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DOE/OR/01-1750&D4

Record of Decision for the Phase I Activities in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

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Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900 BA-YT001U

Prepared for the
U.S. Department of Energy
Office of Environmental Management

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Oak Ridge Y-12 Plant Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U.S. DEPARTMENT OF ENERGY

PREFACE

This *Record of Decision for the Phase I Activities in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1750&D4) was prepared in accordance with requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by (SARA) [42 *United States Code* Sect. 9601 et seq.], and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 *Code of Federal Regulations* (CFR) 300] to present the public with the selected remedy for Phase I activities for protecting human health and the environment from contaminated media within the Bear Creek Valley, west of the Oak Ridge Y-12 Plant. This work was performed under Work Breakdown Structure 1.4.12.1.1.02 (Activity Data Sheet 2302, "Bear Creek Valley"). This record of decision documents the selected remedy agreed on by the U.S. Department of Energy, the Tennessee Department of Environment and Conservation, and the U.S. Environmental Protection Agency. This document summarizes and relies on information from the remedial investigation (DOE/OR/01-1455&D2)/feasibility study (DOE/OR/02-1525&D2) and proposed plan (DOE/OR/02-1647&D3) and the Focused Analysis of Alternatives for Phase I Remedial Actions at S-3 Site Pathway 3 and the Boneyard/Burnyard in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee (Focused Analysis).

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ACRONYMS

ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
COC	constituents of concern
DARA	disposal area remedial action
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EUWG	End Use Working Group
FFA	Federal Facility Agreement
FR	Federal Register
FS	feasibility study
HI	Hazard Index
LDR	land disposal restrictions
LOC	Local Oversight Committee
MCL	maximum contaminant level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act of 1969
NT	north tributary
O&M	operation and maintenance
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyls
ppm	parts per million
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act of 1976
RER	Remediation Effectiveness Report
RI	remedial investigation
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SSAB	Site-Specific Advisory Board
TBC	to be considered
TDEC	Tennessee Department of Environment and Conservation
VOC	volatile organic compound

PART 1. DECLARATION

SITE NAME AND LOCATION

U.S. Department of Energy
Oak Ridge Reservation
Bear Creek Valley at the Y-12 Plant
Oak Ridge, Tennessee
CERCLIS ID # 0404152

STATEMENT OF BASIS AND PURPOSE

This record of decision (ROD) presents the selected remedy for certain waste areas. These areas are Boneyard/Burnyard, Hazardous Chemical Disposal Area, S-3 Ponds Pathway 3, Disposal Area Remedial Action (DARA) Solids Storage Area, and the Oil Landfarm Soil Containment Pad in Bear Creek Valley on the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) (see Figure 2.2, page 2-5). The selected remedial activities are expected to significantly reduce the release of contaminants from these waste areas into Bear Creek and its tributaries and to mitigate ecological and human health hazards from contaminated media within the Bear Creek Valley watershed.

This collection of actions for Bear Creek Valley was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) [42 *United States Code* Sect. 9601 et seq.], and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 *Code of Federal Regulations* (CFR) 300]. The Federal Facility Agreement (FFA) was developed to integrate the requirements of CERCLA and the Resource Conservation and Recovery Act of 1976 (RCRA) and to provide a legal framework for remediation activities at ORR. This integrated approach fulfills the requirements for preparing decision documents under CERCLA and RCRA. In addition, the National Environmental Policy Act of 1969 (NEPA) values have been incorporated into the decision documents prepared for this project per the DOE Secretarial Policy Statement on NEPA (DOE 1994). This policy states that DOE will rely on the CERCLA process for review of actions taken under CERCLA and will address and incorporate NEPA values in CERCLA evaluations to the extent practicable. This includes evaluating remedial alternatives against the criteria established in NEPA. Opportunities for public involvement under CERCLA also provide opportunities for public involvement under NEPA because of this integration.

Remediation measures presented in this ROD are intended to address environmental hazards emanating from certain identified waste units in the Bear Creek Valley Watershed. While additional measures (beyond those presented in this ROD) will be necessary to complete remediation activities in the watershed, implementation of the remedial measures in this ROD will considerably improve environmental conditions, particularly current surface water and groundwater contamination problems. These measures, structured around achieving initial remediation goals for groundwater and final goals for surface water and soil media, include selected source control and migration control strategies that reduce contaminant migration in shallow groundwater and surface water. These actions will result in a reduction of contamination levels in groundwater and surface water downstream of the waste areas over time.

Implementation of these measures is expected to result in meeting applicable ambient water quality criteria (AWQC) for protection of surface water resources throughout Bear Creek and its tributaries within 5 years after implementation. All surface hazards posed by contaminated soils and waste disposal areas are expected to be eliminated immediately after implementation of required field construction activities and land use restrictions. These measures are also expected to reduce the concentration of uranium in Bear Creek to levels that would not exceed an incremental human health risk of 1×10^{-5} to a hypothetical future resident outside the boundary of the restricted industrial use area. In order to attain this risk limit, the uranium flux in Bear Creek would be controlled to not exceed approximately 34 kg/yr at the integration point. Finally, these measures will control potential hazards associated with land use in Bear Creek Valley by excavating primary source areas, installing long term clay caps, and by identifying necessary restrictions on land and groundwater use in the Bear Creek Valley watershed. More detailed identification of Phase I cleanup standards and the expected time frames required to meet these standards are provided in subsequent sections of this ROD.

Because this remedy will result in hazardous constituents remaining on site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

The basis for this decision can be found in the Administrative Record for Bear Creek Valley, including the remedial investigation (RI) (DOE 1997a), the feasibility study (FS) (DOE 1997b), and

the proposed plan (DOE 1998a) and focused analysis (DOE 2000). In addition, DOE has considered all comments received on the proposed plan in preparing this ROD.

DOE is the lead agency for this action. The U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC) are support agencies as parties to the ORR FFA for this action. They adopt the selected remedy pursuant to FFA Section XIV.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances to the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy addresses the principal threats to human health and the environment in Bear Creek Valley associated with the Boneyard/Burnyard; shallow groundwater emanating from the S-3 Ponds Site, specifically Pathway 3; and contaminated soil and debris in several waste units (i.e., Oil Landfarm Soil Storage Facility and DARA Solids Storage Facility). Remedial decisions for waste units in the Bear Creek Burial Grounds and final remediation goals for both groundwater and S-3 Site Pathways 1 and 2 will be addressed in future CERCLA decisions. All parties will agree on a schedule for future CERCLA decision documents.

The major components of the selected remedy are as follows:

- Primary source areas (high-uranium-content material in a leachable form and in contact with groundwater) at the Boneyard/Burnyard will be excavated for disposal. The volume of materials to be excavated at the Boneyard/Burnyard is estimated at approximately 36,000 yd^3. Excavated materials that meet the waste acceptance criteria of the ORR on-site disposal facility will be disposed of at that facility, while materials that exceed these criteria will be sent to a DOE-approved and EPA-permitted off-site disposal facility.

- The remainder of the Boneyard/Burnyard site will be hydraulically isolated. Hydraulic isolation will include consolidation of lower level contaminated material that is not in contact with

groundwater and covering with a clay cap, reconstructing North Tributary (NT)-3 to eliminate recharge from the channel to shallow groundwater and to encourage more efficient conveyance of water through the area, eliminating a man-made stagnation point in the channel of NT-3 at the northwest end of the site, and installing any drains or well points that may be needed to dewater the site.

- Shallow groundwater contamination at the S-3 Site Pathway 3 will be intercepted and treated before entering Bear Creek and its tributaries using a passive in-situ reactive barrier [a trench employing reactive media (iron filings)].

- Soil stored at the DARA Solids Storage Facility and Oil Landfarm Soils Containment Pad will be removed for off-site commercial disposal, and the DARA and Oil Landfarm storage facilities will be decontaminated and dismantled. The volumes of waste stored at these facilities are estimated at approximately 4000 yd^3 and 570 yd^3, respectively.

- Surface water and groundwater monitoring at the existing network of sampling locations will be implemented, and surveillance and maintenance activities in Bear Creek Valley will be continued. Surface water and groundwater samples will be monitored to evaluate reductions in contaminant concentrations and flux in accordance with remedial action objectives (RAOs). Detailed specifications of environmental monitoring requirements to evaluate performance of the selected remedial measures in attaining RAOs will be documented in subsequent remedial action design documents, work plans, and remedial action reports, submitted as required under the FFA. Following implementation of the remedial action, monitoring and enforcement of use restrictions on groundwater and surface water will be conducted as part of the Y-12 Plant site-wide surveillance and maintenance and water quality programs pending the completion of future CERCLA decisions.

- Current use restrictions in Bear Creek Valley (i.e., controlled industrial land use in Zone 3 and access restrictions in Zones 1 and 2) will be maintained, and together with any additional restrictions which may be needed to achieve the following land use control objectives, are being selected as part of this remedy. The land use control objectives necessary to ensure the protectiveness of the selected remedy prevent unauthorized contact, removal, or excavation of buried waste in the Bear Creek Valley; preclude residential use in Zones 2 and 3; and prevent

unauthorized access to contaminated groundwater in Bear Creek Valley. In accordance with a Memorandum of Understanding (DOE 1999) for Implementation of a Land Use Controls Assurance Plan entered by DOE, TDEC, and EPA, a plan implementing the restrictions needed to achieve these land use control objectives will be developed as an appendix to the final Remedial Design Work Plan.

This remedy will address two significant contributors to contamination in Bear Creek Valley: the Boneyard/Burnyard and the S-3 Site Pathway 3. The selected remedy addresses the principal threats to human health and the environment at these sites by excavation and permanent disposal of the primary source areas at the Boneyard/Burnyard and interception and treatment of shallow groundwater migrating from the S-3 Site Pathway 3. Residual materials that pose lower long-term threats will be contained on site through appropriate hydraulic isolation measures.

These actions provide a significant step toward remediating Bear Creek Valley. Remediation goals, once met, could allow a combination of potential land uses, including controlled industrial use, recreational use, and unrestricted use. Land uses achieved by this action are consistent with public input, including the recommendations of the End Use Working Group (EUWG) of the Site-Specific Advisory Board (SSAB).

A primary goal for this selected remedy is to reduce uranium concentrations in surface water at the boundary of the restricted industrial use area to levels that would not exceed an incremental human health risk of 1×10^{-5} at that location, based on residential use outside the restricted industrial area; control potential hazards to personnel within the restricted industrial use area (Zone 3) through removal of primary source areas, installation of clay caps, and implementation of necessary restrictions on land and groundwater use; and attain applicable AWQC for protection of surface water resources throughout Bear Creek and its tributaries within 5 years after implementation. Remedy decisions for Bear Creek Burial Grounds and final remediation goals for groundwater will be addressed in future CERCLA decision documents.

The selected remedy fits into the overall DOE-ORR cleanup strategy by removing and disposing of contaminated media to the extent practicable. The action is also consistent with the ORR EUWG *Community Guidelines for End Uses of Contaminated Properties* (DOE 1997c).

Hazardous substances above health-based levels will remain in Bear Creek Valley if this remedy is implemented. Because hazardous substances are to remain at the site, it is recognized by DOE, TDEC, and EPA that Natural Resource Damage claims, in accordance with CERCLA, may be applicable. This document does not address restoration or rehabilitation of any natural resource injuries that may have occurred at the site, nor whether such injuries have occurred. In the interim, neither DOE nor TDEC waives any rights or defenses they may have under CERCLA section 107(a)4(c).

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and uses permanent solutions and alternative treatment (or resource recovery) to the maximum extent practicable. The selected remedy also satisfies the statutory preference for treatment as a principal element of the remedy. Because this remedy will result in hazardous constituents remaining on site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this site.

- Baseline risk. (page 2-14)
- Cleanup levels and the basis for these levels. (Table 2.22)
- How source materials constituting principal threats are addressed. (page 2-56)
- Current and reasonably anticipated future land use assumptions used in the baseline risk assessment and ROD. (Table 2.1)
- Potential land use that will be available at the site as a result of the Selected Remedy. (Table 2.22)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected. (Table 2.20)
- Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision). (page 2-29)

RECORD OF DECISION FOR THE PHASE I ACTIVITIES IN BEAR CREEK VALLEY AT THE OAK RIDGE Y-12 PLANT, OAK RIDGE, TENNESSEE

Rodney R. Nelson, Assistant Manager
U.S. Department of Energy
Oak Ridge Field Office

6/9/00
Date

Earl C. Leming, Director
U.S. Department of Energy Oversight Division
Tennessee Department of Environment and Conservation

6/12/00
Date

Richard D. Green, Director
Waste Management Division
U.S. Environmental Protection Agency–Region IV

6/16/00
Date

PART 2. DECISION SUMMARY

SITE NAME, LOCATION, AND DESCRIPTION

The 34,516-acre ORR is located within and adjacent to the corporate limits of the city of Oak Ridge, Tennessee, in Roane and Anderson counties (Fig. 2.1). Oak Ridge is located approximately 12.5 miles west-northwest of Knoxville, 12 miles southwest of Clinton, and 10 miles northeast of Kingston. ORR is bounded to the east, south, and west by the Clinch River (Melton Hill Lake) and by the developed portion of the city of Oak Ridge. ORR hosts three major industrial research and production facilities originally constructed as part of the World War II-era Manhattan Project: the East Tennessee Technology Park (formerly the K-25 Site), Oak Ridge National Laboratory (formerly X-10), and the Y-12 Plant.

Bear Creek Valley is approximately 10 miles long and extends from the eastern end of the Y-12 Plant to the Clinch River on the west. This ROD for Bear Creek Valley focuses on that portion of the valley that constitutes the watershed of Bear Creek, extending from the western boundary of the Y-12 Plant to just west of state Highway 95. Auxiliary facilities, including many of the former waste disposal areas for the plant, are in the Bear Creek watershed (Fig. 2.2). The former waste disposal areas contain large volumes (> 500,000 yd^3) of contaminated soil and buried solid waste. Several contaminants have been identified in soil, surface water, and groundwater in the Bear Creek watershed. Contaminants include radionuclides and metals in soil, and uranium, nitrate, and volatile organic compounds (VOCs) in groundwater and surface water. Much of the contamination, particularly in soil and somewhat less in groundwater, is contained within or near the boundaries of the waste disposal areas, but concentrations of contaminants associated with unacceptable risk have migrated into downgradient media. Leaching of contaminants to shallow groundwater and their subsequent migration to surface water is the principal exit pathway from the source areas of contamination.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

SITE HISTORY

The Y-12 Plant was built in 1943 as part of the Manhattan Project to separate uranium isotopes using the electromagnetic process. When the process was discontinued after World War II, the role of the Y-12 Plant changed to manufacturing and developmental engineering. Since that time, the plant has been responsible for producing nuclear weapon components and subassemblies, developing and fabricating

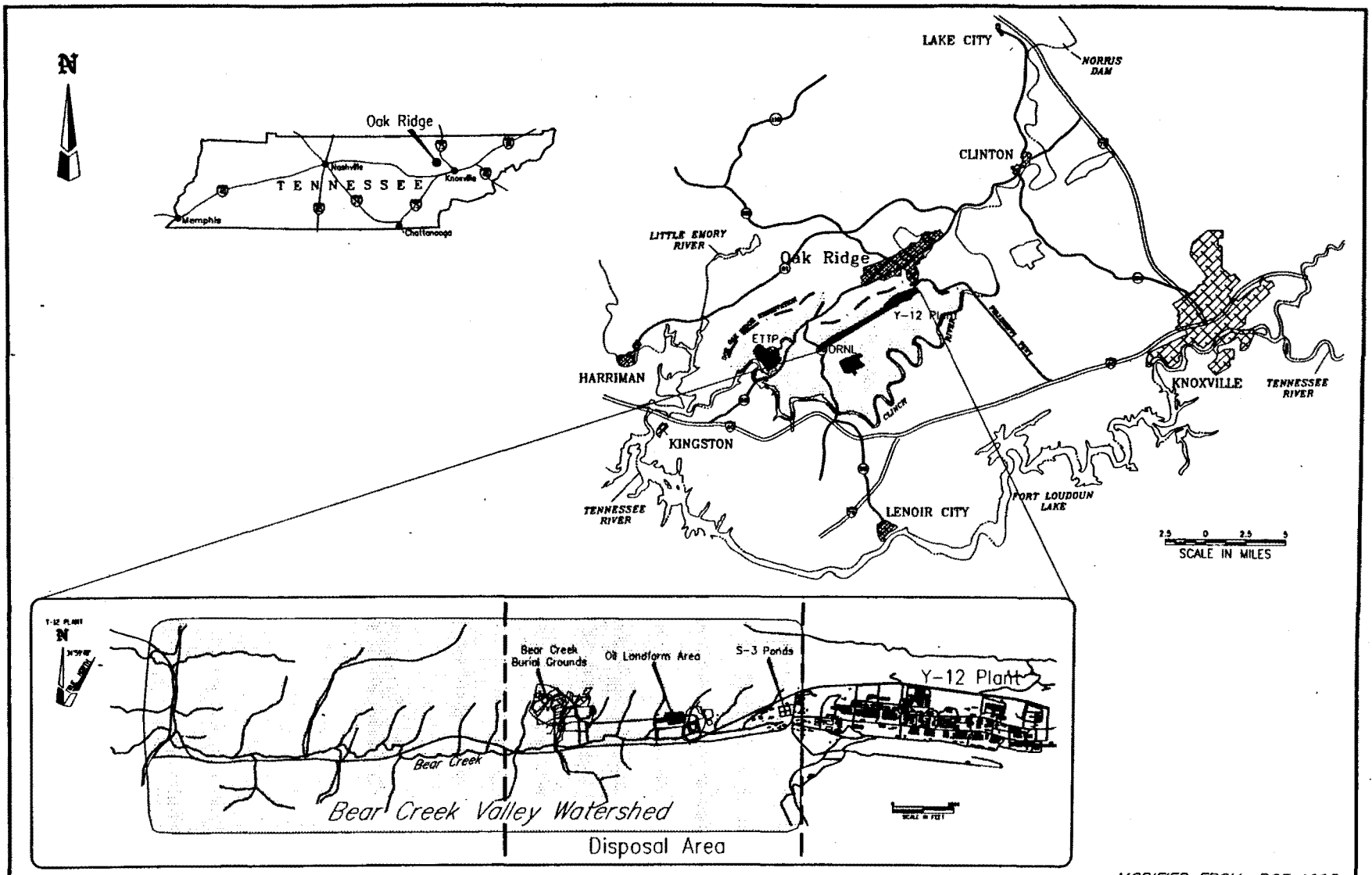


Fig. 2.1	DOE Oak Ridge Reservation and vicinity DOE – Y-12 Plant, Bear Creek Valley – Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0005/70 / ROD	DRAWING ID: 98-16523.DWG	DRAWING DATE: NOVEMBER 11, 1998 SB

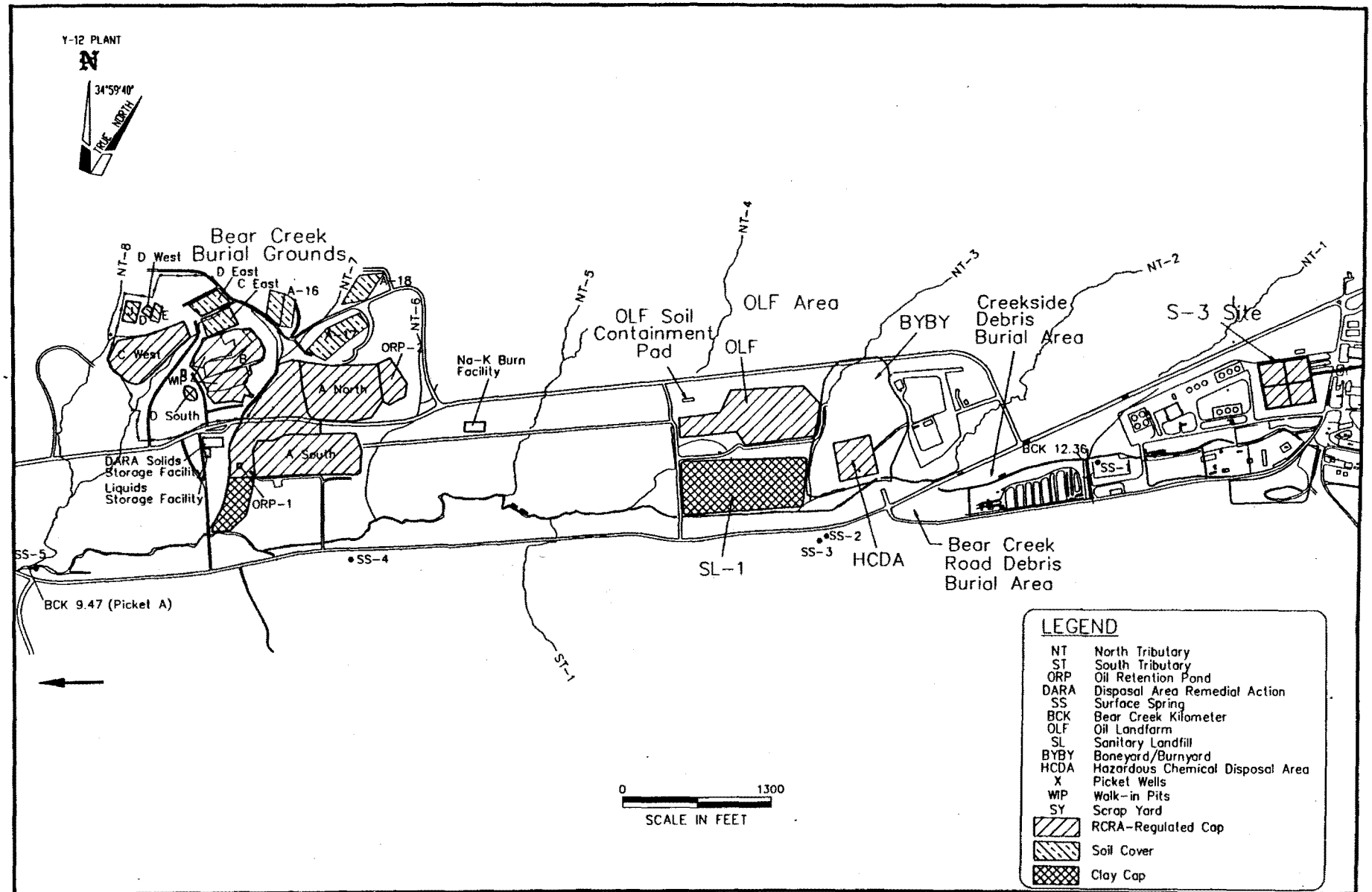


Fig. 2.2	Waste sites in Bear Creek Valley DOE – Y-12 Plant, Bear Creek Valley – Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0005-70 / ROD	DRAWING ID: 98-16524.DWG	DRAWING DATE: NOVEMBER 11, 1998 SB

test hardware for the weapon design laboratories, and providing support to other DOE facilities and to federal agencies. The Y-12 Plant is now engaged in the production of nuclear weapon components, technology development, and weapons disassembly.

A 2-mile section of Bear Creek Valley west of the Y-12 Plant contains three former waste disposal areas used by the plant to dispose of radiological contaminated and nonradiological contaminated wastes, generated primarily by Y-12 Plant operations (Fig. 2.2): (1) the S-3 Site, including the S-3 Ponds; (2) the Oil Landfarm Area, including Oil Landfarm, Sanitary Landfill-1, the Boneyard/Burnyard, Hazardous Chemicals Disposal Area, and the Oil Landfarm Soils Containment Pad; and (3) the Bear Creek Burial Grounds, including numerous disposal pits and the DARA Solids Storage Facility. None of the sites are currently active, and all have either been capped with an engineered cap or have a soil cover. A leachate collection system has been installed at the Bear Creek Burial Grounds to collect leachate at several seeps that have subsequently developed.

S-3 Site

The S-3 Site, adjacent to the west end of the Y-12 Plant, consists of four unlined ponds formerly used for managing liquid waste. Constructed in 1951, the ponds received various liquid wastes from the Y-12 Plant until 1983. In 1983, waste waters in the pond were treated through biodenitrification processes, leaving a 2- to 5-ft-thick sludge layer on the bottom of the ponds. The S-3 Ponds were closed under RCRA in 1988 by stabilizing the ponds and placing a RCRA multilayer cap over the area and covering it with asphalt, thus creating a parking lot.

Oil Landfarm Area

Boneyard/Burnyard. The Boneyard/Burnyard, which is located west of the S-3 Ponds and adjacent to the Oil Landfarm, consists of three sites: Boneyard (used for noncombustible materials), Burnyard (used for combustible materials), and Hazardous Chemicals Disposal Area. The Boneyard/Burnyard was one of the first areas established in Bear Creek Valley for disposal of wastes generated at the Y-12 Plant.

The Boneyard was an active waste disposal site from 1943 to 1970. Wastes include organics, metals (depleted uranium), debris, and acids; the total quantity of material is unknown. Magnesium chips were disposed of in the southwestern corner of the Boneyard by placing them in burn pans and using ignitable

solvents to initiate combustion. Residue was covered with soil and compacted. Remaining land in the Boneyard was used to dispose of construction spoil material, such as concrete and reinforcing bar.

The Burnyard, which operated in the 1960s, consisted of two unlined earthen trenches. The site received refuse from plant operations, including solids, liquids (e.g., solvents, oils, and laboratory chemicals), and sludges. Wastes were placed in the trenches and burned; other flammable liquids were used to initiate combustion. When full, trenches were covered with soil.

The Hazardous Chemicals Disposal Area received solid, liquid, and gaseous waste materials from 1975 to 1981. Material was broadly characterized as ignitable, reactive, corrosive, and/or toxic, and comprised wastes that generally posed safety hazards within the Y-12 Plant. These wastes were allowed to react in a concrete vessel, and liquid residues drained into the soil. In 1989, the entire Hazardous Chemicals Disposal Area, including the contaminated soil, was capped with a RCRA-type multilayer cap.

Oil Landfarm. The Oil Landfarm is approximately 1.5 miles west of the Y-12 Plant, north of Sanitary Landfill-1 and Bear Creek Road. It consists of a former landfarming plot used for biological degradation of approximately 1 million gal of waste oil and machine coolants from the Y-12 Plant between 1973 and 1982. Oils and coolants applied at the Oil Landfarm were contaminated with beryllium compounds, depleted uranium, polychlorinated biphenyls (PCBs), tetrachloroethene, and 1,1,1-trichloroethane. Soil contaminated with PCBs > 25 ppm was excavated and placed in the Oil Landfarm Soil Containment Pad before the Oil Landfarm was closed in 1990 by covering it with a multilayer RCRA cap.

Sanitary Landfill-1. Sanitary Landfill-1 is just north of Bear Creek and immediately south of the Oil Landfarm. It was used between 1968 and 1980 for disposal of combustible and decomposable solid wastes and debris from the Y-12 Plant. The landfill received materials such as paper and cardboard, plastics, rubber, wood, brush, animal bedding, organic garbage, textile products, and asphalt roofing materials. Although administrative controls were used to exclude disposal of toxic chemicals and other contaminated materials, it is possible that some of these materials were disposed of in the landfill. In 1985, the landfill was closed by grading to promote drainage, capping with 2 ft of clay and topsoil, and establishing a vegetative cover.

Bear Creek Burial Grounds

The Bear Creek Burial Grounds are approximately 2 miles west of the Y-12 Plant at the western border of the Bear Creek Valley waste disposal area and operated from approximately 1955 to 1993. The primary purpose of the Bear Creek Burial Grounds was the disposal of depleted uranium turnings and industrial wastes composed of or contaminated with depleted uranium from nuclear weapons production operations at the Y-12 Plant. The Bear Creek Burial Grounds consist of several principal waste disposal units designated as Bear Creek Burial Ground-A, -B, -C, -D, -E, -J, and Walk-in Pits. Each waste disposal unit consists of a series of trenches used for disposal of liquid and solid wastes. Trenches are reportedly between 14 and 25 ft deep. The Bear Creek Burial Grounds have the most heterogenous solid wastes of the Bear Creek Valley disposal sites. The Y-12 Plant also used the Bear Creek Burial Grounds to dispose of certain types of liquid industrial wastes, mop waters, waste oils, and machine coolant liquids. Bear Creek Burial Ground-B, -D, -E, and -J contain significant quantities of depleted uranium, and the Walk-in Pits contain potentially reactive and explosive wastes. Oil Retention Ponds 1 and 2 received PCB-contaminated drainage from Bear Creek Burial Ground-A North and South, respectively.

Disposal activities in the Bear Creek Burial Grounds ended in 1993. Since 1989, several sites have been closed under RCRA, including Bear Creek Burial Ground-A (with the exception of Bear Creek Burial Ground-A-16, -A-17, and -A-18), -B, -C West, and Walk-in Pits North and South. Both Oil Retention Ponds were closed and capped in 1989 under an approved RCRA closure plan. Contaminated soil excavated during closure of the Oil Retention Ponds was placed in the DARA Solids Storage Facility.

Miscellaneous Disposal Sites

Two previously unidentified waste areas in the Bear Creek floodplain were identified during RI field activities. Although no records of these areas exist, they were probably used for disposal of debris before the other disposal sites were available. These sites have been called the Creekside Debris Burial Area and Bear Creek Road Debris Burial Area. Characterization studies conducted since the completion of the RI (DOE 1998d) have indicated that these areas do not contain significant sources of contamination that could pose a risk to health or the environment.

Enforcement Activities

ORR was listed on the National Priorities List on November 21, 1989. As such, investigations and actions on the reservation, including Bear Creek Valley, are required to comply with CERCLA regulations. Remediation efforts in Bear Creek Valley are governed by the FFA among DOE, EPA-Region IV, and TDEC.

By a separate Memorandum of Understanding (DOE 1999), EPA, TDEC, and DOE have agreed to implement, facility wide, certain periodic site inspection, certification and notification procedures set forth in a Land Use Control Assurance Plan (DOE 1999). These procedures are designed to ensure maintenance by DOE of any waste unit-specific Land Use Controls set forth in this ROD and deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of the Memorandum of Understanding is that, through DOE's substantial good-faith compliance with the procedures called for in the Land Use Control Assurance Plan, reasonable assurances would be provided to EPA and TDEC as to the permanency of those remedies, which includes the use of waste unit-specific Land Use Controls at the ORR.

The terms and conditions of the Land Use Control Assurance Plan, or Memorandum of Understanding, are not specifically incorporated or made enforceable herein by reference. However, it is understood and agreed upon by DOE, EPA, and TDEC that the contemplated permanence of the remedy reflected herein is dependent in part upon DOE's substantial good-faith compliance with the specific Land Use Control maintenance commitments reflected therein. Should such compliance not occur or should the Memorandum of Understanding be terminated, it is understood that the protectiveness of the remedy concurred herein may be reconsidered; consequently, additional measures may need to be taken to ensure adequate, necessary, future protection of human health and the environment.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

DOE has sought public input regarding the remediation of Bear Creek Valley at multiple public meetings both before and after issuance of the proposed plan (DOE 1998a). DOE published a public notice of availability for the proposed plan in *The Oak Ridger*, *The Knoxville News-Sentinel*, *The Roane County News*, the *Clinton Courier News*, and other local newspapers within the region of influence. The public notice established a public comment period of June 16, 1998, to July 30, 1998. A public meeting

was held on July 13, 1998, to present the preferred alternative described in the proposed plan and solicit public input. In response to comments received at the public meeting, DOE issued supplemental information to the proposed plan and extended the public comment period to August 13, 1998. All comments on the proposed plan are identified and addressed in Part 3, "Responsiveness Summary," of this ROD.

