DOE/EIS-0391D-SA-01

SUPPLEMENT ANALYSIS

of the

Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington

February 2012

Table of Contents

List of Figures

List of Tables

List of Abbreviations and Acronyms

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
COPC	constituent of potential concern
CY	calendar year
DOE	U.S. Department of Energy
DST	double-shell tank
EIS	environmental impact statement
ERDF	Environmental Restoration Disposal Facility
FBSR	fluidized-bed steam reforming
FFTF	Fast Flux Test Facility
GTCC	greater-than-Class C
GTCC EIS	*Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*
Hanford	Hanford Site
HLW	high-level radioactive waste
IDF	Integrated Disposal Facility
IDF-East	200-East Area IDF
IDF-West	200-West Area IDF
IHLW	immobilized high-level radioactive waste
ILAW	immobilized low-activity waste
INL	Idaho National Laboratory
LAW	low-activity waste
LLBG	low-level radioactive waste burial ground
LLW	low-level radioactive waste
MCL	maximum contaminant level
MLLW	mixed low-level radioactive waste
NEPA	National Environmental Policy Act
RCRA	Resource Conservation and Recovery Act
RH-SC	remote-handled special component
ROD	Record of Decision
RPPDF	River Protection Project Disposal Facility
SA	supplement analysis
SIM	Soil Inventory Model
SNF	spent nuclear fuel
SST	single-shell tank
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
WTP	Waste Treatment Plant

1.0 INTRODUCTION

This supplement analysis (SA) was prepared for the U.S. Department of Energy's (DOE's) *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* (DOE/EIS-0391, 2009) in accordance with regulations implementing the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.). Specifically, Council on Environmental Quality (CEQ) NEPA regulations (40 CFR 1502.9(c)) require Federal agencies to prepare supplements to either draft or final environmental impact statements (EISs) if "(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns" or "(ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." In cases where it is unclear whether a supplemental EIS is required, DOE regulations (10 CFR 1021.314(c)) direct the preparation of an SA to assist in making that determination by assessing whether there is a change in the proposed action that is "substantial" or whether new circumstances or information are "significant," pursuant to the CEQ regulations (40 CFR 1502.9(c)).

Beginning in October 2009, DOE held a 185-day public comment period on the *Draft TC & WM EIS* (74 FR 56194), during which time eight public hearings were held and approximately 3,000 comments were received. DOE is considering all comments equally, whether written, spoken, faxed, mailed, or submitted electronically. In preparing to issue the *Final TC & WM EIS*, including responses to public comments, DOE identified updates or modifications to the technical data analyzed in the *Draft TC & WM EIS,* and expanded specific discussion areas, based on comments, where this could be helpful to the reader. None of this information changed the proposed actions stated in the draft EIS, but DOE found that, in some cases, it was unclear as to whether the updated, modified, or additional information that has become available since the *Draft TC & WM EIS* was issued could warrant a supplement to the draft EIS. Accordingly, DOE prepared this SA to make that determination. DOE identified 14 topics where it is unclear whether updated, modified, or expanded information warrants preparation of a supplemental or new draft EIS. The topics pertain to two major sections of the draft EIS: radioactive and nonradioactive inventories analyzed in the cumulative impacts analysis and changes to alternatives analyses. For each topic, this SA identifies the pertinent aspects of the *Draft TC & WM EIS*, the nature of the update, modification, or expansion, a comparative analysis of the changes, and a discussion in light of the criteria contained in the CEQ and DOE NEPA regulations (40 CFR 1502.9(c) and 10 CFR 1021.314(c)) regarding when a supplemental or new EIS is required.

2.0 PROPOSED ACTIONS AND ALTERNATIVES EVALUATED IN THE *DRAFT TC & WM EIS*

As part of its environmental cleanup and management mission at the Hanford Site (Hanford), DOE needs to accomplish a number of goals, which include three major areas of activity, as follows:

- Disposition of approximately 207 million liters (54.6 million gallons) of mixed radioactive and chemically hazardous waste[1] stored in 177 underground tanks and closure of the single-shell tank (SST) system
- Decommissioning of the Fast Flux Test Facility (FFTF), a nuclear test reactor, and removal of its associated waste and bulk sodium as part of the decommissioning process
- Management of low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) generated on site and from other DOE sites

[1] Waste containing constituents subject to regulation under the Resource Conservation and Recovery Act.

2.1 Proposed Actions

DOE's proposed actions, which remain unchanged from the *Draft TC & WM EIS*, are as follows:

- **Tank Closure.** Retrieve, treat, and dispose of waste being managed in the high-level radioactive waste (HLW) SST and double-shell tank (DST) farms at Hanford and close the SST system, which includes disposition of the SSTs, ancillary equipment, and soils. The SST (149 tanks) and DST (28 tanks) systems contain both hazardous and radioactive waste (mixed waste).

- **FFTF Decommissioning.** Decommission Hanford's FFTF and ancillary facilities; manage the waste from the decommissioning process, including certain waste designated as remote-handled special components (RH-SCs); and manage disposition of Hanford's inventory of radioactively contaminated bulk sodium from FFTF and other facilities on site.

- **Waste Management.** Manage the waste resulting from tank closure and other Hanford activities, as well as limited volumes received from other DOE sites.

2.2 Decisions to Be Made

Through the proposed actions to retrieve, treat, and dispose of tank waste; decommission FFTF; and manage waste at Hanford to provide for disposal of on- and offsite waste, the *TC & WM EIS* is intended to support several decisions that DOE needs to make to meet its mission at the site. These potential decisions are described below.

- **Storage of Tank Waste.** All *TC & WM EIS* alternatives require tank farm waste storage; however, each alternative considers a different length of time. The *TC & WM EIS* evaluates the construction and operation of waste transfer infrastructure, including waste receiver facilities, which are below-grade storage and minimal waste-conditioning facilities; waste transfer line upgrades; and additional or replacement DSTs. The EIS also evaluates various waste storage facilities to manage the treated tank waste and the waste associated with closure activities. This includes construction and operation of additional immobilized high-level radioactive waste (IHLW) storage vaults, melter pads, transuranic (TRU) waste storage facilities, and immobilized low-activity waste (ILAW) storage facilities. The EIS also provides environmental impact information to assist in making informed decisions regarding continued storage of tank waste and storage to support treatment and disposal activities.

- **Retrieval of Tank Waste.** The EIS evaluates various retrieval technologies and benchmarks. The four waste retrieval benchmarks (0, 90, 99, and 99.9 percent) address various requirements or retrieval activities. The 0 percent retrieval benchmark represents the No Action Alternative, evaluated as required by NEPA; 90 percent retrieval represents a programmatic risk analysis for the tank farms as defined by Appendix H of the Hanford Federal Facility Agreement and Consent Order (also known as the Tri-Party Agreement [TPA]),[2] "Single Shell Tank Waste Retrieval Criteria Procedure"; 99 percent retrieval is the goal established by TPA Milestone M-45-00; and 99.9 percent retrieval reflects multiple deployments of retrieval technologies to support clean closure requirements.

- **Treatment of Tank Waste.** Additional waste treatment capability can be achieved by building new treatment facilities that are either part of, or separate from, the Waste Treatment Plant (WTP), which is currently under construction. DOE could also complete treatment sometime after 2028 without supplemental treatment by extending the current WTP operating period until

[2] The TPA is an agreement signed in 1989 by DOE, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology that identifies milestones for key environmental restoration and waste management actions at Hanford.

all the waste is treated. The two primary choices that would comply with DOE's commitments are to treat all the waste in an expanded WTP or to provide supplemental treatment in conjunction with, but separate from, the WTP. DOE has conducted preliminary tests on three supplemental treatment technologies to determine whether one or more could be used to provide the additional capability needed to complete waste treatment. The decision on whether to treat all the waste in the WTP (as is or expanded) or to supplement WTP capacity by adding new treatment capability depends on demonstration of the feasibility of supplemental treatment technologies.

- **Disposal of Treated Tank Waste.** The *TC & WM EIS* addresses on- and offsite disposal, depending on the waste type. Onsite disposal includes disposal of treated tank waste and waste generated from closure activities that meet onsite disposal criteria. The decision to be made involves the onsite location of disposal facilities, specifically, one or two Integrated Disposal Facilities (IDFs), which would manage treated tank waste, and the River Protection Project Disposal Facility (RPPDF), which would manage closure activity waste. The EIS will provide the environmental impact information needed for informed decisions on tank waste that could be classified as TRU waste for disposal. Offsite disposal of tank waste determined to be TRU waste would occur at DOE's Waste Isolation Pilot Plant near Carlsbad, New Mexico.

- **Closure of the SST System.** The *TC & WM EIS* addresses closure of the SST system under all Tank Closure alternatives except Tank Closure Alternatives 1 and 2A (see Section S.2 of the *Draft TC & WM EIS* Summary for a description of the alternatives analyzed in the EIS). Although DOE is committed to retrieving at least 99 percent of the waste, consistent with the TPA, the range of potential impacts in the cases considered includes those of residual waste left in the tanks at different retrieval benchmarks (0, 90, 99, and 99.9 percent). Different closure scenarios are also evaluated: clean closure, selective clean closure/landfill closure, and landfill closure with or without contaminated soil removal. In addition, two structurally different landfill barriers are evaluated to determine the effectiveness of natural and engineered defense-in-depth barriers in minimizing any transport of waste over the long timeframes of interest.

- **Decommissioning of FFTF.** This decision would determine the end state for FFTF's aboveground, belowground, and ancillary support structures.

- **Disposal of Hanford Waste and Offsite DOE LLW and MLLW.** The decision to be made concerns the onsite location of disposal facilities for Hanford's waste and other DOE sites' LLW and MLLW. DOE committed in the *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington* (DOE 2004) Record of Decision (ROD) (69 FR 39449) to disposing of LLW in lined trenches. Thus, the decision is whether to dispose of LLW and MLLW in the 200-East Area IDF (IDF-East) or in a new IDF located in the 200-West Area (IDF-West).

2.3 Summary of Alternatives Analyzed

The alternatives evaluated in the *TC & WM EIS* were identified to represent the range of reasonable alternatives for completing DOE's three sets of proposed actions (tank closure, FFTF decommissioning, and waste management) and to provide an understanding of the differences between the potential environmental impacts of the range of reasonable alternatives. In the *TC & WM EIS*, DOE evaluates the impacts associated with 11 Tank Closure alternatives, 3 FFTF Decommissioning alternatives, and 3 Waste Management alternatives. A No Action Alternative is required under CEQ regulations to provide a basis for comparing the alternatives (40 CFR 1502.14(d)).

For Tank Closure alternatives, impacts resulting from storage, retrieval, treatment, disposal, and closure activities at Hanford's HLW tank farms were evaluated, as were the impacts of a No Action Alternative. These Tank Closure alternatives represent the range of reasonable approaches to removing waste from the tanks to the extent that is technically and economically feasible; treating the waste by vitrifying it in the WTP, and/or using one or more supplemental treatment processes; packaging the waste for either offsite shipment and disposal or onsite disposal; and closing the SST system to permanently reduce the potential risk to human health and the environment.

Tank Closure Alternatives

Alternative 1: No Action

Alternative 2: Implement the *Tank Waste Remediation System EIS* Record of Decision with Modifications

- ***Tank Closure Alternative 2A:*** Existing WTP Vitrification; No Closure
- ***Tank Closure Alternative 2B:*** Expanded WTP Vitrification; Landfill Closure

Alternative 3: Existing WTP Vitrification with Supplemental Treatment Technology; Landfill Closure

- ***Tank Closure Alternative 3A:*** Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure
- ***Tank Closure Alternative 3B:*** Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure
- ***Tank Closure Alternative 3C:*** Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure

Alternative 4: Existing WTP Vitrification with Supplemental Treatment Technologies; Selective Clean Closure/Landfill Closure

Alternative 5: Expanded WTP Vitrification with Supplemental Treatment Technologies; Landfill Closure

Alternative 6: All Waste as Vitrified HLW

- ***Tank Closure Alternative 6A:*** All Vitrification/No Separations; Clean Closure (Base and Option Cases)
- ***Tank Closure Alternative 6B:*** All Vitrification with Separations; Clean Closure (Base and Option Cases)
- ***Tank Closure Alternative 6C:*** All Vitrification with Separations; Landfill Closure

In addition, this *TC & WM EIS* evaluates the potential environmental impacts of proposed activities to decommission FFTF and associated ancillary facilities at Hanford, including management of waste generated by the decommissioning process (such as certain waste designated as RH-SCs) and disposition of Hanford's inventory of radioactively contaminated bulk sodium from FFTF and other onsite facilities.

FFTF Decommissioning Alternatives

Alternative 1: No Action

Alternative 2: Entombment

Alternative 3: Removal

The *TC & WM EIS* evaluates the impacts associated with Waste Management alternatives for managing the storage, processing, and disposal of solid waste at Hanford, as well as subsequent closure of associated disposal facilities. These alternatives represent the range of reasonable approaches to continued storage of LLW, MLLW, and TRU waste at Hanford; onsite waste processing using two expansions of the Waste Receiving and Processing Facility; onsite disposal of onsite-generated LLW and MLLW; disposal of onsite non-CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act] and offsite-generated LLW and MLLW in new onsite facilities; and closure of disposal facilities to reduce water infiltration and the potential for intrusion.

Waste Management Alternatives

Alternative 1: No Action

Alternative 2: Disposal in IDF, 200-East Area Only

Alternative 3: Disposal in IDF, 200-East and 200-West Areas

Because of the large number of combinations of disposal facility configurations that could support the 11 Tank Closure alternatives and 3 FFTF Decommissioning alternatives, three waste disposal groups were analyzed in the *Draft TC & WM EIS* under both Waste Management action alternatives (Waste Management Alternatives 2 and 3). The size, capacity, and number of facilities associated with each disposal group were based on the amounts and types of waste generated under each of the three sets of action alternatives: Tank Closure, FFTF Decommissioning, and Waste Management.

DOE's Preferred Alternatives discussions for each of the three major areas of activity are presented (with minor editorial modifications) from the *Draft TC & WM EIS*, as follows:

Tank Closure

Eleven alternatives for potential tank closure actions were evaluated in the draft EIS. These alternatives cover tank waste retrieval and treatment, as well as closure of the SSTs. In the *Draft TC & WM EIS*, DOE did not identify specific preferred alternatives for retrieval or treatment of the tank waste, but has identified a range of preferred retrieval and treatment options. For retrieval, DOE preferred Tank Closure alternatives that would retrieve at least 99 percent of the tank waste. All Tank Closure alternatives would do this, except Alternatives 1 (No Action) and 5. For treatment, DOE prefers Tank Closure Alternatives 2A, 2B, 3A, 3B, 3C, 4, and 5 because they would allow separation and segregation of the tank waste for management and disposition as LLW and HLW, according to the risks posed. In contrast, DOE does not prefer Tank Closure Alternatives 6A, 6B, or 6C because they would manage all tank waste as HLW. For closure of the SSTs, DOE prefers landfill closure, as provided under Tank Closure Alternatives 2B, 3A, 3B, 3C, 5, and 6C, for the reasons described in Section S.5.4.1 of the *TC & WM EIS* Summary. The Tank Closure alternatives that capture each of DOE's preferred retrieval, treatment, and closure options are Alternatives 2B, 3A, 3B, and 3C. For storage, DOE prefers Alternatives 2A, 2B, 3A, 3B, 3C, 4, and 5. These alternatives assume shipment of IHLW canisters for disposal off site.

FFTF Decommissioning

There are three FFTF Decommissioning alternatives from which the Preferred Alternative was identified: (1) No Action, (2) Entombment, and (3) Removal. DOE's Preferred Alternative for FFTF decommissioning is Alternative 2: Entombment, which would remove all above-grade structures, including the reactor building. Below-grade structures, the reactor vessel, piping, and other components would remain in place and be filled with grout to immobilize the remaining radioactive and hazardous constituents. Waste generated from these activities would be disposed of in an IDF, and an engineered modified Resource Conservation and Recovery Act (RCRA) Subtitle C barrier would be constructed over the filled area. The RH-SCs would be processed at DOE's Idaho National Laboratory (INL), but bulk sodium inventories would be processed at Hanford.

Waste Management

Three Waste Management alternatives were identified for the proposed actions: (1) Alternative 1: No Action, under which all onsite-generated LLW and MLLW would be treated and disposed of in the existing, lined low-level radioactive waste burial ground (LLBG) 218-W-5 trenches and no offsite-generated waste would be accepted; (2) Alternative 2, which would continue treatment of onsite-generated LLW and MLLW in expanded, existing facilities and dispose of onsite-generated and previously treated offsite-generated LLW and MLLW in a single IDF (IDF-East); and (3) Alternative 3, which also would continue treatment of onsite-generated LLW and MLLW in expanded, existing facilities, but would dispose of onsite-generated and previously treated, offsite-generated LLW and MLLW in two IDFs (IDF-East and IDF-West). DOE's Preferred Alternative for waste management is Alternative 2, disposal of onsite-generated LLW and MLLW streams in a single

IDF (IDF-East). Disposal of SST closure waste that is not highly contaminated, such as rubble, soils, and ancillary equipment, in the RPPDF is also included under this alternative. After completion of disposal activities, IDF-East and the RPPDF would be landfill-closed under an engineered modified RCRA Subtitle C barrier. The Preferred Alternative also includes limitations on, and exemptions for, offsite waste importation at Hanford, at least until the WTP is operational, as those limitations and exemptions are defined in DOE's January 6, 2006, Settlement Agreement with the State of Washington (as amended on June 5, 2008) regarding *State of Washington v. Bodman* (Civil No. 2:03-cv-05018-AAM).

2.4 *Draft TC & WM EIS* Summary of Key Environmental Findings

Tank Closure

- Tank Farm Waste Retrieval
  - Continued storage of tank waste with no removal would have negligible additional short-term impacts but significant long-term impacts.
  - Retrieving tank waste rather than leaving it in place would reduce long-term impacts on groundwater and human health.
- WTP Configuration
  - Using the existing WTP treatment configuration would extend treatment time and require replacement DSTs.
  - Using the existing WTP configuration supplemented by expanded ILAW treatment capacity would reduce treatment time and result in minor impacts on most resources.
  - Tank Closure Alternative 6A (all waste treated as HLW with no separation of ILAW and clean closure, i.e., tanks and contaminated soils removed) would have the highest demands for, and thus the greatest short-term impacts on, most resources.
  - Varying the WTP configuration would not change the quantity or performance of waste forms and, therefore, would have minor influence on long-term impacts.
- Primary-, Supplemental-, and Secondary-Waste Forms
  - Differences in potential short-term impacts of facility construction and supplemental treatment operations among the Tank Closure alternatives are relatively small for most resource areas.
  - Estimates of potential long-term human health impacts at the IDF-East barrier due to disposal show that segregation of the maximum amount of waste into ILAW glass, as opposed to other supplemental treatment waste forms, produces the lowest estimate of risk at the disposal facility (Tank Closure Alternative 2B).
  - A combination of ILAW glass with bulk vitrification glass and secondary waste results in the next-lowest estimate of impacts (Tank Closure Alternative 3A).
  - The cast stone waste form results in higher estimates of impacts due to the remaining inventory of technetium-99 not immobilized into IHLW glass and the relatively poor performance of the current Hanford site-specific grout formulation in retaining this radionuclide (Tank Closure Alternative 3B).

   - The steam reforming waste form provides the poorest performance of the supplemental-waste forms, based on data on the assumed release mechanism (Tank Closure Alternative 3C).
   - The analysis suggests that additional treatment or waste form development may be needed for secondary waste.

- Tank-Derived TRU Waste

   - Treating some tank-derived waste as TRU waste could decrease the amount of waste sent to the WTP and the supplemental treatment timeframes, thus reducing the volume of waste to be disposed of on site in an IDF and the associated long-term impacts (Tank Closure Alternatives 3A, 3B, 3C, 4, and 5).

- Technetium Removal in the WTP[3]

   - ILAW glass with technetium removal would have similar impacts, both short and long term, to ILAW glass without technetium removal.
   - The technetium removal process in the WTP would result in most of the technetium being incorporated in IHLW glass and some in secondary waste. The analysis indicates that removal of technetium and its disposal off site as IHLW glass would provide little reduction in the concentrations of technetium-99 at either the Core Zone Boundary or the Columbia River nearshore because the release rate of technetium-99 from ILAW glass is much lower than that from other sources such as Effluent Treatment Facility–generated secondary waste and tank closure secondary waste (Tank Closure Alternatives 2B and 3B).

- Sulfate Grout

   - Use of the sulfate removal technology to increase the waste loading in ILAW glass would result in a reduced treatment timeframe and reduced ILAW glass volume, with minimal potential short-term impacts and no long-term impacts (Tank Closure Alternative 5).

- Closure of the Six Sets of Cribs and Trenches (Ditches)

   - Cribs and trenches (ditches) are major contributors to potential long-term groundwater impacts for all Tank Closure alternatives due to their early discharges in the 1950s and 1960s.

- Closure of SST System Past Leaks

   - Over the short term, past leaks in and around the SST farms could affect clean closure activities. For example, construction dewatering to support clean closure may increase worker dose.
   - Past leaks are major contributors to potential long-term groundwater impacts.

