4.3 Hazard Area 3 - Bethel Valley

The Bethel Valley watershed encompasses approximately 1700 acres, including the main industrial complex of Oak Ridge National Laboratory. Bethel Valley is defined by the upper drainage area of White Oak Creek and its tributaries and extends from the Clinch River at its west end to the easternmost boundary of ORNL. The northern boundary lies somewhat north of Bethel Valley Road; the southern boundary is the crest of Haw Ridge, which is the hydrologic divide between Bethel Valley and Melton Valley. Bethel Valley includes the main administrative offices and research facilities of ORNL. Bethel Valley is subdivided into four regions with varied land use and level of contamination: Raccoon Creek, West Bethel Valley, Central Bethel Valley, and East Bethel Valley. Raccoon Valley is located west of Highway 95 and is wooded land that contains no known contamination source areas but slightly contaminated media due to the migration of contaminants from West Bethel Valley. East Bethel Valley includes the ORNL plant maintenance area, Central Bethel Valley includes the main ORNL plant area, and West Bethel Valley contains a burial ground and a small portion of the plant area.

ORNL was originally constructed in 1943 to produce the first gram quantities of plutonium for use in the atomic bomb for the Manhattan Project during World War II. After the war, it was established as a national laboratory and it continues to conduct applied research and engineering development in support of DOE programs in nuclear energy, fusion, energy conservation, fossil fuels, and other energy technologies, and to perform basic and applied scientific research and development in physical, chemical, materials, biological, environmental, social and computational sciences. ORNL's operations during the past 60 years have resulted in a legacy of sites and facilities contaminated with a wide variety of hazardous and radioactive materials. Contaminated sites include numerous tanks, surface impoundments, reactors and associated buildings, buried waste transfer pipelines, and burial grounds and landfills. Interim actions have been conducted under CERCLA for several Bethel Valley facilities, notably including:

- Corehole 8 Plume – This area of groundwater contamination is located in the central portion of the main plant area of ORNL. The plume emanates from contaminated soil surrounding Tank W-1A in the North Tank Farm and migrates west toward First Creek. Since 1994, DOE has been implementing a series of coordinated actions to minimize the release of contaminants (primarily strontium-90 and uranium) to First Creek and reduce the spread of additional contamination. These actions include: intercepting, collecting, and treating approximately 6 million gallons per year of contaminated groundwater migrating toward First Creek; and removing a significant portion of the source (i.e., 90% of the contaminated soil surrounding Tank W-1A). The remainder of the contaminated soil contains very high concentrations of transuranic radionuclides, for which no disposition pathway is currently available.

- Surface Impoundments Operable Unit (SIOU) - These four surface impoundments located in the south-central portion of ORNL formerly served as intermediate collection, storage, and mixing basins for liquid process wastes. Remediation of the SIOU was conducted under a 1997 interim ROD and was completed in 2003. Contaminated

sediments were removed, treated, and converted to 981 solidified concrete waste forms, and disposed of at the EMWMF and off-site locations.

- Gunite and Associated Tanks (GAAT) – These tanks, located in the South Tank Farm at ORNL and originally constructed in 1943 using an in-place gunite construction process, were used for the collection, neutralization, and storage of radioactive and/or hazardous liquid process wastes. The tanks were located below grade and oriented vertically with nominal capacity of 170,000 gallons each. Waste sludges were removed from the tanks under a 1997 interim ROD and the tank shells and risers were stabilized by filling with grout under a 2001 Action Memorandum.

The *Record of Decision for Interim Actions Bethel Valley* (DOE 2002d) was approved in May 2002. Remedial actions selected under the ROD include a combination of containment, stabilization, removal, treatment, monitoring, and land use controls. The selected remedial actions are designed to significantly reduce the release of contaminants from Bethel Valley sources into White Oak Creek and subsequently into the Clinch River. White Oak Creek is the primary exit pathway for mobile contaminants in Bethel Valley. The point of integration for contaminants in Bethel Valley is where White Oak Creek exits the watershed at the 7500 Bridge. Monitoring at this location provides a watershed-scale measure for remedial action effectiveness. The Bethel Valley watershed currently discharges to the Melton Valley watershed, where additional contaminants enter White Oak Creek before being discharged over White Oak Dam to the Clinch River.