DOE also has held regular public briefings with the SSAB, a citizen's panel that provides advice and recommendations to the DOE Environmental Management Program. The ORR EUWG, a subcommittee of SSAB, is a community-based advisory organization established in 1996 to provide recommendations on postremediation ORR land use, cleanup assumptions and goals, and beneficial reuse of portions of ORR. Input from organizations such as SSAB, Oak Ridge Environmental Peace Alliance, Local Oversight Committee (LOC), and the city of Oak Ridge, as well as members of the general public, assists DOE, EPA, and TDEC in selecting and implementing remediation programs that reflect local community values. Comments received throughout the evaluation process have influenced the approach, content, and conclusions of the CERCLA decision documents for Bear Creek Valley.

The SSAB issued the following recommendation for end uses in Bear Creek Valley: "...the EUWG recommends that Zone III lands be safely maintained under restricted use. Remediation in Zone III must reduce the migration of contamination sufficient to bring contaminants in Zone II to within acceptable levels for unrestricted use and protect Zone I for unrestricted use in perpetuity." (The locations of Zones 1, 2, and 3 are shown in Fig. 2.3.) The selected remedy presented in this ROD is consistent with these recommended end uses. Additionally, the Citizen Advisory Panel of the LOC endorsed the preferred alternative presented in the proposed plan and selected by this ROD.

Based on regulator comments received on the BCV ROD D3 in February, 2000, DOE prepared a *Focused Analysis of Alternatives for Phase I Remedial Actions at the S-3 Site Pathway 3 and the Boneyard/Burnyard in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 2000) to provide focused analysis of alternatives provided in the proposed plan. The comparative analysis completed as part of the focused analysis and discussed here has been completed on a unit basis to inform the proposed remedy selection captured in this ROD.

This ROD presents the selected remedial action for initial remediation of Bear Creek Valley. This action was chosen in accordance with CERCLA as amended by SARA and the NCP. This decision is

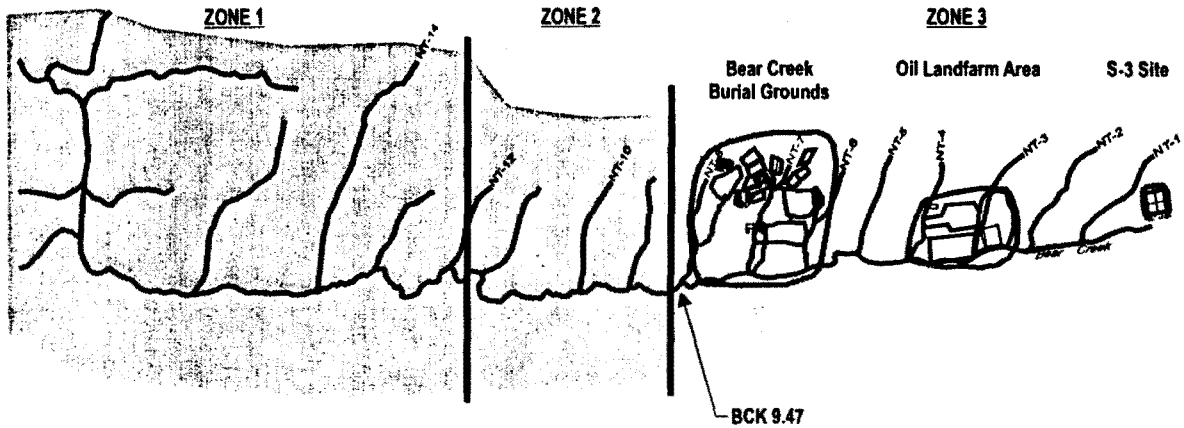


Fig. 2.3	Land use zones in Bear Creek Valley DOE - Y-12 Plant, Bear Creek Valley - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0005-70 / ROD	DRAWING ID: 98-16525.CDR-5	DRAWING DATE: NOVEMBER 11, 1998 SB

based on the Administrative Record for this project. The following are the principal documents supporting this ROD:

- Report on the Remedial Investigation of Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee (DOE 1997a);

- Feasibility Study for Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee (DOE 1997b), and the Focused Analysis; and

- Proposed Plan for Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee (DOE 1998a).

These and other documents/information considered in selecting the remedial action can be found at the Information Resource Center, 105 Broadway Avenue, Oak Ridge, Tennessee, 37830, (865) 241-4582.

SCOPE AND ROLE OF ACTION

Bear Creek Valley has a number of waste units (see Fig. 2-2). This ROD addresses certain of the waste units, while other actions are deferred (see Table 2-16, page 2-57).

Table 2.1 provides the agreed upon remediation goals for the Bear Creek Valley watershed. The specific remedial actions selected in this ROD are consistent with these goals. Although DOE is deferring remediation decisions at the Bear Creek Burial Grounds waste units, final remediation goals for both groundwater and S-3 Ponds Site Pathways 1 and 2, DOE is fully committed to completing remedial actions in the watershed to ensure the protection of human health and the environment. Final measures, including long-term institutional controls for Bear Creek Valley, will be addressed in future CERCLA decision documents.

To proceed with results-oriented, coordinated contamination control measures in Bear Creek Valley, DOE will implement control measures around specific environmental objectives. Because of the varying distribution of contaminated media and waste disposal areas within the valley, the valley has been divided into three zones based on potential future land uses (see Table 2.1 and Fig. 2.3). While the uses

Table 2.1. Groundwater and surface water goals, Bear Creek Valley Y-12 Plant, Oak Ridge, Tennessee

Area of the valley (see Fig. 2.3)	Current situation	Goal
Zone 1—western half of Bear Creek Valley	No unacceptable risk posed to a resident or a recreational user. AWQC and groundwater MCLs are not exceeded.	Maintain clean groundwater and surface water so that this area continues to be acceptable for unrestricted use. Land use: unrestricted
Zone 2—a 1-mile-wide buffer zone between Zones 1 and 3	No unacceptable risk posed to a recreational user. Risk to a resident is within the acceptable risk range except for a small area of groundwater contamination. Groundwater MCLs are exceeded, but AWQC are not.	Improve groundwater and surface water quality in this zone consistent with eventually achieving conditions compatible with unrestricted use. Land use: recreational (short-term); unrestricted (long-term)
Zone 3—eastern half of Bear Creek Valley	Contains all the disposal areas that pose considerable risk. Groundwater MCLs and AWQC are exceeded.	Conduct source control actions to (1) achieve AWQC in all surface water, (2) improve conditions in groundwater to allow Zones 1 and 2 to achieve the intended goals, and (3) reduce risk from direct contact to create conditions compatible with future industrial use. Land use: controlled industrial

AWQC = ambient water quality criteria
MCL = maximum contaminant levels

considered include unrestricted and recreational scenarios, it should be noted that DOE has no current plans for release of land within Bear Creek Valley. These land uses are consistent with recommendations from the EUWG subcommittee of the SSAB. These land uses were conservatively selected to ensure selection of a protective remedy. Using these zones, tailored remediation goals were developed for each zone. These goals can be achieved by following selected source control and migration control strategies that reduce contaminant migration in shallow groundwater and surface water leaving the disposal areas in Zone 3. These initial goals will remain in effect unless new technologies, land use requirements, regulatory requirements, or subsequent CERCLA decisions for Bear Creek Valley establish a basis for revision.

Site-specific goals for remedial actions at the S-3 Site Pathway 3 and the Boneyard/Burnyard are included in Table 2.2.

Table 2.2. Site-specific goals for remedial actions at the S-3 Site Pathway 3 and the Boneyard/Burnyard

Remedial action goals for S-3 Site Pathway 3	Remedial action goals for Boneyard/Burnyard
• Prevent expansion of the nitrate plume into Zone 1. • Reduce concentration of cadmium in NT-1 and upper Bear Creek to meet AWQC (3.9 µg/L) at Bear Creek/NT-1 confluence. • Prevent future increase in release of uranium to Bear Creek to maintain annual flux below 27.2 kg total U at BCK 12.34. • Reduce seasonal nitrate flux at NT-1/Bear Creek confluence by 40%. The seasonal nitrate flux benchmark will be defined by the FFA parties in remedial design.	• Reduce flux of uranium in NT-3 at confluence with Bear Creek to 4.3 kg/yr. • Reduce concentration of mercury in NT-3 to meet AWQC (12 ng/L).

SUMMARY OF SITE CHARACTERISTICS AND RISKS

For the past several years, DOE, in coordination with TDEC and EPA, has completed an extensive characterization of soil, groundwater, and surface water contamination in Bear Creek Valley. Results from these studies were documented in a final RI report in May 1997 (DOE 1997a). Figure 2.4 presents the conceptual model for contaminant migration in Bear Creek Valley. In addition to documenting the extent of contamination within the watershed, the RI report assesses human health and ecological exposure hazards presented by this contamination under current conditions. Further, the RI report assesses future exposure hazards that could result from the additional migration of contamination or from potential changes in land use within the valley. The following are key conclusions from the RI report:

- Large volumes of buried waste exist in unlined trenches, and portions of the buried waste are inundated by shallow groundwater.

- A range of chemicals and radionuclides presents potential exposure hazards within the Bear Creek Valley watershed because of past waste management practices conducted in the area.

- With the current DOE-controlled land use in Bear Creek Valley, the human population is not exposed to unacceptable risks. However, certain terrestrial ecological populations in Bear Creek Valley, specifically at the former waste disposal units, are exposed to unacceptable risks.

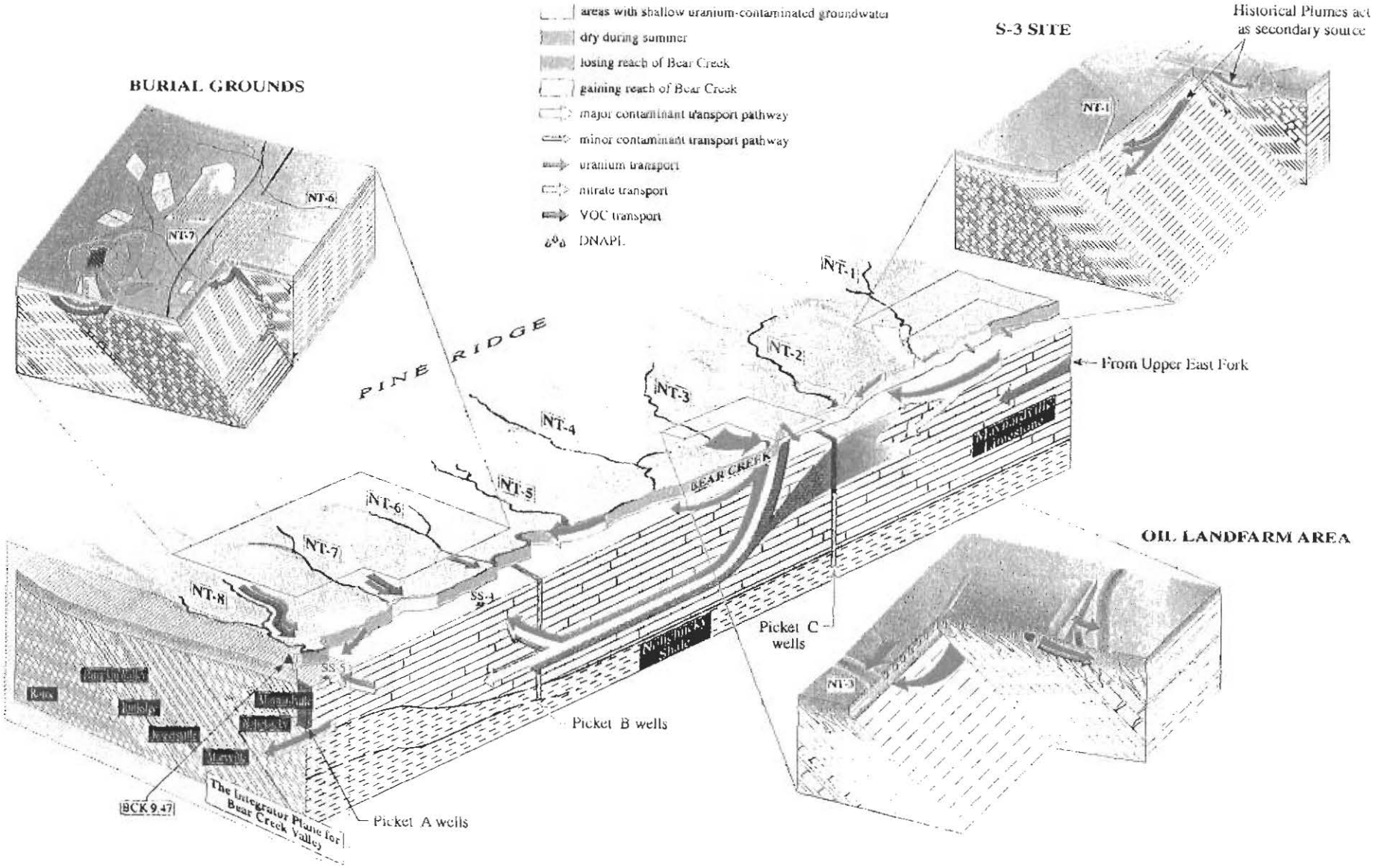


Fig. 2.4 Conceptual Hydrogeological Model for Contaminant Flow

- In addition to direct exposure from waste materials in the disposal areas, the potential pathways for exposure of human and ecological populations to contaminants in Bear Creek Valley are via contact with or use of contaminated surface water and groundwater.

- Tennessee AWQC for protection of ecological populations are exceeded in a single reach of Bear Creek close to the S-3 Site and in NT-1 and NT-3.

- Past waste management activities at three disposal areas in Bear Creek Valley (the S-3 Site, the Oil Landfarm Area, and the Bear Creek Burial Grounds) have caused groundwater and surface water contamination in much of the eastern half of the valley. (The Boneyard/Burnyard in the Oil Landfarm Area and the S-3 Site are the most significant contributors.) Contaminants leave these disposal areas via surface water in tributaries or via shallow groundwater. Interconnectivity of groundwater and surface water causes additional groundwater contamination from recharge of contaminated surface water further downgradient of the disposal areas.

- At two sites, the S-3 Site and the Bear Creek Burial Grounds, dense nonaqueous-phase liquids (DNAPLs) that are separated from the original disposal area sources, contaminate groundwater to depths of > 300 ft.

- Groundwater quality 1 mile west and downgradient of the disposal areas generally meets the Safe Drinking Water Act of 1974 maximum contaminant levels (MCLs). Without action, existing upgradient groundwater contamination may spread into this unimpacted area.

- The ecological health of Bear Creek has improved over the past 10 years. Species richness, density, and biomass of fish and benthic macroinvertebrate communities have increased and are now similar to those in comparable ORR reference streams. However, other indicators, such as select contaminant levels in fish tissue, appear to be elevated in some locations in Bear Creek.

Hydrogeology

The two hydrogeologic formations underlying the valley and impacted by waste management practices are the Nolichucky Shale and Maynardville Limestone. If a conduit is intercepted, a well in the Maynardville Limestone can produce significant quantities of water. The Nolichucky Shale is a very low-yielding formation. Thrust faulting has left tilted beds dipping 45 degrees to the southwest and beds

trending northeast-southwest at outcrop. Geologic formations in Bear Creek Valley are extensively fractured, and limestone units have well-developed, solution-enlarged cavity systems. As a result, groundwater flow in the bedrock is strongly controlled by fractures and cavities, which are well connected and mostly parallel to geologic strike. Fracture width and frequency generally decreases with depth, restricting the depth of active groundwater circulation in both limestone and shale formations.

The Nolichucky Shale is the primary clastic formation that forms the northern flank of Bear Creek Valley. Most groundwater flow in this formation occurs at the water table and shallow bedrock intervals (50 ft) during and immediately following precipitation. Flow is predominantly along geological strike following shallow flowpaths, with discharge to the tributaries of Bear Creek. During storm events, flow in this interval may be rapid (130 ft/day).

The shallow interval (top 100 ft) of the Maynardville Limestone contains a well-connected maze of conduits that is able to transport water rapidly along strike, west along the axis of Bear Creek Valley. Groundwater in this interval is closely connected to flow in Bear Creek. Below 100 ft in this formation, along-strike flow occurs through discrete solution conduits and fractures that are not as well interconnected as those in the shallow interval. The Maynardville Limestone acts as a hydraulic drain for the valley. Bear Creek displays losing and gaining reaches where groundwater is recharged and discharged to the surface from the underlying Maynardville Limestone. At losing reaches, contaminated surface water can recharge to groundwater.

Constituents of Concern for Remedial Action

Wastes contained in the various Bear Creek Valley disposal areas include waste oils, solvents, machine coolants, caustic and acid solutions, uranium turnings and sawfines, and radiologically contaminated material and debris. Accordingly, a wide range of constituents of concern (COCs) exists within the disposal areas. These include radionuclides (primarily uranium), a range of heavy metals (such as cadmium, lead, and mercury), nitrate, and organic compounds typically contained in waste oils and solvents. Of particular concern are chlorinated solvent compounds because of their potential mobility, toxicity, and environmental persistence.

COCs posing environmental hazards due to migration from the disposal areas include nitrate, uranium and cadmium migrating through groundwater and surface water downgradient from the S-3 Site,

uranium and mercury migrating from the Boneyard/Burnyard, and uranium and VOCs migrating out of the Bear Creek Burial Grounds via groundwater and surface water.

An extensive delineation of the nature and extent of contamination within the Bear Creek Valley watershed is provided in the RI report (DOE 1997a), which identifies COCs, within the watershed and also provides information on the spatial extent of these constituents in all media, and constituent concentrations. The RI report is supplemented by a recent, more detailed study of the Boneyard/Burnyard (DOE 1998c).

DNAPLs occur at the S-3 Site and the Bear Creek Burial Grounds in Bear Creek Valley. At these locations, DNAPLs are separated from the original source and have migrated along bedding planes and fractures in the Nolichucky shale. This migration has occurred to significant depth (400 ft) and resulted in dispersed droplets of DNAPLs left in fractures.

At the S-3 Site, DNAPLs have not been directly observed, but direct evidence of DNAPLs exists. Tetrachloroethene has been detected in Well GW-243 at a maximum concentration of 9000 μg/L, which is approximately 6 percent of its maximum solubility (150,000 μg/L) (DOE 1997a). EPA considers concentrations of 1 percent of maximum solubility to indicate the presence of DNAPL. Migration of DNAPLs at the site is downward and westward following bedding planes and strike and is illustrated in Figure D-49 of Volume III of the RI report (DOE 1997a). Additional information can be found in Section D.6.4.4 of Volume III.

Direct evidence of DNAPLs at the Bear Creek Burial Grounds has been observed. Free product was encountered in one boring (GW-625) and possibly two others. In addition, the concentrations of dissolved organic compounds in many of the Bear Creek Burial Grounds area wells are > 5 percent of their solubility limit. These data are consistent with the history of the Bear Creek Burial Grounds, where oils and solvents were discharged into standpipes in unlined trenches. Migration of DNAPLs at the Bear Creek Burial Grounds is downward and westward following bedding planes and strike, as illustrated in Figure D-102 of Volume III of the RI report. Additional information can be found in Section D.8.6.1 of Volume III (DOE 1997a).

The response action selected in this ROD is necessary to protect the public health or welfare of the environment from actual or threatened releases of hazardous substances into the environment.

DESCRIPTION OF REMEDIAL ALTERNATIVES CONTAINED IN THE FEASIBILITY STUDY

The FS for Bear Creek Valley compared remedial alternatives for the entire watershed including the Bear Creek Burial Ground. Subsequent to the FS the scope of the Phase I ROD was reduced. Accordingly, the alternatives described below were developed for a remedial action larger in scope than the action being selected in this ROD.

Each of the preliminary alternatives was designed to achieve one of the following RAOs:

- RAO 1: protect future residents anywhere in Bear Creek Valley from unacceptable risks from exposure to groundwater, surface water, soil, sediment, and waste sources.

- RAO 2: protect future residential users of the valley in Zones 1 and 2 from risks from exposure to groundwater, surface water, soil, sediment, and waste sources; protect industrial workers and maintenance workers in Zone 3 from unacceptable risks from exposure to soil and waste.

- RAO 3: protect future residential users of the valley in Zone 1 from risks from exposure to groundwater, surface water, soil, sediment, and waste sources; protect a passive recreational user in Zone 2 from unacceptable risks from exposure to surface water and sediment; and protect industrial workers and maintenance workers in Zone 3 from unacceptable risks from exposure to soil and waste.

Remedial action alternatives for Bear Creek Valley were developed as part of the FS (DOE 1997b) by identifying remedial technologies and process options that are potentially applicable to the site-specific conditions and contaminated media. Potentially applicable technologies and resource management strategies for control of contaminant migration in surface water and groundwater include:

- Technologies used to eliminate releases from contaminant sources (e.g., excavation and relocation of waste disposal units, in-place immobilization of disposal unit contents, and multilayer caps on top of contaminant sources).

- Technologies used to intercept and treat contaminants that have been released into surface water or groundwater (e.g., shallow groundwater interception trenches filled with treatment media constructed to treat water flowing through the trench, and active groundwater or surface water capture and treatment using traditional waste water treatment facilities).

- Use restrictions implemented to prevent human exposure to migrating contamination (e.g., restrictions on drinking water well construction and use and restrictions on recreational uses such as fishing or wading within affected surface waters).

Remediation strategies to address the risk of direct contact with contaminant source areas by current and potential future users of the land area within Bear Creek Valley include the following:

- capping contaminants to prevent direct contact,
- excavating and removing contaminated waste for subsequent treatment and/or disposal, and
- restricting land use to prevent access to waste areas and intrusion into waste sources.

Combinations of these migration control and source control measures were incorporated into ten preliminary alternatives:

- Alternative 1: Restoration
- Alternative 2: Restoration and groundwater use restrictions
- Alternative 3: Aggressive surface/groundwater actions
- Alternative 4: Source isolation and partial Maynardville Limestone restoration
- Alternative 5: Cap, removal, in situ treatment, and partial Maynardville Limestone restoration
- Alternative 6: Removal, capping, and groundwater containment
- Alternative 7: Removal, on-site/off-site disposal, and groundwater containment
- Alternative 8: Capping and in situ source treatment
- Alternative 9: Capping and groundwater mass reduction
- Alternative 10: Capping

The preliminary alternatives were screened on the basis of effectiveness, implementability, and cost. Alternatives that were impractical to implement, unlikely to effectively meet the RAOs, or were not cost-effective compared to other alternatives that would provide equal or better performance were eliminated

from further consideration. From the screening analysis of the preliminary alternatives, five final alternatives were retained for detailed evaluation:

- Alternative 3: Aggressive surface/groundwater actions
- Alternative 5: Cap, removal, in situ treatment, and partial Maynardville Limestone restoration
- Alternative 7: Removal, on-site/off-site disposal, and groundwater containment
- Alternative 9: Capping and groundwater mass reduction
- Alternative 10: Capping

In addition, the no-action alternative was retained for evaluation in accordance with the CERCLA and NEPA processes to provide a baseline for comparison with the final action alternatives. The major features of each of these alternatives are summarized below.

No-Action Alternative

The NCP requires that the no-action alternative be evaluated at every site to establish a baseline for comparison. Under this alternative, no further action would be taken at Bear Creek Valley and all contaminated media would remain in place. Current institutional controls would not be maintained, allowing unrestricted future land use and access to the site, and potential exposure to waste and contamination. Current engineering control measures (e.g., leachate collection and treatment at the Bear Creek Burial Grounds) and conditions would not be maintained.

Alternative 3: Aggressive Surface/Groundwater Actions

Alternative 3 would address source areas by using a combination of isolation and excavation with consolidation and capping, while groundwater contaminant plumes would be contained near the sources, and contaminated shallow groundwater would be collected for treatment before discharge to surface water. The isolation techniques at waste areas would include capping over disposal sites that have not been previously capped, surface water controls for run-on and run-off, and installation of upgradient, shallow subsurface storm flow drains. The ecology of Bear Creek and its tributaries would be protected by collecting leachate and contaminated seeps in Bear Creek Burial Grounds and by installing shallow groundwater interceptor trenches to collect the contaminated groundwater that is recharging surface water. Contaminated groundwater would be extracted by a series of wells west of the S-3 Site, along the southwestern edge of Bear Creek Burial Grounds in the Nolichucky Shale and southwest of the burial

grounds in the Maynardville Limestone. All collected water would be treated at a new waste water treatment plant. In addition, excavation of primary source areas (i.e., areas of elevated contamination in contact with shallow groundwater) in the Boneyard/Burnyard would remove a significant source of shallow groundwater and surface water contamination from this area. Soil and debris excavated under this alternative would be consolidated in Boneyard/Burnyard before capping, and soil currently in storage facilities (i.e., DARA and Oil Landfarm Soil Containment Pad) would be capped in place after structures are dismantled. Administrative controls would be implemented to maintain land-use restrictions. Long-term operation and maintenance (O&M) activities would include collection and treatment of contaminated groundwater, cap maintenance and repair, and maintenance of shallow groundwater interceptor trenches and storm flow trenches. The total present worth cost is estimated at $89 million. The remedial actions incorporated in Alternative 3 are summarized in Table 2.3.

Alternative 3 is designed to meet RAO 2 (i.e., to retain the present controlled industrial area in Zone 3 and establish Zones 1 and 2 as unrestricted use areas). All land west of BCK 9.47 would be available for unrestricted residential use, AWQC would be achieved in all waters of the state, and ecological populations would be protected.

Table 2.3. Major components of Alternative 3 for each functional area

Functional area	Remedial actions
S-3 Site	Install interceptor trenches to collect shallow groundwater at NT-1, NT-2, and along the headwaters of Bear Creek for treatment at new treatment facility. Install extraction wells for collection of contaminated groundwater for treatment at new waste water treatment facility.
Oil Landfarm Area	Excavate source areas in Boneyard/Burnyard and contaminated floodplain soils and sediments for on-site consolidation and capping. Remove waste stored in Oil Landfarm Soil Containment Pad for on-site consolidation and dismantle structure. Install multilayer cap over consolidated waste and uncapped disposal areas; maintain existing caps.
Bear Creek Burial Grounds	Install multilayer caps at BCBG-C East, -D East, -D West, -D South, -E, -J, -A-16, -A-17, and -A-18; and maintain existing caps. Remove waste stored in DARA facility and dismantle structure caps. Install storm flow trenches to divert shallow storm flow around source areas. Install interceptor trenches to collect shallow groundwater at NT-7 and NT-8E for treatment at new waste water treatment facility. Install extraction wells for collection of contaminated groundwater for treatment at new waste water treatment facility. Enhance leachate collection system to reduce contaminant migration.
Other	Excavate contaminated soils and debris from Creekside Debris Burial Area and Bear Creek Road Debris Burial Area for consolidation at Boneyard/Burnyard under new multilayer cap.

Alternative 5: Cap, Removal, In Situ Treatment, and Partial Maynardville Limestone Restoration

Alternative 5 includes three subalternatives for aggressive source control actions at the Bear Creek Burial Grounds (see Table 2.4). Alternative 5a would involve in situ treatment, consisting of either vitrification or low-pressure grout injection, depending on the waste characteristics of a particular area.

Table 2.4. Major components of Alternative 5 for each functional area

Functional area	Remedial actions
S-3 Site	Install trenches at NT-1 and along the headwaters of Bear Creek for passive in situ treatment of shallow groundwater.
Oil Landfarm Area	Under Alternatives 5a and 5b, source areas in Boneyard/Burnyard, and contaminated floodplain soils and sediments, would be excavated for disposal at ORR on-site disposal facility. Under Alternative 5c, all contaminated materials in Boneyard/Burnyard would be excavated for disposal at the ORR on-site disposal facility. Remove waste stored in Oil Landfarm Soil Containment Pad for disposal at ORR on-site disposal facility and dismantle structure. Install multilayer cap over uncapped disposal areas and maintain existing caps (Alternatives 5a and 5b only).
Bear Creek Burial Grounds	Alternative 5a would include aggressive in situ treatment using in situ vitrification or low-pressure grout injection at Bear Creek Burial Grounds-C East, -C West, -D East, -D West, -D South, -E, and -J, followed by installation of multilayer caps at these locations and -A-16. Alternative 5b would include in situ solidification at Bear Creek Burial Grounds-C East and -C West; excavation of wastes at Bear Creek Burial Grounds-D East, -D West, -D South, -E, and -J to remove approximately 33% of the volume of buried uranium; and installation of multilayer caps at BCBG-A-16, -A-17, -A-18, and -C East. Alternative 5c would include excavation of disposal of all buried wastes in Bear Creek Burial Grounds. Remove waste stored in DARA facility for disposal at ORR on-site disposal facility and dismantle structure. Install storm flow trenches to divert shallow storm flow around source areas (Alternatives 5a and 5b only). Install trenches at NT-7 and NT-8E for passive in situ treatment of shallow groundwater (Alternatives 5a and 5b only).
Other	Excavate contaminated soils and debris from Creekside Debris Burial Area and Bear Creek Road Debris Burial Area for disposal at ORR on-site disposal facility.

Alternative 5b would include a combination of in situ treatment and excavation of buried waste. Alternative 5c would involve the excavation of a majority of the buried waste in the Bear Creek Burial Grounds. Alternatives 5a and 5b would also include capping over the remaining disposal areas that have not previously been capped or excavated, surface water controls for run-on and run-off, and upgradient drains to capture shallow subsurface storm flow. Alternatives 5a and 5b also would include groundwater

treatment trenches to passively intercept and treat contaminated groundwater recharging tributaries of Bear Creek. All three subalternatives would involve excavation of primary source areas in the Boneyard/Burnyard and disposal of the resulting waste at the ORR on-site disposal facility. Subalternatives 5a and 5b would also include hydraulic isolation measures for the Boneyard/Burnyard. Under Alternative 5c, all buried wastes in the Bear Creek Burial Grounds and Boneyard/Burnyard would be excavated, treated, and disposed; those contaminants that have migrated into the unweathered bedrock or deeper would not be removed; and storm flow trenches for hydraulic isolation would not be installed. Wastes currently in storage at the Oil Landfarm Soil Containment Pad and DARA Solids Storage Facility would be disposed of at the ORR on-site disposal facility, and these storage facilities would be decontaminated and dismantled. Administrative controls would be implemented to maintain land-use restrictions. Long-term O&M activities would include cap maintenance and repair, and maintenance of shallow groundwater interceptor trenches, storm flow trenches, and in situ treatment trenches. The total present worth cost for Alternative 5 is estimated at $112–415 million. These cost estimates are based on disposal of most excavated materials in the ORR on-site disposal facility.

Alternative 5 is designed to meet RAO 3 (i.e., to retain the present controlled industrial area in Zone 3, establish a recreational use area in Zone 2, and establish an unrestricted use area in Zone 1).

Alternative 7: Removal, On-site/Off-site Disposal, and Groundwater Containment

Alternative 7 would include installation of multilayer caps over disposal areas that have not been previously capped or removed; excavation of primary source areas from the Boneyard/Burnyard; surface water controls for run-on and run-off; installation of upgradient, shallow subsurface storm flow drains; and collection and treatment of contaminated surface water and shallow groundwater. Contaminated water collected from tributaries (NT-1, NT-2, NT-7, NT-8E) and limited groundwater sources would be treated at a new water treatment facility. Contaminated soil and debris excavated under this Alternative, as well as soil and debris currently in storage, would be placed in the ORR on-site disposal facility, with the exception of floodplain waste, which would be consolidated in place at the Boneyard/Burnyard. Administrative controls would be implemented to maintain land-use restrictions. Long-term O&M activities would be identical to Alternative 3. The total present worth cost for Alternative 7 is estimated at $94 million. The major remedial actions incorporated in Alternative 7 are summarized in Table 2.5.