- Closure of the SST System

   - Total short-term and peak short-term environmental impacts of SST farm closure activities would exceed facility construction impacts for most alternatives and would

[3] Technetium-99 removal results in a significant portion of this radionuclide being removed from the waste feed and treated as IHLW.

substantially add to short-term environmental impacts overall, especially in terms of emissions, worker doses, and resource demands.

- Clean closure of the SST system when compared to landfill closure would have the following potentially adverse short-term impacts:
  - Total land commitments would increase twofold.
  - Electricity use would increase by one order of magnitude.
  - Geologic resource requirements would increase fivefold.
  - Sagebrush habitat affected would increase by over two orders of magnitude.
  - The average worker radiation dose from normal operations would increase more than twofold.
  - LLW and MLLW generation volumes would increase threefold.
  - Total recordable work occurrences would increase sixfold.
- There is a significant uncertainty regarding clean closure in terms of technical feasibility and risk due to the depth of excavation and soil exhumation that would be required.
- The Hanford barrier would have negligible human health benefits at the Core Zone Boundary when measured against the engineered modified RCRA Subtitle C barrier; it would delay release from landfills for only several hundred years.
- Estimates of human health impacts (radiological risk to the drinking-water well user) due to retrieval leaks and releases from tank farm residuals and ancillary equipment correlate to closure actions at the Core Zone Boundary, i.e., the higher the waste retrieval rate, the lower the long-term human health impacts (Tank Closure Alternatives 2B and 4).
- Clean closure of the SST farms would have some beneficial long-term impacts on the groundwater after calendar year (CY) 6000. However, it would provide little, if any, reduction in long-term impacts on the groundwater before then due to the early releases from past leaks and from the cribs and trenches (ditches) contiguous to the SST farms (Tank Closure Alternatives 6B, Base and Option Cases).
- Analysis shows that clean closure of the SST farms and contaminated soil would not reduce the concentrations of iodine-129 and technetium-99 from their respective benchmark[4] concentrations for at least the first 2,000 years; concentrations would remain within an order of magnitude above the benchmark concentrations through the duration of the period of analysis. Thus, there would still be groundwater impacts under the clean closure alternatives due to the early releases from past leaks and intentional releases through the cribs and trenches (ditches).

---

[4] "Benchmark" refers to a dose or concentration known or accepted to be associated with a specific level of effect. Thus, Federal drinking water standards (Title 40 of the *Code of Federal Regulations*, Parts 141 and 143) are used as benchmarks against which potential contamination can be compared. Drinking water standards for Washington State are stated in *Washington Administrative Code* 246-290. "Benchmark" standards used in the environmental impact statement represent dose or concentration levels that correspond to known or established human health effects. For groundwater, the benchmark is the maximum contaminant level (MCL) if an MCL is available. For constituents with no available MCL, additional sources for benchmark standards include Washington State guidance and relevant regulatory standards, e.g., Clean Water Act, Safe Drinking Water Act. For example, the benchmark for iodine-129 is 1 picocurie per liter; for technetium-99, it is 900 picocuries per liter. These benchmark standards for groundwater impacts analysis were agreed upon by DOE and the Washington State Department of Ecology as the basis for comparing the alternatives and representing potential groundwater impacts.

FFTF Decommissioning

- Potential short-term impacts on most resource areas would be similar under FFTF Decommissioning Alternatives 2 (Entombment) and 3 (Removal), with a few notable exceptions. Emissions of nonradioactive air pollutants associated with construction of facilities to support decommissioning activities and geologic resource requirements would be higher under FFTF Decommissioning Alternative 3. Worker radiation doses and waste generation due to removal activities would also be higher under this alternative.

- Potential long-term human health impacts under all alternatives would be minimal. There would be little difference between the No Action and Entombment Alternative impacts, except that Entombment would delay any impacts for 500 years.

- FFTF could remain in surveillance and maintenance status with little environmental impact on groundwater.

Waste Management

- For the disposal groupings under Waste Management Alternatives 2 (disposal in IDF-East) and 3 (disposal in IDF-East and IDF-West), potential demands for, and short-term impacts on, most resources would vary primarily in direct relation to the size, i.e., disposal capacity, and operational lifespan of the disposal facilities.

- Potential total and peak short-term environmental impacts of disposal activities are projected to be very similar for Waste Management Alternatives 2 and 3. Thus, for short-term impacts, disposal facility configuration and location are not discriminators.

- LLBG 218-W-5, trenches 31 and 34

  - The analysis indicates that it would be safe to continue to dispose of onsite-generated non-CERCLA, nontank LLW and MLLW in these trenches. Potential short-term impacts of ongoing disposal operations would be negligible.

- Disposal of Waste in IDF-East and IDF-West

  - Total short-term impacts of constructing and operating two IDFs under Waste Management Alternative 3 would be substantially the same as those under Waste Management Alternative 2 across nearly all resource areas. This is because no economy of scale would be achieved by having two IDFs. Short-term impacts would be generally proportional to the total size, or disposal capacity, and operational lifespan of the disposal facilities rather than the number or location of the disposal facilities.

  - The long-term analysis indicates that an IDF in the 200-West Area would not perform as well as an IDF located in the 200-East Area because of the higher assumed infiltration rate for the 200-West Area location, which would cause the long-term human health impacts (radiological risk to the drinking-water well user) to be higher at the IDF-West barrier boundary than at the IDF-East barrier boundary.

- Disposal of Offsite Waste

  - The analysis shows that receipt of offsite waste streams that contain specified amounts of certain radionuclides, specifically iodine-129 and technetium-99, could have an adverse impact on the environment, i.e., groundwater impacts, suggesting the need to mitigate such impacts by limiting the amount of technetium-99 and iodine-129 from offsite generators that could be disposed of at Hanford.

- Under Waste Management Alternatives 2 and 3, certain radionuclides, specifically iodine-129 and technetium-99, could have an adverse impact on the environment.

- Disposal of Tank Closure Waste in the RPPDF
  - The RPPDF would be a secondary contributor to human health impacts (radiological risk to the drinking-water well user at the Core Zone Boundary) throughout the period of analysis; the estimated radiological risks are less than 1×10^{-4}.

Cumulative Impacts

- Alternative combinations would contribute little to short-term cumulative impacts. Alternative Combination 1 represents the potential impacts resulting from minimal DOE action, Alternative Combination 2 is a midrange case representative of DOE's Preferred Alternative(s), and Alternative Combination 3 represents a combination that generally results in maximum potential short-term impacts but the least long-term impacts.

- Alternative combinations would contribute little to long-term cumulative impacts on environmental justice.

- Long-term cumulative groundwater-related impacts generally would be highest with Alternative Combination 1 and lowest with Alternative Combination 3.

- Cumulative groundwater-related impacts would be dominated by the impacts of past releases.

3.0 ANALYSIS AND DISCUSSION OF THE UPDATED, MODIFIED, OR EXPANDED INFORMATION AS COMPARED WITH THE *DRAFT TC & WM EIS*

DOE identified 14 topics where it is unclear whether updated, modified, or expanded information warrants a supplemental or new *Draft TC & WM EIS*. This information pertains to two major sets of analyses in the draft EIS, which will be used to group the following discussions:

- Radioactive and nonradioactive inventories used in the cumulative impacts analysis (Items 1 through 6)

- Changes to alternatives analyses (Items 7 through 14)

For each of the 14 topics, the following sections present a topic description, a comparison of the results reported in the *Draft TC & WM EIS* with any reanalysis results, and a discussion of any changes to information reported in the draft EIS.

3.1 Radioactive and Nonradioactive Inventories Used in the Cumulative Impacts Analysis

Since publication of the *Draft TC & WM EIS*, revisions were made to the inventory database used for the cumulative impact analyses as a result of public comments and updated or corrected source references, such as SIM [Hanford Soil Inventory Model] (Corbin et al. 2005).

(1) T Plant inventory correction

Description: In the source document for the T Plant inventory (Bushore 2002), results from the sampling of waste tank 15-1 taken between 1989 and 1993 were multiplied by 10,000 "for conservatism," as stated in a footnote. In rechecking these data, DOE determined that, while such conservatism may have been appropriate for the originally intended use of the data (facility safety analyses), a multiplier of four orders of magnitude was likely to be overly conservative for the cumulative impacts analysis in the *Draft TC & WM EIS*. Accordingly, DOE, in the reanalysis, has now reduced the inventory associated with tank 15-1 by the same divisor (i.e., by 10,000) for the radionuclides reported in the source document. These isotopes include the constituents of potential concern (COPCs) carbon-14; strontium-90; technetium-99; iodine-129; cesium-137; uranium-233, -234, -235, and -238; and americium-241.

Comparative Analysis: Table 1 compares the draft EIS inventory estimates of these radionuclide COPCs with those revised in the reanalysis.

Table 1. Comparison of *Draft TC & WM EIS* Radionuclide Constituents of Potential Concern Inventory Estimates with the Reanalysis for T Plant Waste Tank 15-1

Radionuclide	Inventory Estimate (curies)	
	Draft TC & WM EIS	**Reanalysis**
Carbon-14	6.66×10^{1}	6.66×10^{-3}
Strontium-90	1.66×10^{4}	1.66
Technetium-99	4.03×10^{1}	4.03×10^{-3}
Iodine-129	1.40×10^{1}	1.40×10^{-3}
Cesium-137	5.24×10^{4}	5.24
Uranium isotopes (includes uranium-233, -234, -235, -238)	1.26×10^{1}	1.26×10^{-3}
Americium-241	5.49×10^{1}	5.49×10^{-3}

Key: *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*.

Discussion: The inventory corrections (reductions) are to inventories analyzed in the cumulative impacts analysis and are not included in the proposed actions(s) and alternatives as described in the *Draft TC & WM EIS*. Comparison of the reanalysis results using the inventory corrections with the draft EIS cumulative impacts analysis results shows that the COPC concentrations at the Core Zone Boundary and the Columbia River nearshore did not change the results reported in the *Draft TC & WM EIS*.

(2) Magnesium and mercury inventory corrections for Z Area cribs and trenches (ditches)

Description: After the draft EIS was published, DOE became aware of an error in SIM (Corbin et al. 2005). In this case, the magnesium inventories had been incorrectly reported as mercury inventories for several Z Area cribs and trenches (ditches); thus, the mercury inventory was overstated and the magnesium inventory understated. The inventory database for the reanalysis was revised to reflect this correction.

Comparative Analysis: The estimated mercury inventory in the *Draft TC & WM EIS* cumulative impacts analysis for the Z Area cribs and trenches (ditches) was 7.57×10^{5} kilograms. This estimate was corrected to 3.98×10^{2} kilograms in the reanalysis per the conclusions in a later report (Teal 2007). Groundwater and human health impacts associated with mercury are limited by the large retardation factor (mercury moves at less than

1 percent of the pore-water velocity). Because of limited mobility in the vadose zone and groundwater system, human health impacts in the reanalysis associated with mercury are essentially unchanged from the draft EIS. Magnesium is not a COPC and therefore is not analyzed in detail in the EIS.

Discussion: The corrections are to inventories analyzed in the cumulative impacts analysis and are not included in the proposed actions(s) as described in the *Draft TC & WM EIS*. The inventory changes do not result in any significant change to the cumulative impacts analysis in the draft EIS.

(3) Addition of inventories for greater-than-Class C (GTCC) LLW and GTCC-like LLW

Description: At the time the *Draft TC & WM EIS* was issued, Hanford had been identified as a potential disposal site for GTCC waste (GTCC LLW and GTCC-like LLW) in 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/EIS-0375D, 2011), then in preparation. However, the GTCC waste inventory estimates were not available for the cumulative impacts analysis in the *Draft TC & WM EIS*. The *Draft GTCC EIS* was issued in February 2011, and, as a result, DOE has expanded the cumulative impacts inventory for the *TC & WM EIS* with a reanalysis of the cumulative impacts that includes this GTCC waste inventory at the Hanford reference location (200-East Area) analyzed in the *Draft GTCC EIS*.[5]

Comparative Analysis: Of the added inventories for the GTCC waste disposal site analyzed at the Hanford reference location, only two COPCs, technetium-99 and iodine-129, were predicted to release to the aquifer over the 10,000-year model period. Figure 1 shows the technetium-99 concentration-versus-time results at the Core Zone Boundary and the Columbia River nearshore for all the cumulative impacts analysis (i.e., non–*TC & WM EIS*) sites, including GTCC waste. This concentration-versus-time graph is shown as a point of comparison for the individual source locations discussed below. The technetium-99 concentration is estimated to be close to the benchmark for the early peak (CY 1960) and within an order of magnitude for the later peak (CY 3500). The early rise in the technetium-99 concentration-versus-time curve is due to liquid releases and is affected by the travel time through the vadose zone, which is relatively rapid. The later peak is due to partitioning-limited releases and is affected by the travel time through the vadose zone, which is slower because of lower moisture content.

Figure 2 shows the iodine-129 concentration-versus-time results at the Core Zone Boundary and the Columbia River nearshore for all the cumulative impacts analysis (i.e., non–*TC & WM EIS*) sites, including GTCC waste. The iodine-129 concentration-versus-time graph shows a behavior similar to the technetium-99 concentration versus time; however, the peaks are elevated and the early peak is more than an order of magnitude above the benchmark and the later peak is at or above the benchmark.

Figures 3 and 4 show concentrations versus time for technetium-99 and iodine-129, respectively, at the Core Zone Boundary and Columbia River nearshore for the GTCC waste disposal site. These figures can be directly compared to Figures 1 and 2. Note that GTCC waste disposal site (Figures 3 and 4) sources produce peak concentrations more than an order of magnitude less than the peaks for the combined cumulative impacts analysis sources (Figures 1 and 2).

5 DOE did not identify a preferred alternative in the *Draft GTCC EIS*; however, DOE did announce its preference not to dispose of GTCC or GTCC-like waste at Hanford (74 FR 67189), consistent with DOE's commitment to not ship offsite waste, including GTCC or GTCC-like waste, to Hanford, at least until the WTP is operational, currently projected for 2022.

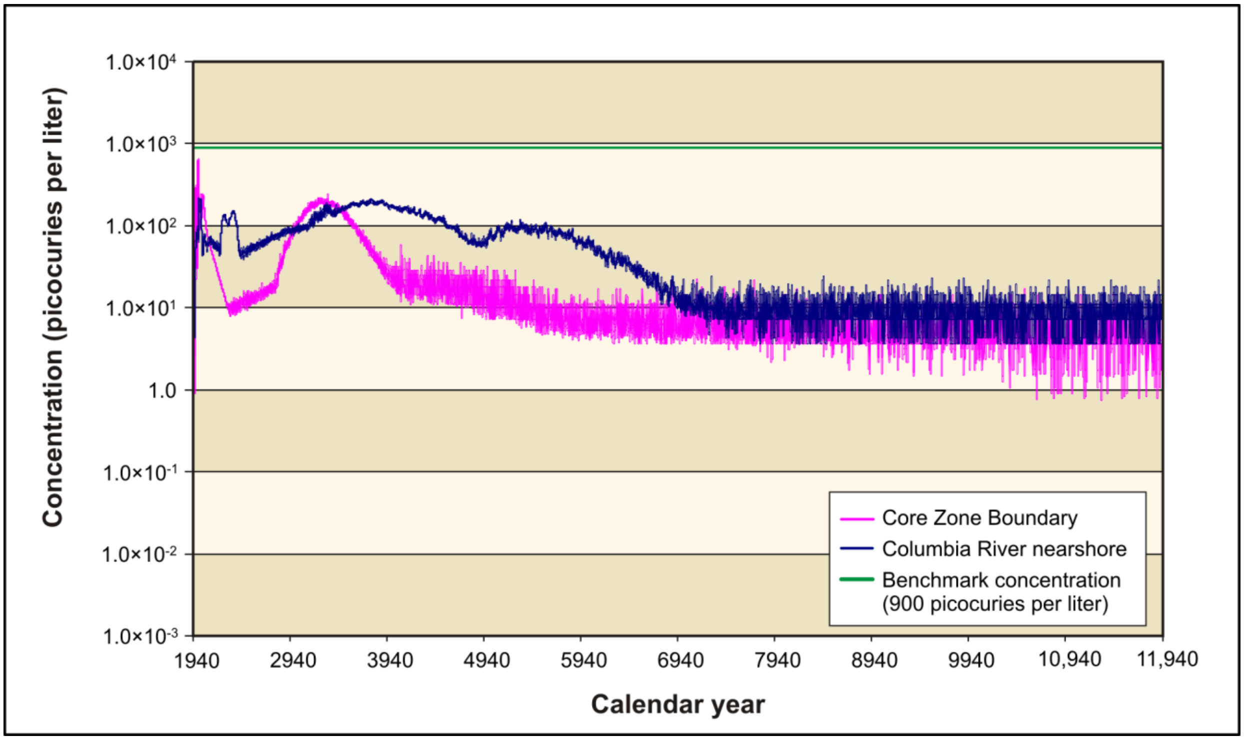

Figure 1. Technetium-99 Concentration Versus Time for All Non–*TC & WM EIS* Sites (Including Greater-Than-Class C Waste Inventory)

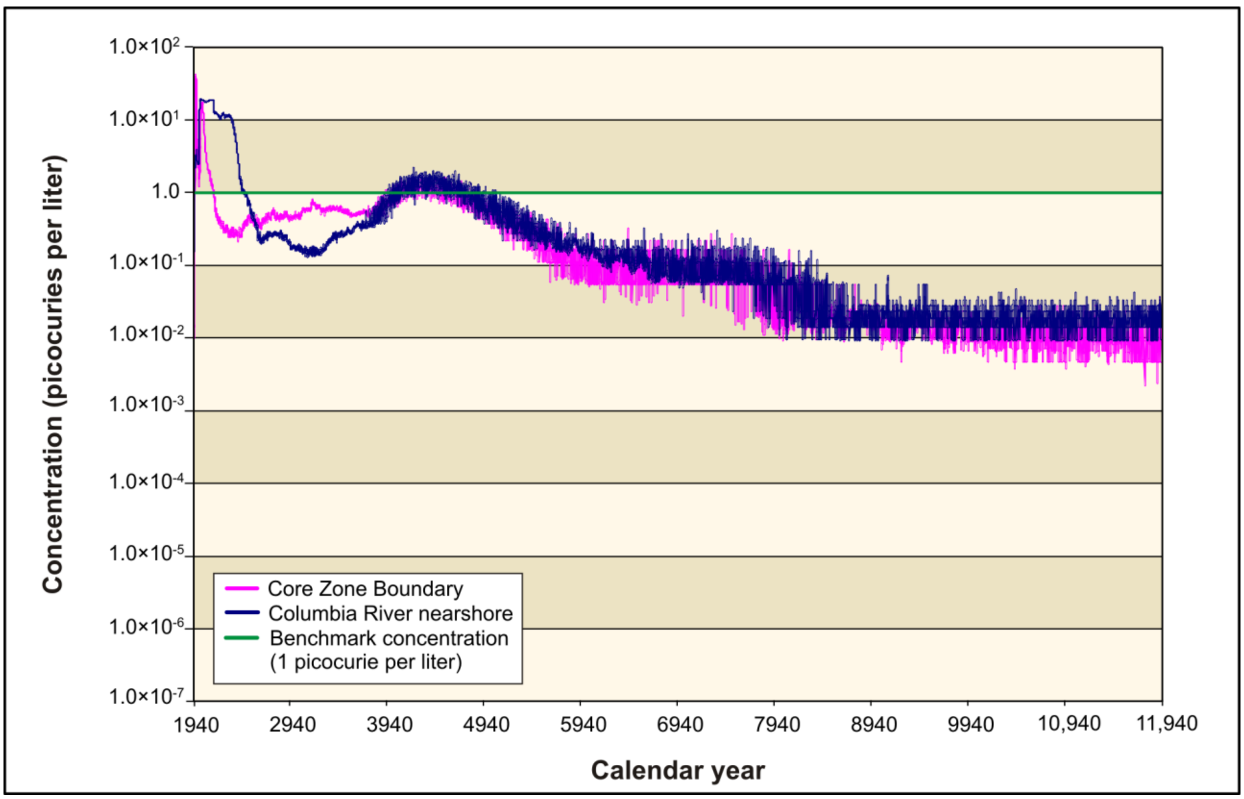

Figure 2. Iodine-129 Concentration Versus Time for All Non–*TC & WM EIS* Sites (Including Greater-Than-Class C Waste Inventory)

