}
216-U-1&2	216-U-1&2 Cribs	Liquid	2001	1.13×10^{2}	1.12×10^{-4}	–	1.17	1.36×10^{-6}	7.27	2.27×10^{-6}
241-U-361	241-U-361 Settling Tank	Liquid	1976	–	–	–	7.60×10^{2}	–	–	–
UPR-200-W-39	UPR-200-W-39 Unplanned Release	Liquid	2001	6.06×10^{-3}	–	–	–	–	1.14×10^{-5}	–
200-W-42[b]	200-W-42 Process Sewer	Liquid	2001	3.20×10^{-1}	–	–	–	–	–	–
UPR-200-W-163	UPR-200-W-163 Unplanned Release	Liquid	2001	9.35×10^{-1}	3.05×10^{-10}	–	1.42×10^{-6}	8.62×10^{-10}	2.27×10^{-3}	2.49×10^{-7}
216-U-16	216-U-16 Crib	Liquid	2001	4.18×10^{3}	9.28×10^{-4}	–	6.71×10^{-8}	–	–	7.53×10^{-8}
216-S-9	216-S-9 Crib	Liquid	2001	1.17×10^{3}	–	–	1.19×10^{2}	2.33×10^{-2}	1.04×10^{-1}	2.95×10^{-2}
216-S-23	216-S-23 Crib	Liquid	2001	4.24×10^{-5}	7.08×10^{-7}	–	1.15×10^{-3}	2.96×10^{-6}	1.86×10^{-5}	2.93×10^{-8}
216-U-8	216-U-8 Crib	Liquid	2001	4.62×10^{3}	6.80×10^{-6}	–	3.25×10^{-2}	1.88×10^{-5}	2.71	4.93×10^{-3}
216-U-12	216-U-12 Crib	Liquid	2001	3.16×10^{3}	7.64×10^{-7}	–	3.00×10^{1}	3.45×10^{-3}	6.78×10^{-1}	1.38×10^{-6}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–48b. Map 9E: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-U-5	216-U-5 Trench	Liquid	2001	–	–	–	4.27×10^{-1}	–	–	–
216-U-6	216-U-6 Trench	Liquid	2001	–	–	–	4.27×10^{-1}	–	–	–
221-U	221-U Process Canyon	Liquid/ solid	2001	2.42×10^{2}	–	–	–	–	7.20×10^{1}	2.60×10^{1}
241-WR-Vault	241-WR Vault	Liquid	1976	–	–	–	–	–	–	–
216-U-15	216-U-15 Trench	Liquid	2001	5.41×10^{-2}	–	1.03×10^{-11}	6.71×10^{-3}	2.24×10^{-6}	2.59×10^{-4}	1.24×10^{-4}
UPR-200-W-138	UPR-200-W-138	Liquid	2001	–	–	–	8.75×10^{-3}	–	–	–
200-W-44	200-W-44 Sand Filter	Solid	Active	6.80×10^{3}	–	–	–	–	4.10×10^{1}	–
216-U-7	216-U-7 French Drain	Liquid	2001	4.84×10^{-5}	–	1.52×10^{-14}	3.71×10^{-11}	4.72×10^{-11}	1.98×10^{-9}	1.37×10^{-9}
UPR-200-W-101	UPR-200-W-101 Unplanned Release	Liquid	2001	–	–	–	2.63×10^{-3}	–	–	–
216-U-4	216-U-4 Reverse Well	Liquid	2001	3.25×10^{-1}	–	1.93×10^{-14}	1.01×10^{-5}	1.03×10^{-6}	1.87×10^{-4}	5.42×10^{-5}
216-U-4A	216-U-4A French Drain	Liquid	2001	7.85×10^{-3}	–	6.96×10^{-13}	2.16×10^{-3}	2.95×10^{-4}	1.10×10^{-1}	2.99×10^{-1}
216-U-1&2	216-U-1&2 Cribs	Liquid	2001	1.81	–	2.07×10^{-9}	2.67	4.26×10^{-4}	4.74×10^{-2}	2.34×10^{-2}
241-U-361	241-U-361 Settling Tank	Liquid	1976	1.37×10^{3}	–	–	–	–	–	–
UPR-200-W-39	UPR-200-W-39 Unplanned Release	Liquid	2001	–	–	–	2.25×10^{-4}	–	–	–
200-W-42[b]	200-W-42 Process Sewer	Liquid	2001	–	–	1.63×10^{-16}	3.63×10^{-7}	1.11×10^{-9}	3.73×10^{-7}	–
UPR-200-W-163	UPR-200-W-163 Unplanned Release	Liquid	2001	3.03×10^{-6}	–	2.06×10^{-17}	1.50×10^{-2}	8.57×10^{-10}	1.31×10^{-7}	2.07×10^{-9}
216-U-16	216-U-16 Crib	Liquid	2001	8.55×10^{-5}	–	9.83×10^{-14}	1.05×10^{-4}	3.65×10^{-7}	1.13×10^{-4}	2.96×10^{-5}
216-S-9	216-S-9 Crib	Liquid	2001	6.04×10^{1}	–	1.01×10^{-10}	2.28×10^{-1}	2.01×10^{-2}	3.57	3.29×10^{-2}
216-S-23	216-S-23 Crib	Liquid	2001	5.88×10^{-2}	–	2.37×10^{-17}	1.13×10^{-8}	8.53×10^{-8}	3.10×10^{-6}	3.39×10^{-6}
216-U-8	216-U-8 Crib	Liquid	2001	5.12×10^{-2}	–	1.38×10^{-12}	1.72×10^{1}	5.63×10^{-5}	8.57×10^{-3}	4.66×10^{-5}
216-U-12	216-U-12 Crib	Liquid	2001	6.96×10^{1}	–	3.54×10^{-4}	4.48	1.68×10^{-5}	4.75×10^{-3}	1.37×10^{-8}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–49a. Map 9F: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-S-19	216-S-19 Pond	Liquid	2001	2.30×10^{-1}	3.42×10^{-3}	–	1.63×10^{-4}	–	–	–
216-S-14	216-S-14 Trench	Liquid	2001	–	–	–	–	–	–	–
216-S-7	216-S-7 Crib	Liquid	2001	8.38×10^{3}	–	–	1.47×10^{3}	5.59×10^{-1}	2.48	3.51×10^{-1}
UPR-200-W-32[b]	UPR-200-W-32	Liquid	2001	7.69×10^{-3}	–	–	–	–	1.56×10^{-5}	–
216-S-13	216-S-13 Crib	Liquid	2001	4.31×10^{1}	1.86×10^{-4}	–	4.20×10^{-1}	6.47×10^{-2}	4.40×10^{-1}	–
216-S-12	216-S-12 Trench	Liquid	2001	1.06×10^{-1}	1.62×10^{-7}	–	1.39	8.53×10^{-4}	3.77×10^{-3}	4.03×10^{-4}
200-W-22	200-W-22 Unplanned Release	Liquid	2001	9.02×10^{-4}	–	–	–	–	2.13×10^{-6}	–
233-S	233-S Plutonium Concentration Facility	Solid	2003	–	–	–	–	–	–	–
200-W-69	200-W-69 Lab Complex (includes 222-S Lab, 222-S DMWSA, 219-S, 222-SA, 296-S-21, 296-S-16, 296-S-23, 296-S-13)	Liquid/ solid	2002	–	–	–	1.80×10^{3}	–	–	–
UPR-200-W-61	UPR-200-W-61	Liquid	2001	2.29×10^{-2}	1.25×10^{-3}	–	2.06	3.48×10^{-3}	2.20×10^{-2}	3.53×10^{-5}
202-S	202-S (REDOX)	Solid	1997	–	–	–	9.84×10^{3}	–	–	–
291-S	291-S Sand Filter	Solid	1998	–	–	–	8.00×10^{3}	–	–	–
216-S-20	216-S-20 Crib	Liquid	2001	1.53×10^{-1}	2.69	–	7.46×10^{1}	3.60×10^{-3}	2.57×10^{-2}	8.15×10^{-3}
216-S-22	216-S-22 Crib	Liquid	2001	2.23	2.04×10^{-9}	–	3.31×10^{-6}	8.54×10^{-9}	5.38×10^{-8}	6.39×10^{-6}
216-S-26	216-S-26 Crib	Liquid	2001	3.87×10^{-2}	5.77×10^{-4}	–	2.74×10^{-5}	–	–	–
218-W-7	218-W-7 Burial Ground (222-S Vault)	Solid	1986	–	–	–	7.82×10^{1}	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; REDOX=Reduction-Oxidation (Facility); Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–49b. Map 9F: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-S-19	216-S-19 Pond	Liquid	2001	1.76×10^{-3}	–	2.19×10^{-13}	5.38×10^{-4}	1.26×10^{-6}	3.74×10^{-4}	1.03×10^{-3}
216-S-14	216-S-14 Trench	Liquid	2001	–	–	–	4.96×10^{-5}	–	–	–
216-S-7	216-S-7 Crib	Liquid	2001	9.79×10^{2}	–	7.63×10^{-10}	2.59	4.87×10^{-1}	8.36×10^{1}	1.68×10^{1}
UPR-200-W-32[b]	UPR-200-W-32	Liquid	2001	–	–	–	1.93×10^{-4}	–	–	–
216-S-13	216-S-13 Crib	Liquid	2001	1.45×10^{2}	–	3.80×10^{-13}	2.08×10^{-3}	1.24×10^{-2}	8.63×10^{-1}	9.36×10^{-1}
216-S-12	216-S-12 Trench	Liquid	2001	1.22	–	1.35×10^{-13}	2.16×10^{-3}	7.47×10^{-4}	1.27×10^{-1}	3.54×10^{-2}
200-W-22	200-W-22 Unplanned Release	Liquid	2001	–	–	–	1.87×10^{-5}	–	–	–
233-S	233-S Plutonium Concentration Facility	Solid	2003	–	–	–	–	2.10×10^{-3}	7.58	3.70
200-W-69	200-W-69 Lab Complex (includes 222-S Lab, 222-S DMWSA, 219-S, 222-SA, 296-S-21, 296-S-16, 296-S-23, 296-S-13)	Liquid/ solid	2002	6.33×10^{2}	–	–	–	–	1.83×10^{1}	1.35×10^{1}
UPR-200-W-61	UPR-200-W-61	Liquid	2001	6.25×10^{1}	–	2.02×10^{-14}	1.74×10^{-5}	1.61×10^{-4}	5.08×10^{-3}	5.58×10^{-3}
202-S	202-S (REDOX)	Solid	1997	–	–	–	–	–	1.64×10^{3}	–
291-S	291-S Sand Filter	Solid	1998	–	–	–	–	–	3.40×10^{2}	–
216-S-20	216-S-20 Crib	Liquid	2001	8.90×10^{1}	–	4.18×10^{-6}	5.59×10^{-1}	1.20×10^{-1}	2.26×10^{1}	5.62×10^{1}
216-S-22	216-S-22 Crib	Liquid	2001	1.70×10^{-6}	–	6.85×10^{-20}	3.27×10^{-11}	2.46×10^{-10}	8.93×10^{-9}	9.77×10^{-9}
216-S-26	216-S-26 Crib	Liquid	2001	2.96×10^{-4}	–	9.07×10^{-14}	9.67×10^{-5}	2.05×10^{-7}	6.33×10^{-5}	1.76×10^{-4}
218-W-7	218-W-7 Burial Ground (222-S Vault)	Solid	1986	8.36×10^{1}	–	–	2.30×10^{-4}	–	5.08×10^{-2}	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; REDOX=Reduction-Oxidation (Facility); Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–50a. Map 10: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
600-148[b]	Environmental Restoration Disposal Facility	Solid	Active	9.26×10^{3}	2.08×10^{2}	4.17×10^{1}	1.20×10^{4}	4.44×10^{1}	8.35×10^{1}	2.00×10^{-2}
N/A	US Ecology[c]	Solid	Active	8.60×10^{5}	5.09×10^{3}	4.76	4.98×10^{4}	–	5.51×10^{1}	5.98
216-W-LWC	216-W-LWC Crib	Liquid	2001	4.40×10^{-5}	–	–	1.92×10^{-1}	–	–	5.08×10^{-2}
216-U-17	216-U-17 Crib	Liquid	2001	1.86×10^{2}	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] Inventories were revised to reflect the current reporting of inventories disposed of at the Environmental Restoration Disposal Facility through March 2010. No projections beyond March 2010 were available and therefore, were not included in the final inventory database.

[c] It is believed that the inventories of iodine-129 and technetium-99 were overestimated when reported on the disposal manifests. This overestimation is believed to be by a factor of 100 to 10,000 (Thatcher 2003)

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; US Ecology=US Ecology Commercial Low-Level Radioactive Waste Disposal Site; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–50b. Map 10: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
600-148[b]	Environmental Restoration Disposal Facility	Solid	Active	1.55×10^{4}	–	1.03	4.11×10^{2}	3.70×10^{-1}	3.39×10^{2}	4.37×10^{2}
N/A	US Ecology[c]	Solid	Active	1.21×10^{5}	–	1.22×10^{1}	1.82×10^{3}	–	6.46×10^{3}	4.67×10^{2}
216-W-LWC	216-W-LWC Crib	Liquid	2001	2.59×10^{-1}	–	1.95×10^{-12}	2.37×10^{-3}	9.23×10^{-4}	3.19×10^{-1}	1.34×10^{-2}
216-U-17	216-U-17 Crib	Liquid	2001	–	–	1.92×10^{-13}	2.05×10^{-4}	6.52×10^{-7}	2.01×10^{-4}	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] Inventories were revised to reflect the current reporting of inventories disposed of at the Environmental Restoration Disposal Facility through March 2010. No projections beyond March 2010 were available and therefore, were not included in the final inventory database.

[c] It is believed that the inventories of iodine-129 and technetium-99 were overestimated when reported on the disposal manifests. This overestimation is believed to be by a factor of 100 to 10,000 (Thatcher 2003)

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; US Ecology=US Ecology Commercial Low-Level Radioactive Waste Disposal Site; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–51a. Map 11: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
218-E-10	218-E-10 Trench	Solid	Varies based on time of disposal	8.00×10^{-8}	–	3.96×10^{-4}	8.53×10^{5}	–	5.07×10^{-3}	–
UPR-200-E-23	UPR-200-E-23	Solid	N/A	Site consolidated with Site WIDS ID 218-E-10						
UPR-200-E-24	UPR-200-E-24	Solid	N/A	Site consolidated with Site WIDS ID 218-E-10						
216-B-50	216-B-50 Crib	Liquid	2001	1.26×10^{2}	3.04×10^{-3}	–	1.52	1.23×10^{-2}	6.60×10^{-2}	9.34×10^{-5}
216-B-57	216-B-57 Crib	Liquid	2001	1.95×10^{2}	9.10×10^{-3}	–	3.55	3.69×10^{-2}	1.97×10^{-1}	2.80×10^{-4}
UPR-200-E-9	UPR-200-E-9	Liquid	2001	2.55×10^{-1}	9.89×10^{-3}	–	1.03×10^{2}	1.20×10^{-4}	1.55×10^{-1}	1.99×10^{-4}
216-B-11A & B	216-B-11A & B	Liquid	2001	1.59×10^{1}	2.77×10^{-4}	–	3.04	9.97×10^{-4}	3.25×10^{-3}	4.54×10^{-6}
216-B-51	216-B-51 French Drain	Liquid	2001	6.24×10^{-3}	2.42×10^{-4}	–	2.66×10^{-2}	2.93×10^{-6}	3.80×10^{-3}	4.87×10^{-6}
218-E-5	218-E-5 Burial Ground	Solid	1986	–	–	–	1.46×10^{2}	–	–	–
218-E-5A	218-E-5A Burial Ground	Solid	1986	–	–	–	3.20×10^{2}	–	–	–
218-E-2	218-E-2 Burial Ground	Solid	1986	–	–	–	4.85×10^{2}	–	–	–
UPR-200-E-79	UPR-200-E-79 Unplanned Release	Liquid	2001	1.82×10^{-2}	1.07×10^{-3}	–	8.82	3.84×10^{-3}	1.25×10^{-2}	1.75×10^{-5}
UPR-200-E-78	UPR-200-E-78 Unplanned Release	Liquid	2001	5.03×10^{-5}	2.18×10^{-5}	–	1.50×10^{1}	1.60×10^{-4}	8.42×10^{-4}	5.05×10^{-8}
218-E-4	218-E-4 Burial Ground	Solid	1986	–	–	–	1.94×10^{-1}	–	–	–
216-B-5	216-B-5 Reverse Well	Liquid	2001	1.07×10^{-4}	1.11×10^{-2}	–	7.55	1.99×10^{-1}	4.25×10^{-3}	1.88×10^{-6}
216-B-9	216-B-9 Crib	Liquid	2001	1.68×10^{-3}	1.10×10^{-2}	–	1.07×10^{1}	2.89×10^{-1}	5.74×10^{-3}	1.32×10^{-6}
216-B-59	216-B-59 Trench	Liquid	2001	7.06×10^{-8}	1.35×10^{-8}	–	8.76×10^{-8}	9.61×10^{-8}	5.15×10^{-7}	3.04×10^{-10}
241-B-361	241-B-361 Settling Tank	Liquid	Unknown	–	–	–	3.06×10^{3}	–	–	–
UPR-200-E-7	UPR-200-E-7 Unplanned Release	Liquid	2001	1.60×10^{-6}	5.36×10^{-6}	–	5.39×10^{-3}	1.37×10^{-4}	2.75×10^{-6}	–
221-B	221-B B Plant/Canyon	Solid	1997	–	–	–	1.15×10^{5}	–	–	–
200-E-28	200-E-28 UPR	Liquid	2001	–	–	–	1.49×10^{-2}	–	–	–
200-E-97	200-E-97 French Drain	Liquid	2001	4.16×10^{-5}	8.05×10^{-7}	–	9.62×10^{-3}	1.89×10^{-6}	1.72×10^{-5}	1.71×10^{-8}
200-E-98[b]	200-E-98 French Drain	Liquid	2001	3.47×10^{-5}	6.71×10^{-7}	–	7.98×10^{-3}	1.57×10^{-6}	1.43×10^{-5}	1.43×10^{-8}
WESF	WESF (Building 225-B)	Solid	2005	–	–	–	4.97×10^{5}	–	–	–
216-B-62	216-B-62 Crib	Liquid	2001	3.57×10^{-1}	6.47×10^{-2}	–	8.25×10^{1}	4.59×10^{-1}	2.39	1.29×10^{-3}
216-B-12	216-B-12 Crib	Liquid	2001	2.34×10^{3}	9.54×10^{-3}	–	1.20×10^{2}	3.37×10^{-2}	1.65	1.55×10^{-4}
216-B-55	216-B-55 Crib	Liquid	2001	1.77×10^{-4}	3.40×10^{-5}	–	2.20×10^{-4}	2.41×10^{-4}	1.29×10^{-3}	7.63×10^{-7}

Table S–51a. Map 11: Radionuclide Inventories (curies) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
212-B	212-B Cask Loading Station	Solid	1997	–	–	–	1.00×10^{3}	–	–	–
216-B-60	216-B-60 Crib	Liquid	2001	4.60×10^{-6}	4.51×10^{-8}	–	2.28×10^{-3}	1.14×10^{-7}	8.14×10^{-7}	1.11×10^{-5}
UPR-200-E-84	UPR-200-E-84 Unplanned Release	Liquid	2001	6.72×10^{-2}	3.94×10^{-8}	–	1.20×10^{-4}	2.30×10^{-7}	1.21×10^{-6}	3.80×10^{-6}
224-B	224-B Plutonium Concentration Facility	Solid	1985	–	–	–	–	–	–	–
UPR-200-E-87	UPR-200-E-87 Unplanned Release	Liquid	2001	4.59×10^{-9}	1.03×10^{-5}	–	1.65×10^{-3}	–	9.29×10^{-7}	4.11×10^{-10}
UPR-200-E-1[b]	UPR-200-E-1 Unplanned Release	Liquid	2001	5.90×10^{-2}	1.95×10^{-3}	–	5.54	1.96×10^{-2}	3.13×10^{-3}	1.54×10^{-6}
UPR-200-E-3[b]	UPR-200-E-3 Unplanned Release	Liquid	2001	2.02×10^{-3}	2.68×10^{-5}	–	2.21×10^{-2}	4.08×10^{-4}	6.68×10^{-5}	5.82×10^{-7}
UPR-200-E-85	UPR-200-E-85 Unplanned Release	Liquid	2001	4.92×10^{-2}	9.40×10^{-3}	–	6.24	6.68×10^{-2}	3.57×10^{-1}	2.09×10^{-4}
216-B-4	216-B-4 Reverse Well	Liquid	2001	1.19×10^{-5}	2.30×10^{-7}	–	1.32×10^{-3}	5.39×10^{-7}	4.90×10^{-6}	4.89×10^{-9}
216-B-6	216-B-6 Reverse Well	Liquid	2001	7.12×10^{-3}	1.38×10^{-4}	–	7.91×10^{-1}	3.23×10^{-4}	2.94×10^{-3}	2.93×10^{-6}
200-E-30	200-E-30 Sand Filter (291-B Sand Filter)	Solid	1994	–	–	–	3.00×10^{3}	–	–	–
200-E-55	200-E-55 French Drain	Liquid	2001	4.08×10^{-5}	7.88×10^{-7}	–	9.51×10^{-3}	1.85×10^{-6}	1.68×10^{-5}	1.68×10^{-8}
200-E-95	200-E-95 French Drain	Liquid	2001	4.16×10^{-5}	8.05×10^{-7}	–	9.28×10^{-3}	1.89×10^{-6}	1.72×10^{-5}	1.71×10^{-8}
216-B-10A	216-B-10A Crib	Liquid	2001	6.37×10^{-2}	2.29×10^{-4}	–	1.32	5.38×10^{-4}	5.35×10^{-3}	4.87×10^{-6}
216-B-10B	216-B-10B Crib	Liquid	2001	5.11×10^{-8}	1.17×10^{-9}	–	1.04×10^{-6}	5.90×10^{-9}	3.13×10^{-8}	1.64×10^{-5}
UPR-200-E-77	UPR-200-E-77 Unplanned Release	Liquid	2001	4.03×10^{-4}	1.08×10^{-5}	–	8.62×10^{-2}	1.33×10^{-7}	2.38×10^{-4}	1.05×10^{-7}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–51b. Map 11: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
218-E-10	218-E-10 Trench	Solid	Varies based on time of disposal	1.02×10^{6}	–	–	1.10×10^{-1}	1.05×10^{-3}	3.94×10^{-3}	1.45×10^{-3}
UPR-200-E-23	UPR-200-E-23	Solid	N/A	Site consolidated with Site WIDS ID 218-E-10						
UPR-200-E-24	UPR-200-E-24	Solid	N/A	Site consolidated with Site WIDS ID 218-E-10						
216-B-50	216-B-50 Crib	Liquid	2001	5.49×10^{1}	–	7.43×10^{-8}	8.59×10^{-5}	2.61×10^{-4}	2.17×10^{-2}	2.24×10^{-3}
216-B-57	216-B-57 Crib	Liquid	2001	1.64×10^{2}	–	2.23×10^{-7}	2.38×10^{-4}	6.30×10^{-4}	3.65×10^{-2}	6.73×10^{-3}
UPR-200-E-9	UPR-200-E-9	Liquid	2001	4.77×10^{2}	–	4.03×10^{-12}	8.72×10^{-4}	1.23×10^{-3}	1.37×10^{-1}	6.81×10^{-2}
216-B-11A & B	216-B-11A & B	Liquid	2001	9.66	–	3.54×10^{-13}	2.85×10^{-5}	3.04×10^{-5}	7.39×10^{-3}	1.58×10^{-3}
216-B-51	216-B-51 French Drain	Liquid	2001	3.51×10^{-2}	–	9.84×10^{-14}	2.10×10^{-5}	3.01×10^{-5}	8.81×10^{-4}	1.67×10^{-3}
218-E-5	218-E-5 Burial Ground	Solid	1986	1.56×10^{2}	–	–	4.02×10^{-2}	–	4.50×10^{1}	–
218-E-5A	218-E-5A Burial Ground	Solid	1986	3.43×10^{2}	–	–	4.02×10^{-2}	–	1.00×10^{2}	–
218-E-2	218-E-2 Burial Ground	Solid	1986	5.19×10^{2}	–	–	–	–	5.80×10^{1}	–
UPR-200-E-79	UPR-200-E-79 Unplanned Release	Liquid	2001	3.68×10^{1}	–	1.36×10^{-12}	8.07×10^{-5}	1.08×10^{-4}	2.25×10^{-2}	6.07×10^{-3}
UPR-200-E-78	UPR-200-E-78 Unplanned Release	Liquid	2001	3.39	–	8.26×10^{-16}	3.25×10^{-6}	3.58×10^{-6}	1.12×10^{-3}	4.38×10^{-2}
218-E-4	218-E-4 Burial Ground	Solid	1986	2.08×10^{-1}	–	–	3.40×10^{-4}	–	7.25×10^{-1}	–
216-B-5	216-B-5 Reverse Well	Liquid	2001	8.67	–	4.81×10^{-10}	7.13×10^{-3}	5.71×10^{-3}	3.97×10^{1}	1.24×10^{-1}
216-B-9	216-B-9 Crib	Liquid	2001	1.24×10^{1}	–	2.12×10^{-10}	8.34×10^{-3}	2.73×10^{-3}	8.80	1.33×10^{-1}
216-B-59	216-B-59 Trench	Liquid	2001	5.71×10^{-5}	–	5.39×10^{-14}	1.36×10^{-10}	1.68×10^{-9}	2.25×10^{-8}	2.56×10^{-8}
241-B-361	241-B-361 Settling Tank	Liquid	Unknown	1.87×10^{2}	–	–	–	–	1.53×10^{2}	–
UPR-200-E-7	UPR-200-E-7 Unplanned Release	Liquid	2001	6.28×10^{-3}	–	1.10×10^{-13}	2.97×10^{-6}	1.51×10^{-6}	3.22×10^{-3}	1.06×10^{-4}
221-B	221-B B Plant/Canyon	Solid	1997	2.37×10^{5}	–	–	–	–	2.10	–
200-E-28	200-E-28 UPR	Liquid	2001	1.75×10^{-3}	–	1.71×10^{-16}	1.83×10^{-7}	1.13×10^{-7}	3.48×10^{-5}	–
200-E-97	200-E-97 French Drain	Liquid	2001	3.86×10^{-2}	–	1.05×10^{-15}	1.23×10^{-6}	1.47×10^{-7}	3.33×10^{-5}	6.02×10^{-6}
200-E-98[b]	200-E-98 French Drain	Liquid	2001	3.21×10^{-2}	–	8.72×10^{-16}	1.03×10^{-6}	1.22×10^{-7}	2.77×10^{-5}	5.01×10^{-6}
WESF	WESF (Building 225-B)	Solid	2005	1.72×10^{5}	–	–	–	–	–	–
216-B-62	216-B-62 Crib	Liquid	2001	9.67×10^{3}	–	3.30×10^{-7}	8.43×10^{-4}	9.95×10^{-3}	2.06×10^{-1}	2.24×10^{-1}
216-B-12	216-B-12 Crib	Liquid	2001	3.26×10^{2}	–	2.93×10^{-11}	1.02×10^{1}	9.93×10^{-4}	2.15×10^{-1}	5.36×10^{-2}
216-B-55	216-B-55 Crib	Liquid	2001	1.43×10^{-1}	–	1.35×10^{-10}	3.41×10^{-7}	4.21×10^{-6}	5.64×10^{-5}	6.43×10^{-5}
212-B	212-B Cask Loading Station	Solid	1997	1.00×10^{2}	–	–	–	–	–	–
216-B-60	216-B-60 Crib	Liquid	2001	2.79×10^{-3}	–	1.27×10^{-10}	4.87×10^{-3}	1.74×10^{-9}	8.44×10^{-2}	2.93×10^{-6}