Table 2.5. Major components of Alternative 7 for each functional area

Functional area	Remedial actions
S-3 Site	Install interceptor trenches to collect shallow groundwater at the headwaters of Bear Creek for treatment at new waste water treatment facility. Install catch basins to collect surface water from NT-1 and NT-2 before entering Bear Creek for treatment at new waste water treatment facility.
Oil Landfarm Area	Excavate source areas in Boneyard/Burnyard for disposal at ORR on-site disposal facility. Excavate contaminated floodplain soils and sediments for on-site consolidation. Remove waste stored in Oil Landfarm Soil Containment Pad for disposal at ORR on-site disposal facility, and dismantle structure. Install multilayer cap over consolidated waste and uncapped disposal areas, maintain existing caps.
Bear Creek Burial Grounds	Install multilayer caps at Bear Creek Burial Ground -A-16, -A-17, and -A-18, -C East, -D East, -D West, -D South, -E, and -J, and maintain existing caps. Remove waste stored in DARA facility for disposal at ORR on-site disposal facility, and dismantle structure. Install storm flow trenches to divert shallow storm flow around source areas. Install catch basins to collect surface water from NT-7 and NT-8 before entering Bear Creek for treatment at new waste water treatment facility. Enhance leachate collection system to reduce contaminant migration. Install extraction wells for collection of contaminated groundwater for treatment at new waste water treatment facility.
Other	Excavate contaminated soils and debris from Creekside Debris Burial Area and Bear Creek Road Debris Burial Area for disposal at ORR on-site disposal facility.

Alternative 7 is designed to meet RAO 2 (i.e., to retain the present controlled industrial area in Zone 3 and establish Zones 1 and 2 as unrestricted use areas). AWQC would be achieved in the entire main stem of Bear Creek, but not in all tributaries. Similarly, ecological populations would be protected in Bear Creek but not all tributaries.

Alternative 9: Capping and Groundwater Mass Reduction

Alternative 9 incorporates isolation techniques, which include placing multilayer caps over disposal areas that have not been covered, surface water controls for run-on and run-off, and installing upgradient, shallow subsurface storm flow drains. Passive in situ treatment systems would be installed in key tributaries (NT-7 and NT-8E) to treat contaminated groundwater recharging tributaries and Bear Creek. Limited surface water collection from key tributaries (NT-1, NT-3) also would be included, rather than excavation of source areas and tributary collection trenches. (This is the only alternative that does not include excavation of source areas from the Boneyard/Burnyard.) Contaminated water collected would be treated at a new water treatment facility. Floodplain sediment and debris excavated under this alternative would be consolidated in the Boneyard/Burnyard before capping. Soil currently in storage

units would be capped in place after dismantling the facilities. Administrative controls would be implemented to maintain land-use requirements. Long-term O&M activities would be similar to Alternative 3. The total present worth cost for Alternative 9 is estimated at $62 million. Major remedial action components of Alternative 9 are summarized in Table 2.6.

Table 2.6. Major components of Alternative 9 for each functional area

Functional area	Remedial actions
S-3 Site	Install catch basins to collect surface water from NT-1 before entering Bear Creek for treatment at new waste water treatment facility.
Oil Landfarm Area	Install catch basins to collect surface water from NT-3 before entering Bear Creek for treatment at new waste water treatment facility. Excavate contaminated soils and sediment from the floodplain of Bear Creek and NT-3 for on-site consolidation. Remove waste stored in Oil Landfarm Soil Containment Pad for on-site consolidation and dismantle structure. Install multilayer cap over consolidated waste and uncapped disposal areas, maintain existing caps.
Bear Creek Burial Grounds	Install multilayer caps at BCBG-A-16, -A-17, -A-18, -C East, -D East, -D West, -D South, -E, and -J; and maintain existing caps. Remove waste stored in DARA facility, dismantle structure and cap. Install storm flow trenches to divert shallow storm flow around source areas. Install trenches at NT-7 and NT-8 for passive in situ treatment of shallow groundwater. Install extraction wells southwest of Walk-In-Pits, and west of NT-7 in Bear Creek Burial Grounds collect contaminated groundwater for treatment at new treatment facility. Enhance leachate collection system to reduce contaminant migration.
Other	Excavate contaminated soils and debris from Creekside Debris Burial Area and Bear Creek Road Debris Burial Area for consolidation at Boneyard/Burnyard under new multilayer cap.

Alternative 9 is designed to meet RAO 3 (i.e., to retain the present controlled industrial area in Zone 3, establish a recreational use area in Zone 2, and establish an unrestricted use area in Zone 1 suitable for future residential use). Ambient water quality criteria would be achieved west of Bear Creek Burial Grounds and ecological populations would be protected in Bear Creek, but not in all tributaries.

Alternative 10: Capping

Alternative 10 would rely primarily on source isolation measures, including installation of multilayer caps over disposal areas that have not been covered, surface water controls for run-on and run-off, and installation of upgradient, shallow subsurface storm flow drains. Excavation of primary source areas in the Boneyard/Burnyard would remove a significant source of shallow groundwater and surface water contamination from this area. Soil, debris, and floodplain material that are excavated under this

Alternative would be consolidated at the Boneyard/Burnyard. Soil that is currently in storage units would be capped in place after dismantling the facilities. Alternative 10 would not involve any collection or treatment of groundwater or surface water, so no new water treatment facilities would be required. Administrative controls would be implemented to maintain land-use requirements. Long-term O&M activities would include cap maintenance and repair and storm flow trench maintenance. The total present worth cost for Alternative 10 is estimated at $33 million. Major components of Alternative 10 are summarized in Table 2.7.

Alternative 10 is designed to meet RAO 3 (i.e., to retain the present controlled industrial area in Zone 3 and establish conditions compatible with recreational land use in Zone 2 and unrestricted land use in Zone 1).

Table 2.7. Major components of Alternative 10 for each functional area

Functional area	Remedial actions
S-3 Site	No remedial actions.
Oil Landfarm Area	Excavate source areas from Boneyard/Burnyard and contaminated soils and sediment from the floodplain of Bear Creek and NT-3 for on-site consolidation. Remove waste stored in Oil Landfarm Soil Containment Pad for on-site consolidation, and dismantle structure. Install multilayer cap over consolidated waste and uncapped disposal areas, maintain existing caps.
Bear Creek Burial Grounds	Install multilayer caps at BCBG-A-16, -A-17, -A-18, -C East, -D East, -D West, -D South, -E, and -J; and maintain existing caps. Remove waste stored in DARA facility, dismantle structure and cap. Install storm flow trenches to divert shallow storm flow around source areas.
Other	Excavate contaminated soils and debris from Creekside Debris Burial Area and Bear Creek Road Debris Burial Area for consolidation at Boneyard/Burnyard under new multilayer cap.

Additional Alternative Presented in the Proposed Plan as the Preferred Alternative

Subsequent to the publication of the FS (DOE 1997b), an additional alternative was developed and presented for consideration in the proposed plan (DOE 1998a) and DOE indicated its preference for this alternative. After public review and comment on the proposed plan and extensive evaluation and consultation with EPA and TDEC, this preferred alternative is being selected for the Phase I actions in Bear Creek Valley. The selected alternative is similar to Alternative 5, except that decisions for the waste units at the Bear Creek Burial Grounds and finalization of remedial goals for both groundwater and S-3 Ponds Site Pathways 1 and 2 (currently focus of removal action) are being deferred to future

CERCLA decisions. Additional field sampling results of the Roadside and Creekside Debris Areas indicated there were no contaminants of concern at these sites; therefore, no action is warranted under CERCLA. Excavation of source areas in the Boneyard/Burnyard will remove a significant source of shallow groundwater and surface water contamination from this area. Hydraulic isolation measures at the Boneyard/Burnyard will include capping disposal areas that have not been capped or excavated, surface water controls for run-on and run-off, and upgradient drains to capture shallow subsurface storm flow. A trench will be installed for interception and passive treatment of shallow, contaminated groundwater recharging NT-1 (S-3 Ponds Pathway 3). Contaminated soil and debris excavated during trench installation will be disposed of in the ORR on-site disposal facility, wastes currently in storage facilities will be removed and disposed of and the storage facilities will be decontaminated and dismantled. Administrative controls will be implemented to maintain land use restrictions. Long-term O&M activities will include cap maintenance and repair, and maintenance of shallow groundwater interceptor trenches, storm flow trenches, and in situ treatment trenches. The total present worth cost for the selected alternative is estimated at $30 million. Major components of the selected alternative are summarized in Table 2.8.

Table 2.8. Major components of selected alternative for each functional area

Functional area	Remedial actions
S-3 Site	Install trench at NT-1 for passive in situ treatment of shallow groundwater.
Oil Landfarm Area	Excavate source areas in Boneyard/Burnyard and contaminated floodplain soils and sediments, for on-site disposal of excavated materials meeting waste acceptance criteria of the ORR on-site disposal facility* and off-site disposal of materials exceeding these waste acceptance criteria. Remove waste stored in Oil Landfarm Soil Containment Pad for commercial off-site disposal and dismantle structure. Install clay cap over uncapped disposal areas at Boneyard/Burnyard, maintain existing caps. Implement hydraulic isolation measures at Boneyard/Burnyard, including reconstruction of NT-3, elimination of stagnation points, and installation of drains or well points.
Bear Creek Burial Grounds	Remedial action decisions for Bear Creek Burning Ground area to be deferred to a future CERCLA decision. Remove waste stored in DARA facility for off-site commercial disposal, and dismantle structure.
Other	Contaminated soils and debris in the Creekside Debris Burial Area and Bear Creek Road Debris Burial Area to be addressed as routine maintenance actions.

*These wastes are assumed to be disposed of at the ORR on-site disposal facility. In the event that these wastes are determined not to meet the waste acceptance criteria for the facility, an alternative disposal strategy would be developed and documented in accordance with CERCLA requirements.

This alternative is designed to meet RAO 3 (i.e., to retain the present controlled industrial use in Zone 3, establish conditions compatible with recreational use in Zone 2 and unrestricted use in Zone 1).

Discussion

The selected alternative does not include final remediation decisions for contaminated materials in all functional areas of the Bear Creek Valley, whereas other alternatives originally evaluated are intended to address all contaminant sources and pathways in some manner to achieve RAOs. Under the selected alternative, remediation decisions for the Bear Creek Burial Grounds and finalization of remediation goals for S-3 Ponds Site Pathways 1 and 2 and groundwater are deferred to future CERCLA decisions. The Oil Landfarm Soil Containment Pad and DARA Solids Storage Facility actions are considered base actions (i.e., are the same for all alternatives analyzed for the Boneyard/Burnyard). The relative merits of these alternatives with respect to the S-3 and Oil Landfarm functional areas are evaluated in a comparative manner in the following section. Comparative analysis of alternatives for remediation of the Bear Creek Burial Grounds, as well as final remediation goals for groundwater, will be considered in future CERCLA decision documents.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES FOR THE S-3 SITE PATHWAY 3 AND BONEYARD/BURNYARD

Based on regulator comments received on the draft ROD for Phase I Actions in Bear Creek Valley in February 2000, DOE prepared a *Focused Analysis of Alternatives for Phase I Remedial Actions at the S-3 Site Pathway and the Boneyard/Burnyard in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 2000) to provide focused analysis of alternatives provided in the proposed plan. The comparative analysis completed as part of the focused analysis and discussed here has been completed on an action-specific basis to inform the proposed remedy selection captured in this ROD. A summary of this analysis is presented in Tables 2.11 and 2.15 (see pages 2-33 and 2-45 respectively).

The NCP identifies nine evaluation criteria against which remedial action alternatives must be evaluated. These criteria are derived from statutory requirements in Sect. 121 of CERCLA, which specifies that a selected remedy must protect human health and the environment, attain all applicable or relevant and appropriate requirements (ARARs) or define criteria for invoking a waiver, be cost effective, and use permanent solutions and alternative treatment or resource recovery technologies to the

maximum extent practicable. These criteria are used as the basis for individual and comparative analyses to determine the optimal alternative for the specific problems at each site. The nine CERCLA evaluation criteria are summarized in Table 2.9.

Table 2.9. Evaluation criteria, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Overall protection of human health and the environment. This criterion addresses whether an alternative provides adequate protection of human health and the environment and how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.
Compliance with applicable or relevant and appropriate requirements. Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA 121(d)(4).
Long-term effectiveness and permanence. This criterion addresses expected residual risks once cleanup levels have been met and the ability of a remedy to maintain reliable protection of human health and the environment over time. Includes the magnitude and nature of risks associated with untreated waste and/or treatment residuals, and consideration of the adequacy and reliability of any associated institutional or engineering controls.
Reduction of toxicity, mobility, or volume through treatment. This criterion addresses the degree to which treatment is used to address the principal hazards of the site; the amount of material treated; the magnitude, significance, and irreversibility of specific reductions; and the nature and quantity of treatment residuals.
Short-term effectiveness. This criterion addresses the effect of implementing an alternative relative to potential risks to the general public during the action period, potential impacts to workers and the environment during the action period, the effectiveness and reliability of mitigative measures, and the time required to achieve protection of workers and the environment.
Implementability. This criterion addresses the technical and administrative feasibility of a remedy from design through construction and operation, including the availability of services and materials, the ease of implementation, the ability to monitor effectiveness, administrative feasibility, and coordination with other governmental entities
Cost. This criterion addresses both capital costs and O&M costs, as well as the combined present worth cost.
State acceptance. This criterion addresses comments and input from the state of Tennessee on the consideration of alternatives and identification of the preferred alternative.
Community acceptance. This criterion addresses comments and input made by the community on the remediation alternatives under consideration.

The first two criteria (overall protection of human health and the environment and compliance with ARARs) are the threshold criteria that must be met by any alternative considered for implementation. The next five criteria (short-term effectiveness; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; implementability; and cost) are considered balancing criteria, and are evaluated together to identify the advantages and disadvantages in terms of effectiveness and cost among the alternatives. The last two criteria (state and community acceptance) are considered modifying criteria and are evaluated after regulatory agency review and public comment on the RI/FS and proposed plan.

In addition to these evaluation criteria specified under CERCLA, the environmental consequences of the remedial alternatives were also evaluated in accordance with values of NEPA, in accordance with DOE policy to integrate NEPA values with the procedural and documentation requirements of CERCLA for sites where DOE has responsibility. The environmental consequences and values under NEPA have been integrated with the CERCLA evaluation criteria, primarily under long-term effectiveness and permanence and under short-term effectiveness and environmental impacts.

The following sections evaluate the relative performance of the individual remedial action alternatives considered for the S-3 Site Pathway 3 and the Boneyard/Burnyard, with respect to the nine CERCLA evaluation criteria and the alternative-specific RAOs discussed previously. This comparative analysis is intended to supplement that provided in the FS and proposed plan to clarify the basis for selection of remedial measures for these primary waste units.

S-3 Site Pathway 3

The following discussion evaluates each of the remedial alternatives for the S-3 Site Pathway 3 relative to the other alternatives. A summary of the cross-walk between these alternatives for the S-3 Site Pathway 3 and the site-wide alternatives evaluated in the FS and proposed plan is shown in Table 2.10.

Table 2.10. S-3 Site Pathway 3 alternatives

S-3 Site Pathway 3 alternative number	Description of remedial measures for S-3 Site Pathway 3	Cross-walk with site-wide alternatives in FS and proposed plan
S3-1	No Action	No Action
S3-2	Passive In Situ Treatment Trench	5, 7, Preferred Alternative
S3-3	Passive In Situ Treatment Trench with Constructed Wetlands	Considered as potential process option in FS under Alternative 5, but not evaluated in detail
S3-4	Pump and Treat	3
S3-5	Surface Water Collection for Ex Situ Treatment	3 (interceptor trenches at NT-1, NT-2, BC) 7 (interceptor trench at upper Bear Creek and catch basins at NT-1 and NT-2) 9 (NT-1catch basin)

As indicated by this cross-walk, some site-wide alternatives include multiple remedial measures at the S-3 Site. Alternative 3, for example, includes interceptor trenches to collect shallow groundwater at Bear Creek, NT-1 and NT-2 for ex situ treatment (Alternative S3-5) and installation of groundwater extraction wells (Alternative S3-4) downgradient from the S-3 Site for ex situ treatment. Alternative 7 includes both an interceptor trench at the headwaters of Bear Creek and catch basins at NT-1 and NT-2

for collection of shallow groundwater and surface water for treatment (S3-5). In addition, Alternative 10 in the FS includes no remedial actions for the S-3 Site; this alternative essentially would be equivalent to the no-action alternative with respect to this waste unit, and is not specifically addressed in this comparative analysis.

Results of the comparative analysis of remedial measures for the S-3 Site Pathway 3 with respect to the CERCLA evaluation criteria are discussed below and summarized in Table 2.11.

Overall Protection of Human Health and the Environment

Pathway 3 at the S-3 Site is the primary source of nitrate and cadmium contamination in Bear Creek. Nitrate is released via discharge from shallow groundwater into NT-1 and NT-2, and cadmium is discharged to NT-1 and upper Bear Creek adjacent to the S-3 Site. In addition, the S-3 Site is an important contributor to uranium contamination in Bear Creek.

Currently, the S-3 Site is estimated to contribute approximately 13% of the uranium and approximately 83% of the nitrate flux in Bear Creek at the integration point (at BCK 9.47). At the S-3 Site, uranium and nitrate are released primarily via discharge from shallow groundwater into NT-1 and upper Bear Creek (combined into NT-1/BCK 12.36 for purposes of analysis), NT-2, and surface spring SS-01.

Estimates of uranium flux associated with the S-3 Site include 14.5 kg/yr via NT-1/BCK 12.36, 4.15 kg/yr via SS-01, and 13.5 kg/yr of ungauged uranium flux attributed to the S-3 Site. Estimates of nitrate flux associated with the S-3 Site include 1500 kg/yr via NT-2, 7440 kg/yr via NT-1/BCK 12.36, and 4010 kg/yr via SS-01.

The likely source of cadmium is the contaminated groundwater from the S-3 Site discharging into NT-1. Concentrations of constituents exceeding AWQC are considered to cause possible adverse impacts to aquatic receptors.

The no-action alternative would not provide any incremental protection to human health and the environment, because no remedial actions would be implemented to address contaminant migration from the S-3 Site. Uranium and nitrate would continue to be released into Bear Creek and migrate down the

Table 2.11. Comparative analysis of alternatives for S-3 site Pathway 3, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

CERCLA criteria	Alternative S3-1 No Action	Alternative S3-2 (Selected Alternative) Passive In-Situ Treatment (Reactive Trench)	Alternative S3-3 Passive In-Situ Treatment with Constructed Wetlands	Alternative S3-4 Groundwater Extraction Wells and Ex-Situ Treatment	Alternative S3-5 Surface Water Collection and Ex-Situ Treatment
Overall protection of human health and the environment	Not protective	Protective – achieves all unit-specific RAOs; achieves site-wide RAOs, in combination with actions for Boneyard/ Burnyard and ongoing early actions for Pathways 1 and 2. Passive, in-situ groundwater treatment reduces contaminant flux to surface water, which in turn limits plume growth. Contaminant flux reduction at NT-1 estimated at 80% for uranium and 40% for nitrate (cadmium reduction not quantified in treatability study but would be expected to be similar, within this range). This is sufficiently protective to meet watershed goals. In-situ treatment avoids significant reduction in streamflow and resulting adverse ecological impacts. Existing S-3 cap continues to reduce vertical infiltration.	Protective – achieves all unit-specific RAOs; achieves site-wide RAOs, in combination with actions for Boneyard/ Burnyard and ongoing early actions for Pathways 1 and 2. Passive, in-situ groundwater treatment reduces contaminant flux to surface water, which in turn limits plume growth. Contaminant flux reduction estimated at 90% for uranium and 70% for nitrate at NT-1, and 40% for uranium and 50% for nitrate at NT-2 (reduction in cadmium at NT-1 not quantified but expected to be similar). In-situ treatment avoids significant reduction in streamflow and resulting adverse ecological impacts. Existing S-3 cap continues to reduce vertical infiltration.	Protective – partially achieves unit-specific RAOs; achieves site-wide RAOs, in combination with actions for Boneyard/ Burnyard and ongoing early actions for Pathways 1 and 2. Groundwater extraction reduces contaminant flux to surface water and reduces migration of nitrate plume. Reduction in nitrate and uranium flux at NT-2 estimated at up to 95%. No reduction in flux at NT-1 due to assumed location of extraction wells between NT-1 and NT-2. Reductions in base streamflow in NT-2 and Bear Creek below NT-1 due to groundwater collection for active ex-situ treatment may result in adverse ecological impacts. Existing S-3 cap continues to reduce vertical infiltration.	Protective – partially achieves unit-specific RAOs; achieves site-wide RAOs, in combination with actions for Boneyard/ Burnyard and ongoing early actions for Pathways 1 and 2. Surface water collection reduces contaminant flux from NT-1 and NT-2 to Bear Creek. Contaminant flux reductions estimated at 80-95% for uranium and 40-95% for nitrate at NT-1, and 95% for nitrate at NT-2. Reductions in streamflow at NT-1 and NT-2 due to surface water collection for active ex-situ treatment may result in adverse ecological impacts. Existing S-3 cap continues to reduce vertical infiltration.
Compliance with ARARs	Does not meet ARARs.	Meets all ARARs.	Meets all ARARs.	Does not attain ARARS – exceedance of AWQC for cadmium at NT-1 will continue.	Does not attain ARARs – exceedance of AWQC for cadmium at NT-1 will continue.
Long-term effectiveness	Not effective	Contribution to risk at exposure point significantly and reliably reduced without need for long-term water collection and ex-situ treatment. Moderate long-term reliability for passive, in-situ treatment system. Existing S-3 cap requires long-term maintenance.	Contribution to risk at exposure point significantly and reliably reduced without need for long-term water collection and ex-situ treatment. Moderate long-term reliability for passive, in-situ treatment system and constructed wetlands. Existing S-3 cap requires long-term maintenance.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Reduction in toxicity, mobility and volume through treatment	No treatment, no reduction	Significantly reduced volume and toxicity of contaminated surface water through passive, in-situ treatment.	Significantly reduced volume (slightly greater S3-2) and toxicity of contaminated surface water through passive, in-situ treatment.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Short-term effectiveness	N/A - no remedial actions conducted	Protective of public. Increased construction risk to remediation workers during installation of passive groundwater treatment components. Moderately significant adverse impacts during remediation.	Protective of public. Increased construction risk to remediation workers during installation of passive groundwater treatment components and constructed wetlands. Moderately significant adverse impacts during remediation.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Implementability	N/A - no remedial actions conducted	Passive, in-situ groundwater treatment system is relatively straightforward to implement; demonstration program for this remediation technology at this site is ongoing. No administrative barriers expected.	Passive, in-situ groundwater treatment system and constructed wetland relatively straightforward to implement. Demonstration program for this passive in-situ treatment technology at this site is ongoing. No administrative barriers expected.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Cost (Present Worth) ($1000, 1997 dollars) Capital O&M Total	N/A - no remedial actions conducted	 $ 2,345 $ 2,502 $ 5,847	 $ 3,537 $ 5,257 $ 8,794	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
State acceptance	Unacceptable	Acceptable	Acceptable	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Community acceptance	Unacceptable	Acceptable	Undetermined	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.

ARAR = applicable or relevant and appropriate requirement
AWQC = ambient water quality criteria
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
N/A = not applicable
NT = north tributary
O&M = operation and maintenance
RAO = Remedial Action Objective

valley and contribute to the incremental risk at the integration point. Cadmium exceeding the AWQC would continue to be present in NT-1, suggesting adverse impacts to aquatic life in this tributary. Since current controls in place at the site (e.g., institutional controls, cap maintenance) would not be maintained, hypothetical future receptors could come into direct contact with high levels of contamination in the waste sludge remaining in the S-3 Ponds and contaminants in groundwater and surface water at this site.

All action alternatives would provide institutional controls and engineering controls to protect human health and the environment. All action alternatives include requirements for continued monitoring and maintenance activities and for administrative controls to restrict site access and land use. Under all action alternatives, the S-3 Site would require long-term monitoring, surveillance, and maintenance to ensure the protection of workers in the area.

All action alternatives would be predicted to achieve some reduction in potential health risk to hypothetical future receptors at downstream locations in Bear Creek Valley. However, the reduction in risk to hypothetical future residents west of the integration point is not a highly useful metric for the S-3 Site Pathway 3, since the contribution to this integrated (human health) risk from this pathway is relatively small in comparison to that from the Boneyard/Burnyard. Therefore, it may be more meaningful to consider the relative protectiveness of the remedial action alternatives for the S-3 Site Pathway 3 in terms of reduction in the flux of contaminants from this site to NT-1, NT-2, and Bear Creek on a more localized level.

As mentioned previously, early actions have been implemented at the S-3 Site to address contaminants migrating via Pathways 1 and 2 with discharge into upper Bear Creek (DOE 1998c). These actions utilize passive in situ trenches for collection and treatment of shallow groundwater and are consistent with actions described under Alternative 5 in the FS. However, neither of these actions addresses contaminants migrating along Pathway 3 and discharging into NT-1. It should be noted that the analysis of flux reduction (and resultant risk reduction) in the FS considered the effects of the combination of remedial actions contained in each site-wide alternative. While the remedial action alternatives for the S-3 Site Pathway 3 considered in this analysis were components of alternatives evaluated in the FS, contributions to flux reductions attributable to individual sites and pathways were not explicitly evaluated. Estimates of the flux reduction efficiency for each alternative for the S-3 Site Pathway 3 are summarized in Table 2.12 and discussed below; any differences from assumptions made in

the FS are noted, where applicable. In each case, it should be noted that these estimates are based on simplified modeling assumptions, and more detailed estimates of reduction efficiency will be developed during remedial design for the selected alternative.

Table 2.12. Estimates of flux reduction associated with S-3 Site Pathway 3 alternatives.

Alternative	Estimated flux reduction at NT-1/BCK 12.36[a]		Estimated flux reduction at NT-2		Cadmium reduction in NT-1 expected?
	Nitrate	Uranium	Nitrate	Uranium	
S3-1	0%[b]	0%[b]	0%	NA	No
S3-2	40%	80%	0%	NA	Yes
S3-3	70%	90%	40-50%	NA	Yes[c]
S3-4	0%[b]	0%[b]	95%	NA	No
S3-5	40-95%	80-95%	95%	NA	No

[a]Estimates are associated with the combined reduction along with early actions are Pathways 1 and 2, except where noted otherwise. Due to the comparatively small contributions of nitrate by Pathways 1 and 2, most of the nitrate reduction would be attributable to actions at Pathway 3.
[b]No flux reduction associated with Pathway 3; flux reduction associated with early actions at Pathways 1 and 2 will occur.
[c]Cadmium is expected to be reduced in water discharged to the constructed wetlands where additional reduction should occur before discharge to Bear Creek.

Alternative S3-4 provides groundwater extraction wells for collection and treatment of groundwater from the S-3 Site to reduce plume growth. To contain the nitrate plume moving downgradient from the S-3 Site, a series of extraction wells would be installed between NT-1 and NT-2 to capture intermediate and deep groundwater from the contaminated plume. Extracted groundwater would be treated at a new waste water treatment facility. This action would be expected to reduce the continued migration of the nitrate plume as well as reduce the discharge of nitrate to surface water in Bear Creek as a result of upwelling into NT-2 and Bear Creek below NT-2. It is estimated that 95% of the nitrate flux measured in NT-2 would be reduced by this alternative. Reduction in base stream flow in NT-2 and in downstream locations of Bear Creek due to the extraction of groundwater may result in adverse impacts to aquatic systems in this area. This alternative would have no effect on reducing uranium or nitrate fluxes associated with NT-1, nor would it have any effect in reducing cadmium concentrations in NT-1. AWQC for protection of aquatic biota would be met and ecological populations would be protected in Bear Creek downstream from the well locations, but AWQC for cadmium may continue to be exceeded in NT-1.

Alternative S3-5 includes collection of surface water in catch basins at the confluence of Bear Creek with NT-1, NT-2, and treatment of the surface water for contaminants released via Pathway 3 in a new waste water treatment facility. This action, in conjunction with the ongoing early action, would be

expected to reduce uranium flux at NT-1/BCK 12.36 between 80% and 95%, and nitrate flux by 40% to 95%. Also, nitrate flux associated with NT-2 would be expected to be reduced by 95%. Cadmium concentrations would be reduced below AWQC in Bear Creek but not in NT-1 above the catch basin. Reduction of base stream flow in NT-1, NT-2, and in Bear Creek just below NT-1 and NT-2 due to the collection of surface water for active, ex situ treatment may result in adverse impacts to aquatic systems in this area.

Alternative S3-2 includes installation of a trench along NT-1 to intercept shallow groundwater along Pathway 3 prior to discharge to NT-1. The trench would contain a reactive media to provide in situ treatment as the contaminated groundwater flows through the media. This action, in conjunction with the early action for Pathways 1 and 2, would be expected to reduce uranium and nitrate flux at NT-1/BCK 12.36 by 80% and 40%, respectively. Additionally, the treatment media also would be expected to remove cadmium from solution, preventing its release into NT-1, and thus lower the cadmium concentration in surface water below the AWQC. AWQC for protection of aquatic biota would be met in all waters of the state, and ecological populations would be protected. This alternative would also be expected to have less adverse impacts to the aquatic habitat relative to Alternatives S3-4 and S3-5, since the passive in situ treatment system for shallow groundwater would cause less significant reductions in stream flow.

Alternative S3-3 is essentially the same as Alternative S3-2, except that a constructed wetland also would be used as a second treatment process to follow treatment in the reactive treatment trench at NT-1 described above. Treated water in the trench would be collected in a sump and pumped to an approximately 2-acre constructed wetland built over NT-1 (NT-1 flow would be diverted to the west and enter Bear Creek above NT-2). An additional wetland would be constructed at NT-2 to treat contaminants from that source. Treatability study results (DOE 1997c, DOE 1998b) indicate that treatment in constructed wetlands could achieve additional reduction in contaminant concentrations up to 50% for nitrate and 40% for uranium. This combination of remedial measures, in addition to the ongoing early action at Pathways 1 and 2, could be expected to reduce the uranium and nitrate flux at NT-1/BCK 12.36 by 90% and 70%, respectively; flux of these contaminants at NT-2 would be reduced by approximately 40 to 50%. Reductions in cadmium concentrations in the water exiting the constructed wetland also would be expected, thus lowering cadmium concentrations in surface water in NT-1 below the AWQC. AWQC for protection of aquatic biota would be met in all waters of the state, and ecological populations would be protected.

Only Alternatives S3-2 and S3-3 would be predicted to achieve reductions in all COCs for the S-3 Site Pathway 3, and attain all remedial action goals for this site.

Compliance with ARARs

Pursuant to EPA guidance, there are no ARARs for the no-action alternative. With no further action, release of contaminants would be expected to exceed water quality standards for certain receiving surface waters. Data from the RI report (DOE 1997a) indicate exceedances of AWQC values for cadmium in a small reach of upper Bear Creek and NT-1, which may continue. Moreover, the condition of the S-3 Site cap and cover system would be allowed to deteriorate, ultimately resulting in failure of containment systems and increased releases to surface water and groundwater from the S-3 Site.