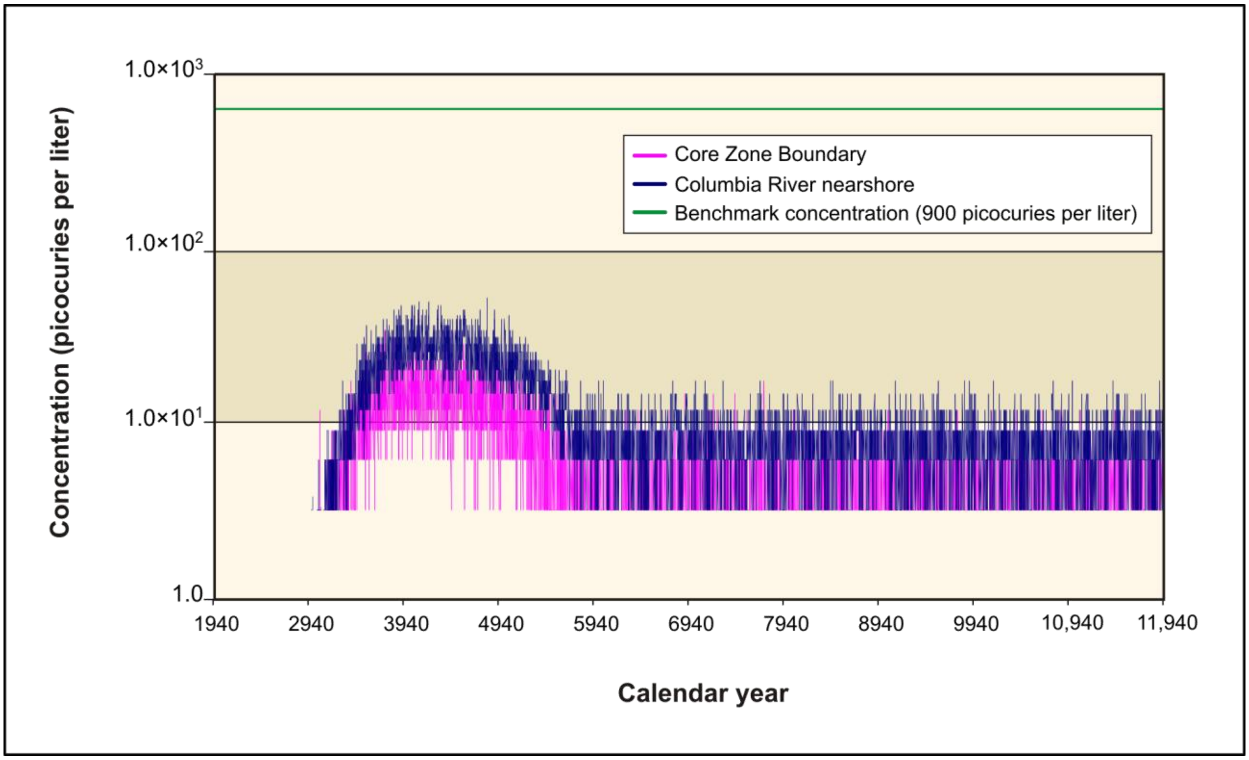

Figure 3. Technetium-99 Concentration Versus Time
(Greater-Than-Class C Waste Disposal Site)

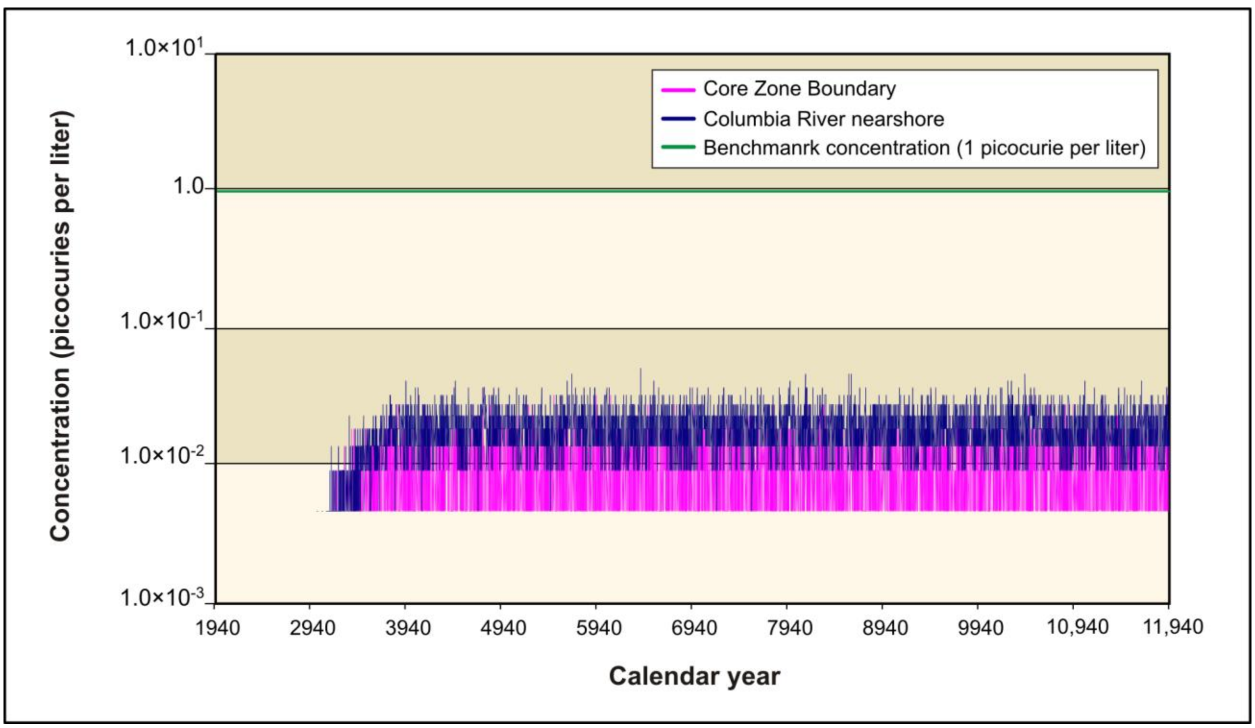

Figure 4. Iodine-129 Concentration Versus Time
(Greater-Than-Class C Waste Disposal Site)

Discussion: Although the inclusion of the GTCC and GTCC-like waste in the *TC & WM EIS* cumulative impacts analysis adds to the total radionuclide concentrations from other sources, the concentrations of technetium-99 and iodine-129 from the GTCC waste disposal site remain below both benchmarks and below the concentration-versus-time results for all the cumulative impacts analysis sites. In other words, the addition of the GTCC waste inventory has no effect on the cumulative impacts analysis provided in the *Draft TC & WM EIS*. This is mainly because of the low moisture content, which limits the peak concentrations and greatly slows the travel times.

(4) Environmental Restoration Disposal Facility (ERDF) inventory update

Description: DOE reanalyzed *Draft TC & WM EIS* impacts in light of updated inventories for ERDF to include waste streams actually disposed of through March 2010. These updated inventories do not include projections of future waste inventories that are analyzed in the cumulative impacts analysis in the *TC & WM EIS* to account for the inventory from CERCLA sites.

Comparative Analysis: Table 2 compares the draft EIS inventory estimates of ERDF COPCs with those revised in the reanalysis.

Table 2. Comparison of *Draft TC & WM EIS* Radionuclide Constituent of Potential Concern Inventory Estimates with the Reanalysis for ERDF

Constituent of Potential Concern	Inventory Estimate (curies)	
	Draft TC & WM EIS	**Reanalysis**
Hydrogen-3 (tritium)	1.50×10^{4}	9.26×10^{3}
Carbon-14	1.20×10^{2}	2.08×10^{2}
Potassium-40	6.01	4.17×10^{1}
Strontium-90	3.70	1.20×10^{4}
Zirconium-93	-	4.44×10^{1}
Technetium-99	2.01×10^{-1}	8.35×10^{1}
Iodine-129	-	2.00×10^{-2}
Cesium-137	3.70	1.55×10^{4}
Thorium-232	1.40×10^{-1}	1.03
Uranium isotopes (includes uranium-233, -234, -235, -238)	5.40×10^{1}	4.11×10^{2}
Neptunium-237	-	3.70×10^{-1}
Plutonium-239, -240	9.16	3.39×10^{2}
Americium-241	2.71	4.37×10^{2}

Note: Dash (-) means no data found or inventory is estimated to be 0 or below detectable levels.
Key: ERDF=Environmental Restoration Disposal Facility; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*.

Table 2 shows that most of the COPC inventory estimates increased in the reanalysis from those used for the *Draft TC & WM EIS*. In addition, comparison of the reanalysis results using the inventory corrections with the draft EIS cumulative impacts analysis results shows that the non-COPC concentrations at the Core Zone Boundary and the Columbia River nearshore did not change.

The estimated concentrations of the two key risk drivers, technetium-99 and iodine-129, at both the Core Zone Boundary and the Columbia River nearshore due to the revised ERDF inventories remain a minimum of one order of magnitude below the benchmark concentrations, as can be seen in Figures 5 and 6, respectively. A comparison with Figures 1 and 2 which provide the concentrations versus time for technetium-99 and iodine-129, respectively, for all non–*TC & WM EIS* sites (cumulative impacts analysis sites), shows that ERDF remains a minor contributor to the total concentrations of technetium-99 and iodine-129 at the Core Zone Boundary and Columbia River nearshore.

Also included for comparison with Figures1 and 2 are technetium-99 and iodine-129 concentration-versus-time graphs for three other disposal sites, all in close proximity to ERDF: an IDF (Tank Closure Alternative 2B), Figures 7 and 8; the proposed GTCC waste disposal site, Figures 9 and 10; and the US Ecology Commercial LLW Disposal Site, Figures 11 and 12.

Figure 5 shows the relative contribution of technetium-99 at the Core Zone Boundary and Columbia River nearshore from ERDF.

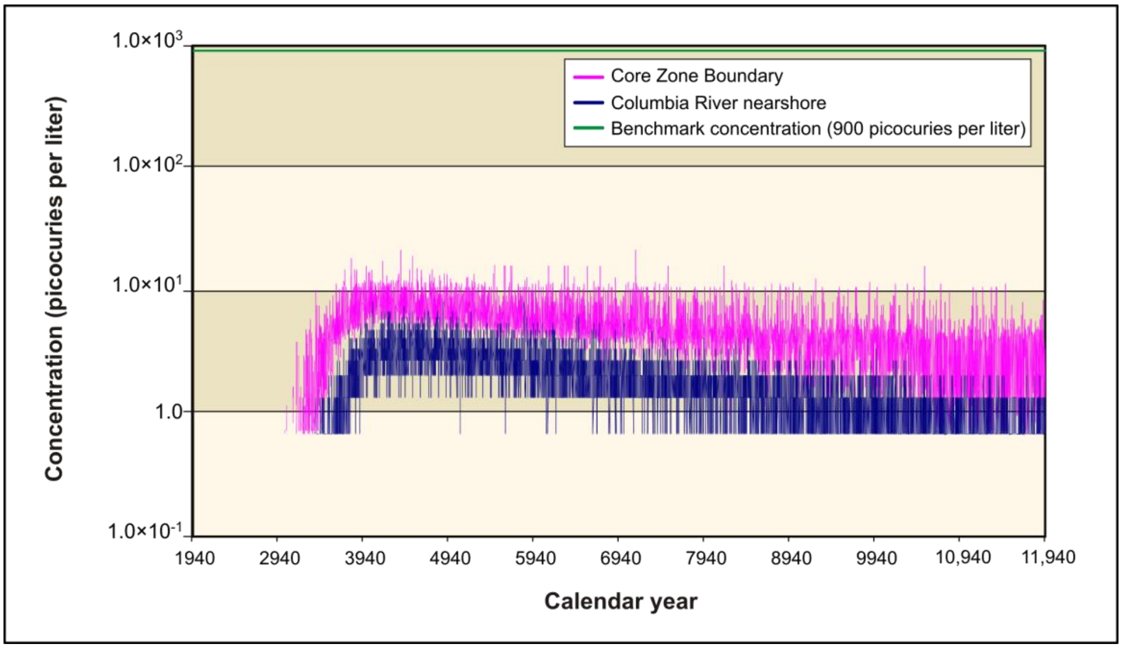

Figure 5. Technetium-99 Concentration Versus Time (Environmental Restoration Disposal Facility)

Figure 6 shows the relative contribution of iodine-129 at the Core Zone Boundary and Columbia River nearshore from ERDF.

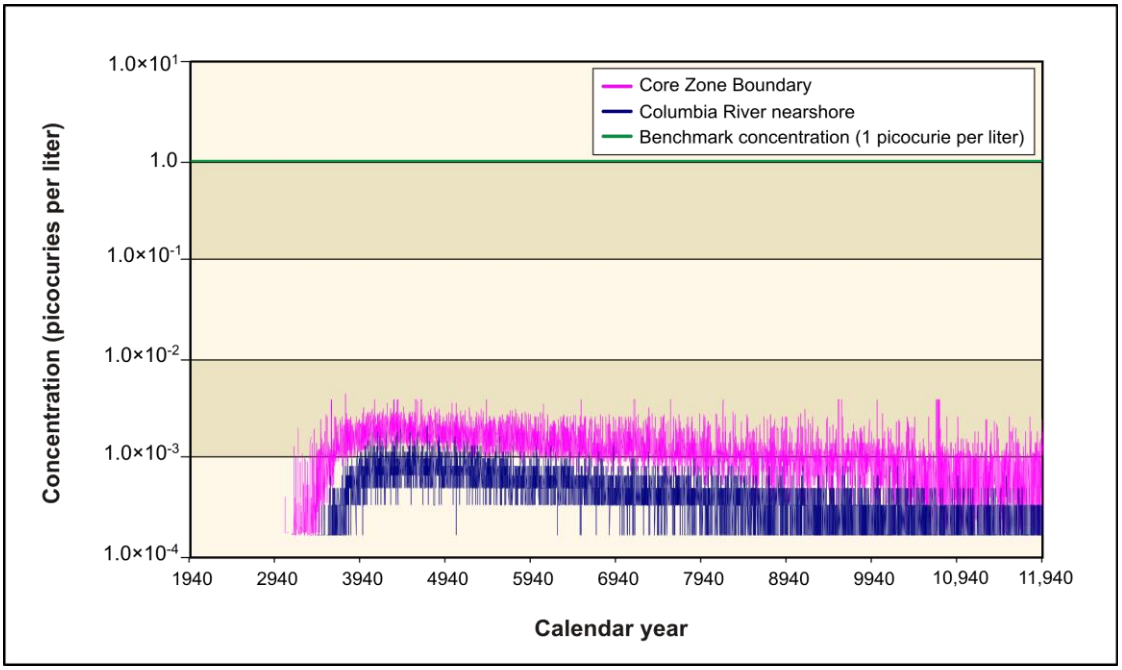

Figure 6. Iodine-129 Concentration Versus Time (Environmental Restoration Disposal Facility)

Figure 7 shows the relative contribution of technetium-99 at the Core Zone Boundary and Columbia River nearshore from IDF-East.

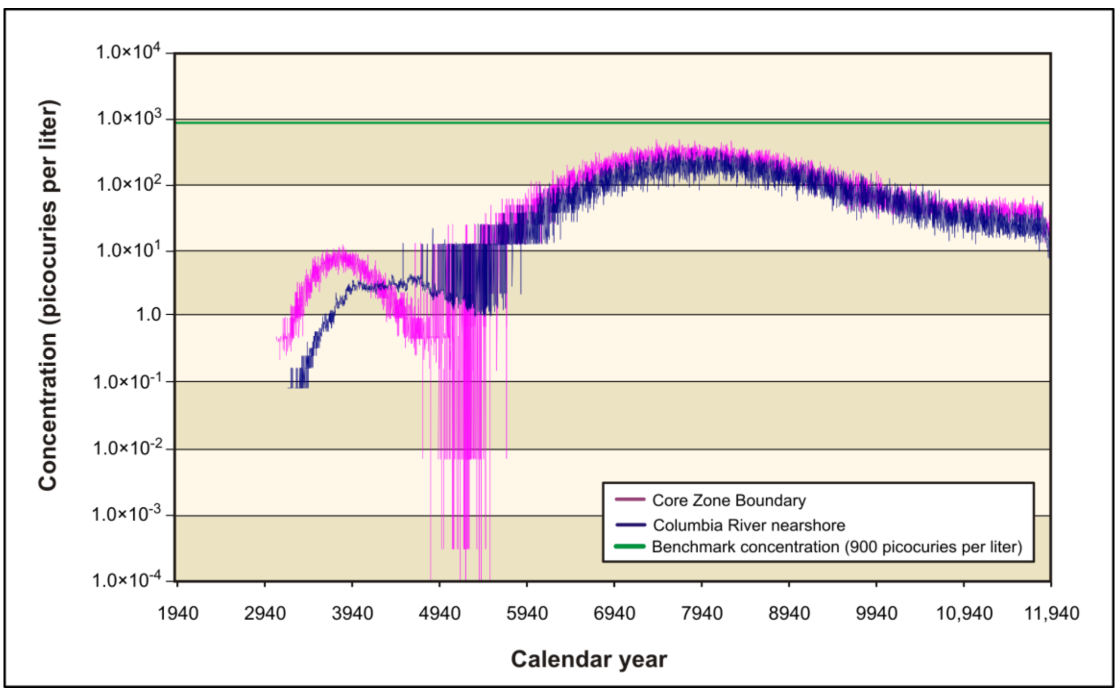

Figure 7. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time (200-East Area Integrated Disposal Facility)

Figure 8 shows the relative contribution of iodine-129 at the Core Zone Boundary and Columbia River nearshore from IDF-East.

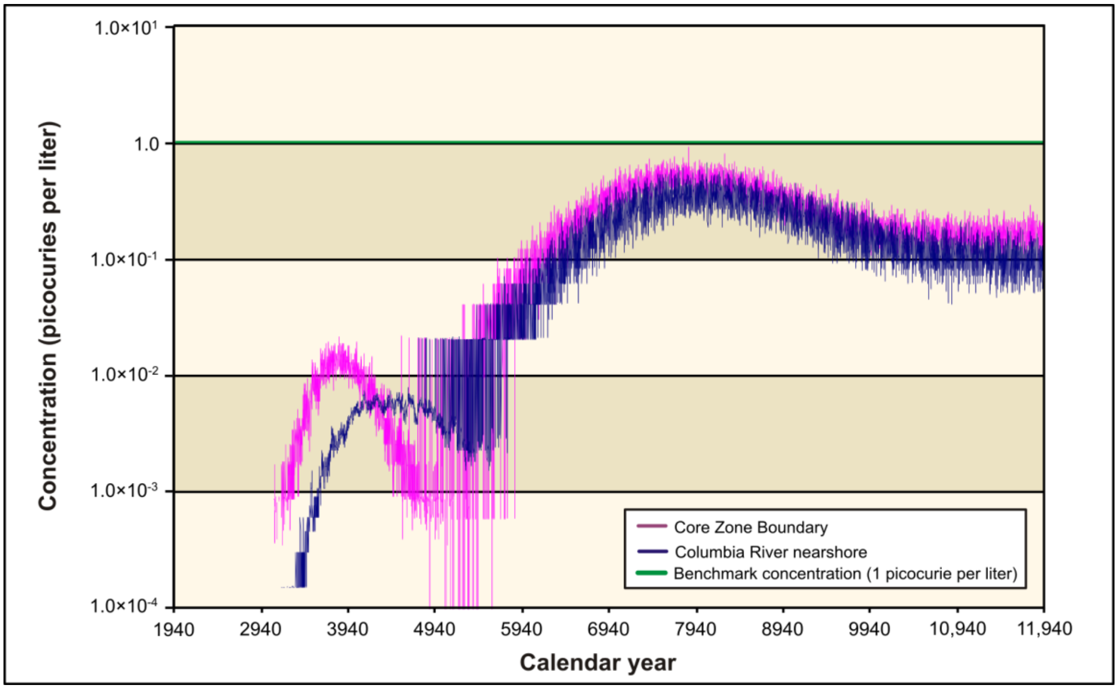

Figure 8. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time (200-East Area Integrated Disposal Facility)

Figure 9 shows the relative contribution of technetium-99 at the Core Zone Boundary and Columbia River nearshore from the proposed GTCC waste disposal site.

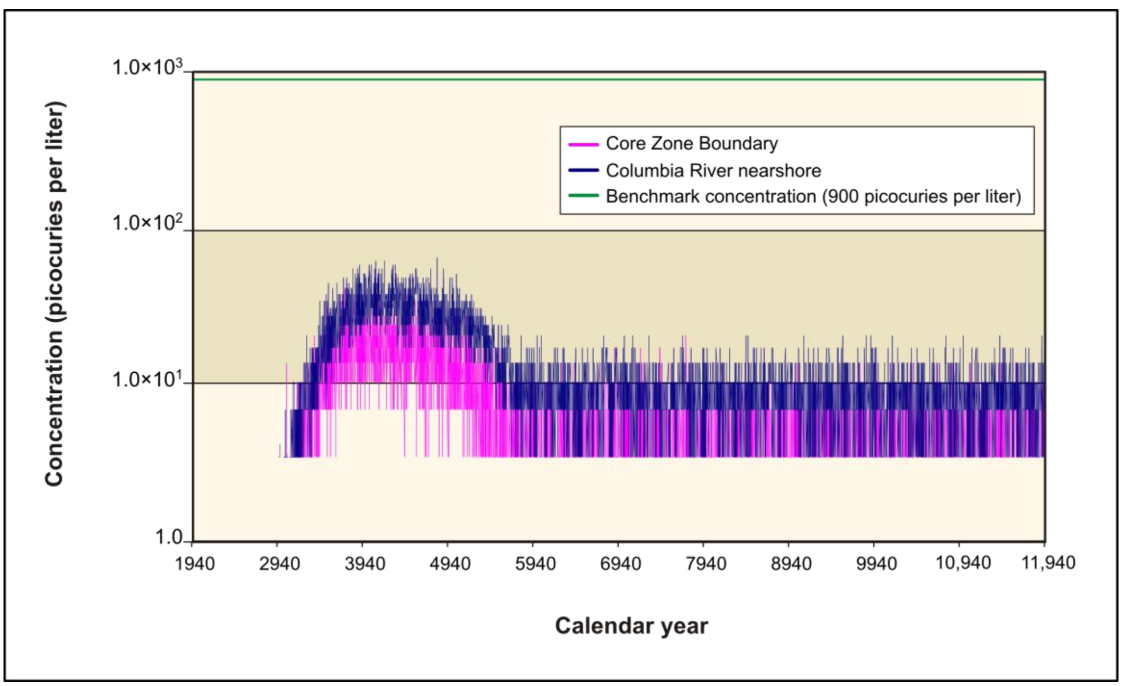

Figure 9. Technetium-99 Concentration Versus Time (Greater-Than-Class C Waste Disposal Site)

Figure 10 shows the relative contribution of iodine-129 at the Core Zone Boundary and Columbia River nearshore from the proposed GTCC waste disposal site.