Table S–51b. Map 11: Radionuclide Inventories (curies) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
UPR-200-E-84	UPR-200-E-84 Unplanned Release	Liquid	2001	4.58×10^{-5}	–	1.51×10^{-15}	5.26×10^{-7}	5.17×10^{-6}	1.54×10^{-4}	1.69×10^{-4}
224-B	224-B Plutonium Concentration Facility	Solid	1985	–	–	–	–	–	8.85×10^{1}	1.14×10^{1}
UPR-200-E-87	UPR-200-E-87 Unplanned Release	Liquid	2001	1.89×10^{-3}	–	9.40×10^{-13}	3.65×10^{-7}	1.12×10^{-5}	2.75	2.41×10^{-4}
UPR-200-E-1[b]	UPR-200-E-1 Unplanned Release	Liquid	2001	6.36	–	5.86×10^{-12}	4.28×10^{-4}	7.09×10^{-5}	1.15×10^{-1}	2.12×10^{-3}
UPR-200-E-3[b]	UPR-200-E-3 Unplanned Release	Liquid	2001	1.51×10^{-1}	–	1.09×10^{-13}	6.91×10^{-6}	1.54×10^{-6}	1.86×10^{-5}	1.71×10^{-4}
UPR-200-E-85	UPR-200-E-85 Unplanned Release	Liquid	2001	3.73×10^{1}	–	3.81×10^{-8}	9.39×10^{-5}	1.15×10^{-3}	1.55×10^{-2}	1.70×10^{-2}
216-B-4	216-B-4 Reverse Well	Liquid	2001	1.08×10^{-2}	–	2.90×10^{-16}	3.36×10^{-7}	3.02×10^{-8}	6.16×10^{-6}	1.72×10^{-6}
216-B-6	216-B-6 Reverse Well	Liquid	2001	6.50	–	1.74×10^{-13}	2.02×10^{-4}	1.81×10^{-5}	3.69×10^{-3}	1.03×10^{-3}
200-E-30	200-E-30 Sand Filter (291-B Sand Filter)	Solid	1994	2.00×10^{3}	–	–	–	–	1.93	–
200-E-55	200-E-55 French Drain	Liquid	2001	3.78×10^{-2}	–	1.03×10^{-15}	1.21×10^{-6}	1.45×10^{-7}	3.28×10^{-5}	5.89×10^{-6}
200-E-95	200-E-95 French Drain	Liquid	2001	3.85×10^{-2}	–	1.04×10^{-15}	1.23×10^{-6}	1.44×10^{-7}	3.25×10^{-5}	6.01×10^{-6}
216-B-10A	216-B-10A Crib	Liquid	2001	1.08×10^{1}	–	2.89×10^{-13}	3.26×10^{-3}	3.02×10^{-5}	6.15×10^{-3}	1.71×10^{-3}
216-B-10B	216-B-10B Crib	Liquid	2001	1.30×10^{-4}	–	4.09×10^{-14}	9.95×10^{-11}	1.27×10^{-10}	5.32×10^{-9}	3.69×10^{-9}
UPR-200-E-77	UPR-200-E-77 Unplanned Release	Liquid	2001	4.84×10^{-1}	–	4.85×10^{-15}	2.24×10^{-5}	1.34×10^{-6}	1.49×10^{-4}	2.91×10^{-5}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–52a. Map 12: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
218-E-12B	218-E-12B Burial Ground	Solid	Varies based on time of disposal	1.12×10^{3}	1.31×10^{2}	9.70×10^{-3}	2.69×10^{4}	5.61×10^{-1}	8.08×10^{-1}	2.94×10^{-3}
218-E-12A	218-E-12A Burial Ground	Solid	1986	–	–	–	1.72×10^{1}	–	–	–
216-B-63	216-B-63 Ditch	Liquid	2001	1.30×10^{2}	3.36×10^{-2}	–	6.91×10^{-1}	1.86×10^{-5}	1.66×10^{-2}	5.89×10^{-8}
216-B-2-2	216-B-2-2 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
216-B-2-1	216-B-2-1 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
UPR-200-E-138	UPR-200-E-138 Unplanned Release	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
218-E-8	218-E-8 Burial Ground	Solid	1986	–	–	–	1.94×10^{-1}	–	–	–
218-E-1	218-E-1 Burial Ground	Solid	1986	–	–	–	1.94	–	–	–
216-B-3	216-B-3 Pond	Liquid	2001	2.01×10^{4}	9.90×10^{1}	–	1.34×10^{2}	4.42×10^{-2}	3.20×10^{-1}	3.20×10^{-3}
216-B-3A Pond / 216-B-3A RAD	216-B-3A Pond / 216-B-3A RAD	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
216-B-3B Pond / 216-B-3B-RAD	216-B-3B Pond / 216-B-3B-RAD	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
216-B-3C Pond / 216-B-3C RAD	216-B-3C Pond / 216-B-3C RAD	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
UPR-200-E-14	Unplanned Release UPR-200-E-14	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
UPR-200-E-34	Unplanned Release UPR-200-E-34	Liquid	N/A	Site consolidated with Site WIDS ID 216-A-25 and 216-B-3						
N/A	Greater-Than-Class C Proposed Disposal Facility	Solid	N/A	2.41×10^{5}	3.34×10^{4}	–	1.62×10^{5}	–	6.57×10^{3}	6.78

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–52b. Map 12: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
218-E-12B	218-E-12B Burial Ground	Solid	Varies based on time of disposal	2.69×10^{4}	–	–	4.59×10^{-2}	3.99×10^{-6}	3.13×10^{-1}	1.91
218-E-12A	218-E-12A Burial Ground	Solid	1986	1.84×10^{1}	–	–	3.32×10^{-1}	–	6.48×10^{2}	–
216-B-63	216-B-63 Ditch	Liquid	2001	9.33×10^{-2}	–	1.24×10^{-11}	1.20×10^{-1}	1.04×10^{-4}	1.95×10^{-2}	4.38×10^{2}
216-B-2-2	216-B-2-2 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
216-B-2-1	216-B-2-1 Ditch	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
UPR-200-E-138	UPR-200-E-138 Unplanned Release	Liquid	N/A	Site consolidated with Site WIDS ID 216-B-3						
218-E-8	218-E-8 Burial Ground	Solid	1986	2.08×10^{-1}	–	–	6.70×10^{-4}	–	1.45	–
218-E-1	218-E-1 Burial Ground	Solid	1986	2.08	–	–	1.34×10^{-1}	–	6.53×10^{1}	–
216-B-3	216-B-3 Pond	Liquid	2001	4.26×10^{2}	–	1.63×10^{-8}	2.22	8.66×10^{-2}	2.43×10^{1}	1.19×10^{1}
216-B-3A Pond / 216-B-3A RAD	216-B-3A Pond / 216-B-3A RAD	Liquid	1994	Site consolidated with Site WIDS ID 216-B-3						
216-B-3B Pond / 216-B-3B-RAD	216-B-3B Pond / 216-B-3B-RAD	Liquid	1994	Site consolidated with Site WIDS ID 216-B-3						
216-B-3C Pond / 216-B-3C RAD	216-B-3C Pond / 216-B-3C RAD	Liquid	1994	Site consolidated with Site WIDS ID 216-B-3						
UPR-200-E-14	Unplanned Release UPR-200-E-14	Liquid	1994	Site consolidated with Site WIDS ID 216-B-3						
UPR-200-E-34	Unplanned Release UPR-200-E-34	Liquid	1994	Site consolidated with Site WIDS ID 216-A-25 and 216-B-3						
N/A	Greater-Than-Class C Proposed Disposal Facility	Solid	N/A	1.89×10^{6}	–	–	8.83×10^{2}	2.71	2.22×10^{4}	1.62×10^{5}

a Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–53a. Map 12A: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-C-9	216-C-9 Swamp	Liquid	2001	8.28×10^{-3}	2.44×10^{-4}	–	1.31	1.89×10^{-4}	1.01×10^{-3}	5.97×10^{-7}
218-C-9	218-C-9 Burial Ground	Solid	Varies based on time of disposal	–	–	–	1.27×10^{1}	–	–	–
UPR-200-E-141[b]	UPR-200-E-141	Liquid	2001	6.50×10^{-3}	–	–	–	–	2.77×10^{-5}	–
200-E-56[b]	200-E-56 Unplanned Release	Liquid	2001	2.47×10^{-2}	1.07×10^{-2}	–	7.38×10^{3}	7.87×10^{-2}	4.13×10^{-1}	2.47×10^{-5}
201-C	201-C Process Building	Liquid/ solid	1988	–	–	–	9.00×10^{3}	–	–	–
216-C-1	216-C-1 Hot Semi Work Crib	Liquid	2001	1.95×10^{-4}	7.11×10^{-5}	–	4.88×10^{1}	5.22×10^{-4}	2.74×10^{-3}	7.70×10^{-6}
216-C-3	216-C-3 Hot Semi Work Crib	Liquid	2001	7.92×10^{1}	1.42×10^{-5}	–	9.78	1.04×10^{-4}	6.96×10^{-4}	3.27×10^{-8}
216-C-4	216-C-4 Hot Semi Work Crib	Liquid	2001	1.68×10^{-4}	1.22×10^{-5}	–	7.40	1.56×10^{-4}	8.05×10^{-4}	4.95×10^{-8}
216-C-5	216-C-5 Hot Semi Work Crib	Liquid	2001	–	–	–	–	–	–	–
216-C-6	216-C-6 Hot Semi Work Crib	Liquid	2001	1.25×10^{1}	3.29×10^{-5}	–	2.07×10^{1}	5.70×10^{-4}	2.84×10^{-3}	1.33×10^{-7}
216-C-10	216-C-10 Hot Semi Work Crib	Liquid	2001	6.54×10^{-5}	2.83×10^{-5}	–	1.96×10^{1}	2.08×10^{-4}	1.09×10^{-3}	6.55×10^{-8}
216-C-2	216-C-2 Semi Works Reverse Well	Liquid	2001	–	–	–	8.00×10^{-2}	–	–	–
200-E-57[b]	200-E-57 Unplanned Release	Liquid	2001	3.71×10^{-2}	1.60×10^{-2}	–	1.11×10^{4}	1.18×10^{-1}	6.21×10^{-1}	3.71×10^{-5}
241-CX-72	241-CX-72 Storage Tank and Vault	Liquid/ solid	1986	–	–	–	–	–	–	–
291-C-1	291-C-1 Burial Ground	Solid	Varies based on time of disposal	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–53b. Map 12A: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-C-9	216-C-9 Swamp	Liquid	2001	2.67×10^{-1}	–	1.06×10^{-10}	3.30×10^{-5}	1.93×10^{-5}	2.97×10^{-3}	2.99×10^{-4}
218-C-9	218-C-9 Burial Ground	Solid	Varies based on time of disposal	7.50	–	–	–	–	–	–
UPR-200-E-141[b]	UPR-200-E-141	Liquid	2001	–	–	–	1.22×10^{-4}	–	–	–
200-E-56[b]	200-E-56 Unplanned Release	Liquid	2001	1.66×10^{3}	–	4.04×10^{-13}	1.59×10^{-3}	1.75×10^{-3}	5.48×10^{-1}	2.14×10^{1}
201-C	201-C Process Building	Liquid/ solid	1988	–	–	–	–	–	4.90	2.00×10^{-1}
216-C-1	216-C-1 Hot Semi Work Crib	Liquid	2001	1.10×10^{1}	–	8.76×10^{-10}	6.42×10^{-1}	1.16×10^{-5}	5.99×10^{-1}	1.42×10^{-1}
216-C-3	216-C-3 Hot Semi Work Crib	Liquid	2001	2.20	–	9.09×10^{-15}	3.06×10^{-3}	3.25×10^{-6}	8.83×10^{-4}	2.84×10^{-2}
216-C-4	216-C-4 Hot Semi Work Crib	Liquid	2001	5.08×10^{-4}	–	2.08×10^{-15}	2.24×10^{-6}	2.51×10^{-6}	7.50×10^{-4}	7.68×10^{-3}
216-C-5	216-C-5 Hot Semi Work Crib	Liquid	2001	–	–	–	1.40×10^{-2}	–	–	–
216-C-6	216-C-6 Hot Semi Work Crib	Liquid	2001	3.88×10^{-1}	–	6.56×10^{-13}	1.47×10^{-3}	1.36×10^{-4}	2.49×10^{-2}	2.10×10^{-2}
216-C-10	216-C-10 Hot Semi Work Crib	Liquid	2001	4.40	–	1.12×10^{-15}	4.45×10^{-6}	4.84×10^{-6}	1.50×10^{-3}	5.67×10^{-2}
216-C-2	216-C-2 Semi Works Reverse Well	Liquid	2001	9.43×10^{-3}	–	3.70×10^{-16}	8.85×10^{-7}	6.72×10^{-7}	1.87×10^{-4}	–
200-E-57[b]	200-E-57 Unplanned Release	Liquid	2001	2.49×10^{3}	–	6.07×10^{-13}	2.39×10^{-3}	2.62×10^{-3}	8.22×10^{-1}	3.22×10^{1}
241-CX-72	241-CX-72 Storage Tank and Vault	Liquid/ solid	1986	–	–	–	–	–	3.00	–
291-C-1	291-C-1 Burial Ground	Solid	Varies based on time of disposal	–	–	–	–	–	1.00×10^{2}	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–54a. Map 12B: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
UPR-200-E-86	UPR-200-E-86	Liquid	2001	7.21×10^{-1}	1.31×10^{-1}	–	1.69×10^{2}	9.34×10^{-1}	4.92	2.61×10^{-3}
216-A-40	216-A-40 Trench	Liquid	2001	1.40×10^{-7}	2.69×10^{-8}	–	1.73×10^{-7}	1.91×10^{-7}	1.02×10^{-6}	6.04×10^{-10}
216-A-41	216-A-41 Crib	Liquid	2001	1.04×10^{-1}	8.93×10^{-9}	–	7.44×10^{-6}	9.43×10^{-8}	4.93×10^{-7}	1.68×10^{-6}
216-A-9	216-A-9 Crib	Liquid	2001	8.07×10^{2}	1.17	–	6.81	3.21×10^{-4}	2.30×10^{-3}	1.22×10^{-3}
216-A-3	216-A-3 Crib	Liquid	2001	4.13×10^{1}	4.04×10^{-7}	–	2.08×10^{-2}	1.01×10^{-6}	2.73×10^{-1}	–
216-A-39	216-A-39 Crib	Liquid	2001	2.36×10^{-4}	5.96×10^{-5}	–	4.96×10^{-2}	6.46×10^{-4}	3.39×10^{-3}	2.04×10^{-7}
216-A-18	216-A-18 Trench	Liquid	2001	–	–	–	–	–	–	–
216-A-1	216-A-1 Crib	Liquid	2001	–	–	–	–	–	–	–
216-A-7	216-A-7 Crib	Liquid	2001	2.33×10^{-1}	3.15×10^{-3}	–	1.02×10^{1}	3.54×10^{-1}	6.39×10^{-2}	4.19×10^{-5}
UPR-200-E-145	UPR-200-E-145	Liquid	2001	1.95×10^{-1}	–	–	–	–	8.31×10^{-4}	–
216-A-16	216-A-16 French Drain	Liquid	2001	3.32×10^{-7}	7.60×10^{-9}	–	6.75×10^{-6}	3.83×10^{-8}	2.03×10^{-7}	3.90×10^{-10}
216-A-17	216-A-17 French Drain	Liquid	2001	1.63×10^{-7}	3.73×10^{-9}	–	3.32×10^{-6}	1.89×10^{-8}	1.00×10^{-7}	1.92×10^{-10}
242-A	242-A Evaporator	Liquid	1998	–	–	–	2.18×10^{4}	–	–	–
216-A-22	216-A-22 Crib (French Drain)	Liquid	2001	7.97×10^{-2}	9.13×10^{-9}	–	5.63×10^{-10}	–	4.89×10^{-4}	1.29×10^{-10}
216-A-28	216-A-28 French Drain	Liquid	2001	3.66×10^{-1}	–	–	–	–	2.48×10^{-3}	–
216-A-32	216-A-32 Crib	Liquid	2001	1.09×10^{-8}	2.49×10^{-10}	–	2.22×10^{-7}	1.26×10^{-9}	6.67×10^{-9}	1.28×10^{-11}
200-E-78	200-E-78 Reverse Well	Liquid	2001	–	7.17×10^{-7}	–	4.42×10^{-8}	–	–	1.01×10^{-8}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–54b. Map 12B: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
UPR-200-E-86	UPR-200-E-86	Liquid	2001	1.98×10^{4}	–	6.75×10^{-7}	1.71×10^{-3}	2.02×10^{-2}	4.20×10^{-1}	4.58×10^{-1}
216-A-40	216-A-40 Trench	Liquid	2001	1.13×10^{-4}	–	1.07×10^{-13}	2.70×10^{-10}	3.32×10^{-9}	4.45×10^{-8}	5.08×10^{-8}
216-A-41	216-A-41 Crib	Liquid	2001	7.01×10^{-5}	–	1.78×10^{-14}	2.34×10^{-7}	2.51×10^{-6}	6.88×10^{-5}	7.40×10^{-5}
216-A-9	216-A-9 Crib	Liquid	2001	7.84	–	3.74×10^{-7}	1.42×10^{1}	1.30×10^{-3}	2.48×10^{2}	1.02×10^{-1}
216-A-3	216-A-3 Crib	Liquid	2001	2.45×10^{-2}	–	1.17×10^{-9}	1.78	1.52×10^{-8}	1.32×10^{-4}	2.69×10^{-5}
216-A-39	216-A-39 Crib	Liquid	2001	1.45×10^{1}	–	4.08×10^{-15}	4.27×10^{-7}	9.14×10^{-6}	1.25×10^{-4}	1.35×10^{-4}
216-A-18	216-A-18 Trench	Liquid	2001	–	–	–	4.59×10^{-1}	–	–	–
216-A-1	216-A-1 Crib	Liquid	2001	–	–	–	9.28×10^{-2}	–	–	–
216-A-7	216-A-7 Crib	Liquid	2001	2.99×10^{3}	–	6.66×10^{-11}	3.32×10^{-1}	3.14×10^{-3}	7.59×10^{-1}	1.85×10^{-1}
UPR-200-E-145	UPR-200-E-145	Liquid	2001	–	–	–	3.66×10^{-3}	–	–	–
216-A-16	216-A-16 French Drain	Liquid	2001	8.43×10^{-4}	–	2.65×10^{-13}	6.46×10^{-10}	8.23×10^{-10}	3.45×10^{-8}	2.39×10^{-8}
216-A-17	216-A-17 French Drain	Liquid	2001	4.15×10^{-4}	–	1.31×10^{-13}	3.18×10^{-10}	4.04×10^{-10}	1.70×10^{-8}	1.18×10^{-8}
242-A	242-A Evaporator	Liquid	1998	1.49×10^{5}	–	–	–	–	1.58×10^{1}	9.90×10^{1}
216-A-22	216-A-22 Crib (French Drain)	Liquid	2001	–	–	2.63×10^{-17}	3.11×10^{-3}	2.42×10^{-9}	3.67×10^{-7}	4.68×10^{-12}
216-A-28	216-A-28 French Drain	Liquid	2001	–	–	–	4.42×10^{-1}	–	–	–
216-A-32	216-A-32 Crib	Liquid	2001	2.77×10^{-5}	–	8.71×10^{-15}	2.12×10^{-11}	2.70×10^{-11}	1.13×10^{-9}	7.86×10^{-10}
200-E-78	200-E-78 Reverse Well	Liquid	2001	–	–	3.67×10^{-15}	6.85×10^{-6}	8.34×10^{-8}	2.46×10^{-5}	3.68×10^{-10}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–55a. Map 12C: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
UPR-200-E-51	UPR-200-E-51	Liquid		Site consolidated with Site WIDS ID 216-A-29						
216-A-24	216-A-24 Crib	Liquid	2001	8.80×10^{3}	3.03	–	1.75	4.75×10^{-2}	8.57×10^{-3}	5.64×10^{-6}
216-A-6	216-A-6 Crib	Liquid	2001	1.16×10^{3}	1.32×10^{-2}	–	2.09	3.99×10^{-3}	2.10×10^{-2}	7.30×10^{-2}
216-A-19	216-A-19 Trench	Liquid	2001	–	–	–	–	–	–	–
216-A-20	216-A-20 Trench	Liquid	2001	2.33	3.37×10^{-3}	–	4.15×10^{-4}	–	–	–
216-A-8	216-A-8 Crib	Liquid	2001	2.46×10^{4}	3.53	–	8.65	2.85×10^{-1}	5.15×10^{-2}	3.74×10^{-5}
216-A-29[b]	216-A-29 Ditch	Liquid	Unknown	–	–	–	–	–	–	–
216-A-30	216-A-30 Crib	Liquid	2001	1.81×10^{-2}	2.89×10^{-2}	–	1.10	1.21×10^{-4}	7.39×10^{-4}	8.91×10^{-3}
216-A-37-1	216-A-37-1 Crib	Liquid	2001	5.92×10^{2}	1.50	–	1.85×10^{-1}	–	–	–
216-A-37-2	216-A-37-2 Crib	Liquid	2001	9.51	4.53×10^{-1}	–	5.56×10^{-2}	–	–	5.44×10^{-5}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–55b. Map 12C: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
UPR-200-E-51	UPR-200-E-51	Liquid		Site consolidated with Site WIDS ID 216-A-29						
216-A-24	216-A-24 Crib	Liquid	2001	4.01×10^{2}	–	2.03×10^{-11}	5.14×10^{-2}	2.27×10^{-3}	4.40×10^{-1}	2.98×10^{-1}
216-A-6	216-A-6 Crib	Liquid	2001	1.10	–	9.53×10^{-10}	1.45×10^{-1}	9.19×10^{-2}	3.61	2.94
216-A-19	216-A-19 Trench	Liquid	2001	–	–	–	2.93×10^{1}	–	–	–
216-A-20	216-A-20 Trench	Liquid	2001	–	–	5.44×10^{-17}	4.18×10^{-1}	2.13×10^{-6}	3.23×10^{-4}	2.70×10^{-4}
216-A-8	216-A-8 Crib	Liquid	2001	2.41×10^{3}	–	1.22×10^{-10}	3.10×10^{-1}	3.77×10^{-3}	1.13	5.18×10^{-1}
216-A-29[b]	216-A-29 Ditch	Liquid	Unknown	–	–	–	–	–	–	–
216-A-30	216-A-30 Crib	Liquid	2001	2.80	–	6.18×10^{-8}	2.58	3.31×10^{-3}	4.14×10^{1}	1.47×10^{-3}
216-A-37-1	216-A-37-1 Crib	Liquid	2001	–	–	1.23×10^{-13}	1.59×10^{-4}	4.31×10^{-4}	1.57×10^{-1}	1.20×10^{-1}
216-A-37-2	216-A-37-2 Crib	Liquid	2001	–	–	3.73×10^{-11}	3.97×10^{-2}	5.76×10^{-4}	1.78×10^{-1}	3.60×10^{-2}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–56a. Map 12D: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
216-A-13	216-A-13 French Drain	Liquid	2001	2.72×10^{-8}	6.23×10^{-10}	–	5.54×10^{-7}	3.14×10^{-9}	1.67×10^{-8}	3.20×10^{-11}
200-E-61	200-E-61 Reverse Well	Liquid	2001	4.90×10^{-6}	1.12×10^{-7}	–	9.96×10^{-5}	5.65×10^{-7}	3.00×10^{-6}	5.75×10^{-9}
200-E-136	200-E-136 PUREX Plant (202-A and others)	Solid	2003	–	–	–	8.92×10^{3}	–	–	6.21×10^{-3}
UPR-200-E-39	UPR-200-E-39 (at 216-A-36B)	Liquid	2001	1.43×10^{-1}	–	–	1.12	1.55×10^{-4}	6.90×10^{-4}	–
UPR-200-E-40	UPR-200-E-40	Liquid	2001	1.10×10^{-2}	–	–	8.64×10^{-2}	1.20×10^{-5}	5.33×10^{-5}	–
200-E-85	200-E-85 Reverse Well	Liquid	2001	3.87×10^{-6}	8.88×10^{-8}	–	7.88×10^{-5}	4.48×10^{-7}	2.37×10^{-6}	4.56×10^{-9}
216-A-35	216-A-35 French Drain	Liquid	2001	2.72×10^{-8}	6.22×10^{-10}	–	5.53×10^{-7}	3.14×10^{-9}	1.67×10^{-8}	3.20×10^{-11}
200-E-54	200-E-54 Unplanned Release	Liquid	2001	5.45×10^{-7}	1.25×10^{-8}	–	1.11×10^{-5}	6.29×10^{-8}	3.34×10^{-7}	6.42×10^{-10}
200-E-103	200-E-103 PUREX Stabilized Area	Liquid	2001	1.09×10^{-8}	2.49×10^{-10}	–	2.21×10^{-7}	1.26×10^{-9}	6.66×10^{-9}	1.28×10^{-11}
UPR-200-E-117[b]	UPR-200-E-117	Liquid	2001	3.54×10^{-3}	6.36×10^{-4}	–	8.21×10^{-1}	4.51×10^{-3}	2.39×10^{-2}	1.27×10^{-5}
216-A-2	216-A-2 Crib	Liquid	2001	1.40×10^{-3}	2.21×10^{-3}	–	8.92×10^{-1}	1.49×10^{-1}	2.70×10^{-2}	1.76×10^{-5}
216-A-26	216-A-26 French Drain	Liquid	2001	1.05×10^{-8}	2.40×10^{-10}	–	2.14×10^{-7}	1.21×10^{-9}	6.43×10^{-9}	1.23×10^{-11}
216-A-26A	216-A-26A French Drain	Liquid	2001	2.72×10^{-9}	6.23×10^{-11}	–	5.54×10^{-8}	3.14×10^{-10}	1.67×10^{-9}	3.20×10^{-12}
216-A-15	216-A-15 French Drain	Liquid	2001	–	3.90×10^{-5}	–	2.40×10^{-6}	–	–	5.51×10^{-7}
200-E-107	200-E-107 Unplanned Release	Liquid	2001	7.28×10^{-9}	1.67×10^{-10}	–	1.49×10^{-7}	8.41×10^{-10}	4.47×10^{-9}	2.34×10^{-6}
218-E-14	218-E-14 PUREX Tunnel 1	Solid	1990	–	–	–	8.45×10^{2}	–	–	–
218-E-15	218-E-15 PUREX Tunnel 2	Solid	1990	–	–	–	–	–	–	–
216-A-4	216-A-4 Crib	Liquid	2001	6.45×10^{1}	8.02×10^{-5}	–	4.14	1.99×10^{-4}	5.72×10^{-1}	–
216-A-5	216-A-5 Crib	Liquid	2001	1.71×10^{4}	9.98×10^{-3}	–	3.03×10^{1}	5.82×10^{-2}	3.07×10^{-1}	9.63×10^{-1}
216-A-10	216-A-10 Crib	Liquid	2001	5.78×10^{4}	1.11×10^{-2}	–	1.84×10^{1}	9.36×10^{-2}	4.89×10^{-1}	1.73
216-A-21	216-A-21 Crib	Liquid	2001	4.95×10^{1}	–	–	6.06	1.69×10^{-3}	7.53×10^{-3}	–
216-A-27	216-A-27 Crib	Liquid	2001	5.01×10^{-2}	4.82×10^{-4}	–	2.48×10^{1}	1.21×10^{-3}	8.61×10^{-3}	7.40×10^{-8}
216-A-31	216-A-31 Crib	Liquid	2001	5.52×10^{-4}	3.51×10^{-4}	–	1.27	4.40×10^{-2}	7.93×10^{-3}	5.20×10^{-6}
216-A-36-A	216-A-36A Crib	Liquid	2001	1.00×10^{2}	–	–	7.89×10^{2}	1.10×10^{-1}	4.89×10^{-1}	–
216-A-36-B	216-A-36B Crib	Liquid	2001	2.00×10^{2}	–	–	2.75×10^{2}	1.43×10^{-2}	6.33×10^{-2}	8.64×10^{-3}
216-A-45	216-A-45 Crib	Liquid	2001	3.22×10^{3}	3.96×10^{-5}	–	6.99×10^{-2}	1.20×10^{-3}	5.84×10^{-3}	3.26×10^{-2}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; PUREX=Plutonium-Uranium Extraction; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–56b. Map 12D: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
216-A-13	216-A-13 French Drain	Liquid	2001	6.92×10^{-5}	–	2.18×10^{-14}	5.30×10^{-11}	6.75×10^{-11}	2.83×10^{-9}	1.96×10^{-9}
200-E-61	200-E-61 Reverse Well	Liquid	2001	1.24×10^{-2}	–	3.92×10^{-12}	9.53×10^{-9}	1.21×10^{-8}	5.09×10^{-7}	3.53×10^{-7}
200-E-136	200-E-136 PUREX Plant (202-A and others)	Solid	2003	1.10×10^{4}	–	–	–	–	4.78×10^{2}	4.91×10^{2}
UPR-200-E-39	UPR-200-E-39 (at 216-A-36B)	Liquid	2001	9.73×10^{-1}	–	6.45×10^{-14}	1.63×10^{-4}	8.47×10^{-6}	4.75×10^{-3}	3.43×10^{-3}
UPR-200-E-40	UPR-200-E-40	Liquid	2001	7.54×10^{-2}	–	4.99×10^{-15}	1.26×10^{-5}	6.56×10^{-7}	3.71×10^{-4}	2.60×10^{-4}
200-E-85	200-E-85 Reverse Well	Liquid	2001	9.85×10^{-3}	–	3.10×10^{-12}	7.55×10^{-9}	9.61×10^{-9}	4.03×10^{-7}	2.80×10^{-7}
216-A-35	216-A-35 French Drain	Liquid	2001	6.91×10^{-5}	–	2.18×10^{-14}	5.29×10^{-11}	6.74×10^{-11}	2.83×10^{-9}	1.96×10^{-9}
200-E-54	200-E-54 Unplanned Release	Liquid	2001	1.39×10^{-3}	–	4.36×10^{-13}	1.06×10^{-9}	1.35×10^{-9}	5.67×10^{-8}	3.93×10^{-8}
200-E-103	200-E-103 PUREX Stabilized Area	Liquid	2001	2.76×10^{-5}	–	8.70×10^{-15}	2.12×10^{-11}	2.70×10^{-11}	1.13×10^{-9}	7.85×10^{-10}
UPR-200-E-117[b]	UPR-200-E-117	Liquid	2001	9.64×10^{1}	–	3.23×10^{-9}	8.35×10^{-6}	9.85×10^{-5}	2.03×10^{-3}	2.24×10^{-3}
216-A-2	216-A-2 Crib	Liquid	2001	1.86	–	2.86×10^{-11}	1.54×10^{-1}	6.23×10^{-2}	9.47	1.76×10^{-1}
216-A-26	216-A-26 French Drain	Liquid	2001	2.67×10^{-5}	–	8.40×10^{-15}	2.04×10^{-11}	2.60×10^{-11}	1.09×10^{-9}	7.57×10^{-10}
216-A-26A	216-A-26A French Drain	Liquid	2001	6.92×10^{-6}	–	2.18×10^{-15}	5.30×10^{-12}	6.75×10^{-12}	2.83×10^{-10}	1.96×10^{-10}
216-A-15	216-A-15 French Drain	Liquid	2001	–	–	8.73×10^{-14}	3.43×10^{-4}	5.84×10^{-6}	1.31×10^{-3}	2.00×10^{-8}
200-E-107	200-E-107 Unplanned Release	Liquid	2001	1.85×10^{-5}	–	5.85×10^{-15}	1.42×10^{-11}	1.81×10^{-11}	7.60×10^{-10}	5.26×10^{-10}
218-E-14	218-E-14 PUREX Tunnel 1	Solid	1990	9.45×10^{2}	–	–	–	–	–	–
218-E-15	218-E-15 PUREX Tunnel 2	Solid	1990	–	–	–	–	–	4.74×10^{1}	–
216-A-4	216-A-4 Crib	Liquid	2001	4.86	–	2.32×10^{-7}	3.71	3.02×10^{-6}	1.47	5.35×10^{-3}
216-A-5	216-A-5 Crib	Liquid	2001	1.16×10^{1}	–	3.84×10^{-10}	1.33×10^{-1}	1.31	3.91×10^{1}	4.30×10^{1}
216-A-10	216-A-10 Crib	Liquid	2001	2.84×10^{1}	–	6.37×10^{-9}	2.50×10^{-1}	2.50	6.99×10^{1}	7.53×10^{1}
216-A-21	216-A-21 Crib	Liquid	2001	6.37×10^{1}	–	2.69×10^{-11}	1.34×10^{-1}	2.37×10^{-2}	5.74	4.61
216-A-27	216-A-27 Crib	Liquid	2001	2.94×10^{1}	–	1.39×10^{-6}	4.99×10^{-1}	1.83×10^{-5}	8.76	3.21×10^{-2}
216-A-31	216-A-31 Crib	Liquid	2001	3.71×10^{2}	–	8.27×10^{-12}	4.12×10^{-2}	3.89×10^{-4}	9.43×10^{-2}	2.29×10^{-2}
216-A-36-A	216-A-36A Crib	Liquid	2001	6.87×10^{2}	–	4.55×10^{-11}	1.15×10^{-1}	5.96×10^{-3}	3.39	2.40
216-A-36-B	216-A-36B Crib	Liquid	2001	2.92×10^{2}	–	9.58×10^{-11}	1.02×10^{-1}	2.43×10^{-4}	7.49×10^{-2}	2.26×10^{-1}
216-A-45	216-A-45 Crib	Liquid	2001	1.59	–	7.82×10^{-10}	6.52×10^{-3}	4.35×10^{-2}	1.18	1.25