Alternatives S3-4 (groundwater extraction and ex situ treatment) and S3-5 (surface water collection and ex situ treatment) would not be expected to reduce cadmium concentrations in NT-1 below AWQC levels, and, therefore, would not attain this chemical-specific ARAR. The collection of groundwater and/or surface water for treatment at a new waste water treatment facility under Alternatives S3-4 and S3-5 may cause reductions in stream flow in the upper reaches of the Bear Creek surface water system that could disrupt the natural system and adversely affect the aquatic habitat of Bear Creek and its tributaries. If the magnitude of the impact to the aquatic systems is projected to be significant and the damage irreparable, a waiver of the requirement to meet AWQC in NT-1 could be invoked under 40 *CFR* 300.430(f)(1)(ii)(C) (2) – "compliance with the requirement will result in greater risk to human health and the environment than other alternatives." However, since other protective alternatives would attain all ARARs, it would seem inappropriate to invoke such a waiver. Therefore, Alternatives S3-4 and S3-5 are eliminated from further consideration on the basis of the threshold criterion of ARARs compliance.

Alternatives S3-2 and S3-3 would be expected to attain all chemical-specific ARARs and to be considered (TBCs) in all waters of the state, including attainment of AWQC for cadmium in NT-1. In addition, the passive in situ groundwater treatment systems that would be implemented under these alternatives would be expected to have no significant impact on stream flow and, thus, would have fewer adverse impacts on aquatic habitat.

Compliance with location-specific ARARs and TBCs would be similar for all alternatives. All construction activities with the potential to affect Bear Creek and its tributaries would be designed and conducted using best management practices, including erosion and siltation controls to meet

requirements for aquatic resource alteration activities. No federal- or state-listed threatened or endangered species would be impacted by any alternative, and none of the three state-listed rare plant species would suffer adverse long-term effects from any of the alternatives. (The *Tennessee dace*, a state-listed "species in need of management," has been identified in NT-1 and might be impacted by reduction in stream flow under Alternatives S3-4 and S3-5, if these alternatives had not already been eliminated.) No known historical, cultural, or archaeological resources would be adversely impacted by any alternative.

All activities conducted under all action alternatives would comply with action-specific ARARs, including control of fugitive dust emissions, construction and excavation standards, surface water controls, and appropriate management of waste streams (e.g., waste generation, treatment, storage, closure, transportation, and disposal requirements).

DOE requirements for radiation protection of the public and the environment (e.g., DOE Order 5400.5) will be met as TBCs under all action alternatives, including requirements to maintain radiation exposures as low as reasonably achievable (ALARA). Similarly, occupational worker protection requirements under 10 *CFR* 835 and 29 *CFR* 1910 will be met under all action alternatives.

Long-term Effectiveness and Permanence

The no-action alternative would not be effective in the long term because it would not remediate contaminated media that may present a risk to human health and the environment. All action alternatives would be effective over the long term and provide permanent solutions for the S-3 Site Pathway 3 (with final remediation decisions for groundwater deferred to a future CERCLA decision). Under all action alternatives, continuing institutional controls would be required to ensure effectiveness, including continuing access restrictions for the S-3 Site disposal area, land use restrictions, and continuing surveillance and maintenance programs.

Alternatives S3-4 and S3-5 are excluded from evaluation under this criterion due to the failure of these alternatives to meet the threshold criterion of ARAR compliance.

Alternatives S3-2 and S3-3 include passive treatment of shallow groundwater from S-3 Site Pathway 3. These passive treatment systems would be designed to operate with minimal maintenance requirements (e.g., periodic changeout of reactive media, reconstruction of trenches every 10 years) and

are considered to have moderate long-term reliability. Under both alternatives, the contribution to risk at the exposure point due to contaminants from S-3 Site Pathway 3 would be significantly and reliably reduced, although Alternative S3-3 would be predicted to provide slightly greater contribution to risk reduction. Under all remaining action alternatives, the existing cap at the S-3 ponds would be maintained, with appropriate long-term surveillance and maintenance.

Long-term environmental effects would be similar for Alternatives S3-2 and S3-3. The passive, in situ treatment system for shallow groundwater under both of these alternatives would not be expected to cause significant reductions in the base stream flow of NT-1 and Bear Creek and no adverse impacts to aquatic habitat. Both of these alternatives would be expected to improve surface water quality at the S-3 Site and contribute to continued recovery of ecological populations. Alternative remedial actions that involve intercepting contaminated groundwater before it discharges to surface water in NT-1 or collecting surface water from NT-1 and NT-2 prior to discharge to Bear Creek for ex situ treatment, would be expected to result in greater reductions in the base stream flow in Bear Creek and its tributaries, and more potential adverse impacts to aquatic habitat.

No critical habitats of threatened or endangered species would be directly affected under Alternatives S3-2 or S3-3. Under Alternative S3-3, approximately 1,000 linear ft of additional habitat would result from the re-routing of NT-1, which may provide habitat for the *Tennessee dace* (a state-listed "species requiring management"). The ongoing ecological recovery of the site, including species diversity and reproduction rates, would be enhanced under both action alternatives.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The no-action alternative does not include treatment and would not result in a reduction of toxicity, mobility, or volume of contaminants.

Alternatives S3-4 and S3-5 are excluded from evaluation under this criterion due to the failure of these alternatives to meet the threshold criterion of ARARs compliance.

Alternative S3-2 would provide a reduction in contaminant volume through passive, in situ treatment of shallow groundwater. Over time, the in situ groundwater treatment systems would significantly reduce the volume of contaminated water at the site; however, additional solid waste would be generated when the reactive media become saturated or fouled and need replacement.

Alternative S3-3 would provide an additional reduction in the toxicity and volume of contaminants, relative to Alternative S3-2, through the combination of a passive in situ treatment trench and constructed wetlands. Treatability study results (DOE 1997c) indicate that treatment in a constructed wetlands could achieve a reduction in nitrate concentrations up to 50% and a reduction in uranium concentrations up to 40%; as noted previously, however, Phase II treatability study results (DOE 1998b) indicated lower removal efficiencies.

Short-term Effectiveness

Under the no-action alternative, no remedial actions would be taken; therefore, short-term effectiveness criteria are not applicable to this alternative. There would be no increase in short-term risks to workers or the community and no short-term environmental impacts. There would be no short-term unavoidable adverse impacts to humans, the environment, socioeconomics, or cultural resources as a result of construction activities. Noise levels would remain unchanged and there would be no cumulative impacts from construction activities.

Alternatives S3-4 and S3-5 are excluded from evaluation under this criterion due to the failure of these alternatives to meet the threshold criterion of ARARs compliance.

All action alternatives would incorporate appropriate institutional and engineering controls (e.g., physical barriers, administrative controls, dust suppression) to protect the community, workers, and the environment during implementation of remedial actions.

The duration for implementation of remedial action activities under the action alternatives is estimated to range from approximately 3 to 5 years. Under all action alternatives, remedial actions would be initiated within 15 months after approval of the ROD.

Alternatives S3-2 and S3-3 would require construction of trenches for passive in situ treatment of shallow groundwater at the S-3 Site. Alternative S3-3 would also require construction of wetlands at NT 1 and NT-2 for additional treatment. Appropriate institutional and engineering controls would be implemented throughout remediation activities to protect the community, workers, and the environment.

An increase in traffic would result from implementation of all action alternatives. Increased traffic would include trucks, heavy equipment, and privately owned vehicles. Most of the heavy traffic would likely occur on Bear Creek Road within fenced areas of DOE property and would not affect the public.

Alternatives S3-2 and S3-3 would have moderately significant adverse impacts during remediation, especially to surface water quality and aquatic habitat, because of short-term sediment loading to Bear Creek from excavation and construction activities. Control measures would reduce but not eliminate this loading, and short-term impacts to the habitat of the *Tennessee dace* would be possible. Surface water would be monitored during remediation to assess potential remedial impacts to the water.

During earthwork and construction activities, sediment deposition into Bear Creek and its tributaries would be controlled under all alternatives so that only minor short-term effects to water quality would occur. Erosion control measures may include surface grading; emplacement of riprap and silt fences; covering surfaces with straw, mulch, riprap, or geotextile fabrics; and using riprap in areas of high water velocity. After completion of all construction and excavation, disturbed areas would be regraded with clean backfill and revegetated.

Implementability

The no-action alternative does not require implementation, because no remedial action would be taken.

Alternatives S3-4 and S3-5 are excluded from evaluation under this criterion due to the failure of these alternatives to meet the threshold criterion of ARARs compliance.

All action alternatives are technically feasible to implement using conventional equipment and construction methods. The site can be easily accessed using existing roads. Virtually all services and materials required for the implementation of all the action alternatives are standard for the construction industry and will be readily available. All action alternatives are considered to be administratively feasible, with no known barriers to implementation.

All action alternatives would utilize remedial action technologies that are technically feasible to implement, including mechanical excavation, collection trenches and/or extraction wells for groundwater, ex situ or in situ water treatment, solids dewatering, access and use restrictions, and

monitoring. The passive in situ treatment of shallow groundwater under Alternatives S3-2 and S3-3 utilizes conventional, proven unit operations. The use of constructed wetlands, as in Alternative S3-3, for the treatment of nitrate and cadmium is also a proven treatment method.

Services and materials required for implementation of all action alternatives at the S-3 Site would be readily available.

Cost

Cost estimates associated with remedial actions conducted for the S-3 Site Pathway 3 are summarized in Table 2.13, including the present worth capital cost, present worth O&M cost, and total present worth cost. Estimated costs for Alternative S3-2 are lower than those for Alternative S3-3 by approximately 34%. Alternatives S3-4 and S3-5 are excluded from evaluation under this criterion due to the failure of these alternatives to meet the threshold criterion of ARAR compliance, but would be estimated to have significantly higher costs.

Table 2.13. Present worth cost estimates for S-3 Site Pathway 3 remedial action alternatives

Alternative	Present worth cost ($1,000–based on 1997 dollars)		
	Capital cost	O&M cost	Total cost
S3-1, No Action	0	0	0
S3-2, Passive In Situ Treatment Trench	2,345	3,502	5,847
S3-3, Passive In Situ Treatment Trench & Constructed Wetland	3,537	5,257	8,794
S3-4, Pump & Treat	NA	NA	NA
S3-5, NT-1 Collection and Ex Situ Treatment	NA	NA	NA

NA - Costs not included due to failure to meet threshold criterion of ARAR compliance.

Under all action alternatives, costs associated with continuing maintenance of the existing cover system at the S-3 Site are not included in these estimates. This system would be maintained in accordance with the approved RCRA closure and post-closure plans.

State Acceptance

The no-action alternative would not be protective of human health and the environment and would not achieve desired RAOs for Bear Creek Valley. Therefore, the no-action alternative would not be acceptable to the state. TDEC has indicated favorable acceptance of the preferred alternative presented in

the proposed plan and Alternative 5 in the FS; these alternatives both utilize the passive, in situ treatment trench described under Alternative S3-2. Favorable acceptance was also given for Alternative S3-3, which uses similar treatment methods as Alternative S3-2.

Community Acceptance

A public comment period to request stakeholder input on the proposed plan (DOE 1998a) was conducted from June 16, 1998, to July 30, 1998, and extended to August 13, 1998. Public comments generally were most supportive of the proposed plans preferred alternative and Alternative 5 in the FS, which utilize passive in situ treatment technology for the S-3 Site, equivalent to Alternative S3-2. However, some stakeholders indicated a preference for Alternative 10 in the FS, which includes no actions at the S-3 Site, due to the lower costs (i.e., it was by far the least expensive action alternative evaluated in detail in the FS).

The Citizen Advisory Panel of the Local Oversight Committee also has endorsed the preferred alternative presented in the proposed plan, which contains remedial actions for the S3 Site Pathway 3 equivalent to Alternative S3-2. All action alternatives for the S-3 Site would be consistent with the recommendations of the ORR EUWG of the SSAB regarding the end use of land areas within the Bear Creek Valley.

Summary

Based on the above nine criteria analysis, Alternative S3-2 is the selected alternative for the S-3 Site Pathway 3.

Boneyard/Burnyard

The following discussion evaluates each of the remedial alternatives for the Boneyard/Burnyard presented relative to the other alternatives. A summary of the cross-walk between these alternatives for the Boneyard/Burnyard and the site-wide alternatives evaluated in the FS and proposed plan are shown in Table 2.14.

Results of the comparative analysis of remedial measures for the Boneyard/Burnyard with respect to the CERCLA evaluation criteria are discussed below and summarized in Table 2.15.

Table 2.14. Boneyard/Burnyard alternatives summary

Boneyard/Burnyard alternative number	Description of remedial measures for Boneyard/Burnyard	Cross-walk with site-wide alternatives in FS and proposed plan
BY-1	No Action	No Action
BY-2	Partial Excavation and Disposal in On-site Facility; Hydraulic Isolation	5a, 5b, 7, Preferred Alternative
BY-3	Partial Excavation and On-site Consolidation under Cap; Hydraulic Isolation	3, 10
BY-4	Complete Excavation and Disposal in On-site Facility	5c
BY-5	Cap-in-place, with Surface Water Collection and Ex Situ Treatment	9

Overall Protection of Human Health and the Environment

The no-action alternative will not protect human health or the environment because no remedial activities would be implemented, and current controls would not be maintained. While current risks to off-site receptors may not exceed permissible levels, predictive modeling indicates that concentrations of contaminants in groundwater and surface water would be likely to increase if no remedial actions are taken. Since current administrative and engineering controls would not be maintained, hypothetical future receptors could come into direct contact with high levels of contamination in the Boneyard/Burnyard.

All action alternatives would provide institutional controls, engineering controls, treatment, containment, or removal and disposal of waste and contaminated soils to protect human health and the environment. All action alternatives include requirements for continued monitoring and maintenance activities and for administrative controls to restrict site access and land use. Under all action alternatives, the Boneyard/Burnyard area would require long-term monitoring, surveillance, and maintenance to ensure the protection of workers in this area.

During the implementation of remedial actions, all action alternatives would involve increased short-term risks to remediation workers, the community, and the environment. In each case, appropriate institutional and engineering controls (e.g., physical barriers, administrative controls, dust suppression) would be implemented to protect the community, workers, and the environment. Short-term risks during the implementation of all action alternatives would be within acceptable limits.

CERCLA criteria	Alternative BY-1 No Action	Alternative BY-2 (Selected Alternative) Partial Excavation and Disposal in On-Site Facility & Hydraulic Isolation	Alternative BY-3 Partial Excavation and On-Site Consolidation Under Cap & Hydraulic Isolation	Alternative BY-4 Complete Excavation and Disposal in On-Site Facility	Alternative BY-5 Cap-in-Place with Surface Water Collection and Ex-Situ Treatment
Overall protection of human health and the environment	Not protective	Protective – achieves all unit-specific RAOs; achieves site-wide RAOs, in combination with actions for S-3 Site. Removal of primary source areas for permanent disposal in on-site disposal facility eliminates direct exposure and contaminant flux to groundwater and surface water. Uranium flux to Bear Creek from Boneyard/Burnyard reduced by ~90%.	Protective – achieves all unit-specific RAOs; achieves site-wide RAOs, in combination with actions for S-3 Site. Removal of primary source areas for on-site consolidation and capping reduces direct exposure and contaminant flux to groundwater and surface water. Uranium flux to Bear Creek from Boneyard/Burnyard reduced by ~90%.	Protective – achieves all unit-specific RAOs; achieves site-wide RAOs, in combination with actions for S-3 Site. Removal of all contaminated materials for permanent disposal in on-site disposal facility reduces direct exposure and contaminant flux to groundwater and surface water. Uranium flux to Bear Creek from Boneyard/Burnyard reduced by ~99%.	Protective – partially achieves unit-specific RAOs; achieves site-wide RAOs, in combination with actions for S-3 Site. Capping of source areas reduces direct exposure. Surface water collection at NT-3 reduces contaminant flux to Bear Creek. Uranium flux to Bear Creek from Boneyard/ Burnyard reduced by ~60%. Reductions in streamflow at NT-3 due to surface water collection for active ex-situ treatment may result in adverse ecological impacts.
Compliance with ARARs	Does not meet ARARs.	Meets all ARARs.	Meets all ARARs	Meets all ARARs.	Does not attain ARARs – exceedance of AWQC for mercury at NT-3 will continue.
Long-term effectiveness	Not effective	Primary source areas removed for permanent disposal in on-site facility. Contribution to risk at exposure point significantly and reliably reduced. Effective long-term isolation of residual material if cap is maintained; cap requires long-term maintenance.	Primary source areas removed for consolidation and capping. Contribution to risk at exposure point significantly and reliably reduced. Effective long-term isolation of residual material if cap is maintained; cap requires long-term maintenance.	All contaminated materials excavated for permanent disposal in on-site facility. Contribution to risk at exposure point significantly and reliably reduced	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance
Reduction in toxicity, mobility and volume through treatment	No treatment, no reduction	No treatment. Primary source areas removed for permanent disposal in on-site engineered facility to reduce contaminant mobility. Engineered controls for on-site disposal facility include liners and leachate collection system. Capping reduces potential for runoff and leachate generation from residual material.	No treatment. Primary source areas removed for on-site consolidation under new cap to reduce contaminant mobility. Capping reduces potential for runoff and leachate generation from residual material.	No treatment. All contaminated materials excavated for permanent disposal in on-site facility to reduce contaminant mobility.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Short-term effectiveness	N/A - no remedial actions conducted	Protective of public. Increased construction risk to remediation workers during implementation of excavation, on-site disposal, and hydraulic isolation components.	Protective of public. Increased construction risk to remediation workers during implementation of excavation, capping, and hydraulic isolation components.	Protective of public. Increased construction risk to remediation workers during implementation of more extensive excavation and disposal operations.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Implementability	N/A - no remedial actions conducted	Waste excavation, capping, and hydraulic isolation measures moderately easy to implement. Design and construction of on-site disposal facility underway. No administrative barriers expected.	Waste excavation, capping, and hydraulic isolation measures moderately easy to implement. No administrative barriers expected.	Waste excavation moderately easy to implement; more extensive waste excavation required than other alternatives. Design and construction of on-site disposal facility underway. No administrative barriers expected.	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Cost (Present Worth) ($1000, 1997 dollars) Capital O&M Total	N/A - no remedial actions conducted	$ 15,420 $ 211 $ 15,631	$ 9,882 $ 220 $ 10,102	$ 44,128 $ 0 $ 44,128	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
State acceptance	Unacceptable	Acceptable	Unacceptable	Acceptable	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.
Community acceptance	Unacceptable	Acceptable	Undetermined	Undetermined	Not evaluated for this criterion, due to failure to meet threshold criterion of ARARs compliance.

ARAR = applicable or relevant and appropriate requirement
AWQC = ambient water quality criteria
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
N/A = not applicable
NT = north tributary
O&M = operation and maintenance
RAO = Remedial Action Objective

All action alternatives include remedial measures designed to reduce the potential for direct exposure to, or migration of, contaminants at the Boneyard/Burnyard. Buried waste at this site in contact with shallow groundwater is a primary contributor of uranium contamination to Bear Creek via NT-3. Approximately 70% of the uranium contamination in Bear Creek at the integration point is attributed to this source. Contaminants from this source are released via discharge from shallow groundwater at the site into NT-3.

Alternative BY-4 would include excavation of all contaminated material from the Boneyard/Burnyard for permanent disposal. The removal of these materials would be predicted to reduce the flux of uranium from this source to Bear Creek by approximately 99%.

Under Alternative BY-2, the primary source areas at the Boneyard/Burnyard (i.e., areas of elevated contamination in contact with shallow groundwater) would be excavated for disposal in the ORR on-site disposal facility. Alternative BY-3 also would require excavation of primary source materials at the Boneyard/Burnyard, but these materials would be consolidated beneath a multilayer cap. In each case, contaminated soils and sediments in the floodplain of Bear Creek and NT-3 would also be excavated, and a cap would be installed over source areas not previously capped or removed. The removal of the primary source material that is in contact with shallow groundwater would be estimated to reduce the flux of uranium to Bear Creek from this source by approximately 90%.

Under Alternative BY-5, no excavation of source areas at the Boneyard/Burnyard would be conducted. Instead, a multilayer cap designed to reduce infiltration of precipitation into the buried wastes would be constructed over this area. Contaminated soils and sediments in the floodplain would be excavated and consolidated under this cap. This alternative also includes collection of surface water from NT-3 for treatment at a new waste water treatment facility to reduce flux of contaminants into Bear Creek; no other alternatives include collection and treatment of groundwater or surface water at the Boneyard/Burnyard. These actions would be estimated to reduce the flux of uranium from the Boneyard/Burnyard to Bear Creek by approximately 60%. Although the new cap may reduce infiltration rates up to 95%, much of the buried waste would still remain in contact with groundwater. Reduction of base stream flow in NT-3 and Bear Creek due to the collection of surface water from NT-3 may result in adverse impacts to aquatic systems in this area. No other action alternatives would be expected to contribute to significant reductions in stream flow and resulting adverse impacts to aquatic habitat.

Compliance with ARARs

Pursuant to EPA guidance, there are no ARARs for the no-action alternative. With no further action, release of contaminants would be expected to exceed water quality standards for certain receiving surface waters. Moreover, the condition of the caps and covers at waste units in the vicinity of the Boneyard/Burnyard (Hazardous Chemicals Disposal Area, Oil Landfarm, Sanitary Landfill-1) will continue to deteriorate, ultimately resulting in failure of containment systems and increased releases to surface water and groundwater.

Alternatives BY-2, BY-3, and BY-4 would comply with all chemical-specific ARARs and TBCs at the Boneyard/Burnyard, including meeting AWQC for recreational use and protection of aquatic organisms in all surface waters downstream of the Boneyard/Burnyard. Characterization data for the Boneyard/Burnyard area indicate a possible exceedance of AWQC for mercury in NT-3. Source removal actions under Alternatives BY-2, BY-3 and BY-4 would be expected to reduce mercury concentrations in NT-3 to attain the AWQC.

Under Alternative BY-5, this possible exceedance of AWQC for mercury and risk-based criteria for uranium in NT-3 may continue, since contaminated materials would not be removed, but only isolated under a new cap. Since other protective alternatives would attain all ARARs and there appears to be no appropriate basis to invoke a waiver, Alternative BY-5 is eliminated from further consideration on the basis of the threshold criterion of ARARs compliance.

Compliance with location-specific ARARs and TBCs would be similar for all remaining action alternatives. All construction activities with the potential to affect Bear Creek and its tributaries would be designed and conducted using best management practices, including erosion and siltation controls to meet requirements for aquatic resource alteration activities. All action alternatives would impact wetlands in the Boneyard/Burnyard area and involve construction activities within the 100-year floodplain of Bear Creek; any adverse impacts to wetlands and floodplain areas would be minimized and mitigated in accordance with identified requirements. No federal- or state-listed threatened or endangered species would be impacted by any alternative, and none of the three state-listed rare plant species or the single state "species in need of management" would suffer adverse long-term effects from any of the alternatives. No known historical, cultural, or archaeological resources would be adversely impacted by any alternative.

All activities conducted under all remaining action alternatives would comply with action-specific ARARs, including control of fugitive dust emissions, construction and excavation standards, surface water controls, and appropriate management of waste streams (e.g., waste generation, treatment, storage, closure, transportation, and disposal requirements).

DOE requirements for radiation protection of the public and the environment (e.g., DOE Order 5400.5) will be met as TBCs under all action alternatives, including requirements to maintain radiation exposures ALARA. Similarly, occupational worker protection requirements under 10 *CFR* 835 and 29 *CFR* 1910 will be met under all action alternatives.

Long-term Effectiveness and Permanence

The no-action alternative would not be effective in the long term because it would not remediate contaminated media that may present a risk to human health and the environment. All action alternatives would rely to some extent on institutional controls at the Boneyard/Burnyard, including continuing access and use restrictions and continuing surveillance and maintenance programs. All action alternatives leave varying quantities of waste in place and would be effective in reducing the residual risks to potential receptors under alternative-specific remedial action goals.

Alternative BY-5 is excluded from evaluation under this criterion due to the failure of this alternative to meet the threshold criterion of ARAR compliance.

All remaining action alternatives would excavate the source areas in the Boneyard/Burnyard, which are the greatest current contributors to risk in the watershed. Only Alternative BY-4 would remove all contaminated materials from the entire Boneyard/Burnyard, providing the most effective long-term isolation of these materials. ORR on-site disposal facility provides the most reduction of mobility and is more permanent than capping because of the existence of engineered controls (i.e., liners and leachate collection system).

Long-term environmental effects at the Boneyard/Burnyard would be similar for all action alternatives. All action alternatives would include excavation of contaminated soil and sediment from the floodplain of Bear Creek and NT-3 for disposal or on-site consolidation and capping.

No critical habitats of threatened or endangered species would be directly affected under any alternative. Integrity of engineered caps at the Boneyard/Burnyard would be ensured over the long term by proper surveillance and maintenance under all action alternatives.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The no-action alternative does not include treatment and would not result in a reduction of toxicity, mobility, or volume of contaminants.

Alternative BY-5 is excluded from evaluation under this criterion due to the failure of this alternative to meet the threshold criterion of ARARs compliance.

All remaining action alternatives include excavation of the primary contaminant source areas at the Boneyard/Burnyard (only Alternative BY-4 would include excavation of the entire Boneyard/Burnyard) and contaminated soils and sediments in the floodplain of Bear Creek and NT-3. Excavated materials would be disposed of in the ORR on-site disposal facility under Alternatives BY-2 and BY-4, or consolidated and capped on-site under Alternative BY-3. All materials for disposal at the ORR on-site disposal facility would be treated, if necessary, to meet waste acceptance criteria. ORR on-site disposal facility provides the greatest reduction of mobility as a result (liners and leachate collection system).

No remaining action alternatives include collection and treatment of groundwater or surface water at the Boneyard/Burnyard.

Short-term Effectiveness

Short-term effectiveness criteria are not applicable to the no-action alternative, since no remedial measures would be taken. There would be no increase in short-term risks to workers or the community and no short-term environmental impacts. There would be no short-term unavoidable adverse impacts to humans, the environment, socioeconomics, or cultural resources as a result of construction activities. Noise levels would remain unchanged and there would be no cumulative impacts from construction activities.

Alternative BY-5 is excluded from evaluation under this criterion due to the failure of this alternative to meet the threshold criterion of ARAR compliance.

All remaining action alternatives would incorporate appropriate institutional and engineering controls (e.g., physical barriers, administrative controls, dust suppression) to protect the community, workers, and the environment during implementation of remedial actions.

The duration for implementation of remedial action activities under the action alternatives is estimated to range from approximately 5 to 6 years. Under all action alternatives, remedial actions would be initiated within 15 months after approval of the ROD.

All remaining action alternatives would remove the primary source areas in the Boneyard/Burnyard, which are the greatest current contributors to human health risk in the Bear Creek Valley watershed. Remedial workers would be exposed to risk for all alternatives during excavation and waste handling activities because of the increased potential for physical contact with the waste and inhalation of suspended particulates. This risk would be greatest for Alternative BY-4 because of the more extensive excavation at the Boneyard/Burnyard; short-term risks to remediation workers for Alternatives BY-2 and BY-3 would be lower and similar in magnitude.

During the implementation of remedial actions, all action alternatives would involve increased short-term risks to remediation workers, the community, and the environment. In each case, appropriate institutional and engineering controls (e.g., physical barriers, administrative controls, dust suppression) would be implemented to protect the community, workers, and the environment. Alternative BY-4 would involve the greatest short-term risks to remediation workers due to the larger volume of wastes to be excavated and disposed. Short-term risks to remediation workers during excavation, disposal, and capping operations would be somewhat lower under Alternatives BY-2 and BY-3. However, short-term risks during the implementation of all action alternatives would be within acceptable limits.

Installation of a new cap at the Boneyard/Burnyard would require the same special health and safety measures for all action alternatives except Alternative BY-4, where the entire Boneyard/Burnyard would be excavated. Appropriate mitigative measures would be used during construction and transportation to attain applicable requirements for protection of workers and public health. By planning and conducting all remediation activities in accordance with applicable codes and standards, best management practices, DOE directives and policies (including the requirement to reduce radiation exposures to workers and the public ALARA), risks from contaminant exposure would be controlled to acceptable levels.

An increase in traffic in the Boneyard/Burnyard area would result from implementation of all action alternatives. Increased traffic would include trucks, heavy equipment, and privately owned vehicles. Most of the heavy traffic would likely occur on Bear Creek Road within fenced areas of DOE property and will not affect the public.

All action alternatives would involve the short-term disturbance of vegetation and wildlife habitat in the areas where remedial actions would be conducted. All action alternatives could result in moderately adverse impacts to surface water quality and aquatic habitat because of short-term sediment loading to Bear Creek from excavation activities. However, appropriate control measures would be implemented to minimize and mitigate such short-term impacts, and over the longer term, all action alternatives would be predicted to have a beneficial impact on surface water quality.

The short-term disturbance of vegetation and wildlife habitat would be greatest under Alternative BY-4, where the entire Boneyard/Burnyard area would be excavated. Alternatives BY-2 and BY-3 would have somewhat less adverse impacts during remediation; however, surface water quality and aquatic habitat may be impacted due to the short-term sediment loading to Bear Creek from excavation in the floodplain area at the Boneyard/Burnyard.

During earthwork and construction activities, sediment deposition into Bear Creek and its tributaries would be controlled under all action alternatives so that only minor short-term effects to water quality would occur. Erosion control measures would include surface grading; emplacement of riprap and silt fences; covering surfaces with straw, mulch, riprap, or geotextile fabrics; and using riprap in areas of high water velocity. After completion of all construction and excavation activities, disturbed areas would be regraded with clean backfill and revegetated. Surface water would be monitored during remediation to assess potential impacts.

Implementability

The no-action alternative does not require implementation, because no remedial action would be taken.

Alternative BY-5 is excluded from evaluation under this criterion due to the failure of this alternative to meet the threshold criterion of ARAR compliance.

All action alternatives are technically feasible to implement using conventional equipment and construction methods. The site can be easily accessed using existing roads. Virtually all services and materials required for the implementation of all the action alternatives are standard for the construction industry and will be readily available. All action alternatives are considered to be administratively feasible, with no known barriers to implementation.

All action alternatives would utilize remedial action technologies at the Boneyard/Burnyard that are technically feasible to implement, including mechanical excavation, storm flow diversion, surface water and sedimentation controls, capping, solids dewatering, site restoration, access and use restrictions, and monitoring. Excavation of Boneyard/Burnyard waste under Alternatives BY-2, BY-3, and BY-4 would be moderately difficult to implement because of the working conditions caused by the unstable substrate (saturated waste). Extensive earthwork in floodplain sediment must be conducted in a manner to minimize sediment loading to the creek, and may require the temporary rerouting or diversion of Bear Creek and/or NT-3. Access to the site is readily available under all alternatives.

All action alternatives are also considered to have favorable administrative feasibility, with no known administrative barriers to implementation. All action alternatives would be expected to have some adverse impacts on wetlands in the area; mitigation of wetlands impacts is planned on a watershed-wide basis. All action alternatives would involve construction activities in the 100-year floodplain of Bear Creek and NT-3.