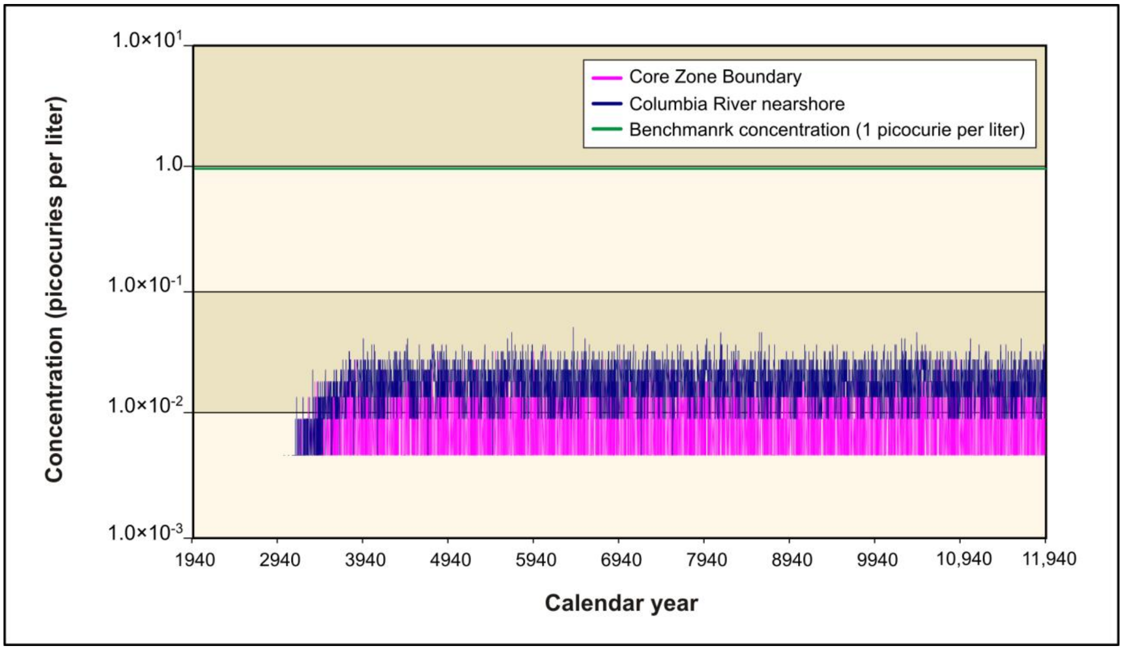

Figure 10. Iodine-129 Concentration Versus Time (Greater-Than-Class C Waste Disposal Site)

Figure 11 shows the relative contribution of technetium-99 at the Core Zone Boundary and Columbia River nearshore from the US Ecology Commercial LLW Disposal Site.

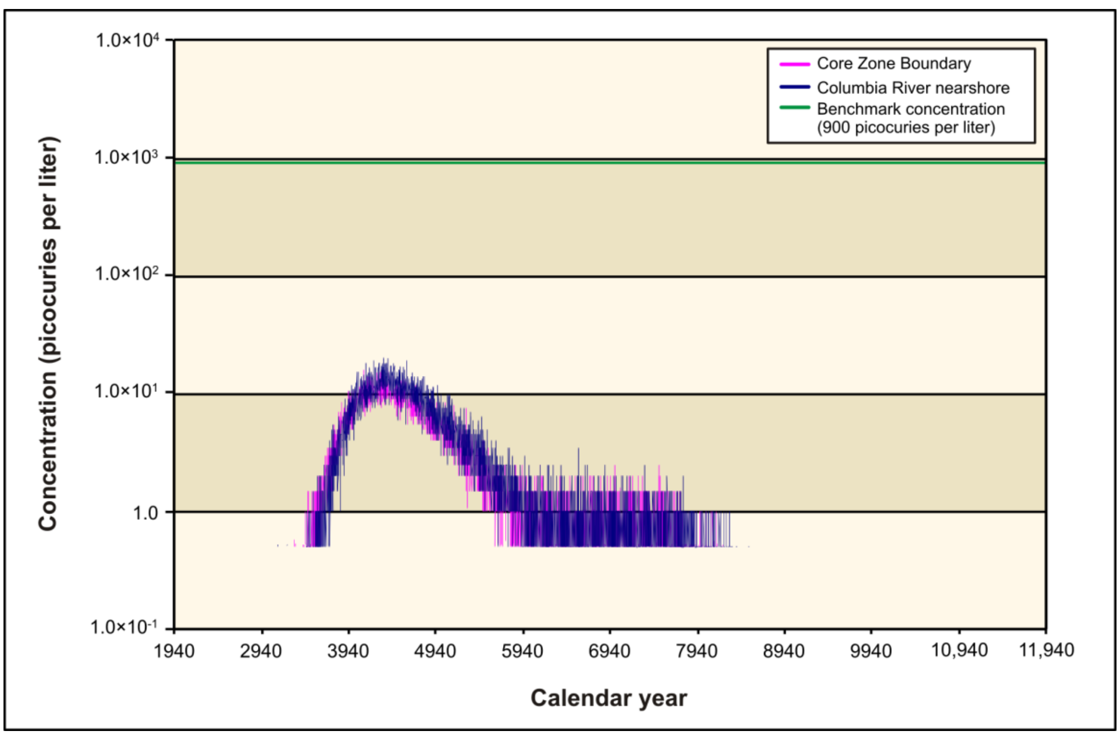

Figure 11. Technetium-99 Concentration Versus Time (US Ecology Commercial Low-Level Radioactive Waste Disposal Site)

Figure 12 shows the relative contribution of iodine-129 at the Core Zone Boundary and Columbia River nearshore from the US Ecology Commercial LLW Disposal Site.

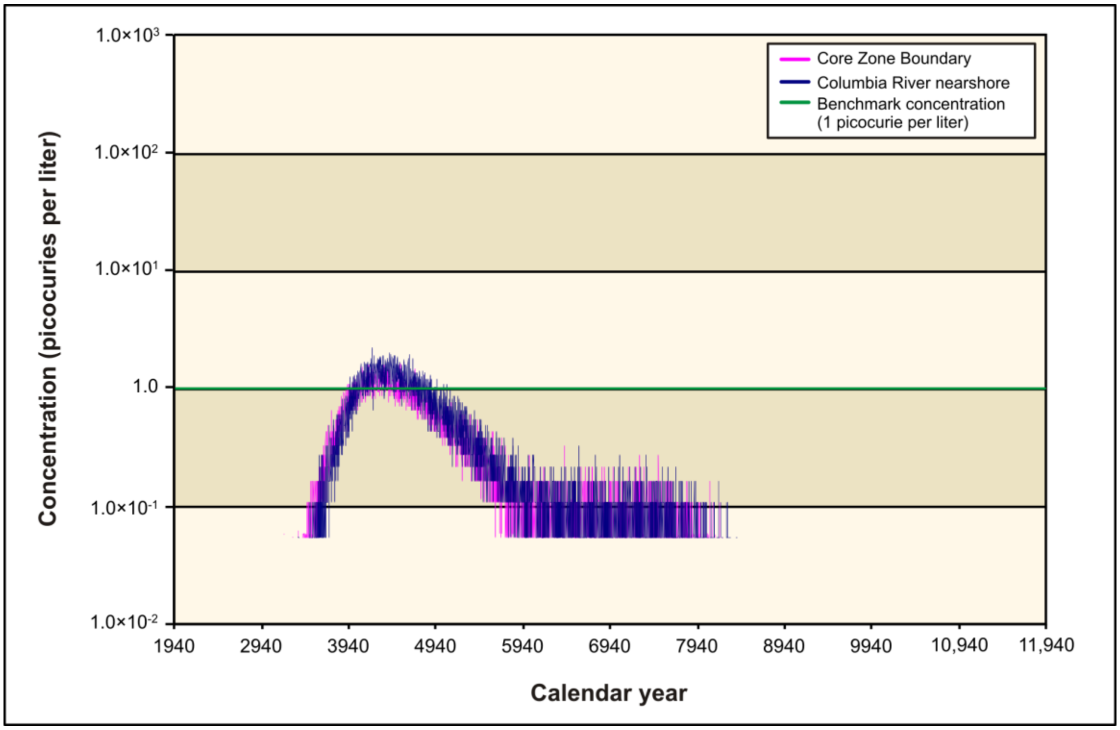

Figure 12. Iodine-129 Concentration Versus Time (US Ecology Commercial Low-Level Radioactive Waste Disposal Site)

Discussion: The increases of technetium-99 and iodine-129 in ERDF as shown in Table 2 and Figures 5 and 6, with the inventory corrections, are not significant contributors to the estimated concentrations of technetium-99 and iodine-129 at the Core Zone Boundary and Columbia River nearshore. ERDF is a low-discharge site, and the mobility of constituents is limited by low soil-moisture content in the vadose zone. Consequently, technetium-99 and iodine-129 concentrations from ERDF are highly attenuated and do not contribute significantly to impacts at the Core Zone Boundary or Columbia River nearshore. As can be seen, ERDF's contribution to the estimated concentrations of technetium-99 and iodine-129 at the Core Zone Boundary and Columbia River nearshore is less than that from any of the other three sites (IDF-East, the GTCC waste disposal site, and the US Ecology Commercial LLW Disposal Site), all in close proximity to ERDF. The contribution of each of the four disposal sites relative to each other for technetium-99 and iodine-127 concentrations at the Core Zone Boundary and Columbia River nearshore remains the same in the reanalysis as in the *Draft TC & WM EIS* analysis.

(5) Carbon tetrachloride inventory correction

Description: DOE corrected the inventory of carbon tetrachloride by removing the inventory of sources in the 200-West Area that were already accounted for in the groundwater plume inventory. In addition to removing this "double counting" of inventory, DOE developed a sensitivity analysis to reflect groundwater remediation activities for carbon tetrachloride, which have been ongoing in the 200 Areas since CY 1994. Annual environmental reports show the carbon tetrachloride plume is 11.48 square kilometers (4.43 square miles), which DOE is planning to remediate using "pump and treat" technology. DOE issued a CERCLA ROD for the 200-ZP-1 Operable Unit (EPA 2008), which implements the pump-and-treat strategy for this plume.

Comparative Analysis: The 2007 groundwater monitoring report estimates the range of dissolved carbon tetrachloride in the unconfined aquifer of the 200-West Area of the Core Zone Boundary as 55,900 to 64,600 kilograms (123,000 to 142,000 pounds) (Hartman and Webber 2008). The draft EIS used a value near the upper end of this range, i.e., 65,000 kilograms (143,000 pounds). In addition, the draft EIS included some sources of carbon tetrachloride that contributed to the dissolved carbon tetrachloride plume, essentially double-counting part of the inventory. The primary sources of the carbon tetrachloride are three of the 216-Z cribs and trenches (ditches) that received waste from the Plutonium Finishing Plant (DOE 2010). In the draft EIS cumulative impacts analysis, 65,000 kilograms (143,300 pounds) of carbon tetrachloride was assumed, for analysis purposes, to be released directly to the aquifer in CY 2005. This did not account for current or planned containment and removal of carbon tetrachloride from the aquifer. The remedial action objective, as defined in the interim ROD (EPA 1995) and carried forward into the final ROD (EPA 2008), states that the pump-and-treat remedy will capture the carbon tetrachloride plume in the upper 15 meters (49 feet) of the unconfined aquifer (DOE 2010). The capture-and-removal scenario was designed to evaluate the potential response of the carbon tetrachloride plume to mass removal from the aquifer that results from pump-and-treat operations.

In the reanalysis, three variations, in which specified masses of aqueous-phase carbon tetrachloride, chromium, and technetium-99 were assumed to be released directly to the aquifer beneath the 200-West Area, are evaluated in the capture-and-removal scenario (uranium was not included in this sensitivity analysis because the uranium cleanup targets will not be added until after completion of the CERCLA process for the 200-UP-1 Operable Unit). The base case assumed no pump-and-treat system; 65,000 kilograms (143,000 pounds) of aqueous-phase carbon tetrachloride, 3,000 kilograms (6,610 pounds) of chromium, and 1.75 curies of technetium-99 were assumed to be released directly to the aquifer in CY 2005 and to migrate under the prevailing hydraulic conditions. The double counting of some sources of carbon tetrachloride was removed in the reanalysis. The second case was designed to represent 95 percent carbon tetrachloride removal, which was implemented by simulating the release of 5 percent of the mass of carbon tetrachloride (3,250 kilograms [7,170 pounds]), chromium (150 kilograms [331 pounds]), and technetium-99 (0.0875 curies) in CY 2040. This case is consistent with the CERCLA ROD for the 200-ZP-1 Operable Unit (EPA 2008). The third case was designed to represent 99 percent removal by releasing 1 percent of the mass of carbon tetrachloride (650 kilograms [1,430 pounds]), chromium (30 kilograms [66.1 pounds]), and technetium-99 (0.0175 curies) in CY 2040. For the pump-and-treat simulations (second and third cases), the effect of pumping on the flow field was not explicitly considered; all three scenarios utilized the groundwater flow field that was used in the draft EIS cumulative impacts and alternatives analyses.

Figures 13 and 14, from the reanalysis, demonstrate that, with no remediation (base case), the projected carbon tetrachloride concentration would remain above the 5-microgram-per-liter benchmark standard until approximately CYs 2140 and 5500 at the Core Zone Boundary and Columbia River nearshore, respectively. With 95 percent removal, the carbon tetrachloride concentration at both locations would fall below the benchmark standard in less than 100 years following active treatment, which is consistent with the 200-ZP-1 Operable Unit ROD. With 99 percent removal, the carbon tetrachloride concentration at both locations would not exceed the benchmark standard and would remain near or up to three orders of magnitude below the benchmark standard for the next 10,000 years. It should be noted that the time scale (*x* axis) on Figure 13 represents 600 years of the model simulation for ease in interpreting the differences between the concentration-versus-time curves at the Core Zone Boundary. The time scale for Figure 14 represents the entire length of the model simulation (10,000 years).

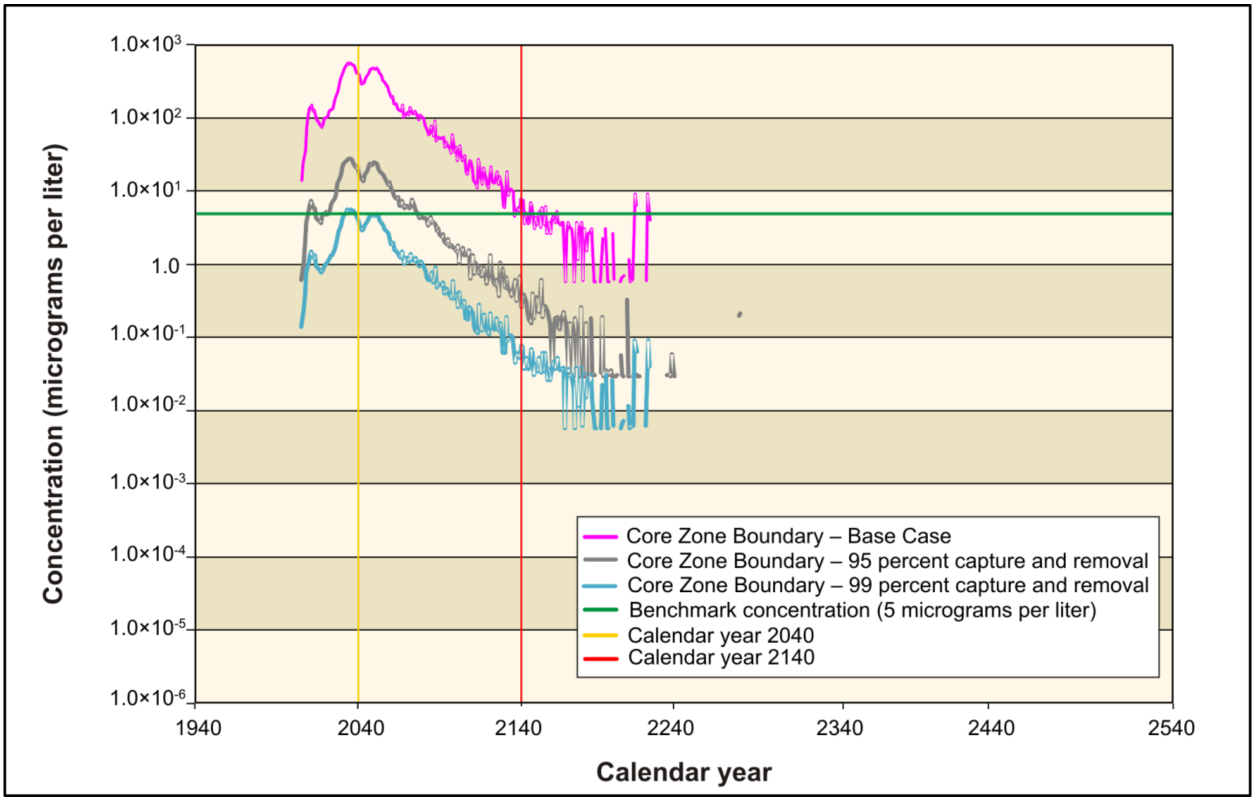

Figure 13. Carbon Tetrachloride Concentration Versus Time at the Core Zone Boundary (Three Cases) (Results from Reanalysis)

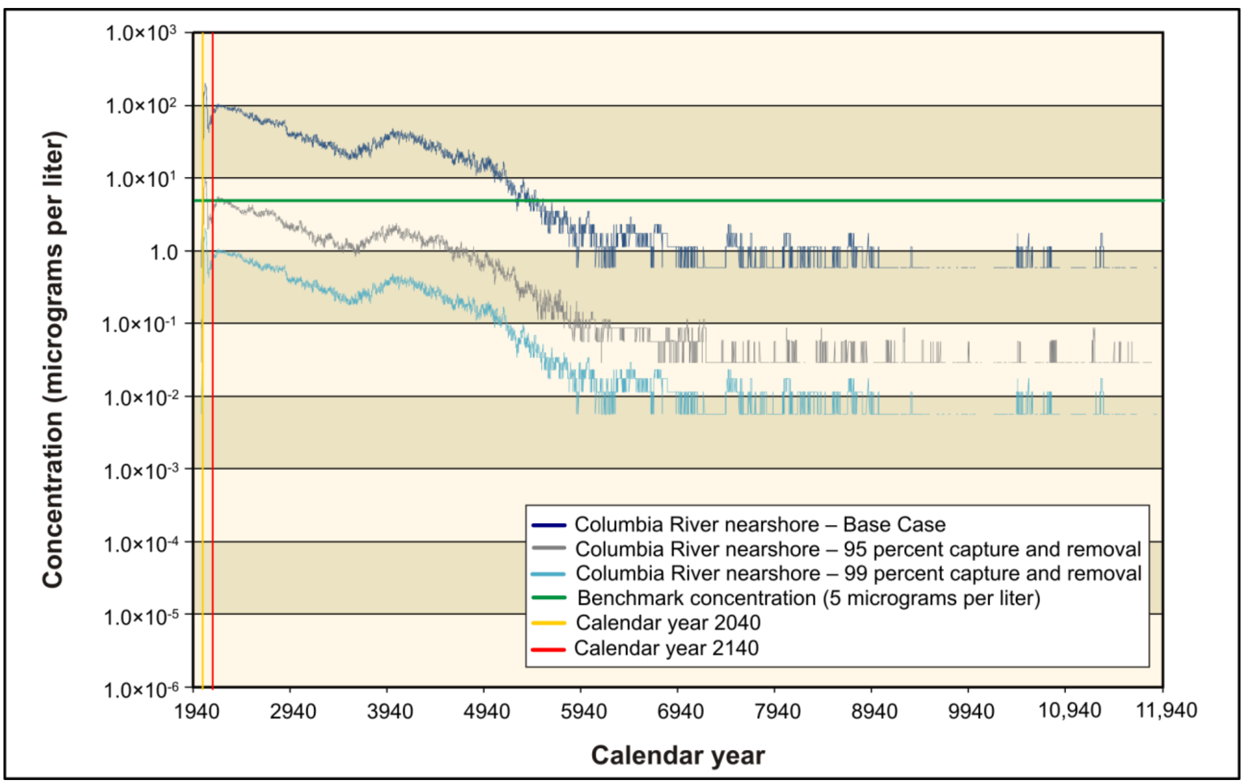

Figure 14. Carbon Tetrachloride Concentration Versus Time at the Columbia River Nearshore (Three Cases) (Results from Reanalysis)

Discussion: A sensitivity analysis based on 95 percent removal of carbon tetrachloride, identified in the CERCLA ROD for the 200-ZP-1 Operable Unit (EPA 2008), shows a potential reduction in the concentration to below the benchmark standard in about less than 100 years following active treatment at both the Core Zone Boundary and Columbia River nearshore. This analysis does not account for additional contributions of carbon tetrachloride to the groundwater from the vadose zone. Any adjustments to address how the pump-and-treat system works, once it is installed, related to carbon tetrachloride will be evaluated in the CERCLA 5-year review process related to the 200-ZP-1 Operable Unit ROD. Carbon tetrachloride is not a COPC that is related to any of the *TC & WM EIS* action alternatives, and the results have no bearing on the comparative analysis of the *TC & WM EIS* alternatives, either from a cumulative impacts standpoint or individually. Carbon tetrachloride is not a contaminant that is present in the tank waste, nor is it expected to be generated as a result of tank waste retrieval or treatment.