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; PUREX=Plutonium-Uranium Extraction; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–57a. Map 13: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
2101-M Pond	2101-M Pond	Liquid	2001	1.50×10^{-1}	3.25×10^{-3}	–	1.69×10^{-4}	–	–	1.43×10^{-5}
216-B-54	216-B-54 Trench	Liquid	2001	1.04×10^{-2}	2.62×10^{-2}	–	5.19	2.50×10^{-4}	1.79×10^{-3}	–
216-B-14	216-B-14 Crib	Liquid	2001	5.41×10^{1}	2.10	–	5.95×10^{2}	2.54×10^{-2}	3.29×10^{1}	4.23×10^{-2}
216-B-15	216-B-15 Crib	Liquid	2001	3.94×10^{1}	1.53	–	1.68×10^{2}	1.85×10^{-2}	2.40×10^{1}	3.08×10^{-2}
216-B-16	216-B-16 Crib	Liquid	2001	3.50×10^{1}	1.31	–	1.45×10^{2}	5.02×10^{-1}	1.97×10^{1}	2.98×10^{-2}
216-B-17	216-B-17 Crib	Liquid	2001	2.13×10^{1}	7.41×10^{-1}	–	8.29×10^{1}	9.90×10^{-1}	9.84	2.17×10^{-2}
216-B-18	216-B-18 Crib	Liquid	2001	5.31×10^{1}	2.06	–	2.27×10^{2}	2.50×10^{-2}	3.24×10^{1}	4.15×10^{-2}
216-B-19	216-B-19 Crib	Liquid	2001	3.97×10^{1}	1.43	–	1.59×10^{2}	1.29	2.01×10^{1}	3.75×10^{-2}
216-B-20	216-B-20 Trench	Liquid	2001	2.92×10^{1}	1.06	–	3.07×10^{2}	8.33×10^{-1}	1.52×10^{1}	2.70×10^{-2}
216-B-21	216-B-21 Trench	Liquid	2001	2.91×10^{1}	1.11	–	1.23×10^{2}	2.06×10^{-1}	1.71×10^{1}	2.38×10^{-2}
216-B-22	216-B-22 Trench	Liquid	2001	2.96×10^{1}	1.10	–	1.22×10^{2}	5.43×10^{-1}	1.63×10^{1}	2.58×10^{-2}
216-B-23	216-B-23 Trench	Liquid	2001	2.82×10^{1}	1.05	–	1.16×10^{2}	5.31×10^{-1}	1.55×10^{1}	2.47×10^{-2}
216-B-24	216-B-24 Trench	Liquid	2001	3.04×10^{1}	1.18	–	1.30×10^{2}	1.43×10^{-2}	1.85×10^{1}	2.37×10^{-2}
216-B-25	216-B-25 Trench	Liquid	2001	3.06×10^{1}	1.19	–	1.31×10^{2}	1.44×10^{-2}	1.87×10^{1}	2.39×10^{-2}
216-B-26	216-B-26 Trench	Liquid	2001	2.96×10^{1}	1.15	–	4.88×10^{2}	1.39×10^{-2}	1.80×10^{1}	2.31×10^{-2}
216-B-27	216-B-27 Trench	Liquid	2001	2.76×10^{1}	1.07	–	1.18×10^{2}	1.30×10^{-2}	1.68×10^{1}	2.15×10^{-2}
216-B-28	216-B-28 Trench	Liquid	2001	3.15×10^{1}	1.18	–	1.30×10^{2}	5.12×10^{-1}	1.76×10^{1}	2.72×10^{-2}
216-B-29	216-B-29 Trench	Liquid	2001	3.01×10^{1}	1.17	–	2.49×10^{2}	1.42×10^{-2}	1.84×10^{1}	2.35×10^{-2}
216-B-30	216-B-30 Trench	Liquid	2001	2.99×10^{1}	1.07	–	1.19×10^{2}	1.02	1.50×10^{1}	2.85×10^{-2}
216-B-31	216-B-31 Trench	Liquid	2001	3.03×10^{1}	1.09	–	1.21×10^{2}	1.02	1.52×10^{1}	2.88×10^{-2}
216-B-32	216-B-32 Trench	Liquid	2001	2.97×10^{1}	1.06	–	1.51×10^{2}	1.06	1.47×10^{1}	2.85×10^{-2}
216-B-33	216-B-33 Trench	Liquid	2001	2.97×10^{1}	1.04	–	1.70×10^{2}	1.24	1.42×10^{1}	2.94×10^{-2}
216-B-34	216-B-34 Trench	Liquid	2001	3.05×10^{1}	1.07	–	1.65×10^{2}	1.29	1.45×10^{1}	3.04×10^{-2}
216-B-52	216-B-52 Trench	Liquid	2001	5.33×10^{1}	1.89	–	3.87×10^{2}	2.00	2.61×10^{1}	5.18×10^{-2}
216-B-53A	216-B-53A Trench	Liquid	2001	1.79×10^{-2}	1.44×10^{-2}	–	8.88	4.29×10^{-4}	3.07×10^{-3}	–
216-B-53B	216-B-53B Trench	Liquid	2001	1.05×10^{-2}	4.97×10^{-4}	–	5.19	2.50×10^{-4}	1.79×10^{-3}	–
216-B-58	216-B-58 Trench	Liquid	2001	8.36×10^{-3}	1.09×10^{-2}	–	4.15	2.00×10^{-4}	1.43×10^{-3}	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–57b. Map 13: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
2101-M Pond	2101-M Pond	Liquid	2001	1.15×10^{-3}	–	1.78×10^{-12}	8.75×10^{-3}	2.14×10^{-4}	3.27×10^{-2}	6.76×10^{-4}
216-B-54	216-B-54 Trench	Liquid	2001	6.12	–	2.91×10^{-7}	6.62×10^{-2}	7.93×10^{-4}	1.30	5.52×10^{-1}
216-B-14	216-B-14 Crib	Liquid	2001	3.04×10^{2}	–	8.53×10^{-10}	1.82×10^{-1}	2.61×10^{-1}	7.64	1.44×10^{1}
216-B-15	216-B-15 Crib	Liquid	2001	2.22×10^{2}	–	6.22×10^{-10}	1.32×10^{-1}	1.91×10^{-1}	5.57	1.05×10^{1}
216-B-16	216-B-16 Crib	Liquid	2001	1.97×10^{2}	–	6.51×10^{-10}	1.17×10^{-1}	1.58×10^{-1}	4.94	8.83
216-B-17	216-B-17 Crib	Liquid	2001	1.20×10^{2}	–	5.38×10^{-10}	7.00×10^{-2}	8.04×10^{-2}	3.02	4.65
216-B-18	216-B-18 Crib	Liquid	2001	2.99×10^{2}	–	8.39×10^{-10}	1.79×10^{-1}	2.57×10^{-1}	7.51	1.42×10^{1}
216-B-19	216-B-19 Crib	Liquid	2001	2.23×10^{2}	–	8.86×10^{-10}	1.31×10^{-1}	1.62×10^{-1}	5.61	9.25
216-B-20	216-B-20 Trench	Liquid	2001	5.49×10^{2}	–	6.30×10^{-10}	9.99×10^{-2}	1.22×10^{-1}	4.25	6.94
216-B-21	216-B-21 Trench	Liquid	2001	1.64×10^{2}	–	4.99×10^{-10}	9.76×10^{-2}	1.36×10^{-1}	4.12	7.58
216-B-22	216-B-22 Trench	Liquid	2001	1.66×10^{2}	–	5.76×10^{-10}	9.86×10^{-2}	1.31×10^{-1}	4.18	7.34
216-B-23	216-B-23 Trench	Liquid	2001	1.59×10^{2}	–	5.52×10^{-10}	9.40×10^{-2}	1.24×10^{-1}	3.99	6.99
216-B-24	216-B-24 Trench	Liquid	2001	1.71×10^{2}	–	4.79×10^{-10}	1.02×10^{-1}	1.47×10^{-1}	4.29	8.11
216-B-25	216-B-25 Trench	Liquid	2001	1.72×10^{2}	–	4.83×10^{-10}	1.03×10^{-1}	1.48×10^{-1}	4.33	8.18
216-B-26	216-B-26 Trench	Liquid	2001	5.85×10^{2}	–	4.67×10^{-10}	1.07×10^{-1}	1.43×10^{-1}	4.27	7.91
216-B-27	216-B-27 Trench	Liquid	2001	1.55×10^{2}	–	4.35×10^{-10}	9.27×10^{-2}	1.33×10^{-1}	3.90	7.36
216-B-28	216-B-28 Trench	Liquid	2001	1.77×10^{2}	–	6.00×10^{-10}	1.05×10^{-1}	1.41×10^{-1}	4.46	7.89
216-B-29	216-B-29 Trench	Liquid	2001	1.70×10^{2}	–	4.75×10^{-10}	1.01×10^{-1}	1.46×10^{-1}	4.26	8.05
216-B-30	216-B-30 Trench	Liquid	2001	1.68×10^{2}	–	6.77×10^{-10}	9.87×10^{-2}	1.21×10^{-1}	4.23	6.92
216-B-31	216-B-31 Trench	Liquid	2001	1.70×10^{2}	–	6.84×10^{-10}	1.00×10^{-1}	1.23×10^{-1}	4.29	7.03
216-B-32	216-B-32 Trench	Liquid	2001	1.67×10^{2}	–	6.83×10^{-10}	9.81×10^{-2}	1.19×10^{-1}	4.20	6.83
216-B-33	216-B-33 Trench	Liquid	2001	1.67×10^{2}	–	7.19×10^{-10}	9.78×10^{-2}	1.15×10^{-1}	4.20	6.63
216-B-34	216-B-34 Trench	Liquid	2001	1.71×10^{2}	–	7.44×10^{-10}	1.00×10^{-1}	1.18×10^{-1}	4.31	6.79
216-B-52	216-B-52 Trench	Liquid	2001	3.00×10^{2}	–	1.25×10^{-9}	1.76×10^{-1}	2.12×10^{-1}	7.54	1.21×10^{1}
216-B-53A	216-B-53A Trench	Liquid	2001	1.05×10^{1}	–	4.99×10^{-7}	2.15×10^{-1}	4.35×10^{-4}	3.86	3.08×10^{-1}
216-B-53B	216-B-53B Trench	Liquid	2001	6.10	–	2.91×10^{-7}	6.25×10^{-2}	1.90×10^{-5}	1.11	1.50×10^{-2}
216-B-58	216-B-58 Trench	Liquid	2001	4.89	–	2.33×10^{-7}	5.17×10^{-2}	3.30×10^{-4}	9.67×10^{-1}	2.32×10^{-1}

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–58a. Map 14: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
600 NRDWL	600 Nonrad Dangerous Waste Landfill	Solid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–58b. Map 14: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
600 NRDWL	600 Nonrad Dangerous Waste Landfill	Solid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–59a. Map 15: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
618-11	300 Wye Burial Ground	Solid	1986	–	–	–	1.00×10^{3}	–	–	–
400 RFD[b]	400 Area Retired French Drains	Liquid	N/A	–	–	–	–	–	–	–
316-4	300 North Cribs, 321 Cribs	Liquid	2001	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site had inventories that were in the initial list of constituents but was screened out during the final screening described in Section S.3.6.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–59b. Map 15: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
618-11	300 Wye Burial Ground	Solid	1986	$1.00{\times}10^{3}$	–	–	–	–	$6.23{\times}10^{2}$	–
400 RFD[b]	400 Area Retired French Drains	Liquid	N/A	–	–	–	–	–	–	–
316-4	300 North Cribs, 321 Cribs	Liquid	2001	–	–	–	$1.30{\times}10^{-4}$	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] This site had inventories that were in the initial list of constituents but was screened out during the final screening described in Section S.3.6.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–60a. Map 16: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	H-3	C-14	K-40	Sr-90	Zr-93	Tc-99	I-129
618-9	300 West Burial Ground	Solid	N/A	–	–	–	–	–	–	–
316-1[b]	300 Area South Process Ponds	Liquid	2001	1.05	$1.23{\times}10^{-1}$	–	$1.17{\times}10^{2}$	$4.78{\times}10^{-2}$	$4.35{\times}10^{-1}$	$1.79{\times}10^{-2}$
316-2[b]	300 Area North Process Ponds	Liquid	2001	$4.69{\times}10^{-1}$	$1.11{\times}10^{-1}$	–	$5.20{\times}10^{1}$	$2.13{\times}10^{-2}$	$1.93{\times}10^{-1}$	$1.76{\times}10^{-2}$
316-5[b]	300 Area Process Trenches	Liquid	2001	–	$1.41{\times}10^{-1}$	–	$8.72{\times}10^{-3}$	–	–	$2.00{\times}10^{-3}$
UPR-300-1	307-340 Waste Line Leak	Liquid	1969	–	–	–	$1.00{\times}10^{1}$	–	–	–
300-19[c]	324 Sodium Removal Pilot Plant	Liquid	Unknown	–	–	–	–	–	–	–
UPR-300-13[c]	Acid Neutralization Tank Leak East of 333 Building	Liquid	N/A	–	–	–	–	–	–	–
300-264	327 Building, Postirradiation Testing Laboratory	Liquid	Unknown	–	–	–	$2.25{\times}10^{2}$	–	–	–
309-WS-1	309 Plutonium Recycle Test Reactor Ion Exchange Vault	Liquid	1994	–	–	–	1.00	–	–	–
316-3	307 Disposal Trenches	Liquid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] The radionuclide inventories for the 300 Area Process Ponds and Trenches were determined to be overly conservative as reported in SIM [the Hanford Soil Inventory Model] (Corbin et al. 2005), which relied upon a surrogate waste stream from the PUREX [plutonium-uranium extraction] process cooling-water/steam condensate. This approach resulted in a significant overestimation of the radionuclide inventory based on analytical data and process knowledge. The inventories for plutonium only have been revised to account for this overestimation (Harrington 2011; Mehta 2011).