Services and materials required for implementation of all action alternatives in the Boneyard/Burnyard would be readily available.

Cost

Costs estimates for remedial action alternatives for the Boneyard/Burnyard are summarized in Table 2-16, including the present worth capital cost, present worth O&M cost, and total present worth cost. Estimated costs would be highest under Alternative BY-4, due to the larger volume of waste requiring excavation and disposal. All excavated waste and surface debris will be disposed of in the on-site disposal facility at a unit rate of $\$200/yd^3$.

Table 2.16. Present worth cost estimates for Boneyard/Burnyard remedial action alternatives

Alternative	Present Worth Cost ($1,000 – based on 1997 dollars)		
	Capital Cost	O&M Cost	Total Cost
BY-1, No Action	0	0	0
BY-2, Partial Excavation and Disposal in On-Site Cell; Hydraulic Isolation	15,420	211	15,631
BY-3, Partial Excavation and On-Site Consolidation under Cap; Hydraulic Isolation	9,882	220	10,102
BY-4, Complete Excavation and Disposal in On-Site Cell	44,128	0	44,128
BY-5, Cap-in-place, with NT-3 Collection and Treatment	NA	NA	NA

NA = Costs not evaluated due to failure to meet threshold criterion of ARAR compliance.

Alternatives BY-2 and BY-3 are estimated to have similar present worth costs. These alternatives both involve excavation of primary source materials at the Boneyard/Burnyard, but differ in the disposition of these materials (i.e., in the on-site disposal facility under Alternative BY-2 and on-site consolidation beneath a newly constructed multilayer cap for Alternative BY-3). In both cases, additional floodplain soils and surface debris would be consolidated and capped on site. For Alternative BY-2 this would be a clay cap and for Alternative BY-3 a multilayer cap would be used. Only those wastes to be disposed at the ORR on-site disposal facility are assumed to require treatment to meet facility waste acceptance criteria, and no treatment for other wastes is assumed.

Costs for Alternative BY-5 are not evaluated due to the failure of this alternative to meet the threshold criterion of ARARs compliance, but would be estimated to be lower than that for Alternative BY-4 but significantly higher than costs for Alternatives BY-2 or BY-3.

State Acceptance

The no-action alternative would not be protective of human health and the environment and would not achieve RAOs for the Bear Creek Valley. Therefore, the no-action alternative would not be acceptable to the state.

TDEC has indicated favorable acceptance of the selected alternative presented in the proposed plan and Alternative 5 presented in the FS (particularly for Subalternative 5c, which involves the excavation and permanent disposal of the greatest quantities of contaminated materials from the Boneyard/Burnyard and the Bear Creek Burial Grounds). These alternatives are both equivalent to Alternative BY-2 with

respect to remedial actions for the Boneyard/Burnyard. TDEC has indicated that alternatives that leave primary source material in the Boneyard/Burnyard are not acceptable (BY-3 and BY-5).

Community Acceptance

A public comment period to request stakeholder input on the proposed plan (DOE 1998a) was conducted from June 16, 1998, to July 30, 1998, and extended to August 13, 1998. Public comments generally were most supportive of the proposed plan's preferred alternative and Alternative 5 of the FS. These site-wide alternatives both include the excavation of primary source materials at the Boneyard/Burnyard in combination with hydraulic isolation measures, and are equivalent to Alternative BY-2 of this document. However, some stakeholders indicated a preference for Alternative 10 of the FS, due to the lower costs (i.e., it was by far the least expensive action alternative evaluated in detail in the FS); this alternative would call for excavation of primary source materials at the Boneyard/Burnyard for on-site consolidation under a RCRA cap, equivalent to Alternative BY-4 of this analysis.

The Citizen Advisory Panel of the Local Oversight Committee also has endorsed the preferred site-wide alternative presented in the Proposed Plan, which contains remedial actions for the Boneyard/Burnyard equivalent to Alternative BY-2. All action alternatives for the Boneyard/Burnyard would be consistent with the recommendations of the ORR EUWG of the SSAB regarding the end use of land areas within the Bear Creek Valley.

Summary

Based on the above nine criteria analysis, Alternative BY-2 is the selected alternative for Boneyard/Burnyard.

Additional NEPA Values

As noted previously, DOE policy (DOE 1994) requires the incorporation of NEPA values within the CERCLA process for review of actions conducted under CERCLA. In large measure, NEPA values are similar to the CERCLA evaluation criteria discussed above. Analysis of additional NEPA values for each alternative is presented in the FS (DOE 1997b), primarily under the discussions of "long-term effectiveness and permanence" and "short-term effectiveness" in the comparative analysis. The results of this analysis are summarized below.

No irretrievable commitment of resources would directly result from implementation of the no-action alternative; however, under the no-action alternative, covers and caps over waste source areas may degrade over time to expose buried wastes, leading to degradation of aquatic and terrestrial habitat. All action alternatives would require the irretrievable commitment of the land areas set aside for waste disposal within each functional area that would not be available for other uses. Fossil fuels and other nonrenewable energy sources would be consumed during the conduct of the remedial actions, and construction materials would be consumed (e.g., clay and liner materials for caps, riprap).

Wetland areas may be adversely impacted under all action alternatives, but such impacts would be mitigated to the extent practicable, and wetlands would be relocated where appropriate. Adverse impacts from habitat degradation during excavation and construction activities in the Bear Creek floodplain and elsewhere, excavation of trenches, cap construction, and installation of wells would not be permanent. Potential adverse impacts from alteration of aquatic habitat in tributaries may be permanent.

No unacceptable noise impacts would be expected from implementation of any alternative.

No identified archaeological sites, historic structures listed in (or eligible for listing in) the National Register of Historic Places, or cultural resources would be adversely impacted by implementing any of the alternatives.

None of the alternatives would be expected to significantly alter the socioeconomics of the area. The remedial actions would be conducted by DOE's contractors, primarily using members of the local labor force. Under all alternatives, land use in the vicinity of waste disposal areas and the primary Y-12 Plant complex (Zone 3) would continue to be restricted to controlled industrial use. While the areas in Zone 1 and Zone 2 would be suitable for recreational and/or residential use after implementation of remedial actions under the various action alternatives, DOE currently has no plans to release any of these areas.

The cumulative effects of the action alternatives would depend on the timing and location of other activities at the Y-12 Plant and the ORR; while it is possible that increases in traffic, noise, and other actions with similar effects that may be conducted in the same area and timeframe, significant cumulative impacts have not been identified. While any impacts on terrestrial and aquatic habitat that might result from the remedial actions would be added to habitat losses and degradation from other activities at the Y-12 Plant and ORR, these impacts are not expected to be significant.

No adverse impacts with respect to environmental justice have been identified for any of the alternatives. The site is located within the DOE ORR and the City of Oak Ridge. The surrounding area includes mixed residential and commercial developments, and is not predominantly occupied by minority or low-income populations.

SELECTED REMEDY

DOE, with EPA and TDEC concurrence, has selected a remedy for the Phase I remediation in the Bear Creek Valley watershed. This remedy appears to offer the best balance of CERCLA evaluation criteria and an appropriate level of protection of human health and the environment, compliance with ARARs, and cost-effectiveness. The selected remedy includes base actions for soils stored at the DARA Solids Storage Facility and Oil Landfarm Soils Containment Pad. These soils will be removed for off-site commercial disposal, and the DARA and Oil Landfarm Storage Facilities will be decontaminated and dismantled. Table 2.17 summarizes the components of the selected remedy.

Table 2.17. Major components of selected remedy for each functional area

Functional area	Remedial actions
S-3 Site	Install trench at NT-1 for passive in situ treatment of shallow groundwater.
Oil Landfarm Area	Excavate source areas in Boneyard/Burnyard and contaminated floodplain soils and sediments, for on-site disposal of excavated materials meeting waste acceptance criteria of the ORR on-site disposal facility* and off-site disposal of materials exceeding these waste acceptance criteria. Remove waste stored in Oil Landfarm Soil Containment Pad for commercial off-site disposal and dismantle structure. Install clay cap over uncapped disposal areas at Boneyard/Burnyard; maintain existing caps. Implement hydraulic isolation measures at Boneyard/Burnyard, including reconstruction of NT-3, elimination of stagnation points, and installation of drains or well points.
Other	Remove waste stored in DARA facility for off-site commercial disposal and dismantle structure.

*These wastes are assumed to be disposed of at the ORR on-site disposal facility. In the event that these wastes are determined not to meet the waste acceptance criteria for the facility, an alternative disposal strategy would be developed and documented in accordance with CERCLA requirements.

The selection of this remedy is based on the comparative analysis of alternatives detailed in the FS and the focused analysis and summarized in this ROD. This remedy includes treatment and/or containment technologies as well as institutional controls to meet the remedial objectives and satisfy the statutory preference for actions that use treatment to reduce toxicity, mobility, or volume. Finally, this

remedy meets the end-use criteria recommended for Bear Creek Valley by the ORR Environmental Management SSAB.

Table 2.18 summarizes the Phase I remedial actions for each site in Bear Creek Valley listed in Appendix C of the FFA. Remedial activities addressed within the scope of this ROD are summarized in Table 2.18. Table 2.18 summarizes previous actions in Bear Creek Valley and actions deferred to future CERCLA decision documents.

As part of its overall ORR cleanup strategy, DOE has evaluated various disposal alternatives for ORR cleanup wastes under a separate CERCLA project. This evaluation ultimately resulted in the November 1999 FFA tri-party approval of a ROD to construct a large-scale disposal facility on ORR to accept most of the cleanup wastes. The waste material excavated under the actions contained in this ROD are assumed to be disposed of in the on-site Environmental Management Waste Management Facility located in Bear Creek Valley. Excavated materials that meet the waste acceptance criteria of the Environmental Management Waste Management Facility will be disposed at that facility, while materials that exceed these criteria will be sent to a DOE-approved and EPA-licensed off-site disposal facility.

Contaminated groundwater leaving the S-3 Site through Pathway 3 will be treated in place, significantly reducing the migration of contamination from this area. Contaminated soils in storage facilities (i.e., DARA Solids Storage Facility and Oil Landfarm Soil Containment Pad) and contaminated soil in the vicinity of the Boneyard/Burnyard will be excavated for appropriate disposal (e.g., commercial off-site disposal for the DARA and Oil Landfarm waste is assumed, while the materials excavated from the Boneyard/Burnyard are assumed to be disposed at the ORR on-site disposal facility). Maintenance and monitoring will ensure actions perform as intended. The selected remedy will create conditions compatible with the following land uses: Zone 3 as a controlled industrial use area, Zone 2 as a recreational use area, and Zone 1 as an unrestricted use area, although DOE currently has no plans to release land in Bear Creek Valley. The following describes the general design elements and institutional control features of the selected remedy by area. Figure 2.5 illustrates the remedial actions for the selected remedy.

Table 2.18. Summary of remedial actions by site, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Functional area	CERCLA site	Selected remedy
A. Remedial Activities Addressed in this Phase I ROD		
S-3	S-3 Ponds Pathway 3	Passive in-situ groundwater treatment. ARARs (App. A): 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16
OLF	Boneyard/Burnyard Hazardous Chemicals Disposal Area	Boneyard/Burnyard: excavate primary source areas for disposal at proposed on-site disposal facility, and hydraulic isolation. Hazardous Chemicals Disposal Area: not a significant contributor to watershed contamination; tie cap incidental to Boneyard/Burnyard action; and maintain existing cap. ARARs (App. A): 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 21, 24, 25, 31, 32, 36, 37, 38
	OLF	Closed under RCRA in 1989. Maintain existing cap.
	Oil Landfarm Soils Containment Pad	Remove waste for disposal in an approved off-site disposal facility, decontaminate and dismantle building. ARARs (App. A): 2, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 38, 39, 40, 41
	Sanitary Landfill-1	Maintain existing cap.
	Bear Creek Tributary 3 Floodplain Soils/Bear Creek Contaminated Floodplain Soils	This is considered Boneyard/Burnyard waste and not a separate CERCLA site. Refer to Boneyard/Burnyard selected remedy.
Other	DARA Solids Storage Facility	Remove waste for disposal in an approved off-site disposal facility, decontaminate and dismantle building ARARs (App. A): 2, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 38, 39, 40, 41
B. Previous Response Action Decisions (Prior to this ROD)		
S-3	Abandoned nitric acid pipeline	Previous NFA ROD approved
	S-3 Ponds Pathways 1 and 2	Previous action memorandum approved; removal action underway. ARARs (App. A): 1, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16
Other	Spoil Area 1 (Landfill)	Previous ROD approved; continued S&M of access controls and surface cover
	SY-200 Yard	Previous ROD approved; continued S&M of access controls and surface cover
	White Wing Scrap Yard	IROD approved

Table 2.18 (continued)

Functional area	CERCLA site	Selected remedy
	Spoil Area 1 (Landfill)	Previous ROD approved; continued S&M of access controls and surface cover
	SY-200 Yard	Previous ROD approved; continued S&M of access controls and surface cover
C. Response Action Decisions Deferred to Future CERCLA Decision Documents		
S-3	Decant Treatment Facility (S-3 Liquid Treatment Facility)	Not a significant contributor to watershed contamination
	Contaminated construction spoil pile	Not a significant contributor to watershed contamination; to be addressed as routine maintenance action.
Bear Creek Burial Grounds	Oil Retention Pond No. 1 and Oil Retention Pond No. 2	To be addressed in future CERCLA decisions
	Bear Creek Burial Grounds	To be addressed in future CERCLA decisions
	Bear Creek Burial Grounds Groundwater Plume and Bear Creek Groundwater	To be addressed in future CERCLA decisions
Other	Maynardville TCE Groundwater Plume	To be addressed in future CERCLA decisions; monitoring for natural attenuation is ongoing by IWQP.
	White Wing Scrap Yard	To be addressed in future CERCLA decisions
	White Wing Scrap Yard East Creek	To be addressed in future CERCLA decisions
	White Wing Scrap Yard West Creek	To be addressed in future CERCLA decisions

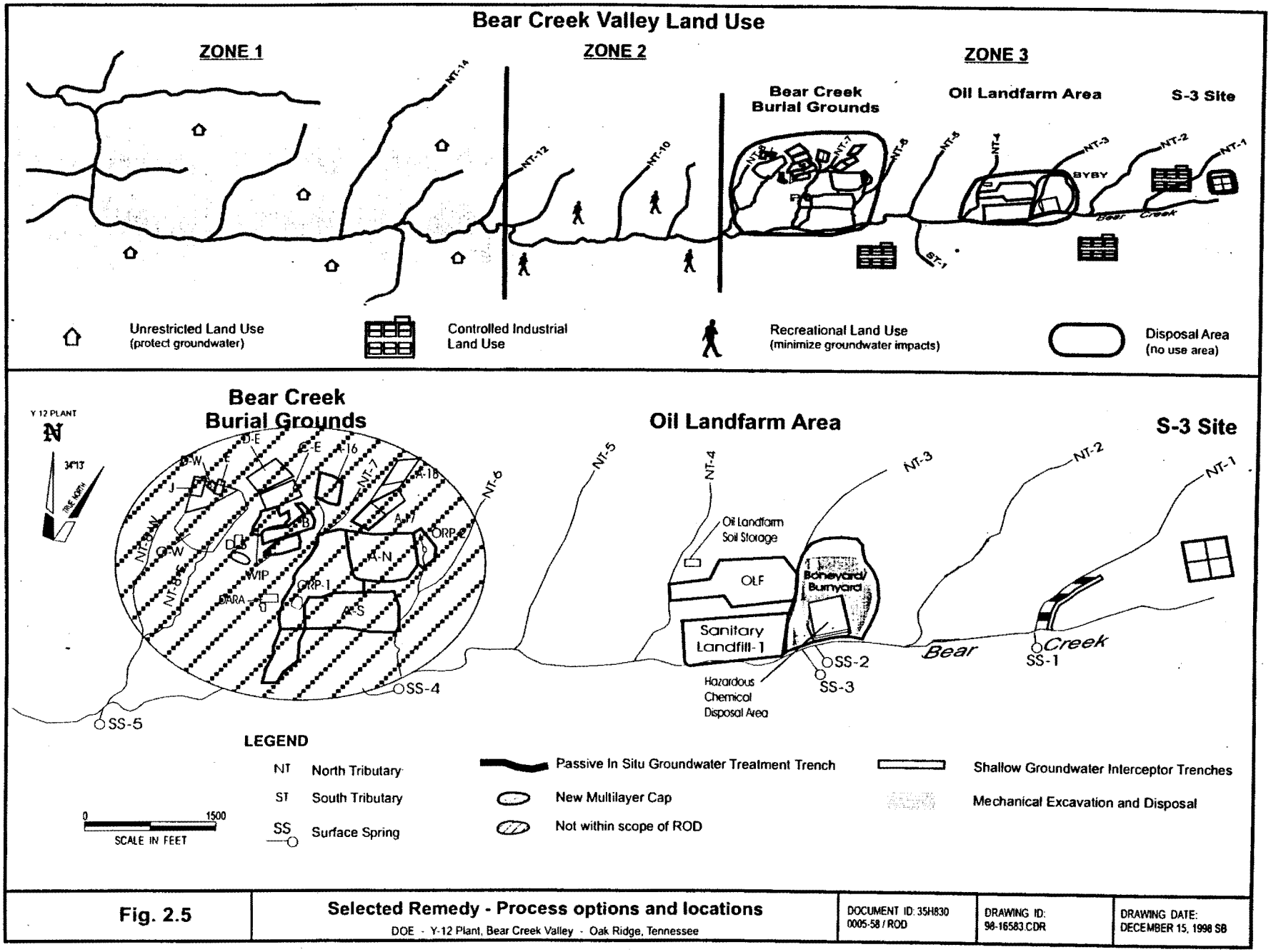


Fig. 2.5	Selected Remedy - Process options and locations DOE - Y-12 Plant, Bear Creek Valley - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0005-58 / ROD	DRAWING ID: 98-16583.CDR	DRAWING DATE: DECEMBER 15, 1998 SB

Table 2.19 presents estimates of the predicted post-action uranium release rates in surface water at the integration point (i.e., at the Zone 3/Zone 2 boundary) and the resulting incremental human health risk to hypothetical future residents at this location under each alternative. Estimated risks under the selected alternative are predicted to meet the remedial goal of 1×10^{-5} incremental lifetime cancer risk at this location.

The estimates of post-remediation uranium release rates and residual risks to human health presented in Table 2.19 reflect the cumulative effectiveness of all remedial measures considered in each alternative in reducing surface water concentrations and potential exposures at the integration point. It is also possible to estimate the relative effectiveness of the remedial actions to be conducted within each functional area under each alternative in achieving the reductions in surface water concentrations at the integration point.

Table 2.19. Alternative risk vs. cost evaluation, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Alternative	Total present worth cost ($M)	Post-action uranium release rate (kg/year) at integration point	Predicted residual risk at integration point	Cost per unit uranium flux reduction ($M)
Current conditions	NA	109	5×10^{-5}	N/A
Selected alternative	21.5*	16.5**	7×10^{-6}	4.7

$ = dollar M = million
Kg = kilogram NA = not applicable
*Excludes base actions at DARA Solids Storage Facility, Oil Landfarm Soils Containment Pad, and site-wide monitoring activities.
**The requirement is to reach 1×10^{-5} residual risk, which equates to 34 kg/yr.

S-3 Site

At the S-3 Site, three primary pathways of contaminant flow have been identified in the shallow groundwater. Pathways 1 and 2 flow through unconsolidated material south and southwest of the former S-3 Ponds, respectively. Both of these pathways discharge contaminants to the main stem of Bear Creek. Pathway 3 moves along strike, discharging contaminated groundwater primarily to a tributary to Bear Creek (i.e., NT-1).

A removal action has been initiated to address Pathways 1 and 2 (DOE 1998b). This action uses passive in situ treatment systems to intercept and treat contaminated groundwater. For Pathway 1, a funnel and gate design has been selected, while Pathway 2 uses a reactive barrier wall design. The passive treatment systems selected for installation under the early action are consistent with the selected

remedy for this ROD. These systems will continue to operate as removal actions for treatment of contaminant releases associated with Pathways 1 and 2.

Contaminated groundwater associated with Pathway 3 upwells primarily into NT-1. Under the selected remedy, the remedial approach for this pathway will use passive in situ treatment technology to address the contaminant releases associated with this groundwater. Primary contaminants at Pathway 3 are nitrate and cadmium. While a reactive barrier utilizing iron metal filing is being selected in this ROD, a modification to utilize other reactive media may be determined during the design of the project. Any change resulting from such a determination will be appropriately documented.

The reactive trench would be constructed parallel to NT-1. The trench would intercept contaminated groundwater before its discharge into the tributary. The collected groundwater would flow through reactive media. Once treated, the water would be discharged to surface water.

OIL LANDFARM AREA

The Oil Landfarm area includes Oil Landfarm, Sanitary Landfill-1, Boneyard/Burnyard, Hazardous Chemical Disposal Area, and Oil Landfarm Soils Containment Pad. The release sites of concern are the Boneyard/Burnyard and Oil Landfarm Soils Containment Pad. Remaining sites in this area have been closed and capped.

Boneyard/Burnyard. The primary source of contaminant migration at the Boneyard/Burnyard is associated with shallow groundwater moving through the waste and discharging to NT-3. The selected remedy will remove and dispose of the primary source areas and hydraulically isolate the remainder of the Boneyard/Burnyard. Primary source areas are defined as those wastes that are leaching uranium (the primary COC) to groundwater because of their high uranium content, their physical nature, and their contact with groundwater. Based on the data presented in the RI and in the Boneyard/Burnyard pre-design study, these source areas are located primarily in the low-lying area in the western portion of the site along NT-3. Figure 2.6, taken from the RI, shows gross alpha concentrations in groundwater and anomalies associated with the geophysical survey of the site. The suspected source areas are concentrated to the northwest of the capped area and are associated with the elevated groundwater contamination and geophysical anomalies as shown on Fig. 2.6. A smaller source area appears at the northern boundary of the site and is also associated with elevated groundwater contamination.

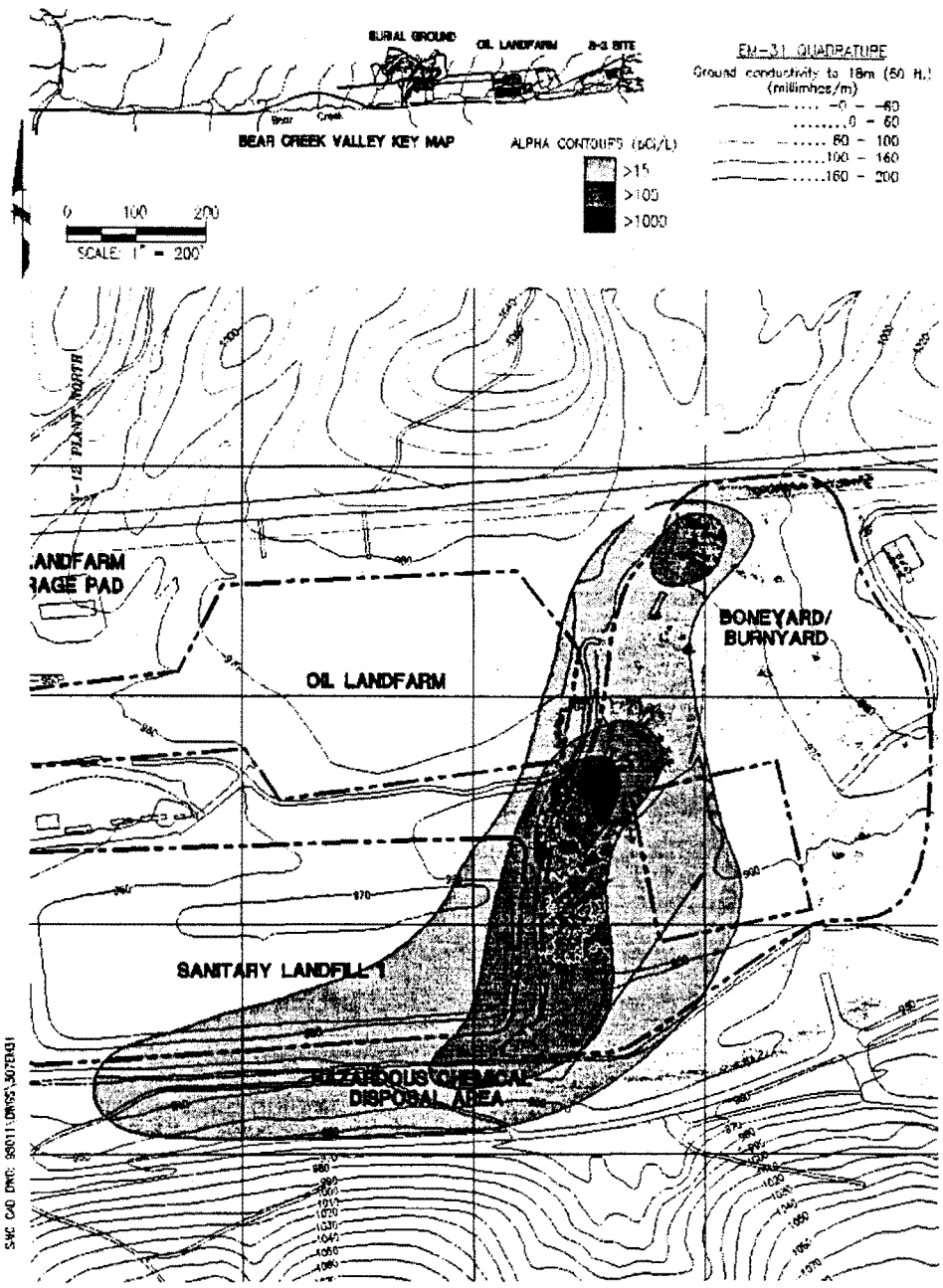


Fig. 2.6

Results of the EM-31 survey, the area underlain by fill material and distribution of the plume of gross alpha - contaminated groundwater

- DOE - Y-12 Plant, Bear Creek Valley - Oak Ridge, Tennessee

DOCUMENT ID: 35H830 00125-43 / WORKPLAN	DRAWING ID: joe-p.CDR	DRAWING DATE: JANUARY 27, 1999

These primary source areas were verified and further delineated in a supplemental characterization of the Boneyard/Burnyard conducted in spring 1998 (DOE 1998c). Figure 2.7 shows the primary source areas as identified in the supplemental investigation. Primary source area material was determined to be visually distinguishable from other soils. This material appears as saturated fill material associated with a dark coloration and ash-like appearance. Excavation of this primary source material will continue until native soil is visually encountered. Based on the supplemental sampling and preliminary design, the estimated volume of this source area material that would require excavation is approximately 36,000 yd^3 (Fig. 2.8).

For the purpose of creating an excavation performance standard in this ROD, primary source areas are defined as ash and ash/soil material which can be visually distinguished as saturated fill material with a dark black color and ash appearance. This material has been determined to be located in areas defined in Fig. 2.8. This ROD authorizes the spatial excavation of primary source material only in those areas defined in Figure 2.8 and as further specified in the Remedial Design document. This ROD also authorizes the excavation of primary source material [including all visually contaminated (stained) native soil material] to the depth of the native soil, plus up to 18 inches of native soil. Any deviations from this performance standard will be discussed and agreed upon by the FFA parties and modifications will be made to this aspect of remedy as appropriate.

Primary source areas will be excavated using conventional excavation equipment (e.g., tracked excavator). Once excavated, this material will be characterized to ensure compliance with the waste acceptance criteria of the ORR on-site disposal facility. Excavated materials that meet the waste acceptance criteria for on-site disposal will be disposed at the on-site facility, while materials that exceed these criteria will be sent to a DOE-approved and EPA-licensed off-site disposal facility. The wastes will be transported by truck to the on-site disposal facility. The excavation areas will be backfilled with high quality clay fill and contoured to promote runoff and reduce any infiltration. A vegetative cover will be established over the backfill to prevent erosion.