(6) 300 Area Process Trenches inventory corrections

Description: The draft EIS inventory database used the inventories for waste sites 316-1, 316-2, and 316-5 as reported in SIM (Corbin et al. 2005), which relied upon a surrogate waste stream from the plutonium-uranium extraction process cooling-water/steam condensate, including 12.8 curies of plutonium-239 and -240. Since the issuance of the draft EIS, a correction to SIM (Mehta 2011) has been issued (in June 2011), which entails deletion of the plutonium inventory at these three waste sites.

Comparative Analysis: The entire inventory of 12.8 curies of plutonium-239 and -240 was deleted in the reanalysis. Plutonium has not been identified as a risk driver in the 300 Area.

Discussion: Comparison of the reanalysis results using the inventory corrections with the draft EIS cumulative impacts analysis results shows that since the plutonium moves very slowly through the soil the concentrations at the Core Zone Boundary and the Columbia River nearshore did not change.

3.2 Changes to Alternatives Analyses

(7) Unplanned-releases inventory modifications

Description: To address the comments on the *Draft TC & WM EIS* that some waste site inventories may not have been included, DOE reviewed tank farm waste inventories in the draft EIS and determined that the inventory for a number of unplanned releases was inadvertently omitted. This inventory is relatively minor, but the inventory estimates and the groundwater analysis were revised to include these additional sources. DOE also revised the inventories estimated for historical leaks to reflect recently updated field investigation reports. These two activities, i.e., updates of inventory for the unplanned releases and updates based on field characterization data, resulted in changes in inventory in the reanalysis, which are reflected in Table 3.

Comparative Analysis: Table 3 compares the inventories of past tank leaks and other releases from the SSTs used for analysis in the *Draft TC & WM EIS* to the updated values resulting from the two changes listed above used in the reanalysis. All of the differences are decreases, except for hydrogen-3 (tritium), which increased from 327 curies to 328 curies (0.3 percent) and is not a radiological risk driver. There is no change to the mercury inventory.

Table 3. Comparison of Inventory Changes for Historical Leaks and Unplanned Releases

	Inventory Estimate	
	Draft TC & WM EIS	**Reanalysis**
Radioactive COPC (curies)		
Hydrogen-3 (tritium)	3.27×10^{2}	3.28×10^{2}
Carbon-14	4.32×10^{1}	3.48×10^{1}
Strontium-90	1.49×10^{5}	1.27×10^{5}
Technetium-99	3.12×10^{2}	2.63×10^{2}
Iodine-129	5.99×10^{-1}	5.10×10^{-1}
Cesium-137	5.65×10^{5}	3.91×10^{5}
Uranium-233, -234, -235, -238	1.97×10^{1}	1.48×10^{1}
Neptunium-237	1.19	9.90×10^{-1}
Plutonium-239, -240	7.21×10^{1}	6.65×10^{1}
Chemical COPC (grams)		
Chromium	9.81×10^{6}	9.44×10^{6}
Mercury	2.20×10^{3}	2.20×10^{3}
Nitrate	5.91×10^{8}	5.68×10^{8}
Lead	3.07×10^{5}	3.02×10^{5}
Total uranium	2.54×10^{7}	1.80×10^{7}
Butanol (n-butyl-alcohol)	1.56×10^{6}	1.13×10^{6}

Note: To convert grams to ounces, multiply by 0.03527.

Key: COPC=constituent of potential concern; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*.

Discussion: The changes to all radioactive and chemical nonradioactive COPC inventories, except tritium and mercury, decreased the inventory estimates analyzed in the *Draft TC & WM EIS*. Tritium, with a short half-life and an inventory increase of less than 1 percent, is not a risk driver in the groundwater or human health impacts analysis. The inventory changes are not large enough to change the results reported in the *Draft TC & WM EIS*.

(8) IHLW Interim Storage Facility

Description: The Secretary of Energy has determined that a Yucca Mountain repository is not a workable option for permanent disposal of spent nuclear fuel (SNF) and HLW. However, DOE remains committed to meeting its obligations to manage and ultimately dispose of these materials. The Administration has convened the Blue Ribbon Commission on America's Nuclear Future to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle, including all alternatives for the storage, processing, and disposal of SNF and HLW. By January 2012, the commission will provide its final recommendations that will form the basis of a new solution to managing and disposing of SNF and HLW.

DOE will need to store WTP IHLW and melters until a path forward is implemented for the disposition of the Nation's SNF and HLW, including the WTP IHLW and melters. Accordingly, DOE has expanded its analysis of storage capabilities.

Comparative Analysis: In reviewing the draft EIS, DOE determined that, because it is now unclear when IHLW shipments off site will begin, each Tank Closure alternative should assume storage (a maximum of 145 years) of all the IHLW canisters produced. Therefore, additional IHLW canister storage capacity would be needed, as follows: (1) Alternative 2A would require an additional 1.5 modules, from 2.0 to 3.5; (2) Alternative 2B would require an additional 0.5 modules, from 3.0 to 3.5; and (3) Alternative 6C would require an additional 0.5 modules, from 3.0 to 3.5. There were no changes to the other Tank Closure alternatives.

For each of these three Tank Closure alternatives, information was developed to support the construction, operations, and deactivation analyses and impacts for each area of analysis in the draft EIS.

Discussion: The results of a review of the additional resources required for construction, operations, and deactivation of the additional storage capacity show that they would be minimal. For example, for Tank Closure Alternative 2A, which would require the largest increase in storage modules (1.5 modules), the increases for electricity, diesel fuel, gasoline, and water would be 0, 0.2, 1.4, and 0 percent, respectively. Additionally, it was found that, relative to the draft EIS, the short-term environmental effect changes would be minimal; the long-term effects would be unchanged; and there are no changes to the human health impacts analysis due to the additional storage modules under Tank Closure Alternatives 2A, 2B, and 6C.

(9) Steam Reforming Facility waste form performance

Description: DOE updated its discussion of steam reforming technology, a potential supplemental treatment technology for low-activity waste (LAW), based on emerging technical information on the performance of steam-reformed final waste forms. This discussion addresses characterization of steam reforming solids and their performance based on solid-phase solubility controls, as well as the performance needed to result in groundwater concentrations at the Core Zone Boundary below benchmark standards, as analyzed in Tank Closure Alternative 3C, using IDF-East. This proposed action is evaluated in Waste Management Alternatives 2 and 3 (Disposal in IDF, 200-East Area Only, and Disposal in IDF, 200-East and 200-West Areas, respectively) in the disposal group associated with Tank Closure Alternative 3C (Disposal Group 1, Subgroup 1-D). In both Waste Management Alternatives 2 and 3, the fluidized-bed steam reforming (FBSR) waste form resulting from the steam reforming supplemental treatment process is analyzed with a final disposal location in IDF-East.

An important factor governing the long-term groundwater impacts analysis is the rate at which key radionuclides and chemicals transfer from the FBSR product into pore waters moving through IDF-East. The preferable approach to the analysis would involve use of experimentally determined waste-form-leaching data collected under conditions that mimic, as closely as possible, the expected conditions in IDF-East. However, available characterization data do not strongly support estimates of release rates over long periods of time, and alternate assumptions for the analysis had to be considered.

Comparative Analysis: In the *Draft TC & WM EIS*, the analysis was predicated on the assumptions that mass transfer of radionuclides and chemicals from the FBSR solids to the pore waters in IDF-East was limited by the rate of dissolution of the FBSR product; that the only constraint on that dissolution was the amount of available pore water; and that, consequently, the release rates of radionuclides and chemicals were governed by the stoichiometry of the assumed dissolution reaction and the rate of pore water movement through the waste form. For both Waste Management Alternatives 2 and 3, the resulting concentration versus time of key risk drivers in groundwater near IDF-East was dominated by releases from the FBSR product. Figures 15 and 16 are reproduced from the *Draft TC & WM EIS* and show the groundwater concentrations versus time at the Core Zone Boundary and Columbia River nearshore for technetium-99 and iodine-99, respectively. The early concentration peaks (between CYs 2940 and 4940) are associated with releases from tank farm closure waste in the RPPDF and are not relevant to this discussion. The later peaks (between CYs 5940 and 11,940) are associated with waste disposed of in IDF-East and are dominated by contributions from the FBSR products, offsite waste, and secondary waste.

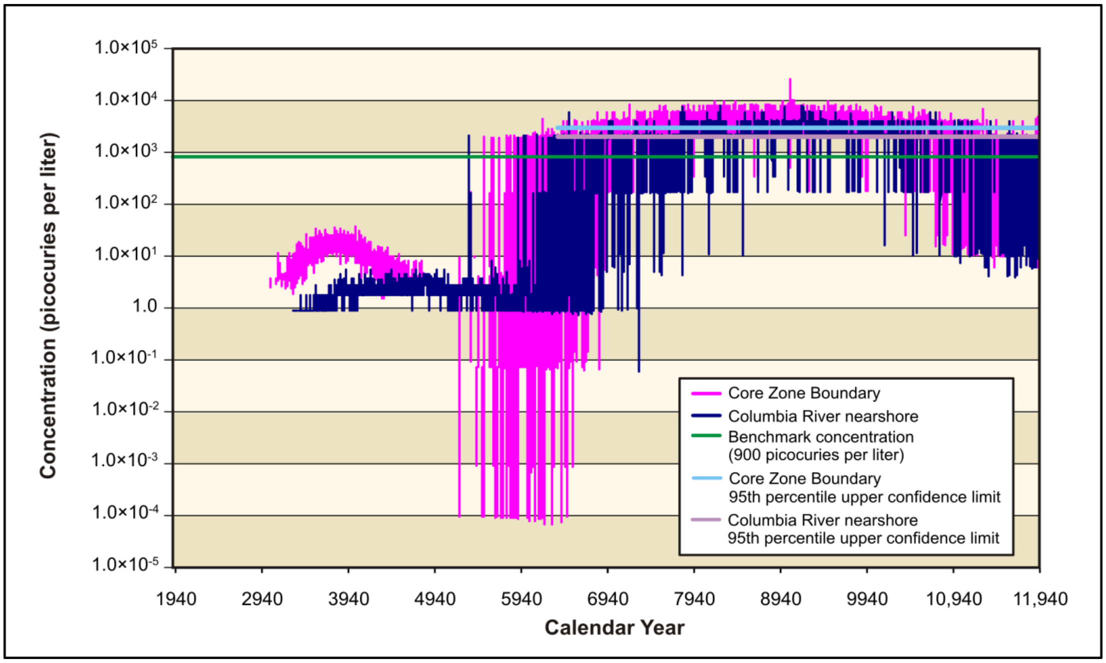

Figure 15. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Technetium-99 Concentration Versus Time (Results from *Draft TC & WM EIS*)

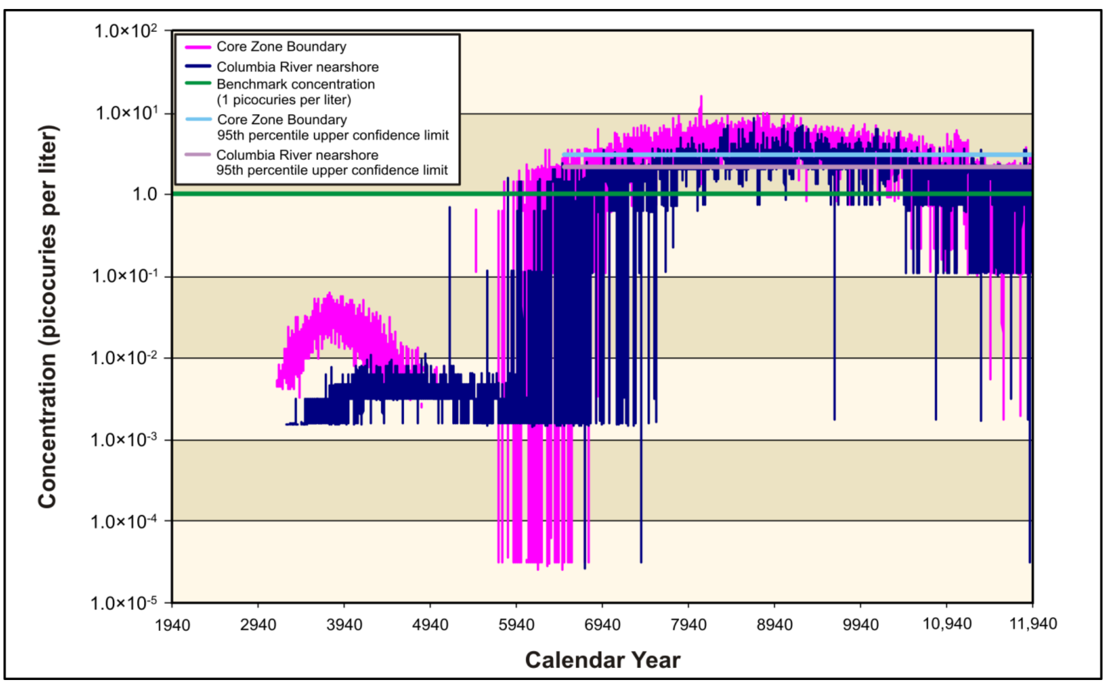

Figure 16. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Iodine-129 Concentration Versus Time (Results from *Draft TC & WM EIS*)

The assumption that mass transfer of radionuclides and chemicals from the FBSR solids to the pore waters in IDF-East was limited by the rate of dissolution of the FBSR product was retained in the reanalysis. However, in addition to the amount of pore water available, a constraint was added to the reanalysis that the solubility products of the dissolved FBSR materials not exceed saturation for a stable-phase assemblage of primary and secondary minerals. Consequently, the release rates of radionuclides and chemicals in the reanalysis are governed by the solubility of the assumed primary- and secondary-mineral assemblages and by the rate of pore water movement through the waste form. Figures 17 and 18, from the reanalysis, show the groundwater concentrations versus time at the Core Zone Boundary and Columbia River nearshore for technetium-99 and iodine-99, respectively. (Figures 17 and 18 also show the groundwater concentrations versus time for the RPPDF and IDF-East barriers, which, although not presented in the *Draft TC & WM EIS*, were developed to provide additional insight to the evaluation of the assumption change.) Again, the early concentration peaks (between CYs 2940 and 4940) are associated with releases from tank farm closure waste in the RPPDF and are not relevant to this discussion. The later peaks (between CYs 5940 and 11,940) are associated with waste disposed of in IDF-East and are dominated by contributions from the FBSR products, offsite waste, and secondary waste.

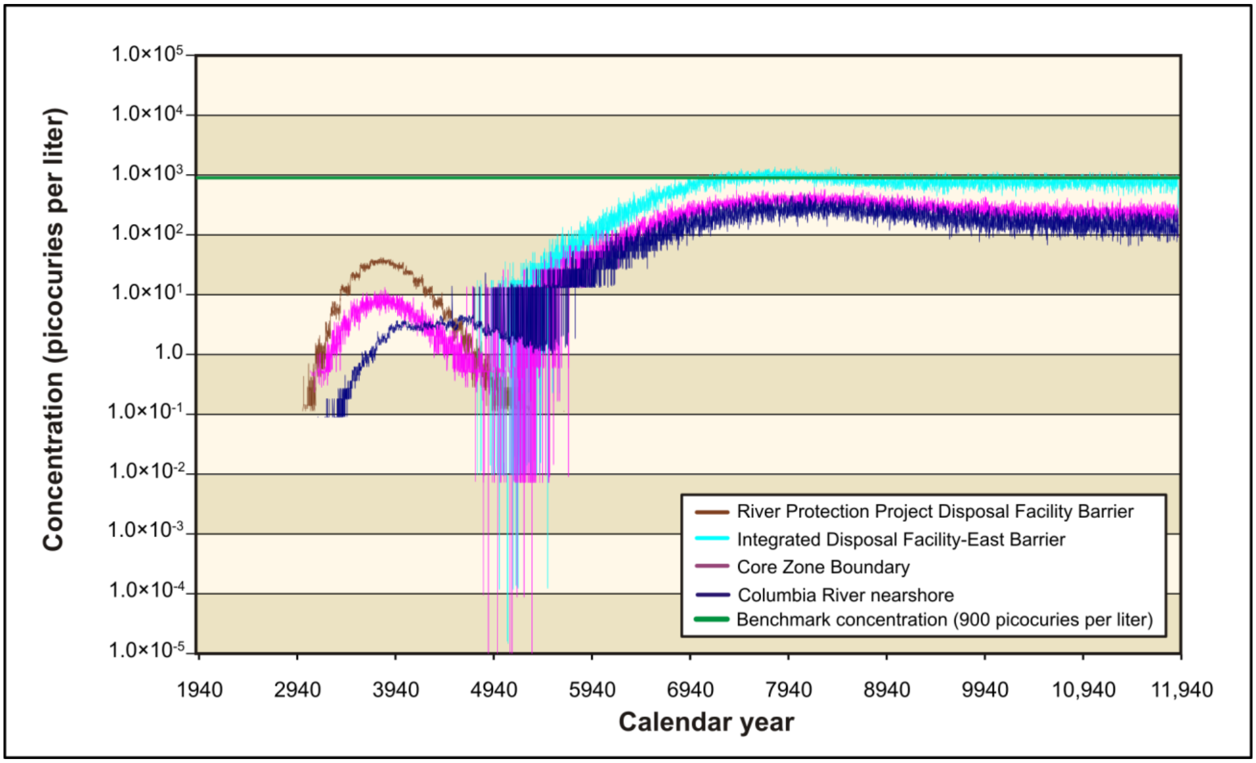

Figure 17. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Technetium-99 Concentration Versus Time (Results from Reanalysis)

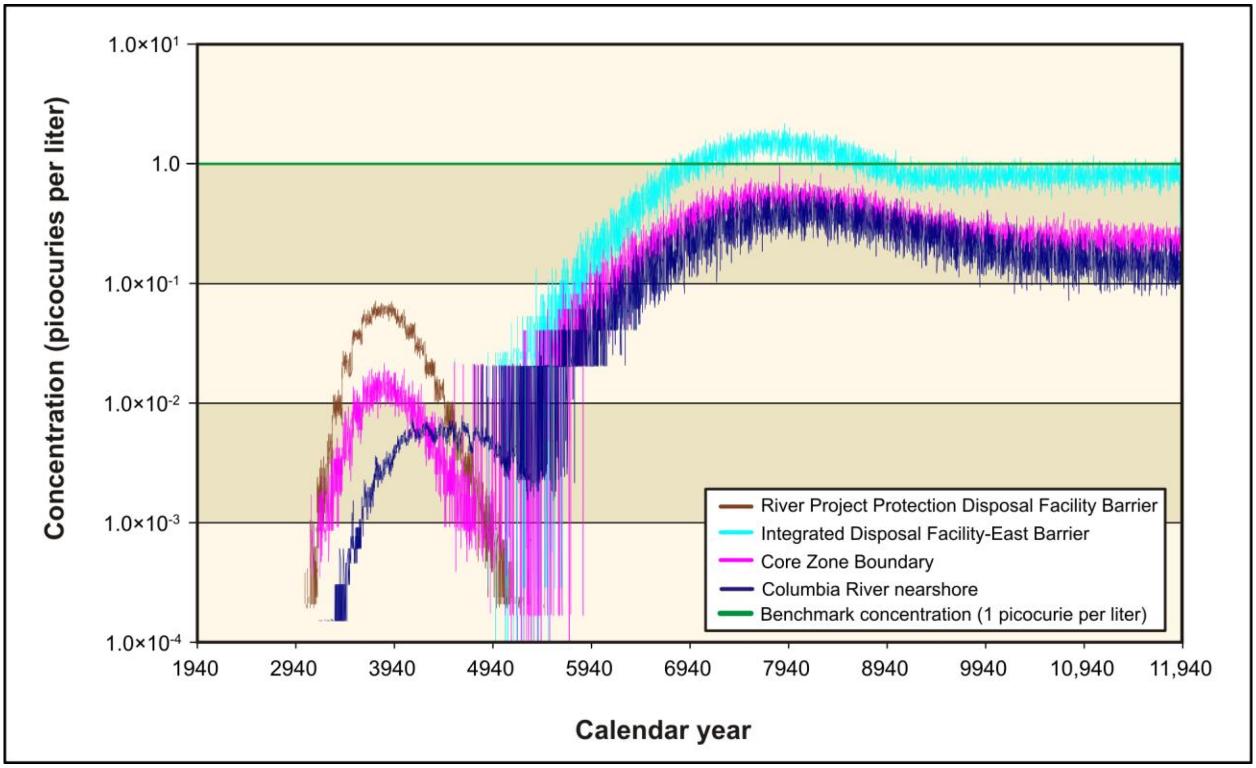

Figure 18. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Iodine-129 Concentration Versus Time (Results from Reanalysis)

Discussion: In the relevant timeframe of interest (between CYs 5940 and 11,940), concentrations associated with two risk-driving radionuclides, technetium-99 and iodine-129, are predicted to be approximately an order of magnitude lower at the Core Zone Boundary and the Columbia River nearshore in the reanalysis relative to the draft EIS, primarily as a result of the addition of solubility constraints to the groundwater model governing release from FSBR solids. However, conclusions from the reanalysis are the same as those from the draft EIS, i.e., that concentrations at the IDF-East barrier would exceed benchmark concentrations.