[c] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: C=carbon; H-3=hydrogen-3 (tritium); I=iodine; ID=identifier; K=potassium; N/A=not applicable; Sr=strontium; Tc=technetium; WIDS=Waste Information Data System; Zr=zirconium.

Source: SAIC 2011.

Table S–60b. Map 16: Radionuclide Inventories (curies)

WIDS ID/ Building Number	Common Site Name	Source Type	Decay Date[a]	Cs-137	Gd-152	Th-232	U-238 (U-233, -234, -235, -238)	Np-237	Pu-239 (Pu-239, -240)	Am-241
618-9	300 West Burial Ground	Solid	N/A	–	–	–	–	–	–	–
316-1[b]	300 Area South Process Ponds	Liquid	2001	9.61×10^{2}	–	3.28×10^{-10}	8.45×10^{1}	1.59×10^{-2}	–	1.52×10^{1}
316-2[b]	300 Area North Process Ponds	Liquid	2001	4.27×10^{2}	–	3.14×10^{-10}	6.16×10^{1}	1.44×10^{-2}	–	6.78×10^{-2}
316-5[b]	300 Area Process Trenches	Liquid	2001	–	–	7.83×10^{-10}	1.41	1.09×10^{-2}	–	7.26×10^{-5}
UPR-300-1	307-340 Waste Line Leak	Liquid	1969	1.00×10^{1}	–	–	–	–	–	–
300-19[c]	324 Sodium Removal Pilot Plant	Liquid	Unknown	4.20×10^{4}	–	–	–	–	7.77	5.67×10^{1}
UPR-300-13[c]	Acid Neutralization Tank Leak East of 333 Building	Liquid	N/A	–	–	–	–	–	–	–
300-264	327 Building, Postirradiation Testing Laboratory	Liquid	Unknown	1.60×10^{2}	–	–	–	–	–	–
309-WS-1	309 Plutonium Recycle Test Reactor Ion Exchange Vault	Liquid	1994	1.00	–	–	–	–	–	–
316-3	307 Disposal Trenches	Liquid	N/A	–	–	–	–	–	–	–

[a] Date of determination of the inventories reflected in this table. For purposes of groundwater modeling (see Appendix N), these concentrations were adjusted (i.e., increased) to account for decay from the date of radionuclide release.

[b] The radionuclide inventories for the 300 Area Process Ponds and Trenches were determined to be overly conservative as reported in SIM [the Hanford Soil Inventory Model] (Corbin et al. 2005), which relied upon a surrogate waste stream from the PUREX [plutonium-uranium extraction] process cooling-water/steam condensate. This approach resulted in a significant overestimation of the radionuclide inventory based on analytical data and process knowledge. The inventories for plutonium only have been revised to account for this overestimation (Harrington 2011; Mehta 2011).

[c] This site was not modeled because not all the information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels.

Key: Am=americium; Cs=cesium; Gd=gadolinium; ID=identifier; N/A=not applicable; Np=neptunium; Pu=plutonium; Th=thorium; U=uranium; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–61a. Map 1: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
116-B-1[a]	107-B Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	2.40×10^{1}	–	–
116-B-4	105-B Dummy Decontamination French Drain	L	–	–	–	–	–	–	–	–	–	–	4.00×10^{2}	–	–
116-B-5	108-B Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-B-6A[a]	116-B-6-1 Crib	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{1}	–	–
116-B-6B	116-B-6-2 Crib	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{1}	–	–
116-B-11[a]	107-B Retention Basins	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-C-5	107-C Retention Basins	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-C-1[a]	107-C Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	4.00×10^{1}	–	–
116-C-2A	105-C Pluto Crib	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{2}	–	–
116-C-2C[a]	105-C Pluto Crib Sand Filter	L	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–61b. Map 1: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
116-B-1[a]	107-B Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	–	8.70×10^{-8}	–
116-B-4	105-B Dummy Decontamination French Drain	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-B-5	108-B Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-B-6A[a]	116-B-6-1 Crib	L	–	–	–	–	–	–	–	–	–	–	–	2.10×10^{-8}	–
116-B-6B	116-B-6-2 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-B-11[a]	107-B Retention Basins	L	–	–	–	–	–	–	–	–	–	–	–	9.76×10^{-6}	–
116-C-5[a]	107-C Retention Basins	L	–	–	–	–	–	–	–	–	–	–	–	3.19×10^{-6}	–
116-C-1[a]	107-C Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	–	1.36×10^{-6}	–
116-C-2A	105-C Pluto Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-C-2C[a]	105-C Pluto Crib Sand Filter	L	–	–	–	–	–	–	–	–	–	–	–	2.40×10^{-6}	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–62a. Map 2: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
116-K-1[a]	100-K Crib	L	–	–	–	–	–	–	–	–	–	–	1.60×10^{1}	–	–
116-K-2[a]	100-K Mile Long Trench	L	–	–	–	–	–	–	–	–	–	–	1.20×10^{5}	–	–
116-KE-4[a]	107-KE Retention Basins	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-KW-3[a]	107-KW Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-KE-1	115-KE Condensate Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-KE-2	1706-KER Waste Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-KW-1	115-KW Condensate Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-K-1[b]	100-KE Fuel Storage Basin Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
120-KE-1	183-KE Filter Waste Facility Drywell	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–62b. Map 2: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
116-K-1[a]	100-K Crib	L	–	–	–	–	–	–	–	–	–	–	–	1.61×10^{-6}	–
116-K-2[a]	100-K Mile Long Trench	L	–	–	–	–	–	–	–	–	–	–	–	5.41×10^{-5}	–
116-KE-4[a]	107-KE Retention Basins	L	–	–	–	–	–	–	–	–	–	–	–	5.85×10^{-9}	–
116-KW-3[a]	107-KW Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	3.79×10^{-8}	–
116-KE-1	115-KE Condensate Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-KE-2	1706-KER Waste Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-KW-1	115-KW Condensate Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-K-1[b]	100-KE Fuel Storage Basin Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
120-KE-1	183-KE Filter Waste Facility Drywell	L/S	–	–	–	2.20×10^{2}	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–63a. Map 3: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
116-N-1[a]	1301-N Liquid Waste Disposal Facility	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-N-3[a]	1325-N Liquid Waste Disposal Facility	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-N-3	Spacer Disposal System Transport Line Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-N-7	Rad Line Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-N-35[b]	100-N Fuel Storage Basin Drainage System Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–63b. Map 3: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
116-N-1[a]	1301-N Liquid Waste Disposal Facility	L	–	–	–	–	–	–	–	–	–	–	–	1.26×10^{-4}	–
116-N-3[a]	1325-N Liquid Waste Disposal Facility	L	–	–	–	–	–	–	–	–	–	–	–	1.63×10^{2}	–
UPR-100-N-3	Spacer Disposal System Transport Line Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-N-7	Rad Line Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-N-35[b]	100-N Fuel Storage Basin Drainage System Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–64a. Map 4: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
116-D-1A[a]	105-D Storage Basin Trenches 1	L	–	–	–	–	–	–	–	–	–	–	4.00×10^{2}	–	–
116-D-1B[a]	105-D Storage Basin Trenches 2	L	–	–	–	–	–	–	–	–	–	–	2.80×10^{2}	–	–
116-D-7[a]	107-D Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-DR-9[a]	107-DR Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	–	–
100-D-25[a, b]	107-DR Basin Leaks	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-100-D-4[a, b]	107-D Basin Leaks	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-DR-1&2[a]	107-DR Liquid Waste Disposal Trenches	L	–	–	–	–	–	–	–	–	–	–	3.20×10^{1}	–	–
116-DR-6	1608-DR Liquid Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	8.00×10^{-1}	–	–
116-DR-7	105-DR Inkwell Crib	L	–	–	–	–	–	–	–	3.30×10^{2}	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–64b. Map 4: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
116-D-1A[a]	105-D Storage Basin Trenches 1	L	–	–	–	–	–	–	–	–	–	–	–	2.10×10^{-7}	–
116-D-1B[a]	105-D Storage Basin Trenches 2	L	–	–	–	–	–	–	–	–	–	–	–	7.03×10^{-8}	–
116-D-7[a]	107-D Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	1.57×10^{-6}	–
116-DR-9[a]	107-DR Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	7.34×10^{-7}	–
100-D-25[a, b]	107-DR Basin Leaks	L	–	–	–	–	–	–	–	–	–	–	–	4.56×10^{-7}	–
UPR-100-D-4[a, b]	107-D Basin Leaks	L	–	–	–	–	–	–	–	–	–	–	–	7.44×10^{-7}	–
116-DR-1&2[a]	107-DR Liquid Waste Disposal Trenches	L	–	–	–	–	–	–	–	–	–	–	–	3.66×10^{-7}	–
116-DR-6	1608-DR Liquid Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-DR-7	105-DR Inkwell Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–65a. Map 5: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
100-H-33	183-H Solar Evaporation Basins Radionuclide Components	L	–	–	–	–	–	–	–	–	–	–	7.35×10^{2}	–	8.74×10^{4}
116-H-6	183-H Solar Evaporation Basins	L	Site consolidated with Site WIDS ID 100-H-33												
116-H-1[a]	107-H Liquid Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	3.60×10^{1}	–	–
116-H-2	1608-H Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	2.40×10^{2}	–	–
116-H-4	105-H Pluto Crib	L	–	–	–	–	–	–	–	–	–	–	4.00×10^{2}	–	–
116-H-7[a]	107-H Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-H-3	105-H Dummy Decontamination French Drain	L	–	–	–	–	–	–	–	–	–	–	8.00×10^{2}	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–65b. Map 5: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
100-H-33	183-H Solar Evaporation Basins Radionuclide Components	L	–	–	1.39×10^{3}	–	–	–	1.36×10^{6}	–	–	–	–	1.96×10^{3}	–
116-H-6	183-H Solar Evaporation Basins	L	Site consolidated with Site WIDS ID 100-H-33												
116-H-1[a]	107-H Liquid Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	–	7.35×10^{-7}	–
116-H-2	1608-H Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-H-4	105-H Pluto Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-H-7[a]	107-H Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	2.53×10^{-6}	–
116-H-3	105-H Dummy Decontamination French Drain	L	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–66a. Map 6: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
116-F-1[a, b]	Lewis Canal	L	–	–	–	–	–	–	–	–	–	–	4.00×10^{1}	–	–
116-F-2[a]	107-F Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	2.40×10^{1}	–	–
116-F-9	Animal Waste Leaching Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-F-3	105-F Storage Basin Trench	L	–	–	–	–	–	–	–	–	–	–	1.60	–	–
116-F-6[a]	105-F Cooling Water Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-F-4[a]	105-F Pluto Crib	L	–	–	–	–	–	–	–	–	–	–	1.60×10^{-3}	–	–
116-F-10	105-F Dummy Decontamination French Drain	L	–	–	–	–	–	–	–	–	–	–	8.00×10^{2}	–	–
116-F-14[a]	107-F Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] This site was not modeled because it emptied directly into the Columbia River.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–66b. Map 6: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
116-F-1[a, b]	Lewis Canal	L	–	–	–	–	–	–	–	–	–	–	–	6.89×10^{-8}	–
116-F-2[a]	107-F Liquid Waste Disposal Trench	L	–	–	–	–	–	–	–	–	–	–	–	8.57×10^{-8}	–
116-F-9	Animal Waste Leaching Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-F-3	105-F Storage Basin Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-F-6[a]	105-F Cooling Water Trench	L	–	–	–	–	–	–	–	–	–	–	–	1.03×10^{-7}	–
116-F-4[a]	105-F Pluto Crib	L	–	–	–	–	–	–	–	–	–	–	–	4.45×10^{-7}	–
116-F-10	105-F Dummy Decontamination French Drain	L	–	–	–	–	–	–	–	–	–	–	–	–	–
116-F-14[a]	107-F Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	8.29×10^{-7}	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because it emptied directly into the Columbia River.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–67a. Map 7: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-N-1	216-N-1 Pond	L	–	–	–	–	–	–	–	–	–	–	–	–	1.22×10^{2}
216-N-2	216-N-2 Trench	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{-2}	–	1.14
216-N-3	216-N-3 Trench	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{-2}	–	1.14
216-N-4	216-N-4 Pond	L	–	–	–	–	–	–	–	–	–	–	2.01×10^{-2}	–	1.23×10^{2}
216-N-5	216-N-5 Trench	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{-2}	–	1.14
216-N-6	216-N-6 Pond	L	–	–	–	–	–	–	–	–	–	–	2.01×10^{-2}	–	1.23×10^{2}
216-N-7	216-N-7 Trench	L	–	–	–	–	–	–	–	–	–	–	2.00×10^{-2}	–	1.14

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–67b. Map 7: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-N-1	216-N-1 Pond	L	–	8.61	2.94×10^{1}	–	–	–	–	–	–	–	–	5.77×10^{-1}	–
216-N-2	216-N-2 Trench	L	–	6.55×10^{-2}	2.24×10^{-1}	6.04×10^{-6}	–	6.46×10^{-3}	4.53	–	–	–	–	2.23×10^{-2}	–
216-N-3	216-N-3 Trench	L	–	6.55×10^{-2}	2.24×10^{-1}	6.04×10^{-6}	–	6.46×10^{-3}	4.53	–	–	–	–	2.23×10^{-2}	–
216-N-4	216-N-4 Pond	L	–	8.61	2.94×10^{1}	6.05×10^{-6}	–	6.47×10^{-3}	4.54	–	–	–	–	5.95×10^{-1}	–
216-N-5	216-N-5 Trench	L	–	6.55×10^{-2}	2.24×10^{-1}	6.04×10^{-6}	–	6.45×10^{-3}	4.53	–	–	–	–	2.23×10^{-2}	–
216-N-6	216-N-6 Pond	L	–	8.61	2.94×10^{1}	6.05×10^{-6}	–	6.46×10^{-3}	4.54	–	–	–	–	5.95×10^{-1}	–
216-N-7	216-N-7 Trench	L	–	6.55×10^{-2}	2.24×10^{-1}	6.04×10^{-6}	–	6.46×10^{-3}	4.53	–	–	–	–	2.23×10^{-2}	–

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–68a. Map 8: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-A-25	216-A-25 Gable Mountain Pond	L	–	–	1.05×10^{4}	–	–	–	–	–	–	2.20×10^{3}	4.58	–	4.88×10^{4}
UPR-200-E-34	UPR-200-E-34	L	Site consolidated with Site WIDS ID 216-A-25												
600-118	600-118 Ditch	L	Site consolidated with Site WIDS ID 216-A-25												

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.
Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–68b. Map 8: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes Nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-A-25	216-A-25 Gable Mountain Pond	L	–	9.37×10^{1}	1.74×10^{3}	8.80×10^{-1}	–	1.35	1.64×10^{5}	–	–	–	–	1.22×10^{4}	–
UPR-200-E-34	UPR-200-E-34	L	Site consolidated with Site WIDS ID 216-A-25												
600-118	600-118 Ditch	L	Site consolidated with Site WIDS ID 216-A-25												

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.
Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–69a. Map 9: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-S-5	216-S-5 Crib	L	–	–	1.04×10^{-3}	–	–	–	–	–	–	–	3.58	–	5.15
216-S-6	216-S-6 Crib	L	–		7.97×10^{-4}	–	–	–	–	–	–	–	1.84×10^{-1}	–	3.94
216-S-10D[a, b]	216-S-10D Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-10P	216-S-10P Pond	L	–	–	–	–	–	–	–	–	–	–	2.98×10^{3}	–	7.43×10^{2}
216-S-11P	216-S-11 Pond	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-16D[a]	216-S-16D Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-16P	216-S-16P Pond	L	–	–	6.10×10^{-4}	–	–	–	–	–	–	–	1.54	–	3.01
216-S-17	216-S-17 Pond	L	–	–	2.22×10^{-4}	–	–	–	–	–	–	–	3.32	–	4.88×10^{2}
UPR-200-W-47	UPR-200-W-47	L	Site consolidated with Site WIDS ID 216-S-16P												
UPR-200-W-59	UPR-200-W-59	L	Site consolidated with Site WIDS ID 216-S-16P												
UPR-200-W-34	UPR-200-W-34	L	Site consolidated with Site WIDS ID 216-S-10D												
218-W-1[b]	218-W-1 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-W-2[b]	218-W-2 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-W-4B	218-W-4B Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-W-4C[c]	218-W-4C Burial Ground	S	–	–	–	–	–	8.08	1.42×10^{-1}	4.90	1.81×10^{2}	8.16×10^{2}	3.75×10^{2}	6.14	5.84×10^{1}
218-W-5	218-W-5 Burial Ground	S	–	–	–	3.20×10^{3}	–	1.83×10^{1}	2.14	1.01×10^{1}	1.21×10^{2}	7.62×10^{-1}	5.08×10^{1}	1.16×10^{2}	7.62×10^{-1}
218-W-3AE[b]	218-W-3AE Burial Ground	S	–	–	–	–	–	9.90×10^{-3}	–	–	3.82×10^{-1}	1.87	3.18×10^{2}	–	1.63×10^{-1}
218-W-3A	218-W-3A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
Z Plant BP	Z Plant Burning Pit	S	Site consolidated with Site WIDS ID 218-W-4C												

[a] This site was consolidated with another site for purposes of modeling.

[b] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[c] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–69b. Map 9: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-S-5	216-S-5 Crib	L	–	1.16×10^{-3}	1.68×10^{-1}	3.99	–	1.53×10^{-1}	5.07×10^{5}	–	–	–	–	1.10×10^{3}	–
216-S-6	216-S-6 Crib	L	–	1.26×10^{-3}	2.66×10^{-3}	4.33	–	1.57×10^{-2}	5.52×10^{5}	–	–	–	–	8.53×10^{2}	–
216-S-10D[a, b]	216-S-10D Ditch	L	–	–	–	–	–	–	–	–	–	–	–	3.19×10^{-8}	–
216-S-10P	216-S-10P Pond	L	–	2.97×10^{3}	4.29×10^{1}	1.20×10^{2}	–	1.97×10^{-1}	9.55×10^{4}	–	–	–	–	5.12×10^{2}	–
216-S-11P	216-S-11 Pond	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-16D[a]	216-S-16D Ditch	L	–	–	–	–	–	–	1.00×10^{1}	–	–	–	–	–	–
216-S-16P	216-S-16P Pond	L	–	1.16×10^{-2}	1.23×10^{-2}	3.97×10^{1}	–	7.01×10^{-2}	5.03×10^{6}	–	–	–	–	6.57×10^{2}	–
216-S-17	216-S-17 Pond	L	–	3.08×10^{-2}	7.06×10^{-2}	5.34	–	1.37×10^{-1}	6.76×10^{5}	–	–	–	–	3.54	–
UPR-200-W-47	UPR-200-W-47	L	Site consolidated with Site WIDS ID 216-S-16P												
UPR-200-W-59	UPR-200-W-59	L	Site consolidated with Site WIDS ID 216-S-16P												
UPR-200-W-34	UPR-200-W-34	L	Site consolidated with Site WIDS ID 216-S-10D												
218-W-1[b]	218-W-1 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	6.99×10^{1}	–
218-W-2[b]	218-W-2 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	1.40×10^{3}	–
218-W-4B	218-W-4B Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-W-4C[c]	218-W-4C Burial Ground	S	–	3.77×10^{5}	7.96×10^{1}	8.42×10^{1}	3.23×10^{1}	1.19×10^{2}	2.86×10^{2}	6.67×10^{-2}	2.98×10^{2}	2.46	1.35×10^{-1}	8.35×10^{1}	9.50×10^{-1}
218-W-5	218-W-5 Burial Ground	S	6.04	4.19×10^{5}	8.28×10^{-1}	1.21×10^{1}	4.98×10^{-3}	3.67×10^{1}	8.63×10^{2}	9.68	7.11×10^{1}	3.40×10^{-4}	1.49×10^{1}	5.54×10^{-2}	1.10
218-W-3AE[b]	218-W-3AE Burial Ground	S	–	7.03×10^{3}	9.00	1.53×10^{2}	4.00×10^{-4}	1.17×10^{-1}	3.21×10^{1}	2.50×10^{-3}	1.64	–	–	3.70×10^{5}	–
218-W-3A	218-W-3A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
Z Plant BP	Z Plant Burning Pit	S	Site consolidated with Site WIDS ID 218-W-4C												

[a] This site was consolidated with another site for purposes of modeling.