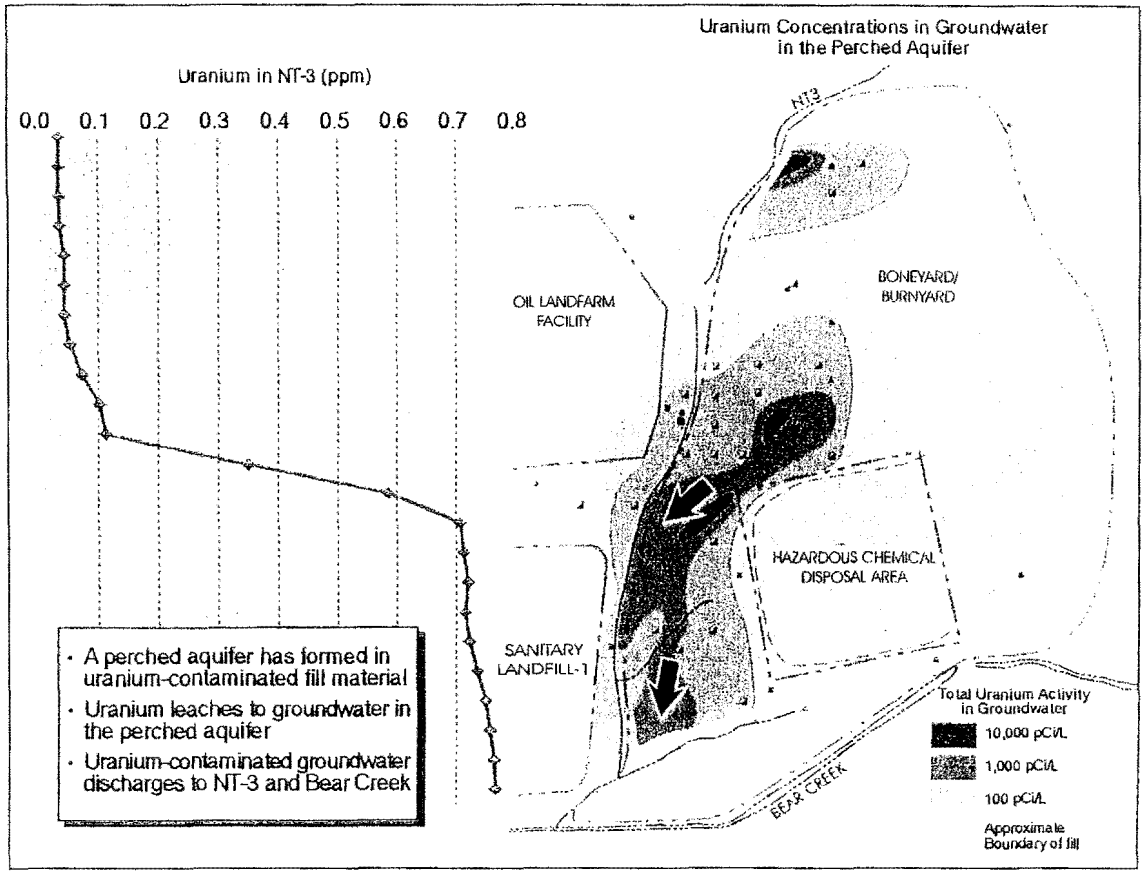
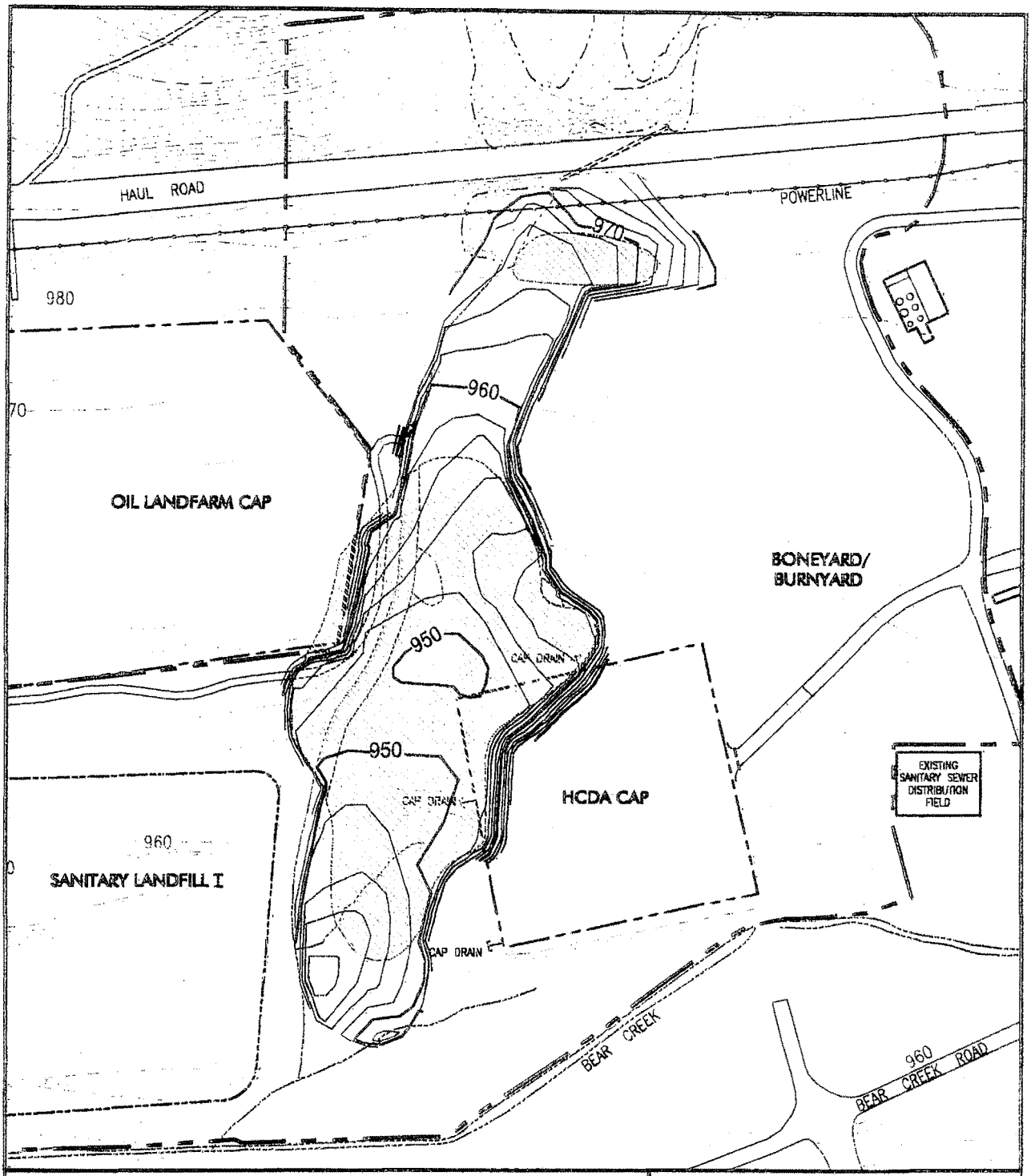


Fig. 2.7

Primary source areas at Boneyard/Burnyard

DOE - Y-12 Plant, Bear Creek Valley - Oak Ridge, Tennessee

DOCUMENT ID: 35H830 4000-99 /	DRAWING ID: joe-p.CDR	DRAWING DATE: JANUARY 27, 1999



LEGEND:

- EXISTING 2' GROUND CONTOUR
- EXISTING 10' GROUND CONTOUR
- PROPOSED EXCAVATION CONTOUR
- CREEK, STREAM, OR TRIBUTARY
- WETLANDS
- WASTE MANAGEMENT AREA
- UNIT 4 AND 5 WASTE MATERIAL

FIG. 2.8

BONEYARD/BURNYARD
PRIMARY SOURCE EXCAVATION AREA

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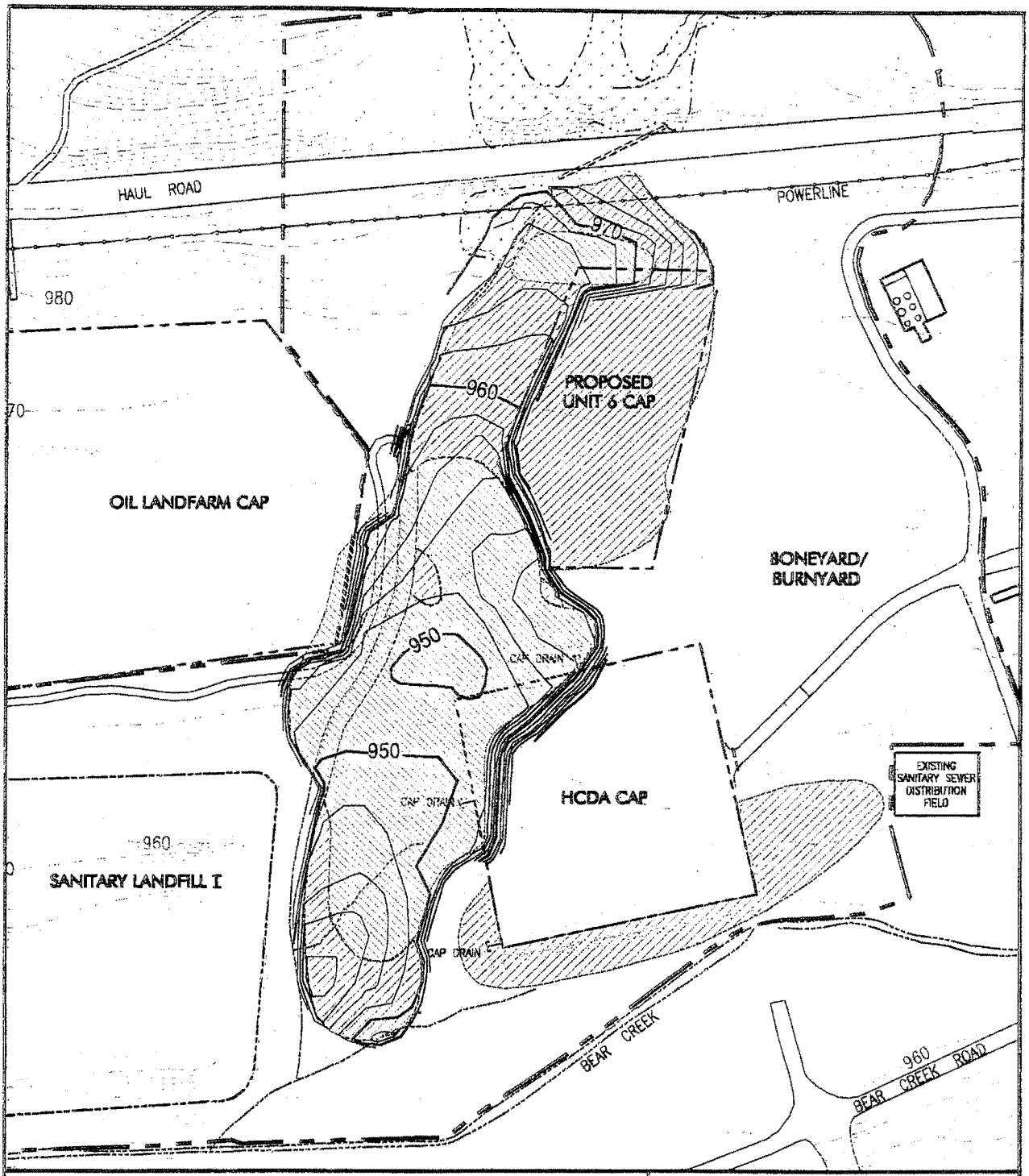
P. HOLM	REV. A / 5-4-00	00021/DWGS/H86-BYBY-A2



LEGEND:

- EXISTING 2' GROUND CONTOUR
- EXISTING 10' GROUND CONTOUR
- PROPOSED EXCAVATION CONTOUR
- CREEK, STREAM, OR TRIBUTARY
- WETLANDS
- WASTE MANAGEMENT AREA
- PROPOSED UNIT 6 CAP
- UNIT 6 WASTE MATERIAL
- UNIT 4 AND 5 WASTE MATERIAL

(NOTE: UNIT 6 WASTE MATERIAL UNDERLIES UNIT 4 & 5 WASTE MATERIAL IN VARIOUS LOCATIONS.)

FIG. 2.9

BONEYARD/BURNYARD EXCAVATION AREAS

DRAWN BY:	REV. NO./DATE:	CAD FILE:
P. HOLM	REV. A / 5-4-00	00021/DWGS/H86-BYBY-A

In addition to the primary source area material that is to be removed for disposal in the ORR on-site disposal facility, an additional quantity of lower level contaminated material in the 100- year floodplain that is not in contact with groundwater and does not represent as significant a threat to human health and the environment as the primary source areas. Though not a threat to groundwater, this material could pose a direct exposure threat if left undressed. This material will be pushed, using conventional construction equipment, to higher ground (i.e., eastern portion of site) and consolidated on top of existing contaminated soils. Once consolidation is completed, the low lying area will be backfilled in the same manner as the primary source areas, and the consolidated pile will be capped using a clay cap. The cap will be designed to protect industrial workers from direct exposure and to control contaminant migration by reducing vertical infiltration of rainwater into the remaining waste. The cap will be tied into the existing Hazardous Chemicals Disposal Area cap. A vegetative layer will be placed over the cap to reduce erosion and further reduce infiltration.

Figure 2.9 illustrates the spatial boundaries of excavation at the Boneyard/Burnyard. The volume of soil to be excavated for disposal or consolidation is approximately 63,000 yd^3.

During remedial investigation activities, a radioactively contaminated drum was located in the Bear Creek floodplain south of the Hazardous Chemical Disposal Area cap. During excavation activities at the Burnyard/Boneyard, the subject drum will be removed and dispositioned as part of the Unit 6 material. Furthermore, if additional radioactively contaminated debris is located during excavation activities, the debris will be removed and properly dispositioned.

To further reduce the potential for contaminant releases from the Boneyard/Burnyard, hydraulic isolation measures will be taken in addition to the clay backfilling, contouring, capping, and establishing vegetative covers that were previously described. These additional measures will include reconstructing NT-3 to encourage more efficient conveyance of water to Bear Creek and eliminating man-made surface water stagnation points that encourage infiltration to groundwater in the waste

Other hydraulic control measures will be determined during the remedial design and may include the use of drains or temporary well points to dewater the site. As a result of remedial actions, monitoring wells GW-076 and GW-067 will be plugged and abandoned or destroyed; detailed technical specifications for closure of these wells (Technical Specification SPB-BC005-2671, Rev. 0) will be included in the

Remedial Design Report. These wells will not be required for monitoring following implementation of the selected remedy.

Oil Landfarm Soil Containment Pad. The Oil Landfarm Soil Containment Pad contains an estimated 570 yd^3 of PCB- and RCRA-contaminated soils. These soils will be removed and sent off-site to a properly licensed commercial facility for disposal. Once the soils have been removed, the polyvinyl chloride-coated polyester building will be decontaminated and dismantled. The remaining concrete pad will be decontaminated and demolished and used as general fill for recontouring the area. A vegetative cover will be established following recontouring.

OTHER AREA

DARA Solids Storage Facility. The PCB-contaminated soils in the DARA Solids Storage Facility is estimated at 4000 yd^3. These soils will be excavated and sent off site to a properly licensed commercial facility for disposal. Once the soils have been removed, the building will be decontaminated and dismantled. The remaining concrete pad will be decontaminated, demolished, and then used as general fill for recontouring the area. A cover consistent with future land use will be established following recontouring.

PERFORMANCE MONITORING

Overall performance of the remedial measures in obtaining the RAOs will be evaluated through an environmental monitoring program, with particular emphasis on the concentration of COCs in Bear Creek surface water and groundwater at the integration point. Performance of individual remedial measures at each remediation site will be evaluated through more localized environmental monitoring, including sampling and analysis of groundwater and surface water (see Table 2.17). Monitoring of surface water will include reaches of Bear Creek and its tributaries that have historically exceeded AWQC (i.e., Upper Bear Creek, NT-1, and NT-3). Additionally, surface water will be monitored for COCs in Bear Creek below the confluence with NT-1, Bear Creek upstream and downstream of the confluence with NT-3, and within NT-3. Detailed specifications of environmental monitoring requirements will be documented in the subsequent remedial action design documents, work plans, and remedial action reports, submitted as required under the FFA. Monitoring plans will be coordinated and agreed upon by DOE, EPA, and TDEC.

Monitoring results will be presented annually in the DOE-ORO RER, which is an FFA document that summarizes annual monitoring results at remediation sites on the ORR. Monitoring results will be evaluated against the objective of reducing contaminant levels to meet applicable AWQC for protection of surface water resources throughout Bear Creek and its tributaries and reducing concentrations of uranium in Bear Creek to levels that would not exceed an incremental human health risk of 1×10^{-5} to a hypothetical future resident outside the boundary of the restricted industrial use area (i.e., uranium flux ≤34 kg/yr at the integration point) within 5 years after implementation.

Institutional Controls. With the exception of the S-3 Site, most of the areas within Bear Creek Valley addressed within the scope of this ROD lie outside the fenced Y-12 Plant boundaries. Posted signs and security patrols of the area restrict access to these sites. DOE will maintain these sites as controlled industrial areas, and continue to limit public access. Procedures for the security patrols in place at the Y-12 Plant are contained in classified documentation.

Following implementation of remedial actions, surveillance and maintenance of the site will be conducted under the Y-12 Plant site-wide surveillance and maintenance program. Surveillance and maintenance procedures are documented in the *Y-12 Surveillance and Maintenance Program Facility Inspection Training and Operating Manual* (BJC/OR-75/R2). Monitoring and enforcement of use restrictions on groundwater and surface water also will be conducted as part of the Y-12 site-wide surveillance and maintenance activities pending the completion of future CERCLA decisions. Institutional controls will include administrative controls to restrict groundwater and surface water use consistent with the designated land use for each zone.

In accordance with an Memorandum of Understanding entered into by DOE, EPA Region IV, and TDEC, a Land Use Control Assurance Plan for the ORR has been developed and approved by EPA and TDEC (DOE 1999). The results of the Bear Creek Valley baseline risk assessment identified potential risks to unprotected maintenance workers; therefore, the selected remedial alternative includes land use controls to protect maintenance workers. A Land Use Control Implementation Plan will be developed and submitted to EPA and TDEC as an appendix to the final Remedial Design Work Plan. As agreed, this will be submitted and reviewed as a primary document under the FFA. The Land Use Control Implementation Plan will specify how the DOE will implement, maintain, and monitor the land use control elements of the remedy necessary to achieve the land use control objectives identified in the ROD. The land use control objectives identified to ensure the protectiveness of the selected alternative

are: prevent unauthorized contact, removal, or excavation of buried waste in the Bear Creek Valley; preclude residential use of Zone 3; and prevent unauthorized access to contaminated groundwater in the Bear Creek Valley. Upon regulatory approval, the Bear Creek Valley Land Use Control Implementation Plan will be added to Appendix B of the ORR Land Use Control Assurance Plan (DOE 1999).Bear Creek Burial Grounds

This ROD does not address remedial actions for the Bear Creek Burial Grounds. Institutional controls in place at the site will be maintained until remediation decisions for the Bear Creek Burial Grounds are addressed in future CERCLA decisions.

SUMMARY OF THE ESTIMATED REMEDY COSTS

Table 2.20 presents a detailed activity and cost estimate breakdown for the remedial actions at each area for the selected remedy.

SEQUENCING OF REMEDIAL ACTIONS

After this ROD is approved, remedial actions will begin immediately. Sequencing of remedial actions will generally be risk-based, beginning with those sites posing the greatest risk to human health and the environment and ending with those sites posing the least risk. An exception to this implementation plan will be the Oil Landfarm Soils Containment Pad. Construction of the ORR on-site disposal facility cannot be completed until the Oil Landfarm Soils Containment Pad is removed; therefore, it will be among the first sites to be remediated. The Boneyard/Burnyard is expected to be the first site remediated in Bear Creek Valley. Schedule prioritization of all sites to be remediated will be provided in the remedial design work plan. Once remediation is initiated at a site, it will proceed unimpeded to completion, within the bounds of funding limitations. It is anticipated that field work will be complete in 2007, if the budget is provided as requested, and reported in the June 1, 1999, "ORO EM Program Life Cycle Baseline."

Table 2.20. Summary of estimated Phase I remedy costs, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Capital costs	Escalated cost ($ thousand)	Present worth ($ thousand)
Site monitoring activities		
Monitoring well installation	1,868	1,396
S-3 Site		
Lower water table during installation	132	
Treatment trench installation	1,655	
General conditions	279	
Safety & training	93	
Waste management	159	
Indirects	586	
Subtotal	2,904	2,345
Boneyard/Burnyard		
Lower water table during source removal	332	
Excavate and dispose of source material	7,316	
Consolidate other soil/debris	3,595	
Cap consolidated soil/debris	3,928	
General conditions	715	
Safety & training	194	
Waste management	703	
Indirects	4,034	
Subtotal	20,817	15,420
Basic Actions (removal/disposal of soils and building dismantle)	1,401	782
DARA and Oil Landfarm Soil Containment Pad		
Total capital costs	26,990	19,943
O&M costs		
S-3 Site		
Treatment media replacement (every 10 yrs)	10,557	3,502
Boneyard/Burnyard		
Cap maintenance and inspections	640	211
Site-wide monitoring (30-yr)	17,352	6,909
Total O&M Cost	28,549	10,622
Total Cost	55,539	30,565

Notes: Cost estimates are within +50 to -30% accuracy expectation. The discount rate is 7%. O&M expenditures are anticipated over 30 years.

$ = dollar
DARA = disposal area remedial action
O&M = operation and maintenance
% = percent

PERFORMANCE STANDARDS OF THE SELECTED REMEDY

Specific performance standards of the selected remedy are summarized in Table 2.21. Table 2.22 presents the performance standards of the selected remedy in terms of resulting land and resource uses and residual risks achieved as a result of the remedial actions. The expected residual risks to hypothetical future recreational and residential receptors are below the goals established in the RAOs for Bear Creek Valley.

Table 2.21. Performance Standards for the selected remedy

Remedy component	Boneyard/Burnyard	S-3 Ponds Pathway 3
Performance standard (surface water)	Uranium flux 4.3 kg/yr Mercury 12 ng/L	Uranium flux 27.2 kg/year Cadmium 3.9 µg/L Nitrates 40% seasonal reduction Benchmark to be determined
Technology performance standard	Excavation – 36,000 yd^3. Excavate to native soils plus up to 18 inches	Reactive barrier trench (metal filings) 40% removal of nitrate Removal of cadmium to meet AWQC
Monitoring Locations (surface water)	In NT-3 at confluence with Bear Creek.	BCK 12.34
Compliance timeframes	5 years	2 years
Residual risk/Hazard Index	1×10^{-5}/1.0	
Compliance point	BCK 9.47	

Table 2.22. Expected Outcome of the selected remedy, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

	Zone 1	Zone 2	Zone 3		
			S-3 Site/Pathway 3	BYBY/OLF Area	BCBG
Available land use and time frame	Unrestricted use (compatible with residential use), available immediately*	Presently restricted use (compatible with recreational use); compatible with unrestricted use in 50 years	Restricted use, long-term waste management area/ controlled industrial use	Restricted use, long-term waste management area/ controlled industrial use	N/A
Available groundwater use and time frame	Unrestricted use (compatible with residential use) available immediately (MCLs met)	Presently restricted use (MCLs not met for nitrates, compatible with recreational use), unrestricted use in 50 years	Restricted use	Restricted use	N/A
Available surface water use and time frame	Unrestricted use (compatible with residential use) available immediately (AWQC met)	Unrestricted use (compatible with residential use) available immediately (AWQC met)	Recreational use, AWQC met in 5 years following implementation	Recreational use, AWQC met in 5 years following implementation	N/A
Cleanup levels, residual risk	- MCLs in groundwater - AWQC in surface water - risk to residential receptor below RAO of 1×10^{-5}	- TBD for groundwater - AWQC in surface water - risk to residential receptor below RAO of 1×10^{-5}	- TBD for groundwater - AWQC in surface water - direct exposure risk to industrial/terrestrial receptors eliminated - risk to industrial receptor below RAO of 1×10^{-5} - Reduce seasonal nitrate flux at the NT-1/Bear Creek confluence by 40%	- TBD for groundwater, - AWQC in surface water, - risk to industrial receptor below RAO of 1×10^{-5}	N/A
Anticipated socioeconomic and community revitalization impacts	Property will meet conditions for residential/ recreational/ industrial use	Property will meet conditions compatible with recreational/industrial use	Waste area is capped and used as a parking lot to support Y-12 Plant activities; surrounding area available for additional controlled industrial use	Area devoted to waste management; proposed on-site disposal facility provides potential to create new jobs	N/A
Anticipated environmental and ecological benefits	Media not impacted	Slightly impacted groundwater will be restored	Impacted surface water will be restored	Impacted surface water will be restored, capping will protect terrestrial species	N/A

*Although the selected remedy will allow unrestricted land use for this zone, there are no plans to transfer ownership of this property.

AWQC = ambient water quality criteria
BCBG = Bear Creek Burial Grounds
BY/BY = Boneyard/Burnyard
μg = microgram
L = liter
MCL = maximum contaminant level
OLF = Old Landfarm
TBD = to be determined
N/A = not applicable
S-3 = Pathway 3
RAO = remedial action objective

Under the selected remedy, land use in Zone 3 would be restricted to controlled industrial use (consistent with current use), Zone 2 would be immediately restored to conditions compatible with recreational land use, and Zone 1 would be protected for unrestricted future development opportunities. Surface water protection objectives include restoration of all surface waters in the valley to meet AWQC within 5 years after implementation. This objective is expected to be met rapidly for most surface waters because even under baseline conditions, only limited stretches of Bear Creek and NT-1 are contaminated to levels exceeding criteria. These isolated stretches of surface water would be quickly brought into compliance by intercepting and treating in-place contaminated groundwater that is impacting those waters. All surface hazards posed by contaminated soils and waste disposal areas are expected to be eliminated immediately after implementation of required field construction activities and land use restrictions. These measures also are expected to reduce concentrations of uranium in Bear Creek to levels compliant with applicable requirements and risk goals. Finally, these measures will control potential hazards associated with land use in Bear Creek Valley by identifying areas requiring installation of long-term engineered cover systems and by identifying necessary restrictions on land and groundwater use in the Bear Creek Valley.

GROUNDWATER CLEANUP EXPECTATIONS

Although groundwater cleanup goals are not being established by this ROD, the selected remedy is expected to achieve the preservation of groundwater in Zone 1 in compliance with safe drinking water standards; the improvement of groundwater conditions in Zone 2 so that unrestricted use conditions could ultimately be achieved (nitrate and uranium concentrations will be reduced); and in Zone 3, a significant reduction in uranium flux from the waste areas into shallow groundwater and surface water such that numeric groundwater and surface water protection objectives in Zones 1 and 2 can be met.

NATURAL RESOURCE DAMAGE ASSESSMENT CONSIDERATIONS

Hazardous substances above health-based levels will remain in the Bear Creek Valley if this remedy is implemented. Because hazardous substances are to remain at the site, it is recognized by DOE, TDEC, and EPA that Natural Resource Damage claims, in accordance with CERCLA, may be applicable. This document does not address restoration or rehabilitation of any natural resource injuries that may have occurred at the site, nor whether such injuries have occurred. In the interim, neither DOE nor TDEC waives any rights or defenses they may have under CERCLA section 107(a)4(c).

STATUTORY DETERMINATIONS

Under CERCLA, Section 121, selected remedies must be protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified and granted), and be cost-effective. Preference is given to alternatives that use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical. In addition, CERCLA includes a preference for remedies that use treatment technologies that significantly and permanently reduce the volume, toxicity, or mobility of hazardous wastes as their principal elements. The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and uses permanent solutions and alternative treatment (or resource recovery) to the maximum extent practicable. The selected remedy also satisfies the statutory preference for treatment as a principal element of the remedy. Because this remedy will result in hazardous constituents remaining on site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment by removing the primary sources of contamination from the Boneyard/Burnyard, preventing the migration of contaminants to surface water from the S-3 Site, establishing land use restrictions, and disposing of removed wastes. Monitoring groundwater and surface water impacted by past contaminant releases and restrictions on groundwater and surface water will be implemented to ensure that RAOs continue to be met. Implementation of this remedial action will not pose unacceptable risks to site workers or members of the public. The goal for this selected remedy is to reduce uranium concentrations in surface water at the boundary of the restricted industrial use area (i.e., the Zone 3/Zone 2 boundary and integration point) to levels that will not exceed an incremental human health risk of 1×10^{-5} at that location, based on residential use outside the restricted industrial area; control potential hazards to personnel within the restricted industrial use area (Zone 3) through removal of primary source areas, installation of engineered cover systems, and implementation of necessary restrictions on land and groundwater use; and attain applicable AWQC for protection of surface water resources throughout Bear Creek and its tributaries within 5 years after implementation.

Long-term, adverse environmental effects are not expected following completion of Phase I remedial action activities. Any areas disturbed during implementation of this remedy will be regraded, stabilized, and revegetated to prevent erosion and promote recovery. Mitigation of wetlands impacted as a result of implementing the selected remedy will be in accordance with ARARs. These wetlands will be mitigated as required in the Wetlands Mitigation Plan for Bear Creek Valley submitted pursuant to the Environmental Management Waste Management Facility ROD.

No long-term impacts to socioeconomics, land use, or noise in the area surrounding Bear Creek Valley are expected after implementation of the selected remedy. While some increase in noise levels may occur during implementation of this remedy as a result of heavy equipment use, noise levels outside the ORR should not be affected. Because Phase I activities only represent a subset of the entire remediation of Bear Creek Valley, change in land use is not expected in the near future. Final impacts to land use may be determined following future CERCLA decisions for Bear Creek Valley.

Implementation of the selected remedy for Phase I activities will require an irretrievable commitment of some natural resources such as fuel and other nonrenewable energy sources. Materials such as grout, fertilizers, riprap, etc., will also be used implementing this remedy. In addition, the land areas dedicated to waste disposal will be irretrievably committed and will not be available for other uses.

COMPLIANCE WITH ARARs

The selected remedy complies with federal and state requirements that are ARARs. Appendix A provides a complete listing and discussion of identified ARARs.

COST-EFFECTIVENESS

Actions taken under CERCLA must consider the estimated total present-worth cost of alternatives. The selected remedy meets regulatory requirements, reduces risk to human health and the environment to acceptable levels, and allows beneficial use of Bear Creek Valley. With a total present worth cost of approximately $31 million (see Table 2.20), the selected remedy is a cost-effective option for protection of human health and the environment. Except for the Boneyard Burnyard component the remedial options selected are those which have the lowest cost in achieving protectiveness.

In selecting the remedial action component for the Boneyard Burnyard component, the Department of Energy has determined it is appropriate to select an option other than the lowest- cost protective option based on the analysis presented in the Focused Analysis (DOE 2000), the cost differential between the two protective remediation options is approximately $6 million. DOE has determined that this cost differential is justified based on the added benefits offered by the selected remedy component. The major difference between the lowest-cost protective alternative and the selected protective alternative is the ultimate placement of the excavated primary source area waste (primary waste) material. In the lowest-cost protective alternative the primary waste is consolidated on-site under a clay cap; whereas, in the selected protective alternative the primary waste is placed in the on-site waste disposal cell. The added benefits of the selected remedy over the lowest-cost protective remedy are: improved long-term protectiveness due to the primary waste material being placed in an engineered cell with bottom liners and leachate collection with ensured long term maintenance and monitoring; improved long term protectiveness by removal of the primary waste material from a potential leachability pathway.

PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

CERCLA, Section 121, establishes a preference for alternatives that use treatment to permanently reduce toxicity, mobility, or volume of hazardous substances. The selected remedy satisfies this statutory preference through the use of passive, in-situ treatment trenches to treat contaminated shallow groundwater, reducing the amount of contaminants discharged to surface water.

STATE ACCEPTANCE

The state of Tennessee concurs with the selected remedy.

COMMUNITY ACCEPTANCE

The "Highlights of Community Participation" section summarizes community participation in evaluating Bear Creek Valley remediation options. Appendix B presents a summary of meetings held in which the public had opportunities to hear presentations by DOE, ask questions, and provide comments as required by CERCLA. These opportunities also satisfy requirements for public involvement under NEPA. Based on input at various public meetings held by DOE, the public supports the selected remedy. The public has submitted written and oral recommendations regarding the Bear Creek Valley proposed

plan. The "Responsiveness Summary," Part 3 of this ROD, presents DOE responses to public comments on the proposed plan.

DOCUMENTATION OF SIGNIFICANT CHANGES

Deferral of NT-7 and NT-8 actions. DOE, EPA, and TDEC reviewed all written and verbal comments submitted during the public comment period. Because of the potential for future actions in the Bear Creek Burial Grounds significantly impacting NT-7 and NT-8, it was decided to postpone actions in these tributaries to a future CERCLA decision document that addresses the Bear Creek Burial Grounds.

Elimination of S-3 Site Pathway 1 and 2 from selected remedy. Both the original proposed plan and the supplement to the proposed plan issued on August 13, 1998, envisioned selecting continued long-term O&M of the passive groundwater treatment systems selected in the action memorandum for the S-3 Pond Site Pathways 1 and 2 removal action. However, neither treatment system (funnel and gate for Pathway 1 or in-situ reactive barrier for Pathway 2) are operational and functional at this time. Therefore, additional work is being performed under the authority of an action memorandum to render the treatment technologies effective and operational and functional. Once the treatment systems have been determined to be operational and functional their long-term operation and maintenance may be included in future remedial action decision documents, if appropriate. These changes do not impact the ability to meet watershed goals described in the proposed plan.

Elimination of Roadside and Creekside Debris Area from selected remedy. Based on additional field sampling of these sites since the completion of the Remedial Investigation, the assessment found that there are not contaminants of concern at these sites and, therefore, no action under CERCLA is warranted. However, DOE intends to remove select material from the Bear Creek floodplain as agreed in April 1998 by EPA and TDEC as a maintenance action.

Preparation of action specific nine criteria analysis for Boneyard/Burnyard and S-3 Site. Based on regulator comments received on the BCV ROD D3 in February, 2000, DOE prepared a *Focused Analysis of Alternatives for Phase I Remedial Actions at the S-3 Site Pathway 3 and the Boneyard/Burnyard in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 2000) to provide focused analysis of alternatives. The comparative analysis completed as part of

the Focused Analysis and included in this ROD has been completed on a unit basis at the request of EPA Region IV to clarify the remedy selection.