(10) Offsite waste inventory and waste acceptance criteria

Description: The *Draft TC & WM EIS* analysis showed that receipt of offsite waste streams containing specific amounts of certain risk-driving radionuclides, e.g., iodine-129 and technetium-99, could cause an exceedance of the benchmark concentrations for these radionuclides. As discussed in the draft EIS, one means of mitigating this impact would be for DOE to limit or restrict receipt of offsite waste containing iodine-129 or technetium-99 at Hanford (e.g., through waste acceptance criteria). In response to public comments on the draft EIS, DOE eliminated one waste stream with relatively high concentrations of technetium-99 and iodine-129 from the offsite waste inventory estimates in the reanalysis. The removal of this waste stream resulted in a significant reduction in the technetium-99 and iodine-129 offsite waste inventories.

Comparative Analysis: Based on the public's input and concerns about offsite-waste disposal at Hanford, DOE eliminated a waste stream from the estimated offsite waste inventory coming to Hanford. Specifically, DOE eliminated from the groundwater long-term analysis one offsite waste stream containing a significant inventory of iodine-129 and technetium-99, among other radionuclides. The results of this reanalysis illustrate the difference this action would make in potential groundwater impacts. This inventory reduction action is analyzed as part of the Waste

Management alternatives. The waste stream had a volume of 6,500 cubic meters (229,500 cubic feet). Tables 4 and 5 summarize the estimated radioactive and chemical COPC inventories, respectively, for this waste stream that were deleted and the percent of the total each represents.

Table 4. Radioactive Constituents of Potential Concern Deleted (in curies) and Percent of Total Reduced

Iodine-129	Cesium-137	Carbon-14	Hydrogen-3	Plutonium-239, -240	Strontium-90	Technetium-99
1.30×10^{1}	1.30×10^{4}	5.20×10^{3}	3.25×10^{3}	4.37×10^{1}	4.88×10^{3}	3.38×10^{2}
85.0%	2.0%	84.8%	5.5%	62.0%	0.7%	18.8%

Table 5. Chemical Constituents of Potential Concern Deleted (in kilograms) and Percent of Total Reduced

Arsenic	Cadmium	Chromium	Silver
2.99	1.95×10^{-2}	1.33×10^{1}	4.10×10^{-2}
37.0%	0.0%	14.2%	0.2%

Note: To convert kilograms to pounds, multiply by 2.2046.

Figures 19 and 20 are reproduced from the *Draft TC & WM EIS*. They show the groundwater concentrations versus time at the Core Zone Boundary and Columbia River nearshore for iodine-99 and technetium-99, respectively. The early concentration peaks (between CYs 2940 and 4940) are associated with releases from tank farm closure waste in the RPPDF and are not relevant to this discussion. The later peaks (between CYs 5940 and 11,940) are associated with waste disposed of in IDF-East and are dominated by contributions from offsite waste and secondary waste.

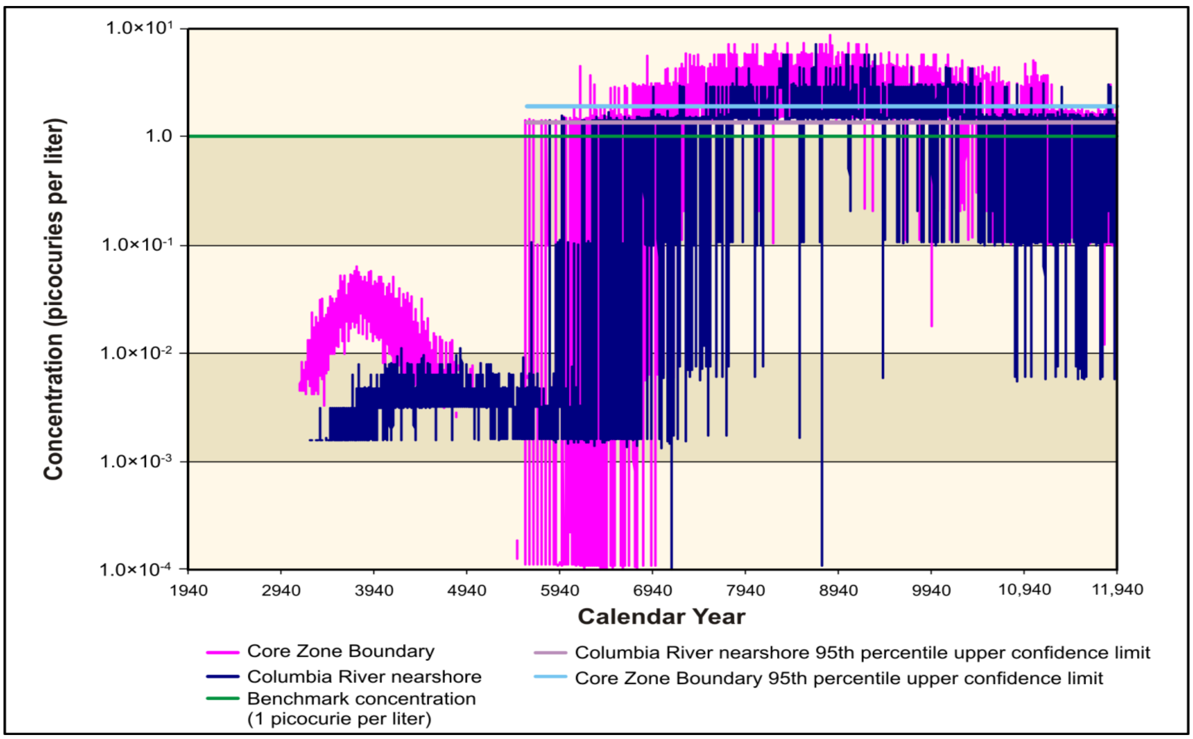

Figure 19. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time (Results from *Draft TC & WM EIS*)

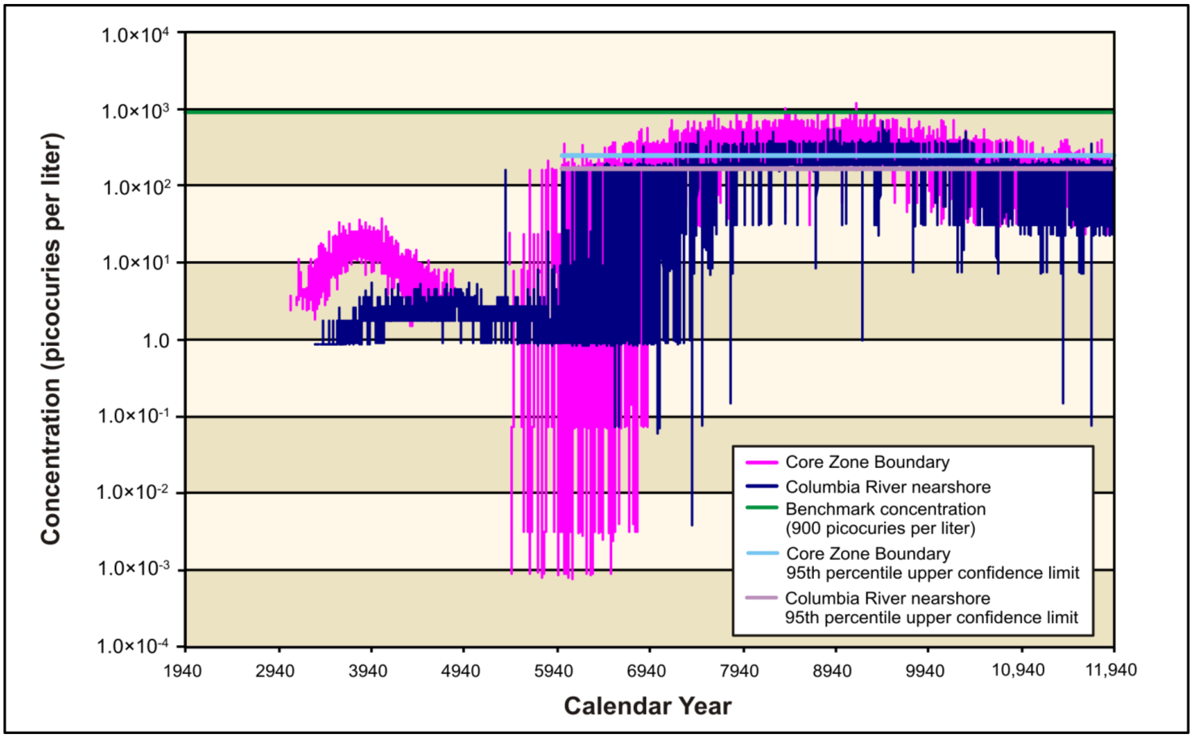

Figure 20. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time (Results from *Draft TC & WM EIS*)

Figures 21 and 22 show results from the reanalysis (i.e., without the one specific offsite waste stream). They show the groundwater concentrations versus time at the Core Zone Boundary and Columbia River nearshore for iodine-99 and technetium-99, respectively. The early concentration peaks (between CYs 2940 and 4940) are associated with releases from tank farm closure waste in the RPPDF and are not relevant to this discussion. The later peaks (between CYs 5940 and 11,940) are associated with waste disposed of in IDF-East and are dominated by contributions from offsite waste and secondary waste.

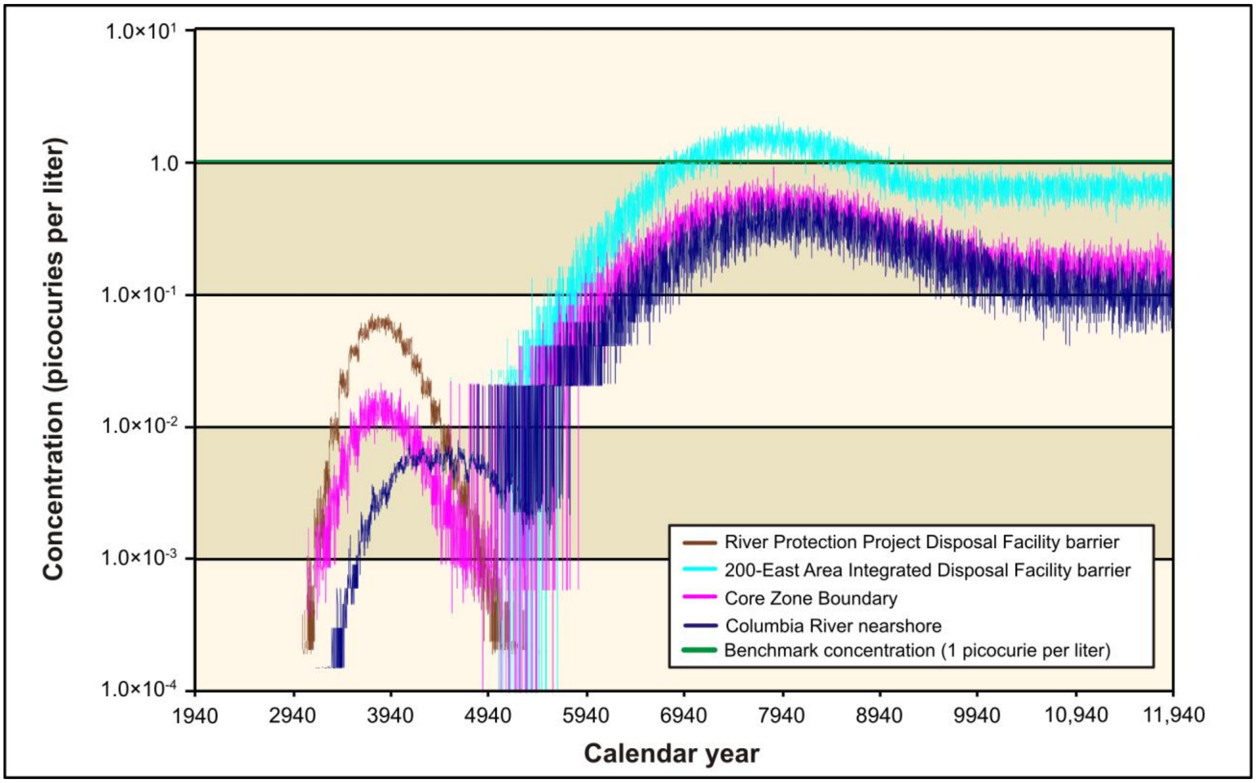

Figure 21. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time (Results from Reanalysis)

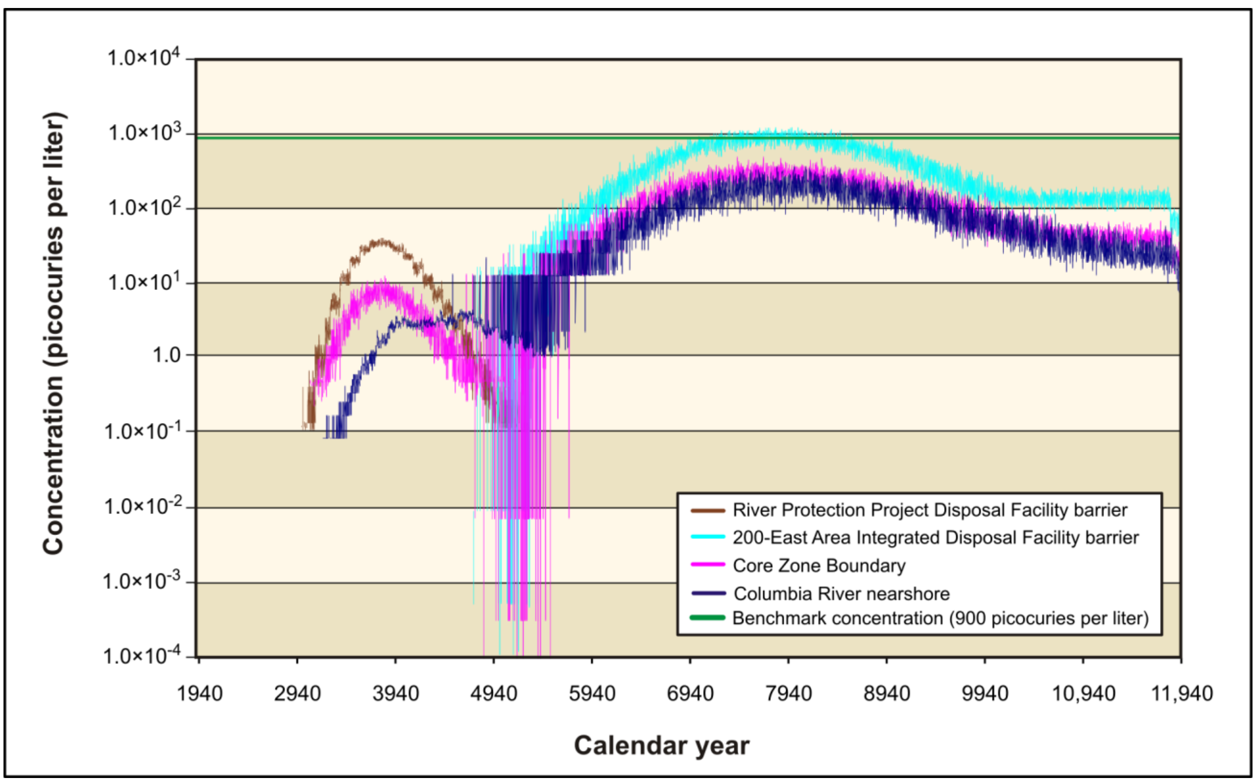

Figure 22. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time (Results from Reanalysis)

Discussion: In the relevant timeframe of interest (between CYs 5940 and 11,940), concentrations associated with two risk-driving radionuclides, technetium-99 and iodine-129, are slightly lower for technetium-99 and an order of magnitude lower for iodine-129 at the Core Zone Boundary and the Columbia River nearshore in the reanalysis relative to the *Draft TC & WM EIS*. However, results from the reanalysis indicate that iodine-129 concentrations at the IDF-East barrier would exceed benchmark concentrations.

The reanalysis confirms DOE's original conclusion that limiting the amount of offsite waste containing technetium-99 and iodine-129 would reduce the concentration of these radionuclides at the Core Zone Boundary and the Columbia River nearshore. However, the two sets of results are sufficiently close to the technetium-99 and iodine-129 benchmark concentrations that additional measures such as waste form performance improvements or applying waste acceptance criteria at IDF may be needed.[6]

(11) Steam Reforming Facility iodine-129 air emissions

Description: In the *Draft TC & WM EIS*, DOE assumed that each thermal supplemental treatment (LAW vitrification, bulk vitrification, and steam reforming) facility would include an iodine-129 abatement capability. This assumption was made due to the lack of a sufficiently mature design for two of the supplemental treatment processes, bulk vitrification and steam reforming. Currently available engineering data for the bulk vitrification process support this assumption; however, data for the steam reforming process do not. Therefore, for Tank Closure Alternative 3C, the previously assumed iodine-129 abatement capability for air releases from the two Steam Reforming Facilities has been eliminated. Specifically, in the *Draft TC & WM EIS*, it was assumed that air treatment technologies, i.e., iodine 129 abatement, would result in a reduction factor of 100 for iodine-129 air emissions from the Steam Reforming Facilities.

Comparative Analysis: DOE performed a sensitivity analysis to evaluate the difference in dose to the public that would result from this change. The results indicate that, over the 22 years of operation of the WTP and the 200-East and 200-West Area facilities, the dose to the public from the combined sources under Tank Closure Alternative 3C would be approximately 1,200 person-rem, with the dose due to WTP emissions representing approximately 30 percent of the total. The contributions from activities in the 200-East and 200-West Areas, where the Steam Reforming Facilities would be located, would be a dose to the public over the 22-year operational period of approximately 450 and 400 person-rem, respectively. Over the 22-year period, the dose to the maximally exposed individual (MEI) would be 15 millirem.

For comparison, in the *Draft TC & WM EIS*, the total dose to the public over the 22 years of operation of the WTP and the 200-East and 200-West Area facilities from the combined sources under Tank Closure Alternative 3C would be approximately 570 person-rem, with the dose to the public due to WTP emissions representing approximately 63 percent of the total. The contributions from activities in the 200-East and 200-West Areas, where the Steam Reforming Facilities would be located, would be a dose to the public over the 22-year operational period of approximately 100 and 100 person-rem, respectively. The dose to the MEI over the life of the project would be approximately 14 millirem.

[6] On December 18, 2009, after the October 30, 2009, issuance of the *Draft TC & WM EIS*, DOE issued a Modification of Preferred Alternatives in the *Federal Register* (74 FR 67189). In this notice, DOE stated that it "would not send LLW and MLLW from other DOE sites to Hanford for disposal (with some limited specific exceptions) at least until the WTP is operational…. Off-site waste would be addressed after the WTP is operational subject to appropriate NEPA review." A deadline of 2022 for initial operations of the WTP was later settled (*State of Washington v. Chu*, Civil No. 2:08-cv-05085-FVS, October 25, 2010).

In both the draft EIS and the sensitivity analysis, the dose to the MEI would be 0.6 and 0.7 millirem per year, respectively, well below the annual dose limit to an individual member of the public of 10 millirem per year (40 CFR 61, Subpart H).

Discussion: Although there would be an increase in total dose to the public and the MEI over the 22-year operational period under Tank Closure Alternative 3C, due primarily to the increase in iodine-129 releases from the Steam Reforming Facilities, the increases correspond to a change in the lifetime risk of a latent cancer fatality, from 8×10^{-6} to 3×10^{-5} (0.03 percent increase). In DOE's comparative assessment of the Tank Closure alternatives, the potential environmental impacts of Tank Closure Alternative 3C are essentially unaltered. Specifically, the relative ranking of Tank Closure Alternative 3C to the maximum- and minimum-impact Tank Closure alternatives is unchanged.

(12) Groundwater B Barrier and Core Zone reporting

Description: In the northeast part of the Core Zone Boundary (in the vicinity of the B/BX/BY SST farms and associated cribs and trenches [ditches]), the unconfined aquifer is thin relative to most other parts of central Hanford. The top-of-basalt surface rises going north toward Gable Mountain, and the water table is nearly flat in this area because of the high hydraulic conductivity of the aquifer materials. As a consequence, in some places, the top-of-basalt surface is known to rise above the water table and the aquifer is nonexistent (i.e., the vadose zone overlies an inactive portion of the aquifer). This feature poses issues for the groundwater modeling system; to ensure mass balance throughout the entire groundwater system, it is desirable for all of the vadose zone and radionuclide flux to be delivered to active portions of the aquifer. In all modeling systems that are constructed around the concept of individual vadose zone models of specific locations that are coupled across the water table to a regional flow model, some compromise must be made to address the nonexistence of the aquifer at such locations. An associated issue is the location of the tracking objects ("lines of analysis") in areas where the aquifer is nonexistent. For the reporting to be meaningful in terms of human health risk assessment, the exposure pathway from the source to the receptor location along the line of analysis should be complete; e.g., a future groundwater user cannot be exposed to contamination contained in groundwater in areas where the aquifer does not exist.