[b] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[c] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–70a. Map 9A: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
218-W-3[a]	218-W-3 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-W-4A[a]	218-W-4A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-W-2A	218-W-2A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-84	UPR-200-W-84	L	Site consolidated with Site WIDS ID 218-W-3A												
UPR-200-W-134	UPR-200-W-134	S	Site consolidated with Site WIDS ID 218-W-3A												
UPR-200-W-53	UPR-200-W-53	L	Site consolidated with Site WIDS ID 218-W-2A												
UPR-200-W-72	UPR-200-W-72	S	Site consolidated with Site WIDS ID 218-W-4A												
UPR-200-W-16	UPR-200-W-16	S	Site consolidated with Site WIDS ID 218-W-1												
216-T-4A[b]	216-T-4A Pond	L	–	–	3.51×10^{-3}	–	–	–	–	–	–	3.62×10^{2}	1.14×10^{4}	–	4.90×10^{3}
216-T-4B	216-T-4B Pond	L	Site consolidated with Site WIDS ID 216-T-4A												
216-T-36	216-T-36 Crib	L	–	–	–	–	–	–	–	–	–	–	2.12×10^{2}	–	–
216-T-4-2	216-T-4-2 Ditch	L	Site consolidated with Site WIDS ID 216-T-4A												
UPR-200-W-97	UPR-200-W-97 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	7.66×10^{-1}	–	8.33
UPR-200-W-29	UPR-200-W-29 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	1.36	–	1.42×10^{1}
216-T-13	216-T-13 Trench	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-T-27	216-T-27 Crib	L	–	–	–	–	–	–	–	–	–	–	1.25×10^{3}	–	5.52×10^{-1}
216-TY-201	216-TY-201 Settling Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–

a Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

b To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–70b. Map 9A: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
218-W-3[a]	218-W-3 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	6.99×10^{4}	–
218-W-4A[a]	218-W-4A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	3.93×10^{5}	–
218-W-2A	218-W-2A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-84	UPR-200-W-84	L	Site consolidated with Site WIDS ID 218-W-3A												
UPR-200-W-134	UPR-200-W-134	S	Site consolidated with Site WIDS ID 218-W-3A												
UPR-200-W-53	UPR-200-W-53	L	Site consolidated with Site WIDS ID 218-W-2A												
UPR-200-W-72	UPR-200-W-72	S	Site consolidated with Site WIDS ID 218-W-4A												
UPR-200-W-16	UPR-200-W-16	S	Site consolidated with Site WIDS ID 218-W-1												
216-T-4A[b]	216-T-4A Pond	L	–	1.35	1.26×10^{1}	1.12	–	2.96×10^{3}	4.11×10^{5}	–	–	–	–	6.07×10^{2}	–
216-T-4B	216-T-4B Pond	L	Site consolidated with Site WIDS ID 216-T-4A												
216-T-36	216-T-36 Crib	L	–	–	–	–	–	9.44×10^{1}	5.71×10^{3}	–	–	–	–	1.72×10^{2}	–
216-T-4-2	216-T-4-2 Ditch	L	Site consolidated with Site WIDS ID 216-T-4A												
UPR-200-W-97	UPR-200-W-97 Unplanned Release	L	–	–	–	–	–	1.87×10^{-1}	1.53×10^{2}	–	–	–	–	1.53×10^{-2}	–
UPR-200-W-29	UPR-200-W-29 Unplanned Release	L	–	–	–	1.23×10^{-3}	–	3.77×10^{-1}	4.18×10^{2}	–	–	–	–	1.17×10^{-1}	–
216-T-13	216-T-13 Trench	L	–	–	–	–	–	–	–	–	–	–	–	5.00×10^{-2}	–
216-T-27	216-T-27 Crib	L	–	2.19	2.30×10^{-2}	9.21×10^{-2}	–	3.20×10^{2}	3.42×10^{4}	–	–	–	–	3.07×10^{1}	–
216-TY-201	216-TY-201 Settling Tank	L	–	1.06×10^{1}	–	–	–	–	–	–	–	8.38	–	8.30	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–71a. Map 9B: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-T-12	216-T-12 Trench	L	–	–	2.52×10^{-2}	–	–	–	–	–	–	–	2.34	–	1.43×10^{2}
218-W-1A[a]	218-W-1A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-26	UPR-200-W-26	S	Site consolidated with Site WIDS ID 218-W-1A												
216-T-29	216-T-29 Crib	L	–	–	–	–	–	–	–	–	–	–	3.48×10^{-2}	–	2.24×10^{-2}
216-T-33	216-T-33 Crib	L	–	–	2.51×10^{-4}	–	–	–	–	–	–	–	2.16×10^{1}	–	1.24
216-T-34	216-T-34 Crib	L	–	–	–	–	–	–	–	–	–	–	5.83×10^{3}	–	4.37×10^{-1}
216-T-35	216-T-35 Crib	L	–	–	–	–	–	–	–	–	–	–	3.00	–	7.56×10^{-1}
216-T-1	216-T-1 Ditch (221-T Ditch)	L	–	–	–	–	–	–	–	–	–	–	8.24×10^{2}	–	2.44×10^{1}
216-T-2	216-T-2 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	2.50×10^{3}	–	–
216-T-3	216-T-3 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	2.65×10^{3}	–	3.86×10^{4}
216-T-6	216-T-6 Cribs	L	–	–	–	–	–	–	–	–	–	–	6.83×10^{2}	–	1.26×10^{4}
216-T-8	216-T-8 Crib	L	–	–	–	–	–	–	–	–	–	–	2.10×10^{1}	–	–
200-W-45	200-W-45 Sand Filter	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-20	2706-T Equipment Decontamination Building	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-20[a]	T Plant Complex (including 221-T Canyon)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
224-T	224-T Canyon	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-9	200-W-9 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	5.66×10^{1}	–	–

Table S–71a. Map 9B: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
UPR-200-W-2[b]	UPR-200-W-2 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	2.24	–	–
UPR-200-W-21	UPR-200-W-21	L	–	–	–	–	–	–	–	–	–	–	2.06	–	–
UPR-200-W-38	UPR-200-W-38 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	1.43	–	–
UPR-200-W-98[b]	UPR-200-W-98 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	6.02×10^{-2}	–	–
UPR-200-W-102	UPR-200-W-102 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	9.38	–	1.36×10^{2}
TRUSAF	TRUSAF (in 224-T Canyon)	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
241-T-361	241-T-361 Settling Tank	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–71b. Map 9B: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-T-12	216-T-12 Trench	L	–	–	4.54×10^{-2}	1.65×10^{-2}	–	7.75×10^{-1}	7.71×10^{4}	–	–	–	–	2.17×10^{2}	–
218-W-1A[a]	218-W-1A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	8.99×10^{2}	–
UPR-200-W-26	UPR-200-W-26	S	Site consolidated with Site WIDS ID 218-W-1A												
216-T-29	216-T-29 Crib	L	–	–	5.51×10^{-5}	6.46×10^{-7}	–	9.07×10^{-3}	1.36	–	–	–	–	1.91×10^{-3}	–
216-T-33	216-T-33 Crib	L	–	–	4.52×10^{-4}	1.85×10^{-4}	–	9.45	1.34×10^{3}	–	–	–	–	6.02×10^{1}	–
216-T-34	216-T-34 Crib	L	–	1.73	1.82×10^{-2}	7.28×10^{-2}	–	1.51×10^{3}	1.57×10^{5}	–	–	–	–	6.37×10^{1}	–
216-T-35	216-T-35 Crib	L	–	3.00	3.15×10^{-2}	1.26×10^{-1}	–	–	3.00	–	–	–	–	3.01×10^{1}	–
216-T-1	216-T-1 Ditch (221-T Ditch)	L	–	2.37	3.39	8.36×10^{-1}	–	2.13×10^{2}	2.24×10^{4}	–	–	–	–	2.13×10^{-1}	–
216-T-2	216-T-2 Reverse Well	L	–	–	–	–	–	6.44×10^{2}	6.75×10^{4}	–	–	–	–	2.99×10^{-1}	–
216-T-3	216-T-3 Reverse Well	L	–	–	1.05×10^{3}	–	–	6.97×10^{2}	6.47×10^{5}	–	–	–	–	2.01	–
216-T-6	216-T-6 Cribs	L	–	–	8.22×10^{1}	–	–	2.78×10^{2}	2.30×10^{5}	–	–	–	–	2.08×10^{1}	–
216-T-8	216-T-8 Crib	L	–	–	–	–	–	9.31	5.66×10^{2}	–	–	–	–	4.75×10^{1}	–
200-W-45	200-W-45 Sand Filter	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-20	2706-T Equipment Decontamination Building	S	–	–	–	–	–	–	8.93×10^{2}	–	–	–	–	–	–
200-W-20[a]	T Plant complex (including 221-T Canyon)	S	–	–	–	–	–	–	3.13×10^{3}	–	–	–	–	1.73	–
224-T	224-T Canyon	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-9	200-W-9 Unplanned Release	L	–	–	–	–	–	1.46×10^{1}	1.53×10^{3}	–	–	–	–	6.75×10^{-3}	–
UPR-200-W-2[b]	UPR-200-W-2 Unplanned Release	L	–	–	–	–	–	1.27	1.54×10^{2}	–	–	–	–	1.17×10^{1}	–

Table S–71b. Map 9B: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
UPR-200-W-21	UPR-200-W-21	L	–	–	–	3.60×10^{-3}	–	1.16	1.42×10^{2}	–	–	–	–	1.06×10^{1}	–
UPR-200-W-38	UPR-200-W-38 Unplanned Release	L	–	–	–	2.50×10^{-3}	–	8.06×10^{-1}	9.83×10^{1}	–	–	–	–	7.34	–
UPR-200-W-98[b]	UPR-200-W-98 Unplanned Release	L	–	–	–	–	–	3.40×10^{-2}	4.15	–	–	–	–	3.15×10^{-1}	–
UPR-200-W-102	UPR-200-W-102 Unplanned Release	L	–	–	1.24×10^{2}	–	–	2.44	2.27×10^{3}	–	–	–	–	5.37×10^{-4}	–
TRUSAF	TRUSAF (in 224-T Canyon)	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
241-T-361	241-T-361 Settling Tank	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–72a. Map 9C: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-Z-16[a]	216-Z-16 Crib	L	–	–	–	–	–	–	–	–	–	–	1.27×10^{1}	–	5.81×10^{6}
231-Z	231-Z Plutonium Isolation Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-4[b]	216-Z-4 Trench	L	–	–	3.16	–	–	–	–	–	–	5.42×10^{-1}	1.14×10^{-4}	–	9.36×10^{-1}
216-Z-5[a, b]	216-Z-5 Crib	L	–	–	5.02×10^{1}	–	–	–	–	–	–	8.60	3.22×10^{-1}	–	1.49×10^{1}
216-Z-6[b]	216-Z-6 Crib	L	–	–	6.73	–	–	–	–	–	–	1.15	1.02×10^{-3}	–	1.99
216-Z-7[a, b]	216-Z-7 Crib	L	–	–	2.12×10^{3}	–	–	–	–	–	–	3.63×10^{2}	2.63×10^{3}	–	6.26×10^{2}
216-Z-8[b]	216-Z-8 Trench	L	–	–	3.14×10^{1}	–	–	–	–	–	–	3.62×10^{2}	2.42×10^{-3}	–	1.21×10^{-3}
216-Z-9[a, b]	216-Z-9 Trench	L	–	–	1.79×10^{4}	–	–	–	–	–	–	2.08×10^{5}	–	–	2.11×10^{4}
216-Z-10[b]	216-Z-10 Reverse Well	L	–	–	6.61×10^{1}	–	–	–	–	–	–	1.13×10^{1}	1.04×10^{-2}	–	1.96×10^{1}
UPR-200-W-130[c]	UPR-200-W-130	L	–	–	–	–	–	–	–	–	–	–	4.12×10^{-5}	–	1.88×10^{1}
216-Z-17[a]	216-Z-17 Trench	L	–	–	–	–	–	–	–	–	–	–	4.59	–	2.10×10^{6}
216-Z-15	216-Z-15 French Drain	L	–	–	–	–	–	–	–	–	–	–	2.43×10^{1}	–	6.56
234-5Z	234-5Z Plutonium Finishing Plant	S	–	–	–	–	–	–	–	–	–	–	–	–	–
2736-Z	2736-Z Plutonium Finishing Plant	S/L	–	–	–	–	–	–	–	–	–	–	–	–	–
242-Z	242-Z Americium Recovery Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-1D[d]	216-Z-1(D) Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
236-Z	236-Z Plutonium Reclamation Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-14[b]	216-Z-14 French Drain	L	–	–	–	–	–	–	–	–	–	2.18×10^{2}	1.31×10^{1}	–	6.53
291-Z	291-Z Exhaust Fan and Compressor House	S	–	–	–	–	–	–	–	–	–	–	–	–	–

Table S–72a. Map 9C: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
UPR-200-W-103[b]	UPR-200-W-103	L	–	–	1.12×10^{1}	–	–	–	–	–	–	1.29×10^{2}	–	–	–
241-Z[d]	241-Z Treatment Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–
241-Z-361[a]	241-Z-361 Settling Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-13[b]	216-Z-13 French Drain	L	–	–	–	–	–	–	–	–	–	2.18×10^{2}	1.26×10^{1}	–	6.28
216-Z-1&2[a, b]	216-Z-1 & 2 Cribs	L	–	–	1.09×10^{3}	–	–	–	–	–	–	3.80×10^{4}	1.61×10^{1}	–	1.20×10^{3}
216-Z-3[a, b]	216-Z-3 Crib	L	–	–	–	–	–	–	–	–	–	2.25×10^{4}	1.56×10^{1}	–	3.79
216-Z-12[a, b]	216-Z-12 Crib	L	–	–	5.03×10^{3}	–	–	–	–	–	–	1.35×10^{5}	5.18×10^{1}	–	9.81×10^{4}
216-Z-1A[a, b]	216-Z-1A Tile Field	L	–	–	2.63×10^{4}	–	–	–	–	–	–	3.07×10^{5}	9.32×10^{1}	–	2.59×10^{4}
216-Z-18[a, b]	216-Z-18 Crib	L	–	–	1.65×10^{4}	–	–	–	–	–	–	1.92×10^{5}	7.11	–	1.96×10^{4}
216-Z-20[b]	216-Z-20 Crib	L	–	–	2.51×10^{4}	–	–	–	–	–	–	2.90×10^{2}	2.89×10^{2}	–	1.67×10^{2}
216-Z-21[b]	216-Z-21 Seepage Basin	L	–	–	–	–	–	–	–	–	–	7.92×10^{3}	3.96×10^{2}	–	1.98×10^{2}
216-Z-11	216-Z-11 Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-U-13	216-U-13 Trench	L	–	–	–	–	–	–	–	–	–	–	4.73	–	–
216-U-14[e]	216-U-14 Ditch	L	–	–	3.46×10^{-3}	–	–	–	–	–	–	–	8.82	–	1.22×10^{3}
207-U	207-U Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-135	UPR-200-W-135 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	7.02×10^{-1}	–	–
UPR-200-W-28	UPR-200-W-28	L	–	–	1.58×10^{-3}	–	–	–	–	–	–	–	3.84×10^{-1}	–	–
UPR-200-W-131[c]	UPR-200-W-131	L	–	–	1.03×10^{-5}	–	–	–	–	–	–	–	2.51×10^{-3}	–	–
200-W PP	200-W PP Powerhouse Pond	L	–	–	–	–	–	–	–	–	–	–	3.44×10^{-2}	–	1.72×10^{3}

Table S–72a. Map 9C: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-T-20	216-T-20 Trench	L	–	–	2.02×10^{-5}	–	–	–	–	–	–	–	1.57×10^{-2}	–	1.20×10^{-1}
232-Z	232-Z Waste Incinerator	S	–	–	–	–	–	–	–	–	–	–	–	–	–

a Mercury inventories were revised because they had been incorrectly reported in SIM [the Hanford Soil Inventory Model] (Corbin et at. 2005) as magnesium inventories for several Z Area cribs and trenches (ditches).

b To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

c This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

d This site had inventories that were in the initial list of constituents, but was screened out during final screening described in Section S.3.6.

e This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–72b. Map 9C: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-Z-16[a]	216-Z-16 Crib	L	–	–	–	2.30	–	1.30×10^{1}	–	–	–	–	–	4.16×10^{-1}	–
231-Z	231-Z Plutonium Isolation Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-4[b]	216-Z-4 Trench	L	–	–	2.26×10^{-4}	–	–	1.27×10^{-4}	3.04×10^{1}	–	–	–	–	1.41×10^{-2}	–
216-Z-5[a, b]	216-Z-5 Crib	L	–	–	6.82×10^{-1}	5.60×10^{-1}	–	3.60×10^{-1}	3.93×10^{4}	–	–	–	–	2.25×10^{-1}	–
216-Z-6[b]	216-Z-6 Crib	L	–	–	2.12×10^{-3}	–	–	1.14×10^{-3}	1.59×10^{2}	–	–	–	–	2.99×10^{-2}	–
216-Z-7[a, b]	216-Z-7 Crib	L	–	–	1.61	1.30	–	7.27×10^{2}	1.75×10^{5}	–	–	–	–	2.20×10^{2}	–
216-Z-8[b]	216-Z-8 Trench	L	–	9.57×10^{-5}	3.39×10^{-5}	1.38×10^{-4}	–	4.92×10^{-5}	–	–	–	–	–	4.75×10^{-6}	–
216-Z-9[a, b]	216-Z-9 Trench	L	–	–	–	1.09×10^{2}	–	–	8.86×10^{5}	–	–	–	–	2.52×10^{-2}	–
216-Z-10[b]	216-Z-10 Reverse Well	L	–	–	2.17×10^{-2}	–	–	1.16×10^{-2}	1.60×10^{3}	–	–	–	–	2.94×10^{-1}	–

Table S–72b. Map 9C: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
UPR-200-W-130[c]	UPR-200-W-130	L	–	–	–	–	–	4.21×10^{-5}	–	–	–	–	–	1.33×10^{-6}	–
216-Z-17[a]	216-Z-17 Trench	L	–	–	–	8.40×10^{-1}	–	4.70	–	–	–	–	–	1.50×10^{-1}	–
216-Z-15	216-Z-15 French Drain	L	–	2.43×10^{1}	9.71×10^{-1}	1.34×10^{-2}	–	2.72×10^{-1}	–	–	–	–	–	2.11×10^{-2}	–
234-5Z	234-5Z Plutonium Finishing Plant	S	–	–	–	–	–	–	–	–	–	–	–	–	–
2736-Z	2736-Z Plutonium Finishing Plant	S/L	–	–	–	–	–	–	–	–	–	–	–	–	–
242-Z	242-Z Americium Recovery Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-1D[d]	216-Z-1(D) Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
236-Z	236-Z Plutonium Reclamation Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-Z-14[b]	216-Z-14 French Drain	L	–	5.16×10^{-1}	1.83×10^{-1}	7.42×10^{-1}	–	2.62×10^{-1}	–	–	–	–	–	2.04×10^{-2}	–
291-Z	291-Z Exhaust Fan and Compressor House	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-103[b]	UPR-200-W-103	L	–	–	–	–	–	–	–	–	–	–	–	3.29×10^{-7}	–
241-Z[d]	241-Z Treatment Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–
241-Z-361[a]	241-Z-361 Settling Tank	L	–	–	–	6.90	–	–	–	–	–	–	–	–	–
216-Z-13[b]	216-Z-13 French Drain	L	–	4.97×10^{-1}	1.76×10^{-1}	7.14×10^{-1}	–	2.52×10^{-1}	–	–	–	–	–	1.96×10^{-2}	–
216-Z-1&2[a, b]	216-Z-1 & 2 Cribs	L	–	1.61×10^{1}	2.06×10^{-1}	3.50	–	1.50×10^{-1}	5.51×10^{4}	–	–	–	–	1.04×10^{-2}	–
216-Z-3[a, b]	216-Z-3 Crib	L	–	1.40×10^{1}	3.34	1.90	–	1.76	1.91×10^{5}	–	–	–	–	1.64×10^{-2}	–
216-Z-12[a, b]	216-Z-12 Crib	L	–	4.99×10^{1}	8.73	4.50	–	6.11	4.37×10^{6}	–	–	–	–	1.94×10^{-1}	–

Table S–72b. Map 9C: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-Z-1A[a, b]	216-Z-1A Tile Field	L	–	9.28×10^{1}	4.93×10^{1}	1.40×10^{2}	–	4.16×10^{1}	1.32×10^{6}	–	–	–	–	9.34×10^{-2}	–
216-Z-18[a, b]	216-Z-18 Crib	L	–	7.08	3.76	1.03×10^{2}	–	3.17	8.41×10^{5}	–	–	–	–	2.40×10^{-2}	–
216-Z-20[b]	216-Z-20 Crib	L	–	2.89×10^{2}	2.60×10^{1}	1.59×10^{-1}	–	3.24	1.04×10^{5}	–	–	–	–	2.52×10^{-1}	–
216-Z-21[b]	216-Z-21 Seepage Basin	L	–	1.56×10^{1}	5.54	2.25×10^{1}	–	8.05	–	–	–	–	–	6.27×10^{-1}	–
216-Z-11	216-Z-11 Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-U-13	216-U-13 Trench	L	–	–	–	–	–	1.26	1.27×10^{2}	–	–	–	–	5.42×10^{-1}	–
216-U-14 [e]	216-U-14 Ditch	L	–	1.93×10^{1}	2.64×10^{1}	1.15	–	1.37×10^{1}	1.83×10^{5}	–	–	–	–	8.28×10^{1}	–
207-U	207-U Retention Basin	L	–	–	–	–	–	–	–	–	–	–	–	4.54×10^{1}	–
UPR-200-W-135	UPR-200-W-135 Unplanned Release	L	–	–	–	1.23×10^{-3}	–	3.96×10^{-1}	4.83×10^{1}	–	–	–	–	3.60	–
UPR-200-W-28	UPR-200-W-28	L	–	–	–	7.33×10^{-4}	–	2.17×10^{-1}	4.44×10^{2}	–	–	–	–	7.18×10^{-2}	–
UPR-200-W-131[c]	UPR-200-W-131	L	–	–	–	4.81×10^{-6}	–	1.42×10^{-3}	2.90	–	–	–	–	4.67×10^{-4}	–
200-W PP	200-W PP Powerhouse Pond	L	–	1.03×10^{-1}	5.85×10^{-2}	3.44×10^{-4}	–	3.44×10^{-2}	1.72×10^{3}	–	–	–	–	–	–
216-T-20	216-T-20 Trench	L	–	–	–	1.08×10^{-5}	–	3.58×10^{-3}	2.00×10^{1}	–	–	–	–	1.07×10^{-3}	–
232-Z	232-Z Waste Incinerator	S	–	–	–	–	–	–	1.33×10^{2}	–	–	–	–	–	–

a Mercury inventories were revised because they had been incorrectly reported in SIM [the Hanford Soil Inventory Model] (Corbin et at. 2005) as magnesium inventories for several Z Area cribs and trenches (ditches).

b To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

c This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

d This site had inventories that were in the initial list of constituents, but was screened out during final screening described in Section S.3.6.

e This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–73a. Map 9D: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-U-10[a]	216-U-10 Pond	L	–	–	1.12×10^{5}	–	–	–	–	–	–	3.91×10^{4}	9.01×10^{3}	–	3.45×10^{4}
216-U-3	216-U-3 French Drain	L	–	–	1.00×10^{-4}	–	–	–	–	–	–	–	3.91×10^{-1}	–	6.90×10^{-1}
UPR-200-W-104	UPR-200-W-104	L	Site consolidated with Site WIDS ID 216-U-10												
UPR-200-W-105	UPR-200-W-105	L	Site consolidated with Site WIDS ID 216-U-10												
UPR-200-W-106	UPR-200-W-106	L	Site consolidated with Site WIDS ID 216-U-10												
216-S-4	216-S-4 French Drain	L	–	–	–	–	–	–	–	–	–	–	5.04×10^{-1}	–	2.52×10^{-1}
216-S-3	216-S-3 Crib	L	–	–	9.09×10^{-3}	–	–	–	–	–	–	–	2.50	–	1.12
216-S-21	216-S-21 Crib	L	–	–	1.04	–	–	–	–	–	–	–	5.08×10^{1}	–	2.19×10^{1}
UPR-200-W-107	UPR-200-W-107	L	Site consolidated with Site WIDS ID 216-U-10												
216-S-25	216-S-25 Crib	L	–	–	7.34×10^{-2}	–	–	–	–	–	–	–	1.40×10^{2}	–	4.27×10^{2}
216-S-1&2	216-S-1 & 216-S-2 Cribs	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-8	216-S-8 Trench	L	–	–	–	–	–	–	–	–	–	–	2.88×10^{4}	–	–
UPR-200-W-95	UPR-200-W-95	L	–	–	–	–	–	–	–	–	–	–	1.41×10^{-1}	–	–

[a] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–73b. Map 9D: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-U-10[a]	216-U-10 Pond	L	–	9.29×10^{3}	1.10×10^{3}	3.46×10^{1}	–	4.54×10^{2}	5.20×10^{6}	–	–	–	–	2.16×10^{3}	–
216-U-3	216-U-3 French Drain	L	–	4.10×10^{-3}	1.81×10^{-4}	1.56×10^{-2}	–	1.10×10^{-3}	3.06×10^{2}	–	–	–	–	1.73×10^{1}	–
UPR-200-W-104	UPR-200-W-104	L	Site consolidated with Site WIDS ID 216-U-10												
UPR-200-W-105	UPR-200-W-105	L	Site consolidated with Site WIDS ID 216-U-10												
UPR-200-W-106	UPR-200-W-106	L	Site consolidated with Site WIDS ID 216-U-10												
216-S-4	216-S-4 French Drain	L	–	5.31×10^{-3}	–	2.02×10^{-2}	–	–	5.19×10^{-1}	–	–	–	–	3.02×10^{-4}	–
216-S-3	216-S-3 Crib	L	–	2.55×10^{-2}	4.09×10^{-3}	8.49×10^{-2}	–	1.44×10^{-2}	8.65×10^{1}	–	–	–	–	2.08	–
216-S-21	216-S-21 Crib	L	–	5.10×10^{-1}	7.48×10^{-2}	1.75	–	2.78×10^{-1}	7.71×10^{2}	–	–	–	–	1.06×10^{-1}	–
UPR-200-W-107	UPR-200-W-107	L	Site consolidated with Site WIDS ID 216-U-10												
216-S-25	216-S-25 Crib	L	–	9.95	2.57×10^{-1}	5.57	–	8.08×10^{-1}	2.23×10^{5}	–	–	–	–	6.89×10^{-1}	–
216-S-1&2	216-S-1 & 216-S-2 Cribs	L	–	–	–	–	–	–	2.11×10^{5}	–	–	–	–	2.22×10^{3}	–
216-S-8	216-S-8 Trench	L	–	–	3.05×10^{2}	3.24	–	1.07×10^{3}	1.87×10^{6}	–	–	–	–	3.10×10^{2}	–
UPR-200-W-95	UPR-200-W-95	L	–	–	1.21×10^{-3}	1.29×10^{-5}	–	4.24×10^{-3}	7.43	–	–	–	–	1.23×10^{-3}	–