Remediation criteria are specified in the Bethel Valley ROD for soils, sediments, and surface water. Remediation goals for surface water are to achieve Ambient Water Quality Criteria (AWQC) in waters of the State of Tennessee, maintain surface water risk below limits for recreational use (i.e., limit risks from surface water pathways not to exceed ELCR=$1x10^{-4}$ and HI ≤ 1 for recreational use), and achieve risk reduction of at least 45% in surface water exiting Bethel Valley (at 7500 Bridge). White Oak Creek is classified for Fish and Aquatic Life, Recreation, and Livestock Watering and Wildlife Use, but not for Domestic or Industrial Water Supply or Irrigation. All other named and unnamed surface waters in Bethel Valley are also classified for Irrigation by default under TDEC rules. Contaminant sources in Bethel Valley are estimated to contribute approximately 20% of the total risk in surface water exiting White Oak Dam, primarily due to strontium-90 and cesium-137.

Remediation criteria for soils and sediments were derived to limit potential risk to future receptors not to exceed 1×10^{-4} ELCR and HI ≤ 1. Remediation criteria are specified for four different land use scenarios: DOE-controlled industrial use, unrestricted industrial use, recreational use (streambed sediment areas), and unrestricted land use in the relatively undeveloped and non-impacted areas of Bethel Valley. The DOE-controlled and unrestricted industrial land use scenarios differ only in the depth to which soils are remediated – 2 ft for DOE-controlled industrial areas and 10 ft for unrestricted industrial areas. The intent of remediation in the streambed sediment areas is to protect a hypothetical recreational user, protect aquatic life, and generally improve surface water quality; seven stream reaches within Bethel Valley have been identified for remediation to the recreational use criteria. The average remediation levels are summarized in Table 4-6.

Table 4-6. Soil & Sediment Remediation Criteria from the Bethel Valley ROD

Principal COC in Soil & Sediment	Soil Remediation Concentration for Industrial Worker	Soil Remediation Concentration for Unrestricted Areas	Sediment Remediation Concentration for Recreational Areas
Carcinogens			
Arochlor-1254	-	-	110 mg/kg
Arochlor-1260	-	-	110 mg/kg
Benz(a)anthracene	260 mg/kg	86 mg/kg	-
Benzo(a)pyrene	26 mg/kg	8.6 mg/kg	62 mg/kg
Benzo(b)fluoranthene	250 mg/kg	86 mg/kg	-
Dibenz(a,h)anthracene	26 mg/kg	8.6 mg/kg	-
Hexachlorodibenzofuran	-	-	4.8 mg/kg
N-nitroso-di-n-propylamine	-	7.8 mg/kg	-
Cobalt-60	7.4 pCi/g	4 pCi/g	200 pCi/g
Iodine-129	1400 pCi/g	-	-
Cesium-137+D	14 pCi/g	7 pCi/g	32 pCi/g
Europium-152	9.5 pCi/g	5 pCi/g	230 pCi/g
Europium-154	11 pCi/g	6 pCi/g	270 pCi/g
Europium-155	710 pCi/g	-	-
Lead-210+D	270 pCi/g	-	-
Radium-226+D*	3 pCi/g	3 pCi/g	-
Radium-228+D*	3 pCi/g	-	-
Thorium-228+D*	3 pCi/g	-	-
Thorium-232+D*	3 pCi/g	3 pCi/g	-
Uranium-235+D	-	37 pCi/g	-
Uranium-238+D	310 pCi/g	91 pCi/g	-
Plutonium-240	540 pCi/g	-	-
Americium-241	450 pCi/g	-	-
Noncarcinogens			
Arsenic	330 mg/kg	-	-

Note: These values apply to single contaminants only. To account for total risk from multiple contaminants, sum-of-ratios calculations must be applied to all significant site-related contaminants that are present above background (except for radium and thorium which are not included in the sum-of-ratios calculation). Actual remediation concentrations, therefore, will likely be lower than the concentrations listed in this table. Concentrations for other contaminants not listed in the table will be determined as necessary and in a manner similar to these COCs.