Comparative Analysis: In the *Draft TC & WM EIS*, the first issue was addressed by individually moving the modeled locations of some sources near the B/BX/BY tank farms to the south, away from the rise in the top of basalt and Gable Mountain. The distance each site was moved was the minimum necessary to ensure that the entire vadose zone model was located over active portions of the aquifer. The B Barrier and Core Zone Boundary were viewed as purely geographic entities and were not relocated in the modeling effort for the *Draft TC & WM EIS*. In the draft EIS, for Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C, the maximum concentrations of technetium-99 and iodine-129 were 144,196 and 187 picocuries per liter, respectively, at the B Barrier (both occurred in CY 1956).

In the reanalysis, a different representation was conducted for the sites located near the B/BX/BY tank farms to promote the value of preserving the spatial relationships of the different sites to each other and to the B Barrier and the Core Zone Boundary. The modeled locations of all sites in the area were collectively moved to the south; the distance was determined to be the minimum distance such that all of the vadose zone models in this area were over active portions of the aquifer. The B Barrier and parts of the Core Zone Boundary were also adjusted to preserve their spatial relationship to the relocated sites. As a result, in the reanalysis, for Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C, the maximum concentrations of technetium-99 and iodine-129 are projected to be 33,680 and 42 picocuries per liter, respectively, at the B Barrier (again, both occurred in CY 1956). The difference in predicted peak concentrations, about a factor of 4, is similar for the other Tank Closure alternatives and, in all cases, is within the factor of 10 (order of magnitude) design specification adopted for the groundwater model system.

Discussion: The reanalysis and reporting do not change the relationship of the impacts of the considered actions with respect to benchmark concentrations; all of the Tank Closure alternatives continue to show exceedances (i.e., greater than two orders of magnitude) during the operational period, consistent with historical observations, as well as varying degrees and durations of exceedances for future times, consistent with expected outcomes for various retrieval and closure scenarios. Results from both the *Draft TC & WM EIS* and the reanalysis, as well as existing field data, indicate that concentrations at the B Barrier and Core Zone Boundary have exceeded benchmark concentrations.

(13) Groundwater analytical methodology: aggregation of individual sources

Description: In both the *Draft TC & WM EIS* and the reanalysis, prepared in response to public comments, groundwater analysis calculations of concentration versus time were made for individual sources, which were subsequently aggregated to produce results for entire alternatives. This methodology was selected primarily to provide information on individual sources (i.e., the Performance Objective in the *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses* [DOE 2005]) and secondarily for computational efficiency.

In the *Draft TC & WM EIS*, tables of the maximum concentration as a function of time were produced for each source. The aggregation to produce results for the alternatives was a summation of the maximum concentrations for all sources, year by year. This approximation works well when the sources for an alternative are closely located and the individual contaminant plumes largely overlap (e.g., for Waste Management Alternative 2, when most of the sources are located at IDF-East). The approximation provides an overestimate when the individual sources are not closely located and the individual contaminant plumes do not overlap (e.g., for all Tank Closure alternatives and Waste Management Alternative 3, where the individual sources are distributed across the Core Zone). In the reanalysis, the aggregation method involves summation of the concentrations for each source at each time step at discrete locations across the model domain. The result is a more-accurate estimate of concentration versus time for Tank Closure alternatives and Waste Management Alternative 3, which includes both an IDF-East and an IDF-West.

Comparative Analysis: In the *Draft TC & WM EIS* groundwater analysis, tables were produced containing maximum concentrations at the barriers, Core Zone Boundary, and Columbia River nearshore as a function of time for each individual source. This method overestimates impacts for situations where individual sources are not collocated and the individual contaminant plumes do not largely overlap (e.g., all Tank Closure alternatives and Waste Management Alternative 3, where the individual sources are distributed across the Core Zone). The aggregated concentration distribution can then be searched for the maximum value associated with the barriers, the Core Zone Boundary, and the Columbia River nearshore. This method still provides an accurate estimate for alternatives with closely located sources and improves the estimate for alternatives with sources distributed over a wide area.

In two earlier sections of this SA (see items (9) and (10) in Section 3.2), on steam reforming waste form performance and on offsite waste inventory and waste acceptance criteria, draft EIS and reanalysis projections of concentration versus time were compared for Waste Management Alternative 2. Some differences can be noted, but, as discussed, the differences are attributable to changes in waste form performance and inventory rather than the method of aggregation. The figures below illustrate the comparison of draft EIS and reanalysis predictions of concentration versus time for Tank Closure Alternative 2B and Waste Management Alternative 3. Figures 23 and 24 show the concentration versus time for Tank Closure Alternative 2B from the draft EIS for iodine-129 and technetium-99, respectively (Chapter 5, Figures 5–80 and 5–81); the corresponding predictions from the reanalysis are provided in Figures 25 and 26. Note that the early structure of the curves (i.e., near the peak concentrations prior to CY 2100) is similar; the peak concentrations are dominated by releases from the B/BX/BY cribs and trenches (ditches), which are nearly collocated. Following this period, the dominance of any single group of closely located sources becomes smaller, and the contaminant plumes are widely distributed across the Core Zone. At these times, the method of aggregation becomes more important and the differences between the results become more apparent. A similar effect is noted for Waste Management Alternative 3, with sources at both IDF-East and IDF-West. Figures 27 and 28 show the concentration versus time from the draft EIS for iodine-129 and technetium-99, respectively; the corresponding predictions from the reanalysis are provided in Figures 29 and 30.

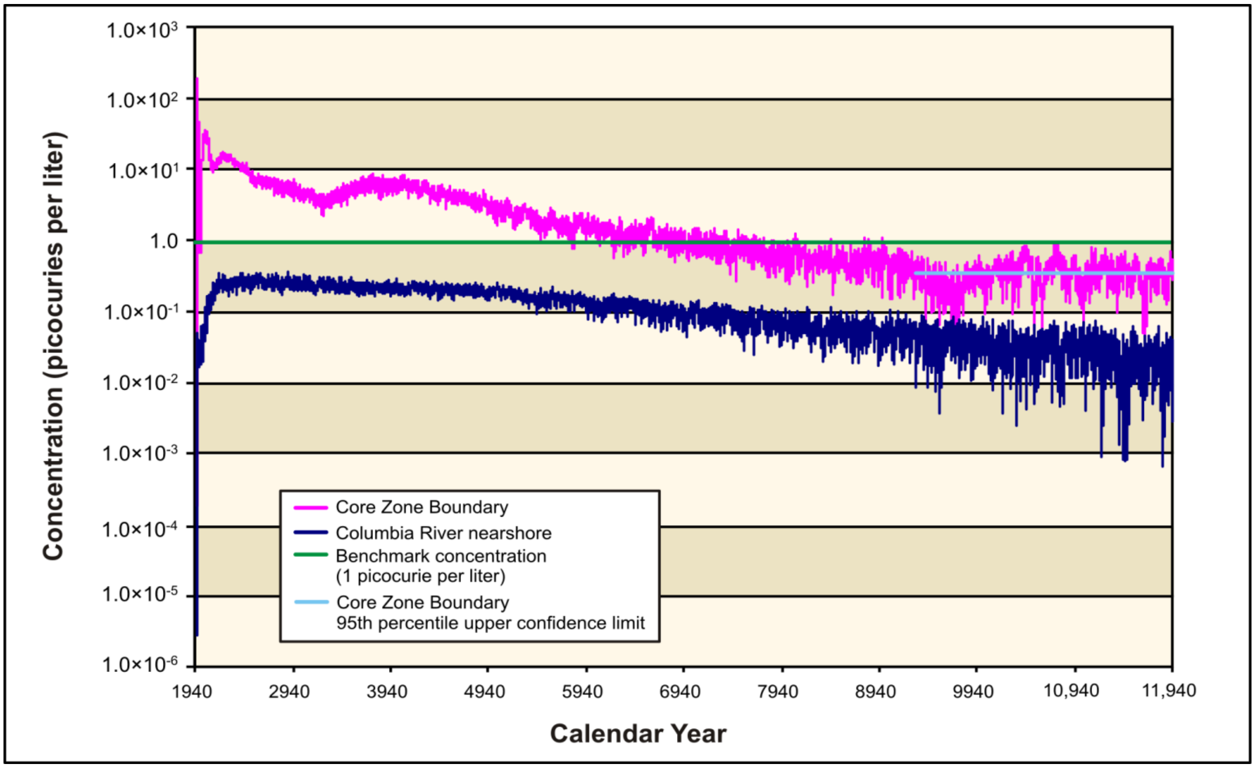

Figure 23. Tank Closure Alternative 2B Iodine-129 Concentration Versus Time (Results from *Draft TC & WM EIS*)

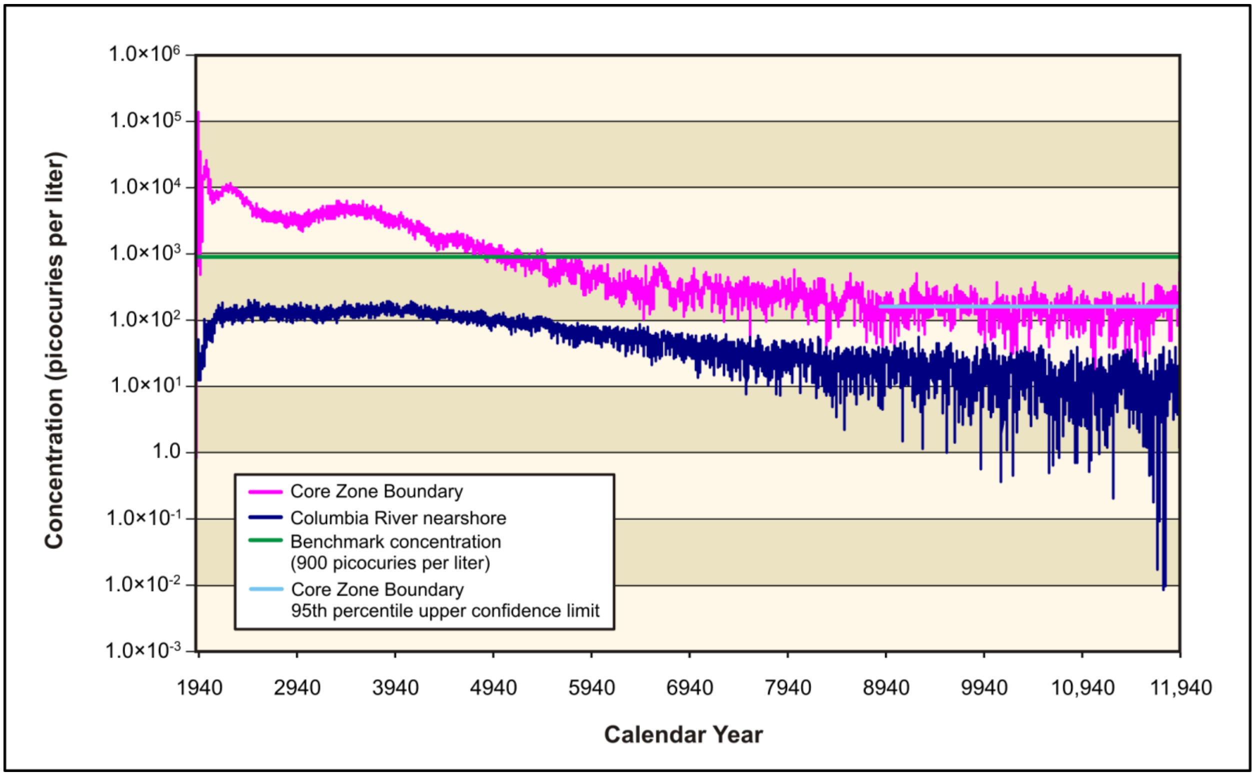

Figure 24. Tank Closure Alternative 2B Technetium-99 Concentration Versus Time (Results from *Draft TC & WM EIS*)

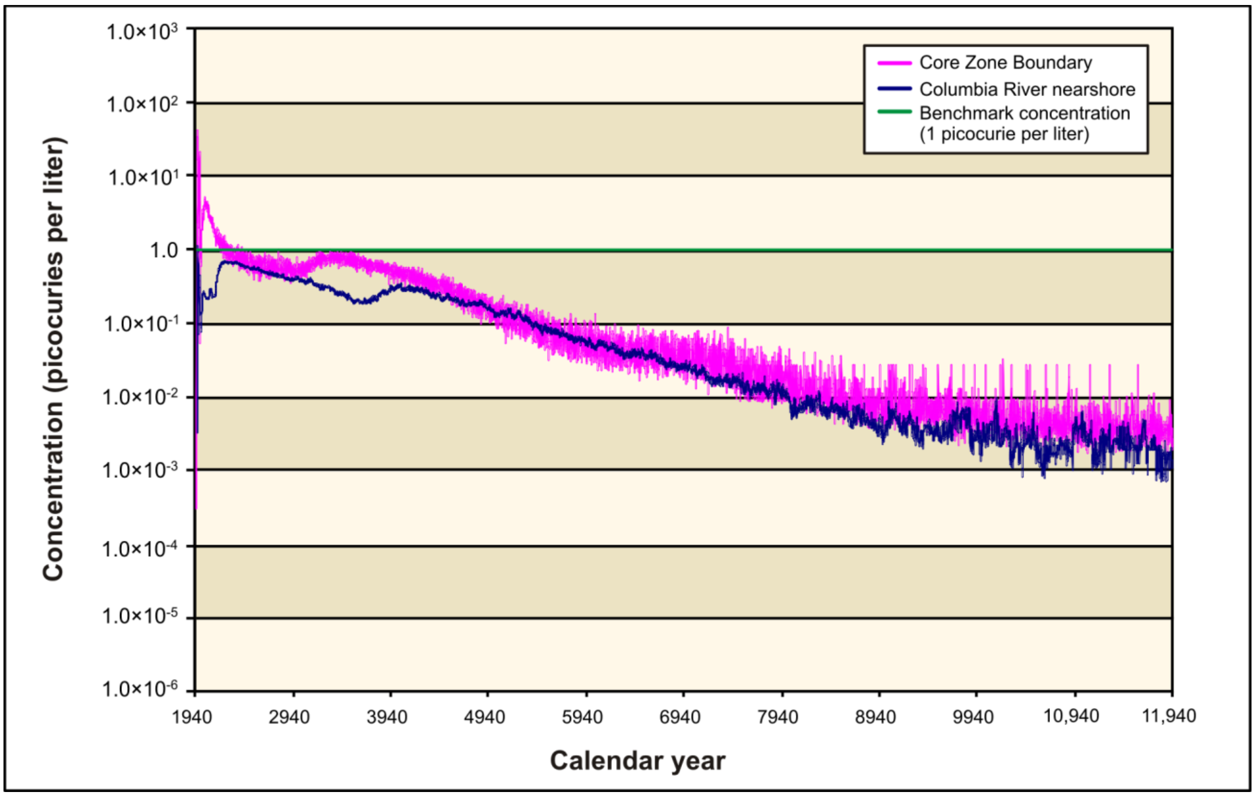

Figure 25. Tank Closure Alternative 2B Iodine-129 Concentration Versus Time (Results from Reanalysis)

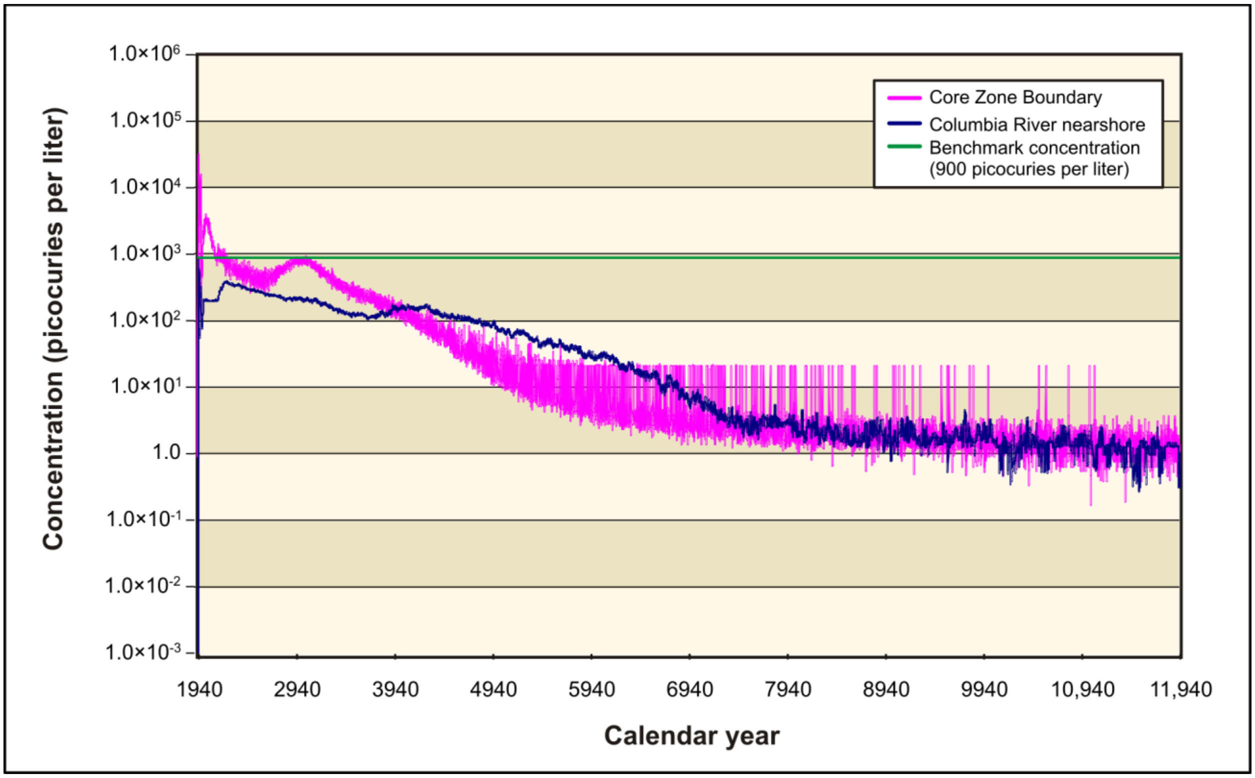

Figure 26. Tank Closure Alternative 2B Technetium-99 Concentration Versus Time (Results from Reanalysis)

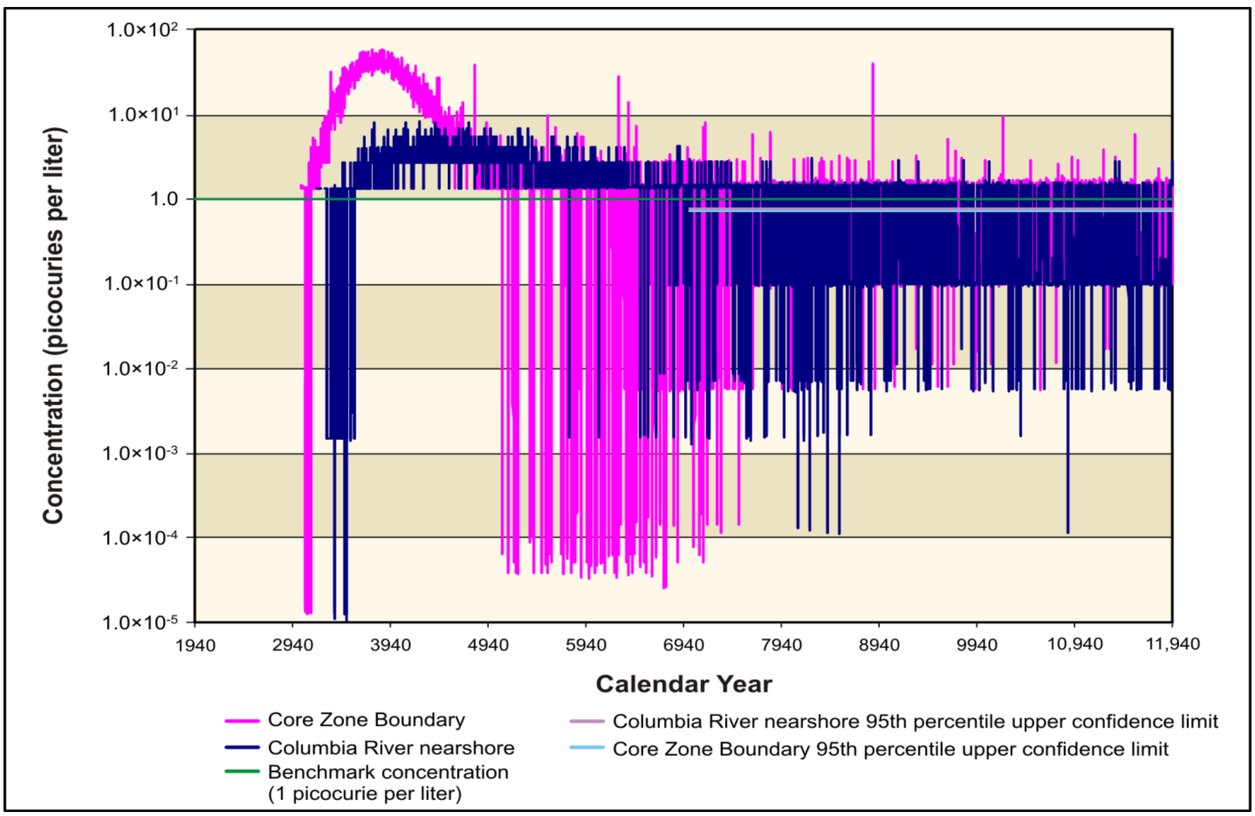

Figure 27. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time (Results from *Draft TC & WM EIS*)