[a] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–74a. Map 9E: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-U-5	216-U-5 Trench	L	–	–	–	–	–	–	–	–	–	–	9.41×10^{2}	–	–
216-U-6	216-U-6 Trench	L	–	–	–	–	–	–	–	–	–	–	9.41×10^{2}	–	–
221-U	221-U Process Canyon	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
241-WR-Vault	241-WR Vault	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-U-15	216-U-15 Trench	L	–	–	4.62	–	–	–	–	–	–	–	1.78×10^{1}	–	–
UPR-200-W-138	UPR-200-W-138	L	–	–	7.46×10^{-5}	–	–	–	–	–	–	–	1.61×10^{-3}	–	3.68×10^{-1}
200-W-44	200-W-44 Sand Filter	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-U-7	216-U-7 French Drain	L	–	–	7.67×10^{-8}	–	–	–	–	–	–	–	1.82×10^{-4}	–	3.91×10^{-3}
UPR-200-W-101	UPR-200-W-101 Unplanned Release	L	–	–	2.26×10^{-5}	–	–	–	–	–	–	–	4.88×10^{-4}	–	1.12×10^{-1}
216-U-4	216-U-4 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	1.25×10^{2}	–	1.55
216-U-4A	216-U-4A French Drain	L	–	–	–	–	–	–	–	–	–	–	4.85×10^{-1}	–	7.20×10^{-2}
216-U-1&2	216-U-1 & 2 Cribs	L	–	–	9.27×10^{2}	–	–	–	–	–	–	–	2.15×10^{2}	–	2.56×10^{2}
241-U-361	241-U-361 Settling Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-39	UPR-200-W-39 Unplanned Release	L	–	–	1.93×10^{-6}	–	–	–	–	–	–	–	4.17×10^{-5}	–	9.55×10^{-3}
200-W-42[a]	200-W-42 Process Sewer	L	–	–	5.61×10^{-5}	–	–	–	–	–	–	–	1.21×10^{-3}	–	2.75×10^{-1}
UPR-200-W-163	UPR-200-W-163 Unplanned Release	L	–	–	1.48×10^{-4}	–	–	–	–	–	–	–	3.20×10^{-3}	–	7.31×10^{-1}
216-U-16	216-U-16 Crib	L	–	–	8.68×10^{3}	–	–	–	–	–	–	–	–	–	1.55×10^{2}
216-S-9	216-S-9 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-23	216-S-23 Crib	L	–	–	–	–	–	–	–	–	–	–	1.28×10^{-3}	–	–
216-U-8	216-U-8 Crib	L	–	–	1.49	–	–	–	–	–	–	–	3.21×10^{1}	–	7.30×10^{3}
216-U-12	216-U-12 Crib	L	–	–	2.25	–	–	–	–	–	–	–	1.91×10^{1}	–	3.71×10^{3}

[a] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–74b. Map 9E: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-U-5	216-U-5 Trench	L	–	5.23×10^{1}	–	1.09	–	2.50×10^{2}	6.31×10^{4}	–	–	–	–	6.35×10^{2}	–
216-U-6	216-U-6 Trench	L	–	5.23×10^{1}	–	1.09	–	2.50×10^{2}	6.31×10^{4}	–	–	–	–	6.34×10^{2}	–
221-U	221-U Process Canyon	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
241-WR-Vault	241-WR Vault	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-U-15	216-U-15 Trench	L	–	–	–	–	–	4.73	5.27×10^{2}	–	–	–	–	9.93	–
UPR-200-W-138	UPR-200-W-138	L	–	–	1.34×10^{-4}	5.50×10^{-5}	–	8.21×10^{-4}	2.27×10^{2}	–	–	–	–	1.29×10^{1}	–
200-W-44	200-W-44 Sand Filter	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-U-7	216-U-7 French Drain	L	–	1.82×10^{-8}	2.65×10^{-9}	3.49×10^{-11}	–	1.52×10^{-4}	2.11	–	–	–	–	9.80×10^{-9}	–
UPR-200-W-101	UPR-200-W-101 Unplanned Release	L	–	–	4.07×10^{-5}	1.66×10^{-5}	–	2.49×10^{-4}	6.87×10^{1}	–	–	–	–	3.89	–
216-U-4	216-U-4 Reverse Well	L	–	–	9.07×10^{-3}	–	–	3.21×10^{1}	3.39×10^{3}	–	–	–	–	1.49×10^{-2}	–
216-U-4A	216-U-4A French Drain	L	–	2.86×10^{-1}	3.00×10^{-3}	1.20×10^{-2}	–	5.13×10^{-2}	5.66	–	–	–	–	2.87	–
216-U-1&2	216-U-1 & 2 Cribs	L	–	–	9.37×10^{-2}	3.18×10^{-2}	–	8.54×10^{1}	1.73×10^{5}	–	–	–	–	3.96×10^{3}	–
241-U-361	241-U-361 Settling Tank	L	–	–	–	–	–	–	–	–	–	–	–	6.90×10^{4}	–
UPR-200-W-39	UPR-200-W-39 Unplanned Release	L	–	–	3.47×10^{-6}	1.42×10^{-6}	–	2.12×10^{-5}	5.87	–	–	–	–	3.32×10^{-1}	–
200-W-42[a]	200-W-42 Process Sewer	L	–	–	1.01×10^{-4}	3.23×10^{-5}	–	6.17×10^{-4}	1.70×10^{2}	–	–	–	–	4.59×10^{-4}	–
UPR-200-W-163	UPR-200-W-163 Unplanned Release	L	–	–	2.67×10^{-4}	1.06×10^{-4}	–	1.63×10^{-3}	4.53×10^{2}	–	–	–	–	2.22×10^{1}	–
216-U-16	216-U-16 Crib	L	–	1.53	4.32	1.60×10^{-1}	–	2.46	1.66×10^{4}	–	–	–	–	1.26×10^{-1}	–
216-S-9	216-S-9 Crib	L	–	–	–	–	–	–	4.18×10^{4}	–	–	–	–	2.76×10^{2}	–
216-S-23	216-S-23 Crib	L	–	9.68×10^{-6}	9.38×10^{-6}	3.32×10^{-2}	–	5.30×10^{-5}	4.20×10^{3}	–	–	–	–	1.57×10^{-5}	–
216-U-8	216-U-8 Crib	L	–	–	2.67	8.79×10^{-1}	–	1.63×10^{1}	4.56×10^{6}	–	–	–	–	2.55×10^{4}	–
216-U-12	216-U-12 Crib	L	–	1.81×10^{-7}	1.35	4.39×10^{-1}	–	9.17	2.28×10^{6}	–	–	–	–	6.46×10^{3}	–

[a] This site was consolidated with another site for purposes of modeling.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–75a. Map 9F: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-S-19	216-S-19 Pond	L	–	–	–	–	–	–	–	–	–	–	6.56×10^{2}	–	1.64×10^{2}
216-S-14	216-S-14 Trench	L	–	–	–	–	–	–	–	–	–	–	2.94×10^{-1}	–	–
216-S-7	216-S-7 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-W-32[a]	UPR-200-W-32	L	–	–	1.66×10^{-6}	–	–	–	–	–	–	–	3.58×10^{-5}	–	8.18×10^{-3}
216-S-13	216-S-13 Crib	L	–	–	9.75×10^{-3}	–	–	–	–	–	–	–	1.21×10^{1}	–	4.79×10^{1}
216-S-12	216-S-12 Trench	L	–	–	–	–	–	–	–	–	–	–	6.40×10^{-3}	–	–
200-W-22	200-W-22 Unplanned Release	L	–	–	1.61×10^{-7}	–	–	–	–	–	–	–	3.47×10^{-6}	–	7.93×10^{-4}
233-S	233-S Plutonium Concentration Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-69	200-W-69 Lab Complex (includes 222-S Lab, 222-S DMWSA, 219-S, 222-SA, 296-S-21, 296-S-16, 296-S-23, 296-S-13)	L/S	–	–	–	–	–	–	–	–	–	–	–	–	1.18×10^{1}
UPR-200-W-61	UPR-200-W-61	L	–	–	–	–	–	–	–	–	–	–	2.39	–	–
202-S	202-S (REDOX)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
291-S	291-S Sand Filter	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-20	216-S-20 Crib	L	–	–	–	–	–	–	–	–	–	–	5.88×10^{3}	–	1.60×10^{1}
216-S-22	216-S-22 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-26	216-S-26 Crib	L	–	–	–	–	–	–	–	–	–	–	1.11×10^{2}	–	2.76×10^{1}
218-W-7[b]	218-W-7 Burial Ground (222-S Vault)	S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

[b] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; REDOX=Reduction-Oxidation (Facility); S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–75b. Map 9F: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-S-19	216-S-19 Pond	L	–	6.56×10^{2}	9.51	2.62×10^{1}	–	–	7.54×10^{2}	–	–	–	–	6.87×10^{-1}	–
216-S-14	216-S-14 Trench	L	–	–	–	–	–	1.14×10^{-2}	1.78×10^{2}	–	–	–	–	7.36×10^{-2}	–
216-S-7	216-S-7 Crib	L	–	–	–	–	–	–	4.32×10^{5}	–	–	–	–	3.41×10^{3}	–
UPR-200-W-32[a]	UPR-200-W-32	L	–	–	2.98×10^{-6}	1.22×10^{-6}	–	1.82×10^{-5}	5.03	–	–	–	–	2.83×10^{-1}	–
216-S-13	216-S-13 Crib	L	–	–	1.76×10^{-2}	5.62×10^{-3}	–	5.69×10^{-1}	3.67×10^{4}	–	–	–	–	3.05	–
216-S-12	216-S-12 Trench	L	–	4.92×10^{-5}	2.14×10^{-6}	2.97×10^{-7}	–	1.26×10^{-4}	3.06×10^{2}	–	–	–	–	3.21	–
200-W-22	200-W-22 Unplanned Release	L	–	–	2.89×10^{-7}	1.18×10^{-7}	–	1.77×10^{-6}	4.88×10^{-1}	–	–	–	–	2.77×10^{-2}	–
233-S	233-S Plutonium Concentration Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-W-69	200-W-69 Lab Complex (includes 222-S Lab, 222-S DMWSA, 219-S, 222-SA, 296-S-21, 296-S-16, 296-S-23, 296-S-13)	L/S	–	–	–	–	–	–	1.55×10^{2}	–	–	–	–	–	–
UPR-200-W-61	UPR-200-W-61	L	–	2.63×10^{-11}	2.54×10^{-2}	2.70×10^{-4}	–	8.90×10^{-2}	1.56×10^{2}	–	–	–	–	2.58×10^{-2}	–
202-S	202-S (REDOX)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
291-S	291-S Sand Filter	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-S-20	216-S-20 Crib	L	–	6.34×10^{1}	7.04×10^{-1}	2.64	–	1.50×10^{3}	1.69×10^{5}	–	–	–	–	5.64×10^{2}	–
216-S-22	216-S-22 Crib	L	–	–	–	–	–	–	6.44×10^{1}	–	–	–	–	4.52×10^{-8}	–
216-S-26	216-S-26 Crib	L	–	1.11×10^{2}	1.60	4.42	–	7.12×10^{-5}	1.27×10^{2}	–	–	–	–	1.16×10^{-1}	–
218-W-7[b]	218-W-7 Burial Ground (222-S Vault)	S	–	–	–	–	–	–	–	–	–	–	–	6.85×10^{-1}	–

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

[b] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; REDOX=Reduction-Oxidation (Facility); S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–76a. Map 10: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
600-148[a]	Environmental Restoration Disposal Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
N/A[a]	US Ecology	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-W-LWC	216-W-LWC Crib	L	–	–	–	–	–	–	–	–	–	–	3.23×10^{1}	–	7.21×10^{2}
216-U-17	216-U-17 Crib	L	–	–	3.00×10^{-2}	–	–	–	–	–	–	–	6.47×10^{-1}	–	1.47×10^{2}

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; N/A=not applicable; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; US Ecology=US Ecology Commercial Low-Level Radioactive Waste Disposal Site; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–76b. Map 10: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
600-148[a]	Environmental Restoration Disposal Facility	S	–	–	–	–	–	–	–	–	–	–	–	8.04×10^{5}	–
N/A[a]	US Ecology	S	–	–	–	–	–	–	–	–	–	–	–	4.51×10^{6}	–
216-W-LWC	216-W-LWC Crib	L	–	1.09×10^{2}	6.71×10^{1}	3.13×10^{-1}	–	4.89×10^{1}	1.38×10^{3}	–	–	–	–	2.87	–
216-U-17	216-U-17 Crib	L	–	–	5.39×10^{-2}	1.72×10^{-2}	–	3.30×10^{-1}	9.08×10^{4}	–	–	–	–	2.46×10^{-1}	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; N/A=not applicable; NO_2=nitrogen dioxide; S=solid; US Ecology=US Ecology Commercial Low-Level Radioactive Waste Disposal Site; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–77a. Map 11: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
218-E-10[a]	218-E-10 Trench	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-23	UPR-200-E-23	S	Site consolidated with Site WIDS ID 218-E-10												
UPR-200-E-24	UPR-200-E-24	S	Site consolidated with Site WIDS ID 218-E-10												
216-B-50	216-B-50 Crib	L	–	–	5.64×10^{-1}	–	–	–	–	–	–	–	1.48×10^{1}	–	7.59
216-B-57	216-B-57 Crib	L	–	–	1.69	–	–	–	–	–	–	–	2.42×10^{1}	–	1.27×10^{1}
UPR-200-E-9	UPR-200-E-9	L	–	–	2.83×10^{-2}	–	–	–	–	–	–	–	6.91	–	–
216-B-11A & B	216-B-11A & B	L	–	–	6.08×10^{-4}	–	–	–	–	–	–	–	4.72×10^{-1}	–	3.60
216-B-51	216-B-51 French Drain	L	–	–	–	–	–	–	–	–	–	–	1.72×10^{-1}	–	4.05
218-E-5[a]	218-E-5 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-E-5A[a]	218-E-5A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-E-2	218-E-2 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-79	UPR-200-E-79 Unplanned Release	L	–	–	2.34×10^{-3}	–	–	–	–	–	–	–	1.82	–	1.38×10^{1}
UPR-200-E-78	UPR-200-E-78 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	6.13×10^{-2}	–	–
218-E-4[a]	218-E-4 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-5	216-B-5 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	3.79×10^{3}	–	5.63×10^{4}
216-B-9	216-B-9 Crib	L	–	–	–	–	–	–	–	–	–	–	6.40×10^{2}	–	9.53×10^{3}
216-B-59	216-B-59 Trench	L	–	–	6.99×10^{-12}	–	–	–	–	–	–	–	5.88×10^{-6}	–	6.36×10^{-2}
241-B-361	241-B-361 Settling Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-7	UPR-200-E-7 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	4.15×10^{-1}	–	5.22

Table S–77a. Map 11: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
221-B	221-B B Plant/Canyon	S	–	–	–	–	–	–	–	–	4.20×10^{-1}	–	1.86×10^{1}	–	–
200-E-28	200-E-28 UPR	L	–	–	–	–	–	–	–	–	–	–	–	–	–
200-E-97	200-E-97 French Drain	L	–	–	–	–	–	–	–	–	–	–	1.95×10^{-3}	–	2.04×10^{-2}
200-E-98[b]	200-E-98 French Drain	L	–	–	–	–	–	–	–	–	–	–	1.63×10^{-3}	–	1.70×10^{-2}
WESF	WESF (Building 225-B)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-62	216-B-62 Crib	L	–	–	4.10×10^{-9}	–	–	–	–	–	–	–	2.96×10^{1}	–	3.77×10^{1}
216-B-12	216-B-12 Crib	L	–	–	9.58×10^{-1}	–	–	–	–	–	–	–	5.61×10^{2}	–	4.74×10^{3}
216-B-55	216-B-55 Crib	L	–	–	1.75×10^{-8}	–	–	–	–	–	–	–	1.47×10^{-2}	–	1.60×10^{2}
212-B	212-B Cask Loading Station	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-60	216-B-60 Crib	L	–	–	–	–	–	–	–	–	–	–	7.87	–	–
UPR-200-E-84	UPR-200-E-84 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	–	–	–
224-B	224-B Plutonium Concentration Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-87	UPR-200-E-87 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	9.41	–	1.37×10^{2}
UPR-200-E-1[b]	UPR-200-E-1 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	7.30	–	7.64×10^{1}
UPR-200-E-3[b]	UPR-200-E-3 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	1.18×10^{-1}	–	1.24
UPR-200-E-85	UPR-200-E-85 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	4.08	–	9.07×10^{-2}

Table S–77a. Map 11: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-B-4	216-B-4 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	5.57×10^{-4}	–	5.83×10^{-3}
216-B-6	216-B-6 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	2.50×10^{3}	–	–
200-E-30	200-E-30 Sand Filter (291-B Sand Filter)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-E-55	200-E-55 French Drain	L	–	–	–	–	–	–	–	–	–	–	1.91×10^{-3}	–	2.00×10^{-2}
200-E-95	200-E-95 French Drain	L	–	–	–	–	–	–	–	–	–	–	1.95×10^{-3}	–	2.04×10^{-2}
216-B-10A	216-B-10A Crib	L	–	–	2.51×10^{-5}	–	–	–	–	–	–	–	4.22×10^{1}	–	5.88
216-B-10B	216-B-10B Crib	L	–	–	–	–	–	–	–	–	–	–	1.17×10^{1}	–	–
UPR-200-E-77	UPR-200-E-77 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	6.33×10^{-3}	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–77b. Map 11: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
218-E-10[a]	218-E-10 Trench	S	–	4.53×10^{5}	–	–	–	–	–	–	–	–	–	8.28×10^{2}	–
UPR-200-E-23	UPR-200-E-23	S	Site consolidated with Site WIDS ID 218-E-10												
UPR-200-E-24	UPR-200-E-24	S	Site consolidated with Site WIDS ID 218-E-10												
216-B-50	216-B-50 Crib	L	–	5.94×10^{-1}	2.01×10^{-1}	7.85×10^{-1}	–	3.55×10^{-2}	1.64×10^{2}	–	–	–	–	2.88×10^{-2}	–
216-B-57	216-B-57 Crib	L	–	9.86×10^{-1}	3.21×10^{-1}	1.21	–	1.07×10^{-1}	4.34×10^{2}	–	–	–	–	5.94×10^{-2}	–
UPR-200-E-9	UPR-200-E-9	L	–	–	–	1.33×10^{-2}	–	3.90	7.99×10^{3}	–	–	–	–	1.29	–
216-B-11A & B	216-B-11A & B	L	–	4.34×10^{-1}	2.09×10^{-1}	2.52×10^{-1}	–	1.07×10^{-1}	2.56×10^{2}	–	–	–	–	4.21×10^{-2}	–
216-B-51	216-B-51 French Drain	L	–	–	–	3.19×10^{-4}	–	1.05×10^{-1}	1.99×10^{2}	–	–	–	–	3.10×10^{-2}	–
218-E-5[a]	218-E-5 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	1.20×10^{2}	–
218-E-5A[a]	218-E-5A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	1.20×10^{2}	–
218-E-2	218-E-2 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-79	UPR-200-E-79 Unplanned Release	L	–	–	–	1.25×10^{-3}	–	4.14×10^{-1}	8.83×10^{2}	–	–	–	–	1.20×10^{-1}	–
UPR-200-E-78	UPR-200-E-78 Unplanned Release	L	–	7.00×10^{-2}	–	5.00×10^{-5}	–	3.62×10^{-2}	1.04×10^{1}	–	–	–	–	4.74×10^{-3}	–
218-E-4[a]	218-E-4 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	1.01	–
216-B-5	216-B-5 Reverse Well	L	–	–	1.93×10^{3}	–	–	1.04×10^{3}	9.50×10^{5}	–	–	–	–	1.05×10^{1}	–
216-B-9	216-B-9 Crib	L	–	–	1.69×10^{1}	–	–	2.02×10^{2}	1.71×10^{5}	–	–	–	–	1.23×10^{1}	–
216-B-59	216-B-59 Trench	L	–	2.65×10^{-3}	2.41×10^{-3}	1.17×10^{-9}	–	3.95×10^{-7}	2.41×10^{-1}	–	–	–	–	1.12×10^{-7}	–
241-B-361	241-B-361 Settling Tank	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-7	UPR-200-E-7 Unplanned Release	L	–	–	1.68×10^{-2}	–	–	1.06×10^{-1}	9.13×10^{1}	–	–	–	–	4.40×10^{-3}	–
221-B	221-B B Plant/ Canyon	S	–	9.71×10^{4}	–	–	–	–	–	–	–	–	–	–	–
200-E-28	200-E-28 UPR	L	–	8.58×10^{-3}	4.14×10^{-3}	4.97×10^{-3}	–	–	5.33×10^{-1}	–	–	–	–	2.18×10^{-4}	–

Table S–77b. Map 11: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
200-E-97	200-E-97 French Drain	L	–	2.89×10^{-3}	1.44×10^{-3}	1.67×10^{-3}	–	6.29×10^{-4}	6.20×10^{-1}	–	–	–	–	1.82×10^{-3}	–
200-E-98[b]	200-E-98 French Drain	L	–	2.38×10^{-3}	1.19×10^{-3}	1.38×10^{-3}	–	5.24×10^{-4}	5.16×10^{-1}	–	–	–	–	1.51×10^{-3}	–
WESF	WESF (Building 225-B)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-62	216-B-62 Crib	L	–	3.11	1.74	1.08×10^{-2}	–	3.56	1.75×10^{3}	–	–	–	–	1.04	–
216-B-12	216-B-12 Crib	L	–	3.54	3.75	2.14	–	1.59×10^{2}	2.86×10^{6}	–	–	–	–	1.51×10^{4}	–
216-B-55	216-B-55 Crib	L	–	6.65	6.04	2.94×10^{-6}	–	9.90×10^{-4}	6.05×10^{2}	–	–	–	–	2.80×10^{-4}	–
212-B	212-B Cask Loading Station	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-60	216-B-60 Crib	L	–	–	–	–	–	2.17	2.12×10^{2}	–	–	–	–	6.33×10^{-1}	–
UPR-200-E-84	UPR-200-E-84 Unplanned Release	L	–	–	–	–	–	–	4.22	–	–	–	–	7.81×10^{-4}	–
224-B	224-B Plutonium Concentration Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-87	UPR-200-E-87 Unplanned Release	L	–	–	1.40×10^{2}	–	–	2.48	2.28×10^{3}	–	–	–	–	5.39×10^{-4}	–
UPR-200-E-1[b]	UPR-200-E-1 Unplanned Release	L	–	–	–	–	–	2.03	2.28×10^{3}	–	–	–	–	6.33×10^{-1}	–
UPR-200-E-3[b]	UPR-200-E-3 Unplanned Release	L	–	–	–	1.07×10^{-4}	–	3.29×10^{-2}	3.64×10^{1}	–	–	–	–	1.02×10^{-2}	–
UPR-200-E-85	UPR-200-E-85 Unplanned Release	L	–	2.51×10^{-1}	4.40×10^{-2}	8.06×10^{-4}	–	2.65×10^{-1}	3.27×10^{2}	–	–	–	–	7.76×10^{-2}	–
216-B-4	216-B-4 Reverse Well	L	–	–	1.43×10^{-5}	1.68×10^{-7}	–	1.80×10^{-4}	1.26×10^{-1}	–	–	–	–	4.98×10^{-4}	–
216-B-6	216-B-6 Reverse Well	L	–	–	–	–	–	6.42×10^{2}	6.73×10^{4}	–	–	–	–	2.98×10^{-1}	
200-E-30	200-E-30 Sand Filter (291-B Sand Filter)	S	–	–	–	–	–	–	–	–	–	–	–	–	–
200-E-55	200-E-55 French Drain	L	–	2.88×10^{-3}	1.44×10^{-3}	1.67×10^{-3}	–	6.16×10^{-4}	6.11×10^{-1}	–	–	–	–	1.78×10^{-3}	–