*Criteria for the Radium-226, Radium-228, Thorium-228, and Thorium-232 decay series are non-risk-based values, set at the alternative concentration limit of 3 pCi/g above site-specific background concentrations. All other criteria are risk-based concentrations for the protection of a hypothetical future worker, and include any contributions from background.

Table 4-7. Primary Contaminants of Concern in Bethel Valley Soils and Sediments

Location	Contaminant of Concern	Range (pC/g)	Exposure Point Conc (pCi/g)	Frequency of Detection
Soils				
Raccoon Creek Area Soil	None	-	-	-
West Bethel Valley Soil	Cesium-137	0.04 – 28,000	21,000	19 / 19
Central Bethel Valley Soil, 2000 Area	Cesium-137	0.035 – 22,220	229	121 / 127
	Cesium-134	0.4 – 70.9	70.9	9 / 9
	Cobalt-60	0.04 – 28.9	8.23	49 / 49
	Europium-152	0.9 – 34.0	27.1	6 / 6
	Europium-154	0.8 – 11.7	10.5	8 / 8
Central Bethel Valley Soil, 3000 North Area	Cesium-137	0 – 3030	8.4	96 / 118
	Cobalt-60	0.1-31.5	14.2	15 / 15
	Europium-152	1-141	141	4 / 4
	Europium-154	0.7-12.1	10.3	6 / 6
Central Bethel Valley Soil, 3000 South Area	Cesium-137	0.03 – 12,700	64.7	140 / 151
	Europium-152	1-274	274	3 / 3
	Europium-154	3-172	172	7 / 7
Central Bethel Valley Soil, 4000 Area	None > RL	-	-	-
East Bethel Valley Soil	None	-	-	-
Sediment				
Central Bethel Valley Sediment – 2000 Area	Cesium-137	1.46 – 2480	2480	6 / 6

An exposure unit approach like that described previously for Melton Valley is used, where both an average remediation level (averaged across the exposure unit) and a maximum remediation level (not to be exceeded at any location) are specified for each contaminant of concern. The maximum remediation level for each COC is set at 10-times the average remediation level shown in Table 4-6. Where multiple COCs are present within an exposure unit, a sum-of-the-ratios approach must be used to ensure that the cumulative risk to the future worker from all contaminants does not exceed 1×10^{-4} ELCR (excluding the radium and thorium decay series) and HI ≤ 1. In addition, any accessible soils determined to be contributing significantly to groundwater contamination at an ELCR $> 1 \times 10^{-4}$ or HI > 1 for industrial use of groundwater will be removed.

The predominant contaminant of concern in soils and sediments in Bethel Valley is cesium-137. Other COCs include Cobalt-60, Europium-152, and Europium-154, with less frequent detections of others listed in Table 4-6. Concentrations of these COCs are summarized in Table 4-7.

With respect to ecological risks, the selected remedy provides overall protection of reach-level populations of aquatic species, valley-wide populations of wide-ranging ecological species, and area-wide populations of terrestrial species in West Bethel Valley, the only area with sufficient habitat. Groundwater treatment actions for mercury and removal of contaminated sediments in the streams will allow AWQC to be met and will protect the aquatic species in those streams. Soil removal actions in West Bethel Valley will remove a threat to individuals of terrestrial

species (populations are already protected). These actions, especially the sediment removal actions, will have some short-term effects on ecological populations, but it is planned to restore those habitats quickly.