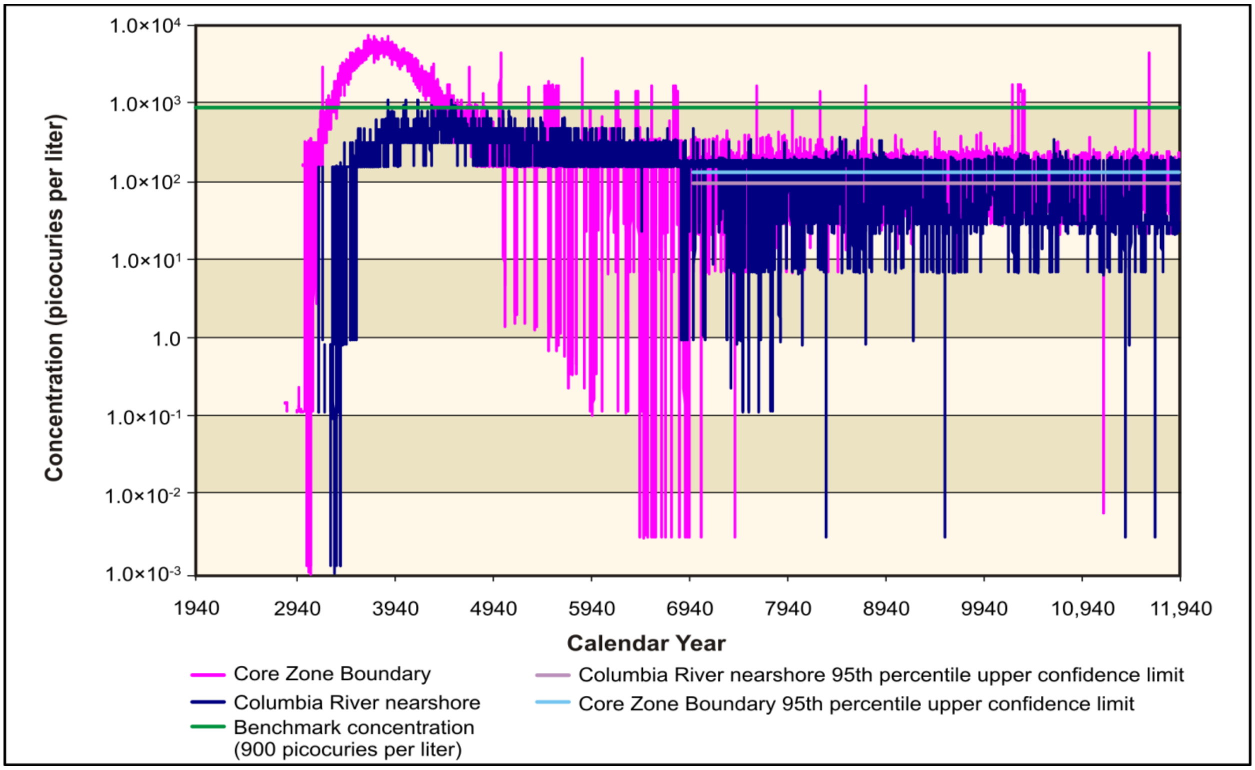

Figure 28. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time (Results from *Draft TC & WM EIS*)

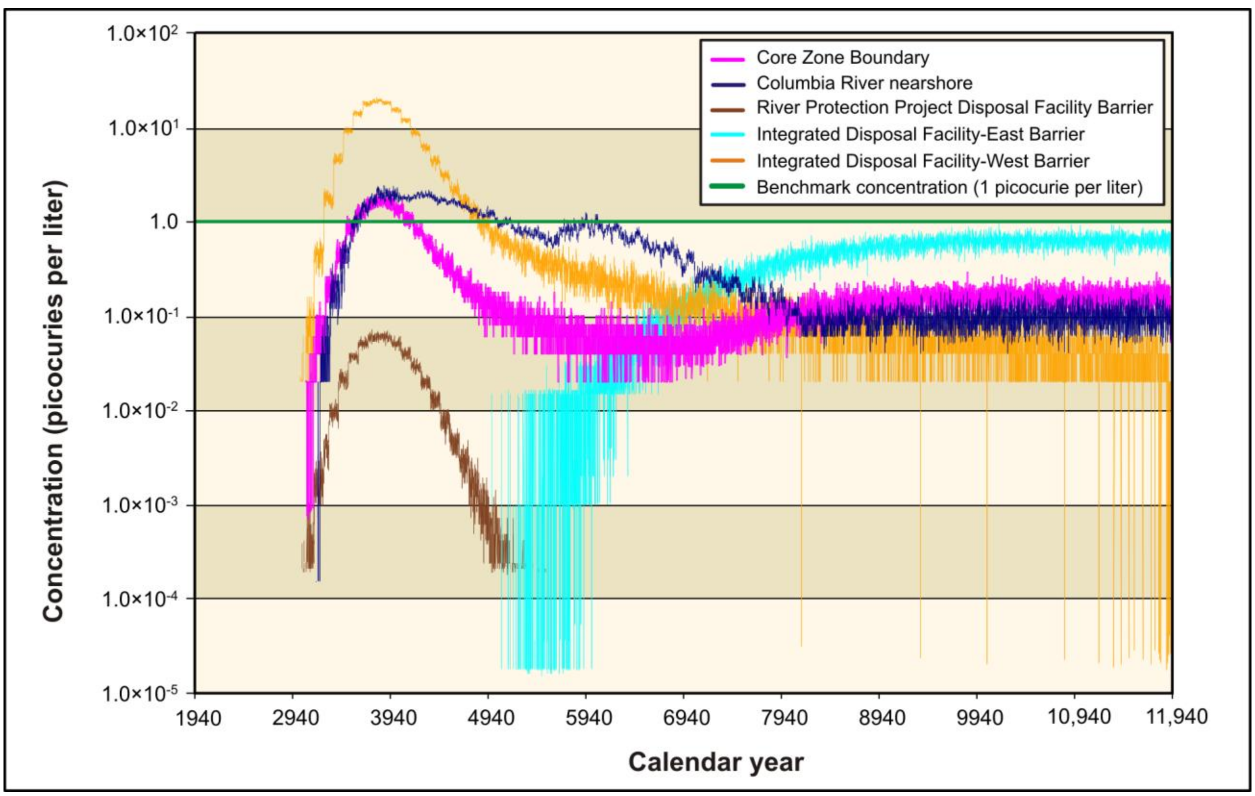

Figure 29. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time (Results from Reanalysis)

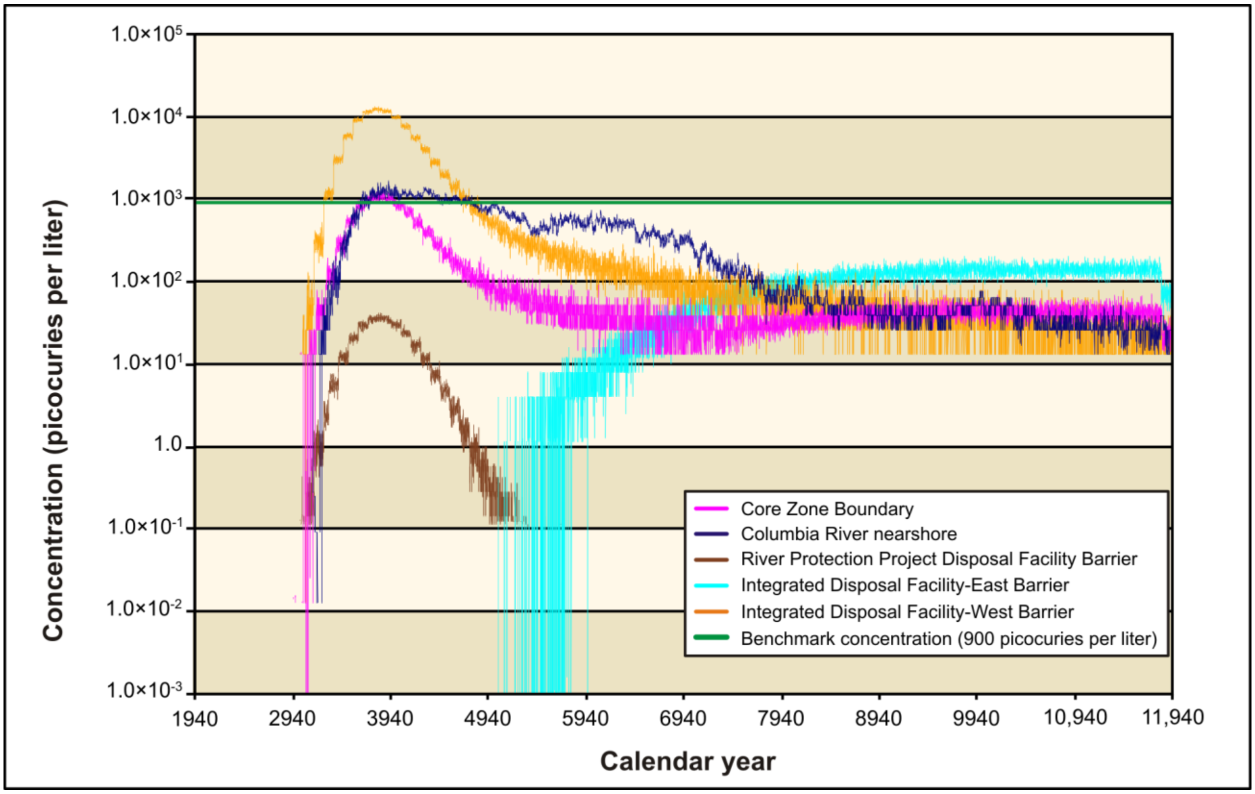

Figure 30. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time (Results from Reanalysis)

Discussion: There are no changes to the proposed action(s). Results of the reanalysis do not change the relative comparison of the impacts of the proposed actions at the barriers, the Core Zone Boundary, or the Columbia River nearshore. In addition, the new information does not change the relationship of the impacts of the proposed actions with respect to benchmark concentrations; all of the Tank Closure alternatives continue to show exceedances (i.e., greater than two orders of magnitude) during the operational period, consistent with historical observations, as well as varying degrees and durations of exceedances for future times, consistent with expected outcomes for various retrieval and closure scenarios. \\

(14) Revised assumed inhalation rate

Description: In the *Draft TC & WM EIS*, the air inhalation rate used for analyzing impacts on the public during normal operations due to atmospheric releases of radioactive materials for all the alternatives was assumed to be 20 cubic meters (706 cubic feet) per day. However, the inhalation rate assumed for the long-term impacts analysis in the draft EIS was 23 cubic meters (812 cubic feet) per day, or 8,400 cubic meters (296,646 cubic feet) per year. DOE has corrected this inconsistency, using the same air inhalation rate for both short- and long-term impact analyses, i.e., 23 cubic meters (812 cubic feet) per day (Beyeler et al. 1999) in the reanalysis for all the alternatives. This increase of 15 percent (from 20 to 23 cubic meters [706 to 812 cubic feet] per day) was applied across all the alternatives.

Comparative Analysis: As expected, a comparison of the air analysis results found that the differences in population doses and calculated latent cancer fatalities between the draft EIS and the reanalysis are linear to the 15 percent increase in inhalation rate and that the dose to the MEI in the year of maximum impact from the three emission source locations due to the increased assumed inhalation rate remains below the annual dose limit to an individual member of the public of 10 millirem per year ("National Emission Standards for Hazardous Air

Pollutants" [40 CFR 61, Subpart H]). The maximum dose to the MEI in the reanalysis due to the increased inhalation rate is estimated to be 2.0 millirem per year under Tank Closure Alternatives 2B and 6B, Base and Option Cases.

Discussion: Further review found that the relative conclusions about the alternatives are unchanged. While there is a change to the inhalation rate for estimating impacts on the general public and as a result of hypothetical accidents, the absolute changes to impacts would be minimal and the change to all *TC & WM EIS* alternatives is the same.

4.0 CONCLUSIONS

In accordance with CEQ regulations (40 CFR 1502.9(c)) and DOE regulations (10 CFR 1021.314(c)), this SA evaluates information previously presented in the *Draft TC & WM EIS* that has been updated, modified, or expanded to determine whether a supplement to the draft EIS is warranted. Table 6 lists the 14 topical areas reviewed and provides a summary discussion of each topic.

Revisions include changes to contaminant inventories, corrections to estimates, updates to characterization data, and new information that was not available at the time of publication of the *Draft TC & WM EIS*. When reanalyzed, the modified inventories do not change the key environmental findings presented in the draft EIS. That is, they do not present significant new circumstances or information relevant to environmental concerns and bearing on the proposed action(s) and their impacts. Similarly, changes to some of the parameters used in the alternatives analysis (e.g., increases in the inhalation rate used for calculation, changes to barrier locations for human health risk reporting, and changes in assumptions used for analytical purposes) do not significantly affect the potential environmental impacts of the alternatives on an absolute or relative basis, whether the changes are considered individually or collectively. These are not substantial changes in the proposed action(s) that are relevant to environmental concerns.

Table 6. Summary of Discussion by Review Topic

Review Topic	Review Topic Number	Discussion	Supplement Analysis Section
Cumulative Impacts Analysis Inventory			
T Plant inventory correction	1	Corrections have no discernible effects on cumulative impacts analysis relevant to environmental concerns and bearing on the proposed action(s) or impacts.	3.1
Magnesium/mercury inventory corrections for Z Area cribs and trenches (ditches)	2	Corrections have no discernible effects on cumulative impacts analysis relevant to environmental concerns and bearing on the proposed action(s) or impacts.	3.1
Addition of inventories for GTCC LLW and GTCC-like LLW	3	Inclusion of GTCC LLW and GTCC-like LLW inventory has no discernible effects on cumulative impacts analysis relevant to environmental concerns and bearing on the proposed action(s) or impacts.	3.1
ERDF inventory update	4	ERDF, with the inventory corrections, remains an insignificant contributor to the estimated concentrations of technetium-99 and iodine-129 at the Core Zone Boundary and Columbia River nearshore. Corrections have no discernible effects on cumulative impacts analysis relevant to environmental concerns and bearing on the proposed action(s) or impacts.	3.1
Carbon tetrachloride inventory sensitivity analysis	5	The reanalysis, at DOE's planned level of 95 percent removal, results in a reduction in the concentration below the benchmark standard in less than 100 years following active treatment, which is consistent with the 200-ZP-1 Operable Unit ROD at both the Core Zone Boundary and the Columbia River nearshore. Carbon tetrachloride is not a COPC that is related to any of the action alternatives, and the results have no bearing on the comparative analysis of the EIS alternatives, either from a cumulative impacts standpoint or individually.	3.1
300 Area Process Trenches inventory corrections	6	Deletion of plutonium inventories for the three waste sites has no discernible effects on cumulative impacts analysis relevant to environmental concerns and bearing on the proposed action(s) or impacts.	3.1
Changes to Alternatives Analyses			
Unplanned-releases inventory modifications	7	Inventory changes resulted in a net decrease (except for hydrogen-3 [tritium] and mercury) and have no discernible effects on the alternatives analyses relevant to environmental concerns and bearing on the proposed action(s).	3.2
IHLW Interim Storage Facility	8	Minimal changes to required resources and short-term impacts; no changes to long-term or human health effects relative to the impacts in the draft EIS due to additional storage modules under Tank Closure Alternatives 2A, 2B, and 6C.	3.2
Steam Reforming Facility waste form performance	9	Groundwater concentration results are approximately an order of magnitude lower; however, conclusions remain the same in the reanalysis as in the *Draft TC & WM EIS*; estimated concentrations at the IDF-East barrier exceed benchmark concentrations, and additional mitigation measures may be necessary.	3.2

Table 6. Summary of Discussion by Review Topic (*continued*)

Review Topic	Review Topic Number	Discussion	Supplement Analysis Section
Offsite waste inventory and waste acceptance criteria	10	Exclusion of one offsite waste stream represents an example of how waste acceptance criteria could be applied at a disposal facility, but is not a change to the proposed action(s).	3.2
Steam Reforming Facility iodine-129 air emissions	11	Minor changes to one alternative (Tank Closure Alternative 3C) that result in increases in total dose to the public and the maximally exposed individual but only 0.03 percent increase in lifetime risk of a latent cancer fatality. The relative ranking of Tank Closure Alternative 3C with other Tank Closure alternatives is unchanged.	3.2
Groundwater B Barrier and Core Zone reporting	12	Reanalysis and reporting do not change relative to the ranking of impacts of alternatives at the B Barrier and Core Zone Boundary nor to the relationship of impacts of the alternatives with respect to benchmark concentrations. Results remain the same in the reanalysis as in the *Draft TC & WM EIS*: estimated concentrations at the B Barrier and Core Zone Boundary have exceeded benchmark concentrations and additional mitigation measures may be necessary.	3.2
Groundwater analytical methodology: aggregation of individual sources	13	Information on long-term groundwater impacts is presented, with results more clearly differentiating outcomes. No changes to relative ranking of impacts for alternatives at the barriers or Columbia River nearshore, and no changes to relationship of impacts of the actions with respect to benchmark concentrations.	3.2
Revised assumed inhalation rate	14	Correction to short-term analysis inhalation rate has a minimal impact and is the same for all *TC & WM EIS* alternatives. Conclusions concerning alternatives are unchanged relative to the draft EIS conclusions.	3.2

Key: COPC=constituent of potential concern; DOE=U.S. Department of Energy; EIS=environmental impact statement; ERDF=Environmental Restoration Disposal Facility; GTCC=greater-than-Class C; IDF-East=200-East Area Integrated Disposal Facility; IHLW=immobilized high-level radioactive waste; LLW=low-level radioactive waste; ROD=Record of Decision; *TC & WM EIS=Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*.

5.0 DETERMINATION

Based on the analyses in this SA, DOE concludes that the updated, modified, or expanded information developed subsequent to the publication of the *Draft TC & WM EIS* does not constitute significant new circumstances or information relevant to environmental concerns and bearing on the proposed action(s) in the *Draft TC & WM EIS* or their impacts. In addition, DOE has not made substantial changes in the proposed action(s) that are relevant to environmental concerns. Therefore, in accordance with CEQ regulations (40 CFR 1502.9(c)) and DOE regulations (10 CFR 1021.314(c)), I have determined that a supplemental or new *Draft TC & WM EIS* is not required.

David Huizenga Date: 2/8/12

David Huizenga
Acting Assistant Secretary for
Environmental Management (EM-1)

6.0 REFERENCES

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.

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.

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.

DOE (U.S. Department of Energy), 2004, *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington*, DOE/EIS-0286F, Richland Operations Office, Richland, Washington, January.

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 (U.S. Department of Energy), 2009, *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391, Office of River Protection, Richland, Washington, October.

DOE (U.S. Department of Energy), 2010, *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), 2011, *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*, DOE/EIS-0375D, Office of Environmental Management, Washington, D.C., February.

EPA (U.S. Environmental Protection Agency), 1995, *EPA Superfund Record of Decision: Hanford 200-Area (USDOE), 200-ZP-1 Operable Unit*, EPA/ROD/R10-95/114, Seattle, Washington, May 24.

EPA (U.S. Environmental Protection Agency), 2008, *Record of Decision, Hanford 200 Area, 200-ZP-1 Superfund Site, Benton County, Washington*, Seattle Washington, September 30.

Hartman, M.J., and W.D. Webber, eds., 2008, *Hanford Site Groundwater Monitoring for Fiscal Year 2007*, DOE/RL-2008-01, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington, March.

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.

Teal, J.A., 2007, *Characterization Information for the 216-Z-9 Crib at the Plutonium Finishing Plant*, HNF-31792, Fluor Hanford, Inc., Richland, Washington, March.

Code of Federal Regulations

10 CFR 1021.314(c), U.S. Department of Energy, "National Environmental Policy Act Implementing Procedures: Supplemental Environmental Impact Statements."

40 CFR 61.90–61.97, U.S. Environmental Protection Agency, "National Emission Standards for Hazardous Air Pollutants," Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities."

40 CFR 1502.9(c), Council on Environmental Quality, "Environmental Impact Statement, Draft, Final, and Supplemental Statements."

40 CFR 1502.14(d), Council on Environmental Quality, "Environmental Impact Statement: Alternatives Including the Proposed Action."

Federal Register

69 FR 39449, U.S. Department of Energy, 2004, "Record of Decision for the Solid Waste Program, Hanford Site, Richland, Washington: Storage and Treatment of Low-Level Waste and Mixed Low-Level Waste; Disposal of Low-Level Waste and Mixed Low-Level Waste, and Storage, Processing, and Certification of Transuranic Waste for Shipment to the Waste Isolation Pilot Plant," June 30.

74 FR 56194, U.S. Environmental Protection Agency, 2009, "Environmental Impact Statements; Notice of Availability," October 30.

74 FR 67189, U.S. Department of Energy, 2009, "Notice of Modifications to the Preferred Alternatives for Tank Waste Treatment and Disposal of Off Site Waste in the *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, WA*," December 18.

United States Code

42 U.S.C. 4321 et seq., National Environmental Policy Act of 1969.