Table S–77b. Map 11: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
200-E-95	200-E-95 French Drain	L	–	2.69×10^{-3}	1.35×10^{-3}	1.56×10^{-3}	–	6.29×10^{-4}	6.09×10^{-1}	–	–	–	–	1.81×10^{-3}	–
216-B-10A	216-B-10A Crib	L	–	–	1.42×10^{-2}	1.85×10^{-4}	–	1.09×10^{1}	1.32×10^{3}	–	–	–	–	4.83	–
216-B-10B	216-B-10B Crib	L	–	–	–	–	–	3.00	3.14×10^{2}	–	–	–	–	2.63×10^{-8}	–
UPR-200-E-77	UPR-200-E-77 Unplanned Release	L	–	–	–	–	–	3.57×10^{-3}	4.36×10^{-1}	–	–	–	–	3.30×10^{-2}	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.
[b] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.
Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.
Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–78a. Map 12: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
218-E-12B[a]	218-E-12B Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-E-12A[a]	218-E-12A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-63	216-B-63 Ditch	L	–	–	1.00×10^{-3}	–	–	–	–	–	–	–	1.38×10^{1}	–	1.12×10^{3}
216-B-2-2	216-B-2-2 Ditch	L	Site consolidated with Site WIDS ID 216-B-3												
216-B-2-1	216-B-2-1 Ditch	L	Site consolidated with Site WIDS ID 216-B-3												
UPR-200-E-138	UPR-200-E-138 Unplanned Release	L	Site consolidated with Site WIDS ID 216-B-3												

Table S–78a. Map 12: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes Hexavalent Chromium and Chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
218-E-8[a]	218-E-8 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-E-1[a]	218-E-1 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-3[b]	216-B-3 Pond	L	–	–	4.26×10^{4}	–	–	–	–	–	–	4.68×10^{3}	1.41×10^{3}	–	4.61×10^{4}
216-B-3A Pond / 216-B-3A RAD	216-B-3A Pond / 216-B-3A RAD	L	Site consolidated with Site WIDS ID 216-B-3												
216-B-3B Pond / 216-B-3B-RAD	216-B-3B Pond / 216-B-3B-RAD	L	Site consolidated with Site WIDS ID 216-B-3												
216-B-3C Pond / 216-B-3C RAD	216-B-3C Pond / 216-B-3C RAD	L	Site consolidated with Site WIDS ID 216-B-3												
UPR-200-E-14	UPR-200-E-14 Unplanned Release	L	Site consolidated with Site WIDS ID 216-B-3												
UPR-200-E-34	UPR-200-E-34 Unplanned Release	L	Site consolidated with Site WIDS ID 216-A-25 and 216-B-3												
N/A	Greater-Than-Class C Proposed Disposal Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; N/A=not applicable; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–78b. Map 12: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
218-E-12B[a]	218-E-12B Burial Ground	S	–	1.06×10^{10}	–	–	–	–	–	1.82×10^{6}	–	–	–	2.61×10^{2}	–
218-E-12A[a]	218-E-12A Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	9.88×10^{2}	–
216-B-63	216-B-63 Ditch	L	–	1.06	4.62×10^{1}	7.81×10^{-1}	–	1.11×10^{-2}	3.14×10^{3}	–	–	–	–	1.78×10^{2}	–
216-B-2-2	216-B-2-2 Ditch	L	Site consolidated with Site WIDS ID 216-B-3												
216-B-2-1	216-B-2-1 Ditch	L	Site consolidated with Site WIDS ID 216-B-3												
UPR-200-E-138	UPR-200-E-138 Unplanned Release	L	Site consolidated with Site WIDS ID 216-B-3												
218-E-8[a]	218-E-8 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	1.99	–
218-E-1[a]	218-E-1 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	3.99×10^{2}	–
216-B-3[b]	216-B-3 Pond	L	–	5.88×10^{3}	2.27×10^{3}	2.79×10^{2}	–	2.50×10^{2}	2.94×10^{5}	–	–	–	–	2.79×10^{3}	–
216-B-3A Pond / 216-B-3A RAD	216-B-3A Pond / 216-B-3A RAD	L	Site consolidated with Site WIDS ID 216-B-3												
216-B-3B Pond / 216-B-3B-RAD	216-B-3B Pond / 216-B-3B-RAD	L	Site consolidated with Site WIDS ID 216-B-3												
216-B-3C Pond / 216-B-3C RAD	216-B-3C Pond / 216-B-3C RAD	L	Site consolidated with Site WIDS ID 216-B-3												
UPR-200-E-14	Unplanned Release UPR-200-E-14	L	Site consolidated with Site WIDS ID 216-B-3												
UPR-200-E-34	Unplanned Release UPR-200-E-34	L	Site consolidated with Site WIDS ID 216-A-25 and 216-B-3												
N/A	Greater-Than-Class C Proposed Disposal Facility	S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] Total uranium inventories were calculated using the appropriate uranium isotopes' inventories reported for these sites and are now provided in the final inventory database.

[b] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; N/A=not applicable; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–79a. Map 12A: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-C-9	216-C-9 Swamp	L	–	–	1.37×10^{-8}	–	–	–	–	–	–	–	1.15×10^{-2}	–	1.32×10^{2}
218-C-9	218-C-9 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-141[a]	UPR-200-E-141	L	–	–	1.04×10^{-6}	–	–	–	–	–	–	–	2.26×10^{-5}	–	5.16×10^{-3}
200-E-56[a]	200-E-56 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	3.01×10^{1}	–	–
201-C	201-C Process Building	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
216-C-1	216-C-1 Hot Semi Work Crib	L	–	–	–	–	–	–	–	–	–	–	5.77×10^{4}	–	–
216-C-3	216-C-3 Hot Semi Work Crib	L	–	–	2.52×10^{-2}	–	–	–	–	–	–	–	5.85×10^{-1}	–	1.24×10^{2}
216-C-4	216-C-4 Hot Semi Work Crib	L	–	–	–	–	–	–	–	–	–	–	1.04×10^{-6}	–	–
216-C-5	216-C-5 Hot Semi Work Crib	L	–	–	–	–	–	–	–	–	–	–	1.63×10^{1}	–	–
216-C-6	216-C-6 Hot Semi Work Crib	L	–	–	–	–	–	–	–	–	–	–	2.82×10^{-6}	–	–
216-C-10	216-C-10 Hot Semi Work Crib	L	–	–	–	–	–	–	–	–	–	–	7.96×10^{-2}	–	–
216-C-2	216-C-2 Semi Works Reverse Well	L	–	–	–	–	–	–	–	–	–	–	–	–	–
200-E-57[a]	200-E-57 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	4.51×10^{1}	–	–
241-CX-72	241-CX-72 Storage Tank and Vault	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
291-C-1	291-C-1 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–79b. Map 12A: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-C-9	216-C-9 Swamp	L	–	5.98	5.47	4.39×10^{-1}	–	7.74×10^{-4}	5.20×10^{2}	–	–	–	–	4.52×10^{-2}	–
218-C-9	218-C-9 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-141[a]	UPR-200-E-141	L	–	–	1.88×10^{-6}	7.69×10^{-7}	–	1.15×10^{-5}	3.18	–	–	–	–	1.80×10^{-1}	–
200-E-56[a]	200-E-56 Unplanned Release	L	–	3.43×10^{1}	–	2.45×10^{-2}	–	1.77×10^{1}	5.10×10^{3}	–	–	–	–	2.35	–
201-C	201-C Process Building	L/S	–	2.27×10^{3}	–	–	–	–	–	–	–	–	–	–	–
216-C-1	216-C-1 Hot Semi Work Crib	L	–	9.15×10^{1}	5.94×10^{2}	7.70	–	2.51×10^{3}	3.76×10^{6}	–	–	–	–	9.08×10^{2}	–
216-C-3	216-C-3 Hot Semi Work Crib	L	–	4.54×10^{-2}	4.54×10^{-2}	1.46×10^{-2}	–	3.01×10^{-1}	7.65×10^{4}	–	–	–	–	4.54	–
216-C-4	216-C-4 Hot Semi Work Crib	L	–	2.49×10^{-3}	1.20×10^{-3}	1.47×10^{-3}	–	5.89×10^{-2}	5.67	–	–	–	–	3.17×10^{-3}	–
216-C-5	216-C-5 Hot Semi Work Crib	L	–	9.03×10^{-1}	–	2.50×10^{-2}	–	4.49	1.09×10^{3}	–	–	–	–	2.07×10^{1}	–
216-C-6	216-C-6 Hot Semi Work Crib	L	–	–	–	8.75×10^{-5}	–	1.59×10^{-1}	2.83×10^{2}	–	–	–	–	1.78	–
216-C-10	216-C-10 Hot Semi Work Crib	L	–	1.04×10^{-1}	6.34×10^{-3}	7.67×10^{-3}	–	4.70×10^{-2}	1.43×10^{1}	–	–	–	–	6.52×10^{-3}	–
216-C-2	216-C-2 Semi Works Reverse Well	L	–	4.62×10^{-2}	2.23×10^{-2}	2.68×10^{-2}	–	–	2.86	–	–	–	–	1.18×10^{-3}	–
200-E-57[a]	200-E-57 Unplanned Release	L	–	5.15×10^{1}	–	3.67×10^{-2}	–	2.66×10^{1}	7.65×10^{3}	–	–	–	–	3.51	–
241-CX-72	241-CX-72 Storage Tank and Vault	L/S	–	–	–	–	–	–	–	–	–	–	–	–	–
291-C-1	291-C-1 Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–80a. Map 12B: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
UPR-200-E-86	UPR-200-E-86	L	–	–	–	–	–	–	–	–	–	–	6.04×10^{1}	–	8.43×10^{-1}
216-A-40	216-A-40 Trench	L	–	–	1.39×10^{-11}	–	–	–	–	–	–	–	1.17×10^{-5}	–	1.26×10^{-1}
216-A-41	216-A-41 Crib	L	–	–	7.83×10^{-8}	–	–	–	–	–	–	–	1.86×10^{-4}	–	3.99×10^{-3}
216-A-9	216-A-9 Crib	L	–	–	3.60×10^{2}	–	–	–	–	–	–	–	8.36×10^{2}	–	1.32×10^{2}
216-A-3	216-A-3 Crib	L	–	–	1.53×10^{-2}	–	–	–	–	–	–	–	3.39×10^{-1}	–	7.56×10^{1}
216-A-39	216-A-39 Crib	L	–	–	–	–	–	–	–	–	–	–	8.47×10^{-3}	–	–
216-A-18	216-A-18 Trench	L	–	–	–	–	–	–	–	–	–	–	2.04×10^{2}	–	–
216-A-1	216-A-1 Crib	L	–	–	–	–	–	–	–	–	–	–	4.11×10^{1}	–	–
216-A-7	216-A-7 Crib	L	–	–	1.32×10^{5}	–	–	–	–	–	–	–	4.84×10^{-3}	–	1.05×10^{-2}
UPR-200-E-145	UPR-200-E-145	L	–	–	3.13×10^{-5}	–	–	–	–	–	–	–	6.77×10^{-4}	–	1.55×10^{-1}
216-A-16	216-A-16 French Drain	L	–	–	1.34×10^{-6}	–	–	–	–	–	–	–	3.17×10^{-3}	–	6.81×10^{-2}
216-A-17	216-A-17 French Drain	L	–	–	6.57×10^{-7}	–	–	–	–	–	–	–	1.56×10^{-3}	–	3.35×10^{-2}
242-A	242-A Evaporator	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-22	216-A-22 Crib (French Drain)	L	–	–	3.70×10^{-1}	–	–	–	–	–	–	–	–	–	4.93×10^{-3}
216-A-28	216-A-28 French Drain	L	–	–	1.43×10^{-4}	–	–	–	–	–	–	–	3.09×10^{-3}	–	7.07×10^{-1}
216-A-32	216-A-32 Crib	L	–	–	4.39×10^{-8}	–	–	–	–	–	–	–	1.04×10^{-4}	–	2.24×10^{-3}
200-E-78	200-E-78 Reverse Well	L	–	–	–	–	–	–	–	–	–	–	–	–	2.51×10^{-2}

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–80b. Map 12B: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
UPR-200-E-86	UPR-200-E-86	L	–	3.17	6.64×10^{-1}	2.20×10^{-2}	–	7.26	3.28×10^{3}	–	–	–	–	2.11	–
216-A-40	216-A-40 Trench	L	–	5.25×10^{-3}	4.78×10^{-3}	2.32×10^{-9}	–	7.83×10^{-7}	4.78×10^{-1}	–	–	–	–	2.22×10^{-7}	–
216-A-41	216-A-41 Crib	L	–	1.86×10^{-8}	2.71×10^{-9}	3.56×10^{-11}	–	1.55×10^{-4}	4.03	–	–	–	–	3.40×10^{-4}	–
216-A-9	216-A-9 Crib	L	–	1.54	8.60	3.20×10^{-2}	–	6.42×10^{2}	2.18×10^{4}	–	–	–	–	1.89×10^{3}	–
216-A-3	216-A-3 Crib	L	–	–	2.75×10^{-2}	1.13×10^{-2}	–	1.70×10^{-1}	4.65×10^{4}	–	–	–	–	2.64×10^{3}	–
216-A-39	216-A-39 Crib	L	–	2.98×10^{-3}	–	6.49×10^{-6}	–	2.14×10^{-3}	9.13×10^{-1}	–	–	–	–	6.21×10^{-4}	–
216-A-18	216-A-18 Trench	L	–	1.13×10^{1}	–	5.82×10^{-1}	–	6.33×10^{1}	1.37×10^{4}	–	–	–	–	6.82×10^{2}	–
216-A-1	216-A-1 Crib	L	–	2.29	–	1.17×10^{-1}	–	1.28×10^{1}	2.76×10^{3}	–	–	–	–	1.38×10^{2}	–
216-A-7	216-A-7 Crib	L	–	4.08×10^{-4}	1.16×10^{-3}	8.49×10^{-6}	–	7.33×10^{-4}	1.49×10^{3}	–	–	–	–	4.81×10^{2}	–
UPR-200-E-145	UPR-200-E-145	L	–	–	5.64×10^{-5}	2.31×10^{-5}	–	3.45×10^{-4}	9.53×10^{1}	–	–	–	–	5.41	–
216-A-16	216-A-16 French Drain	L	–	3.18×10^{-7}	4.62×10^{-8}	6.08×10^{-10}	–	2.65×10^{-3}	3.67×10^{1}	–	–	–	–	1.71×10^{-7}	–
216-A-17	216-A-17 French Drain	L	–	1.56×10^{-7}	2.27×10^{-8}	2.99×10^{-10}	–	1.30×10^{-3}	1.81×10^{1}	–	–	–	–	8.40×10^{-8}	–
242-A	242-A Evaporator	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-22	216-A-22 Crib (French Drain)	L	–	–	8.38×10^{-5}	2.64×10^{-5}	–	4.23×10^{-4}	6.01×10^{-1}	–	–	–	–	4.61	–
216-A-28	216-A-28 French Drain	L	–	–	2.57×10^{-4}	1.05×10^{-4}	–	1.57×10^{-3}	4.35×10^{2}	–	–	–	–	6.54×10^{2}	–
216-A-32	216-A-32 Crib	L	–	1.04×10^{-8}	1.52×10^{-9}	2.00×10^{-11}	–	8.70×10^{-5}	1.21	–	–	–	–	5.61×10^{-9}	–
200-E-78	200-E-78 Reverse Well	L	–	–	1.15×10^{-3}	–	–	–	1.04×10^{-1}	–	–	–	–	8.87×10^{-3}	–

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.
Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–81a. Map 12C: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
UPR-200-E-51	UPR-200-E-51	L	Site consolidated with Site WIDS ID 216-A-29												
216-A-24	216-A-24 Crib	L	–	–	1.88×10^{4}	–	–	–	–	–	–	–	6.49×10^{-4}	–	1.08×10^{2}
216-A-6	216-A-6 Crib	L	–	–	3.72×10^{-4}	–	–	–	–	–	–	–	5.00×10^{3}	–	4.56×10^{2}
216-A-19	216-A-19 Trench	L	–	–	–	–	–	–	–	–	–	–	4.59×10^{2}	–	–
216-A-20	216-A-20 Trench	L	–	–	1.04	–	–	–	–	–	–	–	5.65×10^{1}	–	1.07×10^{-1}
216-A-8	216-A-8 Crib	L	–	–	1.08×10^{5}	–	–	–	–	–	–	–	3.90×10^{-3}	–	1.52×10^{2}
216-A-29[a]	216-A-29 Ditch	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-30	216-A-30 Crib	L	–	–	2.29×10^{-3}	–	–	–	–	–	–	–	6.04×10^{3}	–	1.13×10^{3}
216-A-37-1[b]	216-A-37-1 Crib	L	–	–	4.65×10^{2}	–	–	–	–	–	–	6.68×10^{1}	–	–	4.79×10^{1}
216-A-37-2	216-A-37-2 Crib	L	–	–	1.39×10^{2}	–	–	–	–	–	–	–	–	–	1.49×10^{2}

a This site was consolidated with another site for purposes of modeling.

b To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–81b. Map 12C: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
UPR-200-E-51	UPR-200-E-51	L	Site consolidated with Site WIDS ID 216-A-29												
216-A-24	216-A-24 Crib	L	–	4.31×10^{1}	1.49×10^{1}	1.65	–	9.86×10^{-5}	6.53×10^{2}	–	–	–	–	6.51×10^{1}	–
216-A-6	216-A-6 Crib	L	–	1.36×10^{-1}	2.02×10^{1}	2.71×10^{-3}	–	1.29×10^{3}	2.20×10^{5}	–	–	–	–	1.70×10^{2}	–
216-A-19	216-A-19 Trench	L	–	2.55×10^{1}	–	2.79×10^{1}	–	8.41×10^{2}	3.08×10^{4}	–	–	–	–	4.34×10^{4}	–
216-A-20	216-A-20 Trench	L	–	3.14	1.19×10^{-2}	4.34×10^{-1}	–	2.47×10^{1}	3.79×10^{3}	–	–	–	–	6.21×10^{2}	–
216-A-8	216-A-8 Crib	L	–	1.16×10^{2}	2.49×10^{1}	4.54	–	5.91×10^{-4}	1.83×10^{3}	–	–	–	–	3.91×10^{2}	–
216-A-29[a]	216-A-29 Ditch	L	–	–	–	–	–	–	3.24×10^{2}	–	–	–	–	–	–
216-A-30	216-A-30 Crib	L	–	3.68×10^{-1}	4.68×10^{1}	7.35×10^{-3}	–	1.63×10^{3}	2.30×10^{5}	–	–	–	–	6.56×10^{2}	–
216-A-37-1[b]	216-A-37-1 Crib	L	–	1.86	5.30	3.87×10^{-2}	–	–	2.05×10^{2}	–	–	–	–	1.93×10^{-1}	–
216-A-37-2	216-A-37-2 Crib	L	–	5.55×10^{-1}	7.73	1.16×10^{-2}	–	–	6.18×10^{2}	–	–	–	–	4.76×10^{1}	–

a This site was consolidated with another site for purposes of modeling.

b To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–82a. Map 12D: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-A-13	216-A-13 French Drain	L	–	–	1.10×10^{-7}	–	–	–	–	–	–	–	2.60×10^{-4}	–	5.59×10^{-3}
200-E-61	200-E-61 Reverse Well	L	–	–	1.97×10^{-5}	–	–	–	–	–	–	–	4.67×10^{-2}	–	1.01
200-E-136	200-E-136 PUREX Plant (202-A and others)	S	–	–	–	–	–	–	–	–	1.29×10^{2}	–	–	–	–
UPR-200-E-39	UPR-200-E-39 (at 216-A-36B)	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-200-E-40	UPR-200-E-40	L	–	–	–	–	–	–	–	–	–	–	–	–	–
200-E-85	200-E-85 Reverse Well	L	–	–	1.56×10^{-5}	–	–	–	–	–	–	–	3.70×10^{-2}	–	7.96×10^{-1}
216-A-35	216-A-35 French Drain	L	–	–	1.10×10^{-7}	–	–	–	–	–	–	–	2.60×10^{-4}	–	5.59×10^{-3}
200-E-54	200-E-54 Unplanned Release	L	–	–	2.20×10^{-6}	–	–	–	–	–	–	–	5.21×10^{-3}	–	1.12×10^{-1}
200-E-103	200-E-103 PUREX Stabilized Area	L	–	–	4.38×10^{-8}	–	–	–	–	–	–	–	1.04×10^{-4}	–	2.23×10^{-3}
UPR-200-E-117[a]	UPR-200-E-117	L	–	–	–	–	–	–	–	–	–	–	2.94×10^{-1}	–	4.09×10^{-3}
216-A-2	216-A-2 Crib	L	–	–	1.24×10^{5}	–	–	–	–	–	–	–	4.56×10^{-3}	–	–
216-A-26	216-A-26 French Drain	L	–	–	4.23×10^{-8}	–	–	–	–	–	–	–	1.00×10^{-4}	–	2.16×10^{-3}
216-A-26A	216-A-26A French Drain	L	–	–	1.10×10^{-8}	–	–	–	–	–	–	–	2.60×10^{-5}	–	5.59×10^{-4}
216-A-15	216-A-15 French Drain	L	–	–	–	–	–	–	–	–	–	–	–	–	1.36
200-E-107	200-E-107 Unplanned Release	L	–	–	–	–	–	–	–	–	–	–	1.67	–	–

Table S–82a. Map 12D: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
218-E-14	218-E-14 PUREX Tunnel 1	S	–	–	–	–	–	–	–	–	–	–	–	–	–
218-E-15	218-E-15 PUREX Tunnel 2	S	–	–	–	–	–	–	–	–	6.85×10^{1}	–	9.00	–	–
216-A-4	216-A-4 Crib	L	–	–	3.11×10^{-2}	–	–	–	–	–	–	–	2.34	–	1.54×10^{2}
216-A-5	216-A-5 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-10	216-A-10 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	3.19×10^{1}
216-A-21	216-A-21 Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-27	216-A-27 Crib	L	–	–	2.54×10^{-4}	–	–	–	–	–	–	–	1.06×10^{1}	–	1.29×10^{1}
216-A-31	216-A-31 Crib	L	–	–	1.64×10^{4}	–	–	–	–	–	–	–	6.00×10^{-4}	–	–
216-A-36-A	216-A-36A Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-36-B	216-A-36B Crib	L	–	–	–	–	–	–	–	–	–	–	–	–	–
216-A-45	216-A-45 Crib	L	–	–	2.53×10^{-1}	–	–	–	–	–	–	–	5.45	–	1.24×10^{3}