Groundwater contamination at Bethel Valley occurs primarily in three areas: in Central Bethel Valley in the main plant area, in West Bethel Valley at SWSA 3, and in East Bethel Valley at the services area. Groundwater contamination in Central Bethel Valley results primarily from the numerous liquid waste transfer pipeline leak sites and liquid waste spill sites; primary contaminants include strontium-90, tritium, uranium, and cobalt-60, but numerous other contaminants are also present, including trichloroethene, beryllium, cadmium, chromium, and lead. A strontium-90 plume in West Bethel Valley extends from SWSA 3 west to Raccoon Creek and east to the Northwest Tributary of White Oak. The principal groundwater contamination problem in East Bethel Valley is a VOC plume that originates from the shipping and receiving area, with maximum trichloroethene concentrations exceeding 10 mg/L. While remedial actions under the interim ROD are expected to address these sources, the final decision regarding groundwater has been deferred to the future following completion of ORR-wide investigations (DOE 2004a).

Bethel Valley Current State:

Contamination in Bethel Valley resulted from nuclear reactors, radioisotope operations, particle accelerators, hot cell operations, physical/chemical/biological research, fuel chemical reprocessing research, analytical laboratories, and other research and development operations and support facilities. The major areas of contamination in Bethel Valley include:

- The ORNL Main Plant Area includes active and inactive facilities, four inactive research reactors, numerous underground waste tanks and miles of associated pipelines, surface impoundments and contaminated soils. Strontium-90 is a major contaminant associated with releases from surface impoundments. Contaminated soils have resulted from liquid waste transfer pipeline leaks and spills. Pipeline and tank leaks also have contributed to groundwater contamination. The Corehole 8 groundwater plume is contaminated with strontium-90 and uranium, which resulted from a broken pipe in the North Tank Farm. A major challenge for remediation of the Main Plant Area is the extensive underground network of tanks and pipelines used for radionuclide processing and waste treatment.
- Solid Waste Storage Area 3 (SWSA 3) was used for disposal of low-level and transuranic wastes. Seepage from this area flows into shallow groundwater and then to nearby surface water. Contaminants of concern for SWSA 3 include cesium-137 and strontium-90.
- Radiologically contaminated surface soil poses a risk to workers. Some subsurface contaminated soil resulting from liquid low-level waste pipeline leaks and other sources may contribute to groundwater contamination. The sediment and floodplain soil associated with on-site creeks is contaminated with radionuclides and mercury.
- Groundwater contaminated with strontium-90 and mercury currently discharges to surface water.

The Baseline Risk Assessment (DOE 1999a) identified the following potentially unacceptable risks for the Bethel Valley watershed:

- Soil and Sediment Contamination – Concentrations of radionuclides in soils and sediments present unacceptable risk (>1 x 10^{-4} ELCR) to future workers, primarily via the direct external pathway. Cesium-137 is the predominant contaminant of concern, and other contributors include cobalt-60 and the thorium-232 decay series.
- Burial Ground Contamination – SWSA 3 and associated soils present unacceptable risk (>1 x 10^{-4} ELCR) to future industrial workers.
- Building and Facility Contamination – Contaminated buildings, tanks, pipelines, and other facilities, particularly in Central Bethel Valley, present an unacceptable risk (>1 x 10^{-4} ELCR) to future industrial workers.
- Surface Water Contamination – Contamination from Bethel Valley contributes to unacceptable levels of strontium-90 at White Oak Dam in Melton Valley. Surface water in First Creek exceeds 1 x 10^{-4} ELCR to future workers.
- Groundwater Contamination – Groundwater has been significantly impacted by past operations. Numerous contaminants (e.g., strontium-90, tritium, VOCs) exceed MCLs, although groundwater is not currently used for industrial or other purposes at Bethel Valley.
- Ecological Risks – Potentially unacceptable risks to aquatic and terrestrial biota also were identified. COCs include: metals (primarily mercury) in surface water; metals, PCBs and PAHs in sediment; and radionuclides (primarily cesium-137) in soil.