Modification of cap for Boneyard/Burnyard from multilayer cap to clay cap. Technical considerations for implementation of the selected remedy for the Burnyard/Boneyard have determined that the installation of a low-permeability clay cap will provide an equivalent level of protection to human health and the environment as the multilayer cap previously considered. Also, a clay cap, using confirmed, high quality clay, will provide equivalent long-term effectiveness and permanence. In the event of subsidence after installation of the clay cap, repairing the subsided area is easy to implement in contrast to repairing a subsided engineered, multilayer cap. In addition, the clay is readily available, easy to work with and no specialized equipment or contractor is required to install a clay cap. Furthermore, the cost of installing a clay cap is less than an engineered multilayer cap by $2.1M (escalated).

REFERENCES

DOE (U.S. Department of Energy) 2000. Focused Analysis of Alternatives for Phase I Remedial Actions at the S-3 Site Pathway 3 and the Boneyard/Burnyard in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee, DOE/OR/01-1886 & D1.

DOE 1999. Memorandum of Understanding for implementation of a Land Use Control Assurance Plan (LUCAP) for the United Sates Department of Energy Oak Ridge Reservation

DOE 1998a. *Proposed Plan for Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1647&D3. Oak Ridge, TN.

DOE 1998b. *Engineering Evaluation/Cost Analysis for the Bear Creek Valley Tributary Interception Trenches for the S-3 Uranium Plume, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1701&D3. Oak Ridge, TN.

DOE 1998c. *Characterization Report for the BCV Boneyard/Burnyard Accelerated Action Project for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, BJC/OR-113. Oak Ridge, TN.

DOE 1998d. *Bear Creek Valley Floodplain Hot Spot Removal Early Action Characterization Field Data Summary Report, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*. Y/ER-318. Oak Ridge, TN.

DOE 1997a. *Report on the Remedial Investigation of Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, Vol. I, DOE/OR/01-1455/V1&D2. Oak Ridge, TN.

DOE 1997b. *Feasibility Study for Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1525/V1&D2. Oak Ridge, TN.

DOE 1997c. *Community Guidelines for End Uses of Contaminated Properties*. Oak Ridge, TN.

DOE 1994. Memorandum for Secretarial Officers and Heads of Field Elements from Hazel R. O'Leary, "Secretarial Policy Statement on the National Environmental Policy Act." Washington, DC.

PART 3. RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY

This responsiveness summary was prepared after completion of the public comment period for the *Proposed Plan for Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1998a).

A public meeting was held July 13, 1998, at the Jacobs Technical Center in Oak Ridge, Tennessee. A transcript of the meeting is available at the Information Resource Center, 105 Broadway Ave., Oak Ridge, Tennessee. This meeting provided the public an opportunity to raise issues, express concerns, and ask questions regarding the DOE preferred alternative for remedial action in Bear Creek Valley. Below is a paraphrased summary of the issues/concerns/questions raised by the public at this meeting.

***Question*: Does DOE plan to monitor groundwater at the Zones 1 and 2 interface in West Bear Creek Valley? The monitoring plan does not show any wells.**

***Response*:** Yes. The monitoring plan presented in the proposed plan is a conceptual plan for costing purposes. The figure shows wells at Bear Creek Kilometer 7.5, as noted in the footnote, which corresponds to the Zones 1 and 2 interface. A final plan to be developed specifically for the remedial actions will be reviewed and approved by the regulators.

***Issue*:** It is requested that DOE prepare a fact sheet clearly describing the preferred alternative in 11 by 17 in. format and made available to the public.

***Response*:** DOE prepared a fact sheet and copies were mailed to all meeting participants. Copies are available to the public in the Information Resources Center at 105 Broadway Ave., Oak Ridge, Tennessee.

***Question*: What is DOE doing to protect off-reservation sole source aquifer users on the west side of the Clinch River, downgradient of Bear Creek Valley?**

***Response*:** It is DOE policy that access to private property must be granted only through explicit permission by the property owner. Currently, DOE and TDEC conduct independent programs for monitoring off-site wells that are primarily residential. DOE has been monitoring wells on the southwest

side of the Clinch River since 1989. In 1997, six residential wells were sampled and none showed any impact from the DOE reservation.

TDEC began sampling wells on the southwest side of the river in 1995 and has actively sought well owner participation in the target area. The number of wells sampled has increased from 1 in 1995 to 12 in 1997. Ten of the wells sampled in 1997 are residential, while two are owned by the U.S. Geological Survey. To date, no impacts from the DOE reservation have been observed in any of these wells.

Only one of the combined wells was sampled by both agencies; therefore, a total of 17 wells were sampled. Both agencies issue annual reports (available to the public) containing data from the off-site well sampling programs.

Issue: The proposed plan does not contain any quantitative postremediation levels or goals. In other words, how does DOE determine when the remediation work is complete?

Response: DOE has done analyses to determine goals for remedial alternatives developed in the FS. These goals have been added to appropriate sections in the ROD to illustrate expected post-remediation conditions. DOE will monitor to determine how effective the remedial actions are in achieving these goals. Final endpoints will be identified in a future CERCLA decision.

Issue: There is no clear definition of which alternative presented in the FS is being chosen in this proposed plan.

Response: The ROD was written to clarify that the selected remedy is similar to Alternative 5, excluding actions for the waste units in the Bear Creek Burial Grounds and groundwater. Table 2.18 of this ROD itemizes all the actions that are part of the selected remedy, as well as waste sites in which action is being deferred at this time.

Question: **What is the implementation schedule for the selected remedy? Also, a commitment by DOE to continue evaluations to complete remedial actions at the Burial Grounds should be made.**

Response: The actual implementation schedule for the actions is dictated by several constraints, including construction, funding, and regulatory compliance. It has been noted in the ROD that the action at the Boneyard/Burnyard is of greatest importance because it is the greatest current contributor to

watershed contamination. A detailed construction schedule will be presented in the remedial design work plan that will be reviewed and approved by EPA and TDEC.

The ROD clarifies that there will be future CERCLA decisions addressing any remaining issues with respect to the Bear Creek Burial Grounds and groundwater.

***Issue*:** Iron filings used in the current treatability study at the S-3 Site should be recycled if possible.

***Response*:** Potential decontamination and reuse of iron filings will be investigated to the extent practicable.

Formal written comments from the Oak Ridge Environmental Peace Alliance were submitted to DOE July 28, 1998. Following are the comments and the DOE responses.

***Comments*: In general, we are in agreement with the current strategy to address Bear Creek Valley in two phases. However, as discussed at the public meeting on July 13, 1998, the proposed plan is not currently written such that the reader can easily understand what the "preferred alternative" for the first phase of work entails. The preferred alternative should be described in terms of the alternatives described in Attachment 1; if the preferred alternative is actually Alternative 5a minus the Burial Grounds, it would be helpful to acknowledge that in the document.**

***Response*:** The ROD was written to clarify that the selected remedy is similar to Alternative 5, excluding actions for the waste units in the Bear Creek Burial Grounds and groundwater. Table 2.18 of this ROD itemizes all the actions that are part of the selected remedy, as well as waste sites in which action is being deferred at this time.

***Comments*: Also, the document is not clear about how final cleanup goals for Bear Creek Valley will be determined. For instance, on Page 9, the document states that initial goals "...would remain in effect until new technologies, land use requirements, or regulatory requirements establish a basis for revision of these goals. Final goals for contaminated media will be established by second ROD for Bear Creek Valley, based in part on the observed performance of remediation measures proposed in the document." This wording is confusing as to the basis for revising initial goals; will it be based on technology, land use, or regulatory requirements, or will it be based on performance of remediation measures?**

Response: The intent of the Phase I remediation in Bear Creek Valley is to address the contributors to downstream contaminant migration. The two primary contributors are the Boneyard/Burnyard and the S-3 Site shallow groundwater. Contaminant migration includes uranium that is released to surface water and subsequently moves down the valley in Bear Creek. Actions are intended to mitigate this contaminant migration to surface water and, to an extent, to deep groundwater because the sources are cut off. Because final decisions are not being made on groundwater in Bear Creek Valley, current groundwater goals for Zones 1 and 2 have been designated as initial goals. Following evaluations of the extent to which actions being taken under Phase I mitigate contaminant migration to groundwater, final goals will be documented in a future CERCLA decision for Bear Creek Valley.

Comment: **Also, initial goals are not clearly defined. Although surface water and groundwater protection objectives are described on Page 15, it is not clear if these objectives are initial goals, final goals, or something else. Ecological protection objectives or goals also need to be defined and described in the proposed plan.**

Response: Greater detail on the surface water goals for the remedial alternatives, including the selected remedy, have been added to the Phase I ROD. This includes goals for both human health protection and ecological protection.

Comment: **There needs to be a description of the process by which it will be determined if initial goals have been reached. If initial goals are revised, particularly to less stringent requirements, the public must be informed and have the opportunity to provide input on the revisions; this should be explicitly stated in the proposed plan.**

Response: As discussed in the proposed plan, a detailed environmental sampling and analysis plan will be developed and implemented to provide information relative to the performance of the remedial actions taken as part of Phase I in achieving reductions in media contamination levels. This information will form the basis for determining whether the actions taken result in achieving the initial goals as presented in the proposed plan. Results of sampling and analysis will be presented annually in the document titled *Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*. In addition, postremediation conditions will be examined every 5 years following commencement of remedial actions. The results will be made available to the public for review and

comment. Finally, the public will have the opportunity to participate in the development of subsequent proposed plans and RODs, which will finalize the remedial goals for Bear Creek Valley.

***Comment*: The preferred alternative monitoring plan described on Pages 15 and 16 and depicted in Figure 6 does not specify groundwater monitoring well depths. Will there be any deep monitoring wells? Also, the number and location of monitoring wells east of the Burial Grounds (one downgradient of the Oil Landfarm Area and one downgradient of the S-3 Site) seem sparse. It is difficult to imagine that these two wells will be adequate to determine the effectiveness of remediation for these two major areas. Also, how will one know if ambient water quality criteria are being met for all of the waters of the state if there are no surface water sampling stations for NT-3, NT-4, NT-5 or ST-1. Because the monitoring program is critical for determining remediation effectiveness and determination of final cleanup goals, it must be fully described and justified in the proposed plan.**

***Response*:** The monitoring plan described in the proposed plan is conceptual only, for illustration and costing purposes, and is only summarized here. Appendix M of the FS contains more detail of the conceptual monitoring plans for all alternatives, including well depths. A detailed environmental monitoring plan, which will be reviewed and approved by the regulators, will be developed for Bear Creek Valley. This final plan will include groundwater and surface water sampling locations appropriate for monitoring the effectiveness of the remedial actions taken under Phase I. Surface water monitoring for AWQC compliance is only planned for in-stream reaches in which AWQC are exceeded, that is, in NT-1 and Upper Bear Creek near the S-3 Site.

***Comment*: There is also no discussion in the proposed plan about stewardship activities. Although the record of decision for this proposed plan will be followed by another record of decision to address groundwater, the Burial Grounds and stewardship issue, it is not too early to discuss plans for determining stewardship responsibilities and funding. At previous public meetings we have been told that an interagency committee is working on this issue; this should be documented in the proposed plan. Also, there need to be avenues for public involvement established for this effort and acknowledged in the proposed plan.**

Response: A brief section on institutional controls has been added to the ROD. However, given the issues related to appropriated funding, this section does not discuss funding related to long-term institutional controls and S&M activities.

Formal written comments from the city of Oak Ridge, Tennessee, were submitted to DOE July 29, 1998. Below are the questions contained in the letter and the DOE response.

Comment: **A phased approach to remediation of the valley makes sense, given budgetary constraints, the complexity of the site, and the need to determine effectiveness of the migration and source control approach. It is unclear, however, what the DOE time frame is for the initial phase and for a comprehensive solution to the problem, which includes a second record of decision. This information should be provided to give the community a better understanding of how DOE envisions reaching some closure and permanence.**

Response: The actual implementation schedule for the actions is dictated by several constraints including construction, funding, and regulatory requirements. It has been noted in the ROD that the action at the Boneyard/Burnyard is of greatest importance because it is the greatest current contributor to watershed contamination, and will, therefore, be the first major action in Bear Creek Valley. A detailed construction schedule for the Phase I activities will be presented in the remedial design work plan, which will be reviewed and approved by EPA and TDEC. Further, a statement is made in the ROD that indicates DOE's commitment to completing required evaluations and making a final decision regarding action at the Bear Creek Burial Grounds. In addition, a technology demonstration is to be initiated next fiscal year to evaluate a potential technology that may be applicable to the waste units in the Bear Creek Burial Grounds. Currently, a schedule for reaching closure has not been developed among the FFA parties.

Comments: **Nor does the document clearly state a risk-reduction level goal similar to those identified in other DOE proposed plans, e.g., 400 ppm of mercury for East Fork Poplar Creek. Pages 9 and 10 refer to the goals, but no associated levels are provided. Readers should not have to refer back to the remedial investigation/feasibility study to obtain these figures. By including them in the proposed plan, the community and other stakeholders will have a better sense for the benefits associated with the proposed remedial actions.**

Response: DOE has done analyses to determine goals for remedial alternatives developed in the FS. These goals have been added to appropriate sections in the ROD to illustrate the expected

postremediation conditions. These conditions, however, are based on analysis only; therefore, postremediation monitoring of the selected remedy will be required to show actual efficiencies of the remedial actions in terms of contaminant concentration reductions in environmental media.

***Comment*: The document states that all the options rely on restrictions and long-term monitoring and maintenance programs to ensure their continued effectiveness. The cost estimates provided for the preferred alternative—$26 million for capital expenditures and $12 million for surveillance and maintenance—appear low for a 30-year time frame. Costs are not provided for the time frame beyond 30 years. These estimates are important in performing a valid cost/benefit analysis that compares perpetual institutional controls to alternatives that incorporate additional contaminant removal. Furthermore, in a recent examination of the use of institutional controls at Department of Defense sites, the Center for Public Environmental Oversight urged that the loss of productive industrial use and property tax losses should be quantified.**

***Response*:** Costs presented for the preferred alternative, $26 million and $12 million for capital expenditures and O&M, respectively, are present worth costs. The presentation of present worth costs complies with EPA guidance on preparation of CERCLA cost estimates, such that direct cost comparisons can be made between alternatives. The time frame for costing purposes is 30 years. Also, because the land area in which remedial actions are to take place is within DOE property not available for public use, an analysis of the loss of productive industrial use and property tax losses is not required at this time.

***Comment*: It would also be helpful for DOE to demonstrate its commitment to this project by describing how it fits within the scope of the recent *Paths to Closure* and the overall DOE environmental management strategy. In addition, the document should explain what R&D efforts are underway that exemplify the type of scientific research being conducted to help address the challenging problems associated with this project, such as groundwater contamination.**

***Response*:** As stated in *Initial Accelerating Cleanup Paths to Closure Oak Ridge Operations Office* (DOE/OR/01-1746), the emphasis of the DOE Environmental Management Program is to manage risks to human health and the environment posed by contaminated sites and facilities, legacy waste, and newly generated waste in the most cost-efficient and responsible manner possible to provide for future beneficial reuse. The remedial actions taken under this ROD for Bear Creek Valley address the principal

threats to human health and the environment, that is mitigating contaminant migration from the two greatest current contributors to watershed contamination (i.e., the Boneyard/Burnyard and the S-3 Site). These remedial measures, which are deemed most cost-efficient, should considerably improve environmental conditions in Bear Creek Valley. Further, these actions will create conditions compatible with future land uses such as controlled industrial, recreational, and unrestricted. Such land use conditions may offer opportunities for future beneficial reuse, which is a goal of the Environmental Management Program.

DOE is committed to research and development efforts that may have applicability to the Environmental Management Program. Efforts are underway at several sites within ORR to evaluate and implement appropriate, cost-effective technologies to improve environmental conditions. This includes the Innovative Treatment and Remediation Demonstration evaluating treatment technologies for deep DNAPLs at the East End Plume in Upper East Fork Poplar Creek watershed. Technologies that may have applicability to this problem may also have applicability in Bear Creek watershed. As innovative technologies develop to better deal with environmental problems on ORR, DOE will continually seek support to implement those that show the most promise.

***Comment*: Finally, I am pleased to see that DOE's goals are recreational land use for Zone 2 and unrestricted use for Zone 1. As city manager, I am sensitive to the fact that the city's future development opportunities are directly related to land use restrictions on the reservation. Thus, I am requesting that DOE include in its community involvement plan more direct engagement with city officials before the development of future proposed plans. The city has improved regular communication with DOE regulators, and I believe a similar interface with DOE's environmental managers would be beneficial.**

***Response*:** Enhanced involvement with city officials, as well as the public, in the CERCLA process being conducted on ORR, is beneficial to all stakeholders. DOE encourages all interested parties to continue dialogue and participation in the decision-making process. DOE is committed to providing opportunities for public involvement and welcomes all comments on documents made available to the public through the Information Resource Center.

Formal written comments from the Citizen's Advisory Panel of the Oak Ridge Reservation LOC were submitted to DOE on July 16, 1998. Below are the comments contained in the letter and DOE's response.

***Comment*: As a report, this document has many of the same faults as the Engineering Evaluation/Cost Analysis (EE/CA) for BCV Tributary Interception Trenches for the S-3 Uranium Plume (please see comments on the *EE/CA for the BCV Tributary Interception Trenches for the S-3 Uranium Plume* (DOE/OR/02-1701&D3) dated June 24, 1998). A major deficiency is the lack of a concise statement of the before- and after-remediation estimates of risk levels and contaminant fluxes at the integration point. This, in conjunction with a cost breakdown for the preferred alternative, would enable the public to meaningfully evaluate the proposal based on its cost and benefits.**

***Response*:** DOE has prepared a fact sheet summarizing the information requested in this comment. Copies were mailed to all meeting participants. In addition, this information has been added to appropriate sections in the ROD (see Table 2-19).

***Comment*: It is also confusing to find that the preferred alternative is not one of the summarized remedial alternatives and that the minimal data presented are not really applicable. The utility and understandability of these documents must be improved such that they are accessible to the lay stakeholder.**

***Response*:** The ROD was written to clarify that the selected remedy is Alternative 5, excluding actions for the waste units in the Bear Creek Burial Grounds and groundwater. Table 2.18 of this ROD itemizes all the actions that are part of the selected remedy, as well as waste sites in which action is being deferred at this time.

DOE continually strives to present results of detailed analyses in decision documents in the most clear and concise manner possible. However, the fact sheet prepared for the preferred alternative for Bear Creek Valley allowed for a more reader-friendly format, which DOE intends to continue preparing for other projects. In addition, DOE welcomes public input that can be used to refine the documents made available to the public.

***Comment*: After additional information was received via a phone call, we found that the preferred alternative has a high degree of compliance with the End Use Working Group's Community Guidelines and the Recommendations for Bear Creek Valley. It is particularly encouraging that the proposal followed the recommendations to leave contaminated ground- water in place under**

waste-disposal areas until such time that trap-and-treat methods can be evaluated for their ability to prevent contaminant spread and eliminate exterior plumes.

Response: Continued interaction between DOE and the stakeholders is extremely important to the CERCLA process. This interaction is indeed evident in the process for Bear Creek Valley, and DOE continues to encourage dialogue and participation in the decision-making process. In addition, as emerging technologies become available to effectively address contamination problems in Bear Creek Valley, information as to their applicability will be provided to the public.

Comment: **While it is noted that the risk levels are not high at the downstream integration point (BCK 9.47), the proposed plan provides for some improvement in water quality and, more importantly, provides a greater margin of safety and breakthrough protection for human health at reasonable costs.**

Response: The emphasis of the DOE EM Program is to manage risks to human health and the environment posed by contaminated sites and facilities in the most cost-efficient and responsible manner possible. Thus, the remedial actions to be taken in Bear Creek Valley as part of this ROD are intended to improve environmental conditions at reasonable cost to the public.

Comment: **The CAP suggests that DOE make the commitment in the document to complete an annual literature search for new and improved technologies and appropriate patented technology for the remediation of the specific groundwater contaminants found under the BCV and S-3 Ponds sites. This activity should begin in Fiscal Year 1999. The annotated results should be published for the public to review each year. In addition, DOE should undertake the laboratory and field verification of suitable promising technologies as they appear.**

As an example of patented technologies currently available, enclosed are the summaries of U.S. Patent No. 5641020 that addresses in situ treatment of DNAPLs and U.S. Patent No. 5679256 "In-situ groundwater cleanup and radionuclide disposal method." There are numerous similar technologies that DOE should be evaluating for application to this problem. A simple on-line search by the LOC resulted in the enclosed sample list of potentially applicable patented technologies.

Response: Implementing this suggestion will be evaluated by DOE. However, it should be noted that representatives of DOE-Oak Ridge Operations are continuously engaged with other representatives throughout the entire DOE complex exchanging the type of information suggested in the above comment. In addition, attendance at industry conferences is made to the extent practicable in which such information is presented.

There are efforts underway at several sites within ORR to evaluate and implement appropriate cost-effective technologies to improve environmental conditions. This includes the information technology resources program evaluating treatment technologies for deep DNAPLs at the East End DNAPL Plume in Upper East Fork Poplar Creek watershed. As innovative technologies develop to better deal with environmental problems at ORR, DOE will continually seek support to implement those that show the most promise.

Comment: **The CAP is pleased to endorse the preferred alternative. The CAP encourages DOE, EPA, and TDEC approve and sign the ROD(s) for BCV as soon as a compromise among the stakeholders and the signatories is reached. This will allow expedited implementation of the preferred alternative, resulting in better assessment of any further phases of work required in BCV.**

Response: DOE appreciates the work of the CAP and looks forward to the implementation of the remedial actions described in this ROD.

APPENDIX A
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) AND TO BE CONSIDERED (TBC) INFORMATION

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS and TO BE CONSIDERED (TBC) INFORMATION

In summary, CERCLA Section 121(d), specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e.,ARAR) to the hazardous substances or particular circumstances at a site or obtain a waiver [see also 40 CFR 300.430(f)(1)(ii)(B)]. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria or guidance may be considered in determining remedies (so-called To-Be-Consisdered [TBC] category). ARARs include only federal and state environmental laws/regulations, and do not include occupational safety regulations. In accordance with 40 CFR 300.400(g), the DOE, TDEC and EPA have identifed the specific ARARs for the Phase I remedial actions which includes source control actions for the Boneyard/Burnyard and S-3 Sites, actions designed to address surface water contamination in Bear Creek and its tributaries, as well as closure of the DARA/OLFSCP waste piles. Source control decisions for Bear Creek Burial Grounds and any remaining groundwater contamination will be addressed in a future ROD. ARARs and TBC for these Phase I remedial actions are listed in Tables B.1, B.2, and B.3 beginning on page B-6 and discussed below. The selected remedy complies with all identified ARARs and does not require a waiver(s).

Chemical-Specific. Chemical-specific ARARs provide health or risk-based concentration limits or discharge limitations in various environmental media (e.g., surface water, groundwater, soils) for specific hazardous substances, pollutants, or contaminants and are listed on Table B.1 as well as discussed briefly below.

Bear Creek and its tributaries are classified for *Fish and Aquatic Life, Recreation, Irrigation* and *Livestock Watering and Wildlife* uses (Rules of the TDEC Chapter 1200-4-4). After completion of the source control actions in Bear Creek Valley, the numeric and narrative criteria for protection of aquatic organisms are expected to be met in all surface waters within the valley. Consistent with EPA guidance (EPA 823-B-94-005A, 1994), compliance with numeric AWQC for *Recreation* and/or *Fish and Aquatic Life* use classifications is sufficently stringent to ensure protection of other uses for which there are narrative, but no numeric criteria (i.e., *Irrigation* or *Livestock Watering and Wildlife*).

Radiation Protection. Relevant and appropriate Nuclear Regulatory Commission (NRC) radiation protection requirements include: (1) an exposure limit for individual members of the public of 100mrem/year total effective dose equivalent (EDE) from all sources excluding dose contributions from background radiation, medical exposures, or voluntary participation in medical/research

programs [10 CFR 20.1301(a)]; and (2) the need to further reduce exposures to as low as reasonably achievable (ALARA) levels [10 CFR 20.1101(b)].

Location-Specific. Location-specific ARARs include restrictions placed upon the concentrations of hazardous substances or the conduct of activities soley because of they are in special locations (e.g., wetlands, floodplains, critical habitats, streams).

Wetlands. The excavation activites for this remedial action will impact the wetland areas in the Bear Creek Valley watershed, thus ARARs for wetlands at 10 CFR 1022.3 must be met. Mitigation strategy for destroyed or disturbed wetlands includes creation, restoration, or enhancement of existing wetlands adjacent to Bear Creek Valley in Roane County near the intersection of State highways 58 and 95. .

Threatened or Endangered Species. The *Tennessee dace,* listed by the state of Tennessee as "in need of management", has been identified in Bear Creek Valley streams. Any remedial actions within or near Bear Creek and its tributaries that would impact the streams will be scheduled to avoid to the extent possible disturbance of the fishes spring spawning activities..

Aquatic Resources. The Phase I remdial actions will involve miscellaneous land-disturbing activities nearby or in streams (including relocation of some tributaries or wet weather conveyances) and thus must meet the substantive requirements for TDEC aquatic resource alteration program general permits listed in Table B.2. These requirements include use of Best Management Practices (BMPs) for erosion and siltation control, streambed and bank stabilization, and mininmizing disturbance of riparian vegetation to prevent erosion and prevent pollution of nearby streams. The Clean Water Act Section 404 requirements for protection of aquatic resources at 40 CFR 230.10 must also be met if the action involves any discharge of dredged or fill material into the Bear Creek or its tributaries .

Cultural Resouces. Although the Bear Creek Valley watershed contains no identified historic or archeologic properties, there is the potential for discovery of unidentified archeologic materials or Native American remains during site grading and construction activities, in particular, near or in the Bear Creek Valley floodplain areas. In the event such resources are discovered, the requirements of the Archaeological Resources Protection Act of 1979 and the Native American Graves Protection and Repatriation Act of 1990 would be ARAR. .

Action-Specifc. Action-specific ARARs include operation, performance and design requirements or limitations based on the waste types, media, and remedial activities and are provided in Table B.3 and discussed below.

Site Preparation and Excavation Activites. The TDEC requirements for control of fugitive dust and stormwater runoff apply to all land disturbing activities, including, but not limited to excavation of contaminated soils, land grading, and demolition of structures. Reasonable precautions include use of BMPs to prevent runoff, and application of water on exposed soil surfaces to prevent particulate matter from becoming airborne. In addition, diffuse or fugitive emissions of radionuclides to the ambient air from the remediation activities, which is only one of potentially many sources of radionuclide emissions at a DOE facility, must comply with the requirements in 40 CFR 61.

Waste Characterization and Management. The process of excavating and removing contaminated soils will generate wastestreams potentially contaminated with RCRA hazardous waste, Toxic Substances Control Act of 1976 PCBs, and radionuclides. The primary wastestreams (e.g., soils) and secondary wastestreams (e.g., contaminated PPE, decontamination wastewaters) must be characterized and accordingly managed as either solid waste, RCRA hazardous waste, PCB waste, LLW or mixed waste. The requirements for generation, characterization, and mangement (including temporary storage) of these wastes types are listed in Table B.3..

All collected wastewater, whether from the Boneyard/Burnyard soils dewatering actions, decontamination activities, etc., will be characterized and sent by tanker truck to the existing Y-12 Plant Groundwater Treatment Facility, an National Pollutant Discharge Elimination System (NPDES)-permitted facility. Some of those waters may fail the Toxicity Characteristic Leaching Procedure and be considered RCRA-characteristic waste. However, on-site wastewater treatment or elementary neutralization units (as defined in 40 CFR 260.10) that are operating under an NPDES permit are not subject to RCRA Subtitle C hazardous waste management standards [40 CFR 270.1(c)(2)(v); 40 CFR 264.1(g)(6)]. EPA has stated that the method of conveyance to the treatment unit is covered by this exemption and may be via pipeline, truck, or any other means, and intermediate sumps, tanks, or holding ponds (53 FR 34080, September 2, 1988).

Removal of Contaminated Soils. The Boneyard/Burnyard is not considered a RCRA-regulated unit but, instead, an inactive solid waste management unit. A review of available documentation did not result in information that would identify waste disposed of at the Boneyard/Burnyard or Hazardous Chemical Disposal Area as RCRA-listed waste. EPA has stated that it is necessary to know the origin of the waste to determine whether it is a listed waste and that, if this documentation is lacking, the lead agency may assume it is not a listed waste (55 FR 8758, March 8, 1990). Current analytical data indicate that waste (i.e., contaminated soils) to be excavated from the Boneyard/Burnyard is not expected to be characteristically hazardous but instead is radiologically contaminated and would be considered LLW. Further characterization may be

required for meeting the disposal facility WAC. Any soils subsequently determined to be hazardous will be managed in accordance with the RCRA requirements.

As currently designed and scheduled , transfer of Boneyard/Burnyard source area wastes to the receiving disposal facility will occur immediately after excavation and any necessary treatment is complete. However, if scheduling necessitates temporary storage until the on-site EMWMF is operational or a permitted off-site disposal facility is ready to receive the waste, then the wastewill be stored temporarily in a manner that complies with the requirements of DOE M 435.1-1 for LLW storage.

Waste Treatment and Disposal. Any RCRA-hazardous soils removed from the areal extent of contamination or from the DARA/OLFSCP waste piles for subsequent disposal in a land-based unit (i.e, the proposed EMWMF or an approved off-site disposal facility) will need to meet land disposal restrictions (LDRs) for hazardous waste at 40 CFR 268.40 before disposal. Under CERCLA Section 121(d) remedial actions must comply with federal or more stringent state ARARs. EPA has recently promulgated alternative treatment standards for soils [63 *Federal Register* (FR) 28555, May 26, 1988] which are considered to be less stringent than the current LDRs in the state of Tennessee hazardous waste regulations. However, if Tennessee adopts the alternative standards before issuance of the ROD then these new soil treatment standards will be considered ARAR. In addition, the DAR/OLFSCP soils which are considered bulk PCB remediation waste must be disposed of in accordance with the requirements of 40 CFR 761.61. Upon closure these wastes are expected to be sent to an off-site permitted RCRA Subtitle C disposal facility. Consistent with DOE M 435.1-1 requirements, for soils that are considered LLW, no treatment is expected unless deemed necessary to meet the disposal facility waste acceptance criteria.

Waste Pile Closure. The DARA Solids Storage Facility and the OLF Soil Containment Pad are RCRA waste piles containing mixed waste (RCRA, low-level radioactive, PCB-contaminated soil and debris). The mixed waste will continue to be stored in compliance with the requirements of RCRA, TSCA , and DOE M 435.1-1 until it can be transferred to an appropriate disposal facility. The Site Treatment Plan (STP) indicates that the wastes stored at the DARA and OLF facilities will be addressed under CERCLA and are not subject to the STP requirements. The RCRA-closure requirements for a waste pile are applicable, and clean closure (i.e., removal of all contaminated soils and decontamination of all structures) of these units is expected. Building demolition materials from the closure activities will be characterized to determine if they are RCRA hazardous waste, PCB waste, LLW, mixed or simply solid waste and disposed accordingly in an on-site solid waste landfill, the EMWMF, an off-site disposal facility or partially left in place. If a clean closure (i.e., removal of all contaminated soils and decontamination of all structures) is not possible, these

units will be closed as RCRA landfills in accordance with the requirements under Subpart N (40 CFR 265.20) and postclosure-care requirements of 40 CFR 265.258(b).