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; PUREX=Plutonium-Uranium Extraction; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–82b. Map 12D: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
216-A-13	216-A-13 French Drain	L	–	2.61×10^{-8}	3.79×10^{-9}	4.99×10^{-11}	–	2.17×10^{-4}	3.01	–	–	–	–	1.40×10^{-8}	–
200-E-61	200-E-61 Reverse Well	L	–	4.69×10^{-6}	6.82×10^{-7}	8.97×10^{-9}	–	3.91×10^{-2}	5.42×10^{2}	–	–	–	–	2.52×10^{-6}	–
200-E-136	200-E-136 PUREX Plant (202-A and others)	S	–	1.81×10^{4}	–	1.14×10^{2}	–	–	–	–	–	–	–	–	–
UPR-200-E-39	UPR-200-E-39 (at 216-A-36B)	L	–	–	–	–	–	–	6.24	–	–	–	–	2.08×10^{-1}	–
UPR-200-E-40	UPR-200-E-40	L	–	–	–	–	–	–	4.80×10^{-1}	–	–	–	–	1.59×10^{-2}	–
200-E-85	200-E-85 Reverse Well	L	–	3.71×10^{-6}	5.40×10^{-7}	7.11×10^{-9}	–	3.10×10^{-2}	4.29×10^{2}	–	–	–	–	2.00×10^{-6}	–
216-A-35	216-A-35 French Drain	L	–	2.60×10^{-8}	3.79×10^{-9}	4.98×10^{-11}	–	2.17×10^{-4}	3.01	–	–	–	–	1.40×10^{-8}	–
200-E-54	200-E-54 Unplanned Release	L	–	5.22×10^{-7}	7.61×10^{-8}	1.00×10^{-9}	–	4.36×10^{-3}	6.04×10^{1}	–	–	–	–	2.81×10^{-7}	–
200-E-103	200-E-103 PUREX Stabilized Area	L	–	1.04×10^{-8}	1.52×10^{-9}	1.99×10^{-11}	–	8.68×10^{-5}	1.20	–	–	–	–	5.61×10^{-9}	–
UPR-200-E-117[a]	UPR-200-E-117	L	–	1.54×10^{-2}	3.23×10^{-3}	1.07×10^{-4}	–	3.53×10^{-2}	1.60×10^{1}	–	–	–	–	1.01×10^{-2}	–
216-A-2	216-A-2 Crib	L	–	–	–	–	–	7.00×10^{-4}	2.37×10^{3}	–	–	–	–	2.28×10^{2}	–
216-A-26	216-A-26 French Drain	L	–	1.00×10^{-8}	1.46×10^{-9}	1.92×10^{-11}	–	8.38×10^{-5}	1.16	–	–	–	–	5.40×10^{-9}	–
216-A-26A	216-A-26A French Drain	L	–	2.61×10^{-9}	3.79×10^{-10}	4.99×10^{-12}	–	2.17×10^{-5}	3.01×10^{-1}	–	–	–	–	1.40×10^{-9}	–
216-A-15	216-A-15 French Drain	L	–	–	6.23×10^{-2}	–	–	–	5.64	–	–	–	–	4.82×10^{-1}	–
200-E-107	200-E-107 Unplanned Release	L	–	–	–	–	–	4.28×10^{-1}	4.49×10^{1}	–	–	–	–	3.75×10^{-9}	–

Table S–82b. Map 12D: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
218-E-14	218-E-14 PUREX Tunnel 1	S	–	2.30×10^{2}	–	–	–	–	–	–	–	–	–	–	–
218-E-15	218-E-15 PUREX Tunnel 2	S	–	9.73×10^{3}	–	1.30×10^{2}	–	–	–	–	7.40×10^{2}	–	–	–	–
216-A-4	216-A-4 Crib	L	–	–	5.61×10^{-2}	2.29×10^{-2}	–	1.16	9.54×10^{4}	–	–	–	–	5.39×10^{3}	–
216-A-5	216-A-5 Crib	L	–	–	–	–	–	–	1.07×10^{6}	–	–	–	–	1.98×10^{2}	–
216-A-10	216-A-10 Crib	L	–	–	1.46	–	–	–	1.92×10^{6}	–	–	–	–	3.58×10^{2}	–
216-A-21	216-A-21 Crib	L	–	–	–	–	–	–	3.20×10^{5}	–	–	–	–	1.95×10^{2}	–
216-A-27	216-A-27 Crib	L	–	6.03×10^{-5}	8.77×10^{-6}	1.15×10^{-7}	–	5.40	1.13×10^{4}	–	–	–	–	6.51×10^{1}	–
216-A-31	216-A-31 Crib	L	–	–	–	–	–	9.10×10^{-5}	1.85×10^{2}	–	–	–	–	5.98×10^{1}	–
216-A-36-A	216-A-36A Crib	L	–	–	–	–	–	–	4.39×10^{3}	–	–	–	–	1.45×10^{2}	–
216-A-36-B	216-A-36B Crib	L	–	–	–	–	–	–	1.30×10^{6}	–	–	–	–	1.22×10^{2}	–
216-A-45	216-A-45 Crib	L	–	4.82×10^{-3}	4.59×10^{-1}	1.45×10^{-1}	–	2.78	8.00×10^{5}	–	–	–	–	7.82	–

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; PUREX=Plutonium-Uranium Extraction; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–83a. Map 13: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
2101-M Pond	2101-M Pond	L	–	–	–	–	–	–	–	–	–	–	4.30×10^{2}	–	1.43×10^{2}
216-B-54	216-B-54 Trench	L	–	–	–	–	–	–	–	–	–	–	2.61	–	1.32×10^{-1}
216-B-14	216-B-14 Crib	L	–	–	–	–	–	–	–	–	–	–	1.49×10^{3}	–	3.51×10^{4}
216-B-15	216-B-15 Crib	L	–	–	–	–	–	–	–	–	–	–	1.09×10^{3}	–	2.56×10^{4}
216-B-16	216-B-16 Crib	L	–	–	1.89	–	–	–	–	–	–	–	1.08×10^{3}	–	1.89×10^{4}
216-B-17	216-B-17 Crib	L	–	–	3.82	–	–	–	–	–	–	–	8.19×10^{2}	–	6.11×10^{3}
216-B-18	216-B-18 Crib	L	–	–	–	–	–	–	–	–	–	–	1.46×10^{3}	–	3.45×10^{4}
216-B-19	216-B-19 Crib	L	–	–	4.94	–	–	–	–	–	–	–	1.39×10^{3}	–	1.58×10^{4}
216-B-20	216-B-20 Trench	L	–	–	3.19	–	–	–	–	–	–	–	9.98×10^{2}	–	1.25×10^{4}
216-B-21	216-B-21 Trench	L	–	–	7.50×10^{-1}	–	–	–	–	–	–	–	8.49×10^{2}	–	1.74×10^{4}
216-B-22	216-B-22 Trench	L	–	–	2.06	–	–	–	–	–	–	–	9.41×10^{2}	–	1.50×10^{4}
216-B-23	216-B-23 Trench	L	–	–	2.02	–	–	–	–	–	–	–	9.00×10^{2}	–	1.42×10^{4}
216-B-24	216-B-24 Trench	L	–	–	–	–	–	–	–	–	–	–	8.38×10^{2}	–	1.97×10^{4}
216-B-25	216-B-25 Trench	L	–	–	–	–	–	–	–	–	–	–	8.44×10^{2}	–	1.99×10^{4}
216-B-26	216-B-26 Trench	L	–	–	–	–	–	–	–	–	–	–	8.17×10^{2}	–	1.92×10^{4}
216-B-27	216-B-27 Trench	L	–	–	–	–	–	–	–	–	–	–	7.60×10^{2}	–	1.79×10^{4}
216-B-28	216-B-28 Trench	L	–	–	1.94	–	–	–	–	–	–	–	9.86×10^{2}	–	1.65×10^{4}
216-B-29	216-B-29 Trench	L	–	–	–	–	–	–	–	–	–	–	8.31×10^{2}	–	1.96×10^{4}
216-B-30	216-B-30 Trench	L	–	–	3.91	–	–	–	–	–	–	–	1.06×10^{3}	–	1.15×10^{4}
216-B-31	216-B-31 Trench	L	–	–	3.91	–	–	–	–	–	–	–	1.07×10^{3}	–	1.18×10^{4}

Table S–83a. Map 13: Chemical Inventories (kilograms) *(continued)*

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
216-B-32	216-B-32 Trench	L	–	–	4.06	–	–	–	–	–	–	–	1.06×10^{3}	–	1.11×10^{4}
216-B-33	216-B-33 Trench	L	–	–	4.76	–	–	–	–	–	–	–	1.11×10^{3}	–	9.63×10^{3}
216-B-34	216-B-34 Trench	L	–	–	4.98	–	–	–	–	–	–	–	1.14×10^{3}	–	9.70×10^{3}
216-B-52	216-B-52 Trench	L	–	–	7.71	–	–	–	–	–	–	–	1.94×10^{3}	–	1.90×10^{4}
216-B-53A	216-B-53A Trench	L	–	–	–	–	–	–	–	–	–	–	3.86	–	7.15×10^{-2}
216-B-53B	216-B-53B Trench	L	–	–	–	–	–	–	–	–	–	–	2.10	–	2.00×10^{-3}
216-B-58	216-B-58 Trench	L	–	–	–	–	–	–	–	–	–	–	1.89	–	5.46×10^{-2}

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.
Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; TBP=tributyl phosphate; WIDS=Waste Information Data System.
Source: SAIC 2011.

Table S–83b. Map 13: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
2101-M Pond	2101-M Pond	L	–	4.29×10^{2}	7.84	1.72×10^{1}	–	–	6.40×10^{2}	–	–	–	–	1.29×10^{1}	–
216-B-54	216-B-54 Trench	L	–	5.22×10^{-1}	5.48×10^{-3}	2.19×10^{-2}	–	8.26×10^{-1}	8.99×10^{2}	–	–	–	–	1.34×10^{1}	–
216-B-14	216-B-14 Crib	L	–	–	–	2.76	–	9.11×10^{2}	1.73×10^{6}	–	–	–	–	2.69×10^{2}	–
216-B-15	216-B-15 Crib	L	–	–	–	2.01	–	6.64×10^{2}	1.26×10^{6}	–	–	–	–	1.96×10^{2}	–
216-B-16	216-B-16 Crib	L	–	2.28	–	1.68	–	5.89×10^{2}	1.07×10^{6}	–	–	–	–	1.73×10^{2}	–
216-B-17	216-B-17 Crib	L	–	4.60	–	8.72×10^{-1}	–	3.58×10^{2}	5.87×10^{5}	–	–	–	–	1.04×10^{2}	–
216-B-18	216-B-18 Crib	L	–	–	–	2.71	–	8.95×10^{2}	1.70×10^{6}	–	–	–	–	2.64×10^{2}	–
216-B-19	216-B-19 Crib	L	–	5.94	–	1.75	–	6.67×10^{2}	1.15×10^{6}	–	–	–	–	1.94×10^{2}	–
216-B-20	216-B-20 Trench	L	–	3.84	–	1.36	–	5.18×10^{2}	8.54×10^{5}	–	–	–	–	1.48×10^{2}	–
216-B-21	216-B-21 Trench	L	–	9.03×10^{-1}	–	1.45	–	4.91×10^{2}	9.13×10^{5}	–	–	–	–	1.44×10^{2}	–
216-B-22	216-B-22 Trench	L	–	2.48	–	1.40	–	4.98×10^{2}	8.94×10^{5}	–	–	–	–	1.46×10^{2}	–
216-B-23	216-B-23 Trench	L	–	2.43	–	1.33	–	4.75×10^{2}	8.52×10^{5}	–	–	–	–	1.39×10^{2}	–
216-B-24	216-B-24 Trench	L	–	–	–	1.55	–	5.12×10^{2}	9.71×10^{5}	–	–	–	–	1.51×10^{2}	–
216-B-25	216-B-25 Trench	L	–	–	–	1.56	–	5.16×10^{2}	9.79×10^{5}	–	–	–	–	1.52×10^{2}	–
216-B-26	216-B-26 Trench	L	–	–	–	1.63	–	5.11×10^{2}	9.46×10^{5}	–	–	–	–	1.59×10^{2}	–
216-B-27	216-B-27 Trench	L	–	–	–	1.41	–	4.65×10^{2}	8.81×10^{5}	–	–	–	–	1.37×10^{2}	–
216-B-28	216-B-28 Trench	L	–	2.33	–	1.50	–	5.31×10^{2}	9.59×10^{5}	–	–	–	–	1.56×10^{2}	–
216-B-29	216-B-29 Trench	L	–	–	–	1.54	–	5.07×10^{2}	9.62×10^{5}	–	–	–	–	1.50×10^{2}	–
216-B-30	216-B-30 Trench	L	–	4.71	–	1.30	–	5.02×10^{2}	8.57×10^{5}	–	–	–	–	1.46×10^{2}	–
216-B-31	216-B-31 Trench	L	–	4.70	–	1.33	–	5.10×10^{2}	8.71×10^{5}	–	–	–	–	1.48×10^{2}	–
216-B-32	216-B-32 Trench	L	–	4.89	–	1.29	–	5.00×10^{2}	8.48×10^{5}	–	–	–	–	1.45×10^{2}	–
216-B-33	216-B-33 Trench	L	–	5.73	–	1.25	–	4.99×10^{2}	8.30×10^{5}	–	–	–	–	1.45×10^{2}	–
216-B-34	216-B-34 Trench	L	–	5.99	–	1.28	–	5.13×10^{2}	8.51×10^{5}	–	–	–	–	1.48×10^{2}	–
216-B-52	216-B-52 Trench	L	–	9.29	–	2.29	–	8.96×10^{2}	1.51×10^{6}	–	–	–	–	2.60×10^{2}	–
216-B-53A	216-B-53A Trench	L	–	2.84×10^{-1}	2.98×10^{-3}	1.19×10^{-2}	–	1.92	1.54×10^{3}	–	–	–	–	3.07×10^{1}	–
216-B-53B	216-B-53B Trench	L	–	7.92×10^{-3}	8.32×10^{-5}	3.33×10^{-4}	–	8.26×10^{-1}	8.98×10^{2}	–	–	–	–	8.26	–
216-B-58	216-B-58 Trench	L	–	2.17×10^{-1}	2.27×10^{-3}	9.10×10^{-3}	–	6.60×10^{-1}	7.19×10^{2}	–	–	–	–	8.76	–

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–84a. Map 14: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
600 NRDWL[a]	600 Nonrad Dangerous Waste Landfill	S	3.00	7.95×10^{1}	1.35×10^{1}	–	4.50	2.72×10^{-1}	3.56×10^{2}	6.51×10^{2}	4.48×10^{2}	9.40×10^{1}	2.64×10^{1}	2.10×10^{1}	7.62×10^{1}

[a] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–84b. Map 14: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
600 NRDWL[a]	600 Nonrad Dangerous Waste Landfill	S	3.15×10^{2}	1.04×10^{1}	6.09	1.36×10^{2}	1.90	2.24×10^{3}	1.06×10^{4}	–	1.27×10^{-1}	4.10×10^{-2}	6.31×10^{2}	–	–

[a] To reflect ongoing groundwater remediation activities occurring in the 200 Areas addressing the carbon tetrachloride plume (i.e., pump and treat), a revised inventory representing the sites contributing to this plume was used and modeled as a single source. Therefore, this site was not modeled individually for carbon tetrachloride.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–85a. Map 15: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
618-11	300 Wye Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
400 RFD[a]	400 Area Retired French Drains	L	–	–	–	–	–	–	–	–	–	–	–	–	–
316-4	300 North Cribs, 321 Cribs	L	–	–	–	–	–	–	–	–	–	–	7.73×10^{-1}	–	–

[a] This site had inventories that were on the initial list of constituents, but was screened out during final screening described in Section S.3.6.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–85b. Map 15: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
618-11	300 Wye Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
400 RFD[a]	400 Area Retired French Drains	L	–	–	–	–	–	–	–	–	–	–	–	–	–
316-4	300 North Cribs, 321 Cribs	L	–	–	–	–	–	3.01×10^{-2}	4.68×10^{2}	–	–	–	–	1.94×10^{-1}	–

[a] This site had inventories that were on the initial list of constituents, but was screened out during final screening described in Section S.3.6.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–86a. Map 16: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	1,2-Dichloroethane	1,4-Dioxane	1-Butanol (includes butanol and 1-butanol from TBP)	2,4,6-Trichlorophenol	Acetonitrile	Arsenic (inorganic)	Benzene	Boron and Compound	Cadmium	Carbon Tetrachloride	Chromium (includes hexavalent chromium and chromium from $Na_2Cr_2O_7$)	Dichloromethane	Fluoride (soluble fluoride) (includes fluorine and fluorine from HF)
618-9	300 West Burial Ground	S	–	–	4.98×10^{3}	–	–	–	–	–	–	–	–	–	–
316-1	300 Area South Process Ponds	L	–	–	–	–	–	–	–	–	–	–	2.78×10^{4}	–	4.07×10^{3}
316-2	300 Area North Process Ponds	L	–	–	–	–	–	–	–	–	–	–	2.03×10^{4}	–	3.80×10^{3}
316-5	300 Area Process Trenches	L	–	–	–	–	–	–	–	–	–	–	–	–	4.94×10^{3}
UPR-300-1	307-340 Waste Line Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
300-19[a]	324 Sodium Removal Pilot Plant	L	–	–	–	–	–	–	–	–	–	–	–	–	–
UPR-300-13[a]	Acid Neutralization Tank Leak East of 333 Building	L	–	–	–	–	–	–	–	–	–	–	–	–	–
300-264	327 Building, Postirradiation Testing Laboratory	L	–	–	–	–	–	–	–	–	–	–	–	–	–
309-WS-1	309 Plutonium Recycle Test Reactor Ion Exchange Vault	L	–	–	–	–	–	–	–	–	–	–	–	–	–
316-3	307 Disposal Trenches	L	–	–	–	–	–	–	–	–	2.00×10^{1}	–	1.00×10^{3}	–	2.00×10^{3}

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HF=hydrogen fluoride; ID=identifier; L=liquid; $Na_2Cr_2O_7$=sodium dichromate; S=solid; TBP=tributyl phosphate; WIDS=Waste Information Data System.

Source: SAIC 2011.

Table S–86b. Map 16: Chemical Inventories (kilograms)

WIDS ID/ Building Number	Common Site Name	Source Type	Hydrazine/ Hydrazine Sulfate	Lead	Manganese	Mercury	Molybdenum	Nickel (soluble salt)	Nitrate (includes nitrate, nitrate from HNO_3, and nitrate from NO_2)	Polychlorinated Biphenyls	Silver	Strontium (stable)	Trichloroethylene	Total Uranium	Vinyl Chloride
618-9	300 West Burial Ground	S	–	–	–	–	–	–	–	–	–	–	–	–	–
316-1	300 Area South Process Ponds	L	–	3.48×10^{4}	1.65×10^{2}	1.45×10^{-2}	–	8.89×10^{3}	3.86×10^{6}	–	–	–	–	2.62×10^{4}	–
316-2	300 Area North Process Ponds	L	–	2.54×10^{4}	1.64×10^{2}	6.49×10^{-3}	–	6.48×10^{3}	2.82×10^{6}	–	–	–	–	1.94×10^{4}	–
316-5	300 Area Process Trenches	L	–	–	2.26×10^{2}	–	–	–	2.05×10^{4}	–	–	–	–	1.75×10^{3}	–
UPR-300-1	307-340 Waste Line Leak	L	–	–	–	–	–	–	–	–	–	–	–	–	–
300-19[a]	324 Sodium Removal Pilot Plant	L	–	–		–	–	–	–	–	–	–	–	–	–
UPR-300-13[a]	Acid Neutralization Tank Leak East of 333 Building	L	–	–	–	–	–	–	1.99×10^{3}	–	–	–	–	1.35	–
300-264	327 Building, Postirradiation Testing Laboratory	L	–	–	–	–	–	–	–	–	–	–	–	–	–
309-WS-1	309 Plutonium Recycle Test Reactor Ion Exchange Vault	L	–	–	–	–	–	–	–	–	–	–	–	–	–
316-3	307 Disposal Trenches	L	–	6.00×10^{2}	–	1.00×10^{1}	–	3.00×10^{3}	–	–	–	–	–	1.00×10^{4}	–

[a] This site was not modeled because not all information needed to prepare model input files was available and assumptions could not be made.

Note: Dash (–) means no data found or inventory is estimated to be 0 or below detectable levels. To convert kilograms to pounds, multiply by 2.2046.

Key: HNO_3=nitric acid; ID=identifier; L=liquid; NO_2=nitrogen dioxide; S=solid; WIDS=Waste Information Data System.

Source: SAIC 2011.

S.4 REFERENCES

Anderson, J.D., and D.L. Hagel, 1996, *Summary of Radioactive Solid Waste Received in the 200 Areas During Calendar Year 1995*, WHC-EP-0125-8, Westinghouse Hanford Company, Richland, Washington, June.

BHI (Bechtel Hanford, Inc.), 2001. This reference is for Official Use Only.

Bushore, R.P., 2002, *Interim Safety Basis for Solid Waste Facilities (T Plant)*, HNF-SD-WM-ISB-006, Rev. 2B, Fluor Hanford, Inc., Richland, Washington, June 28.

CH2M HILL (CH2M HILL Hanford Group, Inc.), 2002, *Field Investigation Report for Waste Management Area S-SX*, RPP-7884, Rev. 0, Richland, Washington, January 31.

Corbin, R.A., B.C. Simpson, M.J. Anderson, W.F. Danielson III, J.G. Field, T.E. Jones, and C.T. Kincaid, 2005, *Hanford Soil Inventory Model, Rev. 1*, RPP-26744, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, September.

Diediker, L.P., 1999, *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site*, HNF-1744, Fluor Daniel Hanford, Inc., Richland, Washington, August.

DOE (U.S. Department of Energy), 1987, *Hanford Site Waste Management Units Report*, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 2003, *Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, WA: Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0, Office of River Protection, Richland, Washington, April 17.

DOE (U.S. Department of Energy), 2011, *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*, DOE/EIS-0375-D, Office of Environmental Management, Washington, D.C., February.

Ecology, EPA, and DOE (Washington State Department of Ecology, Olympia, Washington; U.S. Environmental Protection Agency, Washington, D.C.; and U.S. Department of Energy, Richland, Washington), 1989, Hanford Federal Facility Agreement and Consent Order, 89-10, as amended, accessed through http://www.hanford.gov/tpa/tpahome.htm, May 15.

Field, J.G., 2003, *Single-Shell Tank System Description*, RPP-15043, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, March.

Fluor Hanford (Fluor Hanford, Inc.), 2004, *Plan for Central Plateau Closure*, CP-22319-DEL, Rev. 0, Richland, Washington, September.

Harrington, P.G., 2011, U.S. Department of Energy, Office of River Protection, Richland, Washington, personal communication (email) to M.B. Burandt, U.S. Department of Energy, Office of River Protection, Richland, Washington, "Incorporation of Updated SIM Inventory," June 22.

Jones, T.E., B.C. Simpson, M.I. Wood, and R.A. Corbin, 2000, *Preliminary Inventory Estimates for Single-Shell Tank Leaks in T, TX, and TY Tank Farms*, RPP-7218, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, November.

Jones, T.E., B.C. Simpson, M.I. Wood, and R.A. Corbin, 2001, *Preliminary Inventory Estimates for Single-Shell Tank Leaks in B, BX, and BY Tank Farms*, RPP-7389, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, February.

Mehta, S., 2011, *Corrective Analysis of Hanford Soil Inventory Model (SIM, 2005) Results for 300 Area Waste Sites*, ECF-HANFORD-11-0140, Rev. 0, CH2M Hill Plateau Remediation Company, Richland, Washington, June.

Myers, D.A., 2005, *Field Investigation Report for Waste Management Areas T and TX-TY*, RPP-23752, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, June.

Nelson, S., and M. Preston, 2010, Science Applications International Corporation, Germantown, Maryland, personal communication (memorandum and attachments) to M.A. Spivey, Science Applications International Corporation, Germantown, Maryland, "Evaluation of Carbon Tetrachloride 65,000 kg Plume," March 24.

SAIC (Science Applications International Corporation), 2006, *Cumulative Impacts Analysis, Inventory Development*, Rev. 4, Germantown, Maryland, October 2.

SAIC (Science Applications International Corporation), 2011, *Cumulative Impacts Analysis*, *Inventory Development*, Rev. 6, Germantown, Maryland, June 27.

Shearer, J.P., 2005a, *Hanford Site Waste Management Units Report*, DOE/RL-88-30, Rev. 14, U.S. Department of Energy, Richland Operations Office, Richland, Washington, January.

Shearer, J.P., 2005b, Fluor Hanford, Inc., Richland, Washington, personal communication (email) to E. Orr, Science Applications International Corporation, Richland, Washington, "Re: WIDS Report Request," April 6.

Teal, J.A., 2007, *Characterization Information for the* 216-*Z-9 Crib at the Plutonium Finishing Plant*, HNF-31792, Rev. 0, Fluor Hanford, Inc., Richland, Washington, March.

Thatcher, A.H., 2003, *Radiological Risk Assessment, Low-Level Radioactive Waste Disposal Site, Richland*, *Washington*, Washington State Department of Health, Office of Radiation Protection, Olympia, Washington, October.

Wood, M.I., and T.E. Jones, 2003, *Subsurface Conditions Description of the U Waste Management Areas*, RPP-15808, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, April.

Wood, M.I., T.E. Jones, B.N. Bjornstad, D.G. Horton, S.M. Narbutovskih, and R. Schalla, 2003, *Subsurface Conditions Description of the C and A-AX Waste Management Areas*, RPP-14430, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, April.

Code of Federal Regulations

10 CFR 61, U.S. Nuclear Regulatory Commission, "Licensing Requirements for Land Disposal of Radioactive Waste."