Closure of BYBY/Institutional Controls. After soil excavation to remove certain contamination, the BYBY will be covered in a manner that meets the the RCRA closure performance standard as well as the relevant and appropriate NRC LLW disposal requirements. Access to the property and restricted use of the area will be controlled through appropriate administrative and physical controls as specified in DOE Order 5400.5 Chapter IV(6)(1)(e) and Rules of the TDEC 1200-1-13-.08(10). Additional insitutional controls, including monitoring and surveillance activities will be specified in the Land Use Controls Implementation Plan which will be issued after the ROD.

Transportation. Any wastes that are transfered off-site for disposal must meet the requirements summarized in Table B3., depending on the type of waste (e.g. RCRA, PCB, LLW or mixed). These include packaging, labeling, marking, manifesting and placarding requirements. In addition, to the extent practicable, the volume of waste and number of shipments shall be minimized. Before shipping any waste to an off-site facility, DOE will verify that the facility is acceptable with EPA for receipt of CERCLA remediation wastes in accordance with the requirements of the "Off-Site Rule" in 40 CFR 300.440(a)(4).

Table A.1. Chemical-specific ARARs and TBC guidance for the Bear Creek Valley watershed Phase I ROD, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Medium/action	Requirements	Citation
1. Restoration of surface waters classified for Fish and Aquatic Life Use	Waters shall not contain toxic substances or a combination of substances including disease-causing agents which, by way of either direct exposure or indirect exposure through food chains, may cause death, disease, behavorial abnormalities, cancer, genetic mutations, physiological malfunctions, physical deformations, or restrict or impair growth in fish or aquatic life or their offspring—**relevant and appropriate**	TDEC 1200-4-3.03(3)(g)
	May not exceed the following AWQC in surface waters—**relevant and appropriate** Compound — CMC[a]/CCC[b] (µg/l) Cadmium, dissolved[c] — 3.9/1.1	TDEC 1200-4-3-.03(3)(g)
	Waters shall not contain other pollutants that will be detrimental to fish or aquatic life—**relevant and appropriate**	TDEC 1200-4-3-.03(3)(h)
2. Releases of radionuclides into the environment	Exposure to the individual members of the public from radiation shall not exceed a total EDE of 0.1 rem/year (100 mrem/year), exclusive of the dose contributions from background radiation, any medical administration the individual has received, or voluntary participation in medical/research programs—**relevant and appropriate**	10 CFR 20.1301(a)
	Shall use, to the extent practicable, procedures and engineering controls based on sound radiation protection principles to achieve doses to members of the public that are ALARA—**relevant and appropriate**	10 CFR 20.1101(b)

[a] The highest concentration of a pollutant to which aquatic life can be exposed for a 1-hour average time period.
[b] The highest concentration of a pollutant to which aquatic life can be exposed in a 4-day time period.
[c] Criteria for this metal is expressed as a function of total hardness of 100 mg/l.

ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
AWQC = ambient water quality criteria
CFR = *Code of Federal Regulations*
CCC = criterion continuous concentration
CMC = criterion maximum concentration
EDE = effective dose equivalent
L = liter
µg = microgram
mg = milligram
mrem = millirem
rem = roentgen equivalent man
ROD = record of decision
TBC = to be considered
TDEC = Rules of the Tennessee Department of Environment and Conservation

Table A.2. Location-specific ARARs and TBC guidance for the Bear Creek Valley watershed, Phase I ROD, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Location characteristic(s)	Requirements	Prerequisite	Citation
	Floodplains		
3. Presence of floodplain as defined in 10 CFR 1022.4(i)	Avoid, to the extent possible, the long- and short-term adverse effects associated with occupancy and modification of floodplains. Measures to mitigate adverse effects of actions in a floodplain include but are not limited to: minimum grading requirements, runoff controls, design and construction constraints, and protection of ecology-sensitive areas as provided in 10 CFR 1022.12(a)(3).	Federal actions that involve potential impacts to, or take place within, floodplains—**applicable**	10 CFR 1022.3(a)
	Potential effects of any action taken in a floodplain shall be evaluated. Identify, evaluate, and implement alternative actions that may avoid or mitigate adverse impacts on floodplains.		10 CFR 1022.3(c) and (d)
	Design or modify selected alternatives to minimize harm to or within floodplains and restore and preserve floodplain values.		10 CFR 1022.5(b)
	Wetlands		
4. Presence of wetlands as defined in 10 CFR 1022.4(v)	Avoid, to the extent possible, the long- and short-term adverse effects associated with destruction, occupancy and modification of wetlands. Measures to mitigate adverse effects of actions in a floodplain include, but are not limited to: minimum grading requirements, runoff controls, design and construction constraints, and protection of ecology-sensitive areas as provided in 10 CFR 1022.12(a)(3).	Federal actions that involve potential impacts to, or take place within, wetlands—**applicable**	10 CFR 1022.3(a)
	Take action, to extent practicable, to minimize destruction, loss or degradation of wetlands, and to preserve, restore, and enhance the natural and beneficial values of wetlands.		10 CFR 1022.3(b)
	Potential effects of any new construction in wetlands shall be evaluated. Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse impacts on wetlands.		10 CFR 1022.3(c) *and* (d)

Table A.2. (continued)

Location characteristic(s)	Requirements	Prerequisite	Citation
	Aquatic resources		
5. Within an area potentially impacting waters of the state as defined in TCA 69-3-103(33)	Must comply with the substantive requirements of the ARAP for erosion and sediment control to prevent pollution.	Action potentially altering the properties of any waters of the state—**applicable**	TCA 69-3-108 (b)(1)(j)
	Erosion and sediment control requirements include, but are not limited to: • Limit clearing, grubbing, and other disturbances in areas in or immediately adjacent to waters of the state to the minimum necessary to accomplish the proposed activity. • Unnecessary vegetation removal is prohibited and all disturbed areas must be properly stabilized and revegetated as soon as practicable. • Limit excavation, dredging, bank reshaping, or grading to the minimum necessary to install authorized structures, accommodate stabilization, or prepare banks for revegetation. • Maintain the erosion and sedimentation control measures throughout the construction period. • On achievement of final grade, stabilize and revegetate, within 30 days, all disturbed areas by sodding, seeding, or mulching, or using appropriate native riparian species.	Action potentially altering the properties of any waters of the state—**TBC**	Rules of the TDEC Aquatic Resource Alteration General Permit Program Requirements
6. Within area impacting stream or any other body of water and presence of wildlife resources (e.g., fish)	The effects of water-related projects on fish and wildlife resources and their habitat should be considered with a view to the conservation of fish and wildlife resources by preventing loss of and damage to such resources.	Action that impounds, modifies, diverts, or controls waters, including navigation and drainage activities—**relevant and appropriate**	Fish and Wildlife Coordination Act (16 USC 661 *et seq.*)

Table A.2. (continued)

Location characteristic(s)	Requirements	Prerequisite	Citation
7. Location encompassing aquatic ecosystem as defined in 40 CFR 230.3(c)	No discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practicable alternative that would have less adverse impact.	Action that involves the discharge of dredged or fill material into waters of the U.S., including jurisdictional wetlands — **applicable**	40 CFR 230.10(a)
	No discharge of dredged or fill material shall be permitted unless appropriate and practicable steps per 40 CFR 230.70 *et seq.* have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem.		40 CFR 230.10(d)
Endangered, threatened or rare species			
8. Presence of Tennessee nongame species (*Tennessee dace*) as defined in TCA 70-8-103	May not take (i.e., harass, hunt, capture, kill or attempt to kill), possess, transport, export, or process wildlife species.	Action impacting Tennessee nongame species, including wildlife species which are in need of management (as listed in TWRCP 94-16 and 94-17)—**applicable**	TCA 70-8-104(c)
	May not knowingly destroy the habitat of such wildlife species.		TWRCP 94-16(II)(1)(a) and TWRCP 94-17(II)
	Upon good cause shown and where necessary to protect human health or safety, endangered or threatened species may be removed, captured, or destroyed.		TCA 70-8-106(e) TWRCP 94-16(II)(1)(c)

ARAR = applicable or relevant and appropriate requirement
ARAP = Aquatic Resource Alteration Permit
CFR = Code of Federal Regulations
ROD = record of decision
TBC = to be considered

TCA = Tennessee Code Annotated
TDEC = Rules of the Tennessee Department of Environment and Conservation
TWRCP = Tennessee Wildlife Resources Commission Proclamation
USC = United States Code

Table A.3. Action-specific ARARs and TBC guidance for the Bear Creek Valley watershed Phase I ROD, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Action	Requirements	Prerequisite	Citation
	Site preparation, construction and excavation activities		
9. Activities causing fugitive dust emissions	Shall take reasonable precautions to prevent particulate matter from becoming airborne. Reasonable precautions shall include, but are not limited to, the following:	Fugitive emissions from demolition of structures, construction operations, grading of roads, or the clearing of land— **applicable**	TDEC 1200-3-8-.01
	• Use, where possible, of water or chemicals for control of dust;		TDEC 1200-3-8-.01(1)(a)
	• Application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces which can create airborne dusts.		TDEC 1200-3-8-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner to exceed 5 minutes/hour or 20 minutes/day beyond property boundary lines on which emission originates.		TDEC 1200-3-8-.01(2)
10. Activities causing radionuclide emissions	Shall not exceed those amounts that would cause any member of the public to receive an EDE of 10 mrem per year.	Radionuclide emissions from point sources, as well as diffuse or fugitive emissions at a DOE facility— **applicable**	40 CFR 61.92 TDEC 1200-3-11-.08(6)
11. Activities causing stormwater runoff	Implement good construction management techniques (including sediment and erosion controls), vegetative and structural controls per TDEC 1200-4-10-.05(6)(a-f), (g-i), (j-m), respectively, to ensure stormwater discharge:	Dewatering or stormwater runoff discharges from land disturbed by construction activities- disturbance of ≥ 5 acres total—**applicable**; < 5 acres —**relevant and appropriate**	TDEC 1200-4-10-.05(6)
	• does not contain distinctly visible floating scum, oil, or other matter;		TDEC 1200-4-10-.05(6)(n)
	• does not cause an objectionable color contrast in the receiving stream;		TDEC 1200-4-10-.05(6)(o)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
	• results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream.		TDEC 1200-4-10-.05(6)(p)
	Waste generation activities		
12. Characterization of solid waste (e.g., contaminated PPE, equipment, soils, wastewater)	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4; and	Generation of solid waste as defined in 40 CFR 261.2 and which is not excluded under 40 CFR 261.4(a) —**applicable**	40 CFR 262.11(a) TDEC 1200-1-11-.03(1)(b)(1)
	Must determine if waste is listed under 40 CFR Part 261; or		40 CFR 262.11(b) TDEC 1200-1-11-.03(1)(b)(2)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used. If waste is determined to be hazardous, it must be managed in accordance with 40 CFR 261-268.		40 CFR 262.11(c) and (d) TDEC 1200-1-11-.03(1)(b)
13. Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) that at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with 40 CFR 264 and 268.	Generation of RCRA hazardous waste for storage, treatment or disposal —**applicable**	40 CFR 264.13(a)(1) TDEC 1200-1-11-.06(2)(d)
	Must determine if the waste is restricted from land disposal under 40 CFR 268 et seq. by testing in accordance with prescribed methods or use of generator knowledge of waste.		40 CFR 268.7 TDEC 1200-1-11-.10(1)(g)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
14. Characterization of LLW (e.g., contaminated PPE, equipment, soils, wastewater)	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the WAC of the receiving facility.	Generation of LLW for storage or disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(I)
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste:		DOE M 435.1-1(IV)(I)(2)
	• physical and chemical characteristics;		DOE M 435.1-1 (IV)(I)(2)(a)
	• volume, including the waste and any stabilization or absorbent media;		DOE M 435.1-1 (IV)(I)(2)(b)
	• weight of the container and contents;		DOE M 435.1-1 (IV)(I)(2)(c)
	• identities, activities, and concentrations of major radionuclides;		DOE M 435.1-1 (IV)(I)(2)(d)
	• characterization date;		DOE M 435.1-1 (IV)(I)(2)(e)
	• generating source; and		DOE M 435.1-1 (IV)(I)(2)(f)
	• any other information which may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with performance objectives.		DOE M 435.1-1 (IV)(I)(2)(g)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
15. Management of PCB waste (e.g., contaminated PPE, equipment, soils, wastewater)	Any person storing or disposing of PCB waste must do so in accordance with 40 CFR 761, Subpart D.	Generation of waste containing PCBs at concentrations ≥ 50 ppm—**applicable**	40 CFR 761.50(a)
	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found.	Generation of PCB remediation waste as defined in 40 CFR 761.3—**applicable**	40 CFR 761.61
16. Management of PCB/Radioactive waste	Any person storing such waste ≥ 50 ppm PCBs must do so taking into account both its PCB concentration and radioactive properties, except as provided in 40 CFR 761.65(a)(1), (b)(1)(ii) and (c)(6)(i).	Generation of PCB/ Radioactive waste for storage and disposal — **applicable**	40 CFR 761.50(b)(7)(i)
	Any person disposing of such waste must do so taking into account both its PCB concentration and its radioactive properties.		40 CFR 761.50(b)(7)(ii)
Storage			
17. Temporary storage of hazardous waste in containers (e.g., PPE, rags, etc.)	A generator may accumulate hazardous waste at the facility provided that: • waste is placed in containers that comply with 40 CFR 265.171-173 (Subpart I); and • container is marked with the words "hazardous waste" or; • container may be marked with other words that identify the contents.	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10—**applicable** Accumulation of 55 gal. or less of RCRA hazardous waste at or near any point of generation —**applicable**	40 CFR 262.34(a) TDEC 1200-1-11-.03(4)(e) 40 CFR 262.34(c)(1) TDEC 1200-1-11-.03(4)(e)(5)
18. Use and management of hazardous waste in	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste	Storage of RCRA hazardous waste in containers	40 CFR 264.171 TDEC 1200-1-11-

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
containers	into container in good condition.	—**applicable**	.05(9)()(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired;		40 CFR 264.172 TDEC 1200-1-11-.05(9)(c)
	Keep containers closed during storage, except to add/remove waste;		40 CFR 264.173(a) TDEC 1200-1-11-.05(9)(d)(1)
	Open, handle and store containers in a manner that will not cause containers to rupture or leak.		40 CFR 264.173(b) TDEC 1200-1-11-.05(9)(d)(2)
19. Storage of hazardous waste in DARA/OLFSCP	Requirements of 40 *CFR* 264.251 and Subpart F (*Releases from Solid Waste Management Units*) do not apply, provided that:	Storage of RCRA-hazardous waste in a RCRA waste pile inside or under a structure that provides protection from precipitation so that neither runoff nor leachate is generated —**applicable**	40 CFR 264.250(c); TDEC 1200-1-11-.06(12)
	• liquids or materials containing free liquids are not placed in the pile;		40 CFR 264.250(c)(1)
	• pile is protected from surface water run-on by the structure or in some other manner;		40 CFR 264.250(c)(2)
	• pile is operated to control wind dispersal without the use of wetting materials; and		40 CFR 264.250(c)(3)
	• pile will not generate leachate through decomposition or other reactions.		40 CFR 264.250(c)(4)
20. Temporary storage of LLW (e.g., staging BYBY excavated soils)	Ensure that radioactive waste is stored in a manner that protects the public, workers, and the environment and that the integrity of waste storage is maintained for the expected time of storage.	Management of LLW at a DOE facility—**TBC**	DOE M 435.1-1 (IV)(N)(1)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water.		DOE M 435.1-1 (IV)(N)(1)
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage.		DOE M 435.1-1 (IV)(N)(3)
	Shall be managed to identify and segregate LLW from mixed waste.		DOE M 435.1-1 (IV)(N)(6)
21. Packaging of LLW (e.g., PPE, rags)	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container.	Storage of LLW in containers at a DOE facility—**TBC**	DOE M 435.1-1 (IV)(L)(1)(a)
	Vents or other mesures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container.		DOE M 435.1-1 (IV)(L)(1)(b)
	Containers shall be marked such that their contents can be identified.		DOE M 435.1-1 (IV)(L)(1)(c)
22. Temporary storage of PCB waste (e.g., PPE, rags) in containers	Container(s) shall be marked as illustrated in 40 CFR 761.45(a).	Storage of PCBs and PCB Items at concentrations ≥50 ppm for disposal — **applicable**	40 CFR 761.65 (a)(1)
	Storage area must be properly marked as required by 40 CFR 761.40(a)(10).		40 CFR 761.65(c)(3)
	Any leaking PCB Items and their contents shall be transferred immediately to a properly marked non-leaking container(s).		40 CFR 761.65(c)(5)
	Container(s) shall be in accordance with requirements set forth in DOT HMR at 49 CFR 171-180.		40 CFR 761.65(c)(6)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
23. Storage of PCB/radioactive waste in containers (e.g. PPE, wastewaters)	For liquid wastes, containers must be nonleaking.	Storage of PCB/radioactive waste in containers other than those meeting DOT HMR performance standards—**applicable**	40 CFR 761.65(c)(6)(i)(A)
	For nonliquid wastes, containers must be designed to prevent buildup of liquids if such containers are stored in an area meeting the containment requirements of 40 CFR 761.65(b)(1)(ii); and		40 CFR 761.65(c)(6(i)(B)
	For both liquid and nonliquid wastes, containers must meet all regulations and requirements pertaining to nuclear criticality safety.		40 CFR 761.65(c)(6)(i)(C)
Treatment/Disposal			
24. Treatment of LLW	Treatment to provide more stable waste forms and to improve the long-term performance of a LLW disposal facility shall be implemented as necessary to meet the performance objectives of the disposal facility.	Generation of LLW for disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(O)
25. Treatment of uranium and thorium bearing LLW	Such wastes shall be properly conditioned so that the generation and escape of biogenic gases will not cause exceedance of Rn-222 emission limits of DOE Order 5400.5(IV)(6)(d)(1)(b) and will not result in premature structure failure of the facility.	Placement of potentially biodegradeable contaminated wastes in a long-term management facility—**TBC**	DOE Order 5400.5(IV)(6)(d)(1)(c)
26. Disposal of LLW at an on-site disposal facility or an off-site disposal facility	LLW shall be certified as meeting waste acceptance requirements before it is transferred to the receiving facility.	Generation of LLW for disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(J)(2)
27. Packaging of LLW for disposal (e.g., PPE, demolition debris)	Must have structural stability either by processing the waste or placing the waste in a container or structure that provides stability after disposal.	Generation of LLW for disposal at a LLW disposal facility — **relevant and appropriate**	TDEC 1200-2-11-.17(7)(b)(1)
	Void spaces within the waste and between the waste and its package must be reduced to the extent practicable.		TDEC 1200-2-11-.17(7)(b)(3)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
28. Disposal of RCRA/TSCA waste at an off-site commercial facility	Meet authorized limits established in accordance with basic dose limits and consistent with guidelines contained in DOE-EH guidance before release. Authorized limits shall be consistent with limits and guidelines established by other applicable federal and state laws.	Release of hazardous wastes potentially containing residual radioactive material throughout the volume—**TBC**	DOE Order 5400.5(II)(5)(c)(6) and 5400.5(IV)(5)(a)
29. Performance-based disposal of PCB remediation waste at an on-site disposal facility or an off-site disposal facility	May dispose by one of the following methods: • in a high-temperature incinerator approved under Section 761.70(b), • by an alternate disposal method approved under Section 761.60(e), • in a chemical waste landfill approved under Section 761.75, • in a facility with a coordinated approval issued under Section 761.77, or • through decontamination in accordance with under 40 CFR 761.79.	Disposal of nonliquid PCB remediation waste—**applicable**	40 CFR 761.61(b)(2) 40 CFR 761.61(b)(2)(i) 40 CFR 761.61(b)(2)(ii)
30. Disposal of bulk PCB remediation waste at an off-site disposal facility (self-implementing)	May be sent off-site for decontamination or disposal provided the waste is either dewatered on-site or transported off-site in containers meeting the requirements of DOT HMR at 49 CFR parts 171-180.	Generation of bulk PCB remediation waste (as defined in 40 CFR 761.3) for disposal — **applicable**	40 CFR 761.61(a)(5)(i)(B)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
	Must provide written notice including the quantity to be shipped and highest concentration of PCBs [using extraction EPA Method 3500B/3540C or Method 3500B/3550B followed by chemical analysis using Method 8082 in SW-846 or methods validated under 40 CFR 761.320-26 (Subpart Q)] at least 15 days before the first shipment of waste to each off-site facility where the waste is destined for an area not subject to a TSCA PCB Disposal Approval.		40 CFR 761.61(a)(5)(i)(B)(2)*(iv)*
	Shall be disposed of in accordance with the provisions for Cleanup wastes at 40 CFR 761.61(a)(5)(v)(A).	Bulk PCB remediation waste which has been de-watered and with a PCB concentration < 50 ppm — **applicable**	40 CFR 761.61(a)(5)(i)(B)(2)*(ii)*
	Shall be disposed of: • in a hazardous waste landfill permitted by EPA under §3004 of RCRA; • in a hazardous waste landfill permitted by a State authorized under §3006 of RCRA; or • in a PCB disposal facility approved under 40 CFR 761.60.	Bulk PCB remediation waste which has been de-watered and with a PCB concentration ≥ 50 ppm — **applicable**	40 CFR 761.61(a)(5)(i)(B)(2)*(iii)*

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
31. Disposal of PCB cleanup wastes (PPE, rags, nonliquid cleaning materials)	Shall be disposed of either: • in a facility permitted, licensed or registered by a state to manage municipal solid waste under 40 CFR 258 or nonmunicipal, nonhazardous waste subject to 40 CFR 257.5 thru 257.30; or • in a RCRA Subtitle C landfill permitted by a state to accept PCB waste, or • in an approved PCB disposal facility, or • through decontamination under 40 CFR 761.79(b) or (c).	Generation of nonliquid PCBs at any concentration during and from the cleanup of PCB remediation waste—**applicable**	40 CFR 761.61(a)(5)(v)(A)
32. Disposal of PCB cleaning solvents, abrasives, and equipment	May be reused after decontamination in accordance with 761.79	Generation of PCB wastes from the cleanup of PCB remediation waste—**applicable**	40 CFR 761.61(a)(5)(v)(B)
33. Disposal of RCRA-hazardous waste in a land-based unit	May be land disposed only if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste—**applicable**	40 CFR 268.40(a) TDEC 1200-1-11-.10(3)(a)
	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c), or according to the UTSs specified in 40 CFR 268.48 applicable to the listed and/or characteristic waste contaminating the soil, prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils—**applicable**	40 CFR 268.49(b) TDEC 1200-1-11-.10(3)(j)(2)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
	Closure/postclosure		
34. Closure with LLW in place at BYBY	Remedial action shall not be considered complete until the residual radioactive material levels meet the authorized limits as established pursuant to DOE Order 5400.5(IV)(5)(b) or supplemental limits as authorized pursuant to DOE Order 5400.5(IV)(7).	Long-term management of LLW at DOE facilities—**TBC**	DOE Order 5400.5(IV)(5)(b)
	Design cover to minimize water infiltration and direct percolating or surface water away from unit and to resist degradation.	Closure of LLW disposal facility—**relevant and appropriate**	TDEC 1200-2-11-.17(2)(d)
	Ensure surface features direct surface water drainage away from unit.		TDEC 1200-2-11-.17(2)(e)
	Minimize contact of percolating or standing water with waste after disposal.		TDEC 1200-2-11-.17(2)(f)
35. Closure with hazardous waste in place in Hazardous Chemical Disposal Area at the BYBY and clean closure of DARA/OLFSCP waste piles	Must close the unit(s) in a manner that: • minimizes the need for further maintenance; and • controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to ground or surface waters or to the atmosphere.	Closure of a RCRA hazardous waste management facility—**applicable** to DARA/OLFSCP;—**relevant and appropriate** to BYBY	40 CFR 265.111 TDEC 1200-1-11-.05(7)(b)
36. Clean closure of the DARA/OLFSCP waste piles	Remove or decontaminate all waste residues, contaminated containment system components, contaminated subsoil, and structures or equipment contaminated with waste/leachate and manage as hazardous waste.	Closure of a RCRA waste pile —**applicable**	40 CFR 265.258(a) TDEC 1200-1-11-.05(12)(i)
	If all contaminated subsoils cannot be removed or decontaminated, must close facility and perform postclosure care in accordance with closure and postclosure requirements that apply to landfills (40 CFR 265.310).		40 CFR 265.258(b) TDEC 1200-1-11-.05(12)(i)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
37. Clean closure of TSCA storage facilities (e.g., DARA/OLFSCP)	TSCA/RCRA storage facilities closed under RCRA are exempt from the TSCA closure requirements of 40 CFR 761.65(c).	Closure of TSCA/RCRA storage facility—**applicable**	40 CFR 761.65(e)(3)
38. Closure of RCRA groundwater monitoring wells	Shall be completely filled and sealed in such a manner that vertical movement of fluid either into or between formation(s) containing ground water classified pursuant to Rules of the TDEC 1200-4-6-.05(1) through the bore hole is not allowed. Shall be performed in accordance with the provisions for Seals at 1200-4-6-.09(6)(e), (f), and (g), for Fill Materials at 1200-4-6-.09(6)(h) and (i), for Temporary Bridges at 1200-4-6-.09(6)(j), for Placement of Sealing Materials at 1200-4-6-.09(7)(a) and (b), and Special Conditions at 1200-4-6-.09(8)(a) and (b), as appropriate.	Permanent plugging and abandonment of a well -- **relevant and appropriate**	TDEC 1200-4-6-.09(6)(d)
	Institutional controls		
39. Waste left in place	Institutional controls are required and shall include, at a minimum, deed restrictions for sale and use of property and securing area to prevent human contact with hazardous substances.	Hazardous substances left in place which may pose an unreasonable threat to public health, safety, or the environment—**relevant and appropriate**	TDEC 1200-1-13-.08(10)
40. Radioactive waste left in place	Use of, and access to, residual radioactive material shall be controlled through appropriate administrative and physical controls.	Long-term management of radioactive material at DOE facility—**TBC**	DOE Order 5400.5(IV)(6)(d)(1)(c)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
	Transportation		
41. Transportation of LLW waste off site	LLW waste shall be packaged and transported in accordance with DOE O 460.1A and DOE O 460.2. To the extent practicable, the volume of waste and number of shipments shall be minimized.	Shipment of LLW off site—**TBC**	DOE M 435.1-1(I)(1)(E)(11) DOE M 435.1-1(IV)(L)(2)
42. Transportation of PCB wastes off site	Must comply with the manifesting provisions at 40 CFR 761.207 through 218.	Relinquishment of control over PCB wastes by transporting, or offering for transport—**applicable**	40 CFR 761.207 (a)
43. Transportation of hazardous waste off site	Must comply with the generator requirements of 40 CFR 262.20-23 for manifesting; Section 262.30 for packaging; Section 262.31 for labeling, Section 262.32 for marking, Section 262.33 for placarding; Section 262.40, 262.41(a) for record keeping requirements; and Section 262.12 to obtain EPA ID number.	Off-site transportation of RCRA hazardous waste—**applicable**	40 CFR 262.10(h) TDEC 1200-1-11-.03(1)(a)(8)
	Must comply with the requirements of 40 CFR 263.11-263.31. A transporter that meets all applicable requirements of 49 CFR 171-179 and the requirements of 40 CFR 263.11 and 263.31 will be deemed in compliance with 40 CFR 263	Transportation of hazardous waste within the United States requiring a manifest —**applicable**	40 CFR 263.10(a) TDEC 1200-1-11-.04(1)(a)(1)
44. Transportation of hazardous waste on-site	The generator manifesting requirements of 40 CFR 262.20 through 262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.8 in the event of a discharge of hazardous waste on private or public right-of-way.	Transportation of hazardous waste on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way —**applicable**	40 CFR 262.20(f) TDEC 1200-1-11-.03(3)(a)(6)

Table A.3. (continued)

Action	Requirements	Prerequisite	Citation
45. Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171-180	Any person who, under contract with an department or agency of the federal government, transports, or causes to be transported or shipped, a hazardous material—**applicable**	49 CFR 171.1(c)

ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
BMP = best management plan
BYBY = Boneyard/Burnyard
CFR = Code of Federal Regulations
DARA/OLFSCP = Disposal Area Remedial Action/Oil Landfarm Soil Containment Pad
DOE = U.S. Department of Energy
DOT = U.S. Department of Transportation
DOE M = Radioactive Waste Management Manual
DOE O = Order
EDE = effective dose equivalent
EH = Environmental Health
EPA = U.S. Environmental Protection Agency
> = greater than
≥ = greater than or equal to
gal = gallon
HMR = Hazardous Materials Regulations
HMTA = Hazardous Materials Transportation Act
ID = identification number
< = less than
≤ = less than or equal to
LLW = low-level (radioactive) waste
mrem = millirem
mSv = millisievert
ORO = Oak Ridge Operations
PCB = polychlorinated biphenyl

Table A.3. (continued)

PPE = personal protective equipment
ppm = parts per million
RCRA = Resource Conservation and Recovery Act of 1976
ROD = record of decision
TBC = to be considered
TDEC = Rules of the Tennessee Department of Environment and Conservation
TSCA = Toxic Substances Control Act of 1976
WAC = waste acceptance criteria

APPENDIX B

SUMMARY OF COMMUNITY PARTICIPATION

Table B.1. Summary of community participation in the remedial decision-making process, Bear Creek Valley, Y-12 Plant, Oak Ridge, Tennessee

Date	Content	Comments
May 31, 1997 (EUWG)	Tour of Bear Creek Valley	N/A
July 21, 1997 (EUWG)	Public workshop to discuss possible cleanup strategies for Bear Creek Valley	DOE held a public workshop at the Jacobs Technical Center to present and discuss the alternatives considered for remediating Bear Creek Valley. The workshop also included a presentation and discussion on the CERCLA waste disposal options
November 5, 1997 (SSAB)	Watershed strategy presentation	N/A
January 12 ,1998 (SSAB)	Proposed plan update	N/A
February 9, 1998 (SSAB)	Bear Creek Valley issues discussion	N/A
March 9, 1998 (SSAB)	Proposed plan recommendation	N/A
March 11, 1998 (SSAB)	Proposed plan–proposed technologies discussion	N/A
March 25, 1998 (EUWG)	Public workshop to discuss site conditions as presented in the RI and remediation alternatives developed in the FS	DOE held a workshop to discuss the site conditions and alternatives developed and evaluated for remediation of the Bear Creek watershed. The workshop also included presentation and discussion on the disposal of wastes derived from cleanup of ORR
April 6, 1998 (SSAB)	Proposed plan discussion	N/A
May 7, 1998 (SSAB)	Additional proposed plan technology discussion	N/A
June 8, 1998 (SSAB)	Proposed technologies presentation	N/A
June 16, 1998	Proposed plan issued for public comment	N/A
July 9, 1998 (SSAB)	In situ vitrification technologies discussion	N/A
July 13, 1998 (EUWG)	Public meeting on the Phase I proposed plan for Bear Creek Valley	DOE held a public meeting to present the preferred alternative for Phase I remediation of Bear Creek Valley and hear comments on the proposed plan. The public comment period on the proposed plan was from June 16 through August 13, 1998
August 10, 1998 (SSAB)	Discussion of technologies	N/A
September 3, 1998 (SSAB)	Recommendation of in situ vitrification demonstration for Bear Creek Valley	N/A

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DOE = U.S. Department of Energy
EUWG = End Use Working Group
FS = feasibility study
N/A = not applicable
ORR = Oak Ridge Reservation
RI = remedial investigation
SSAB = Site Specific Advisory Board

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