Life-Cycle Baseline Plan for Bethel Valley:

Under the current baseline, certain actions with opportunities for high risk reduction in Bethel Valley would be completed by 2008:

- The Bethel Valley Groundwater Engineering Study will be conducted to identify sources of groundwater contamination. This groundwater engineering study is specifically identified in the ROD to address data needs for the design of several remedial actions related to groundwater contamination in Bethel Valley, including: deep groundwater extraction at the Corehole 8 plume, in-situ biodegradation for the East Bethel Valley VOC plume, groundwater monitoring in West Bethel Valley, and soil excavation at known leak sites to minimize impacts to groundwater.
- The Corehole 8 removal action will be completed, including removal of tank W-1A and surrounding contaminated soils for off-site disposal.
- Completion of the Corehole 8 Plume groundwater extraction will be implemented to minimize further impacts to groundwater and to protect surface water bodies from contaminated discharges. Four deep extraction wells will be installed to collect water from bedrock, and sumps will be installed near storm drain junction boxes to collect and treat contaminated shallow groundwater. Enhanced biodegradation will be implemented in East Bethel Valley to address a volatile organic compound plume.
- The removal and off-site disposal of contaminated sediments from the Surface Impoundments Operable Unit was completed in 2003. Radiologically contaminated sediments were removed from these four former surface impoundments under an interim ROD issued in 1997. Most of this waste was successfully disposed at the EMWMF resulting in a significant cost savings relative to the off-site disposal alternative previously planned.

The remainder of remedial actions in Bethel Valley would be completed by 2015, including:

- Inactive buildings/facilities will be demolished and the Graphite Reactor core will be stabilized.
- Soil contaminated above remediation levels established for worker protection will be removed to a maximum depth of 2 feet in the controlled industrial area and to a maximum depth of 10 feet in the unrestricted industrial area.
- Solid Waste Storage Area 3 will be hydraulically isolated through capping.
- Institutional controls will be maintained in perpetuity to control future land use, to restrict access to capped waste disposal areas, and to prohibit onsite use of groundwater.

End State Vision for Bethel Valley:

Current baseline plans for Bethel Valley are designed to support the planned industrial end use of the ORNL site, and remediation criteria were derived to achieve an acceptably low level of risk to future workers. The actions planned under the life-cycle baseline are considered to be entirely consistent with remedial actions designed solely on the basis of the end state vision. Therefore, no variances have been identified for Bethel Valley.

The remedy contained in the existing ROD for Bethel Valley is based on future use of portions of the site for DOE-controlled industrial use, other portions for uncontrolled industrial use, recreational use for stream reaches, and still other portions for unrestricted use. Remediation criteria for each of these subareas are derived to limit the potential risk to future receptors not to exceed 1×10^{-4} ELCR and HI ≤ 1. Since DOE plans to maintain ownership and control over the entire Bethel Valley watershed for the foreseeable future in support of the ongoing ORNL mission, the division of the site into these different land use categories may be unnecessary to support the end state vision. However, remediation to levels appropriate for these more conservative land uses is thought to involve modest additional cost in this instance.

Maps of the Bethel Valley watershed under current and end state conditions are provided in Figures 4.3a1 and 4.3b1. Conceptual site models under current state and end state conditions are illustrated in Figures 4.3a2 and 4.3b2, respectively. The end state scenario for Bethel Valley is considered to be identical to the current baseline. Contaminants in buildings, soil, and other materials above risk-based criteria for industrial use will be removed for off-site disposal. A long-term stewardship program will ensure the continuing protectiveness of the remedy, including continuing surveillance and maintenance. The containment system for the capped areas will require periodic maintenance and repair to minimize the potential for failure. Groundwater monitoring wells will require periodic maintenance and replacement at longer intervals (assumed 30 years). Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment. The DOE Office of Science will retain ownership of the Bethel Valley watershed and the remainder of ORNL for the foreseeable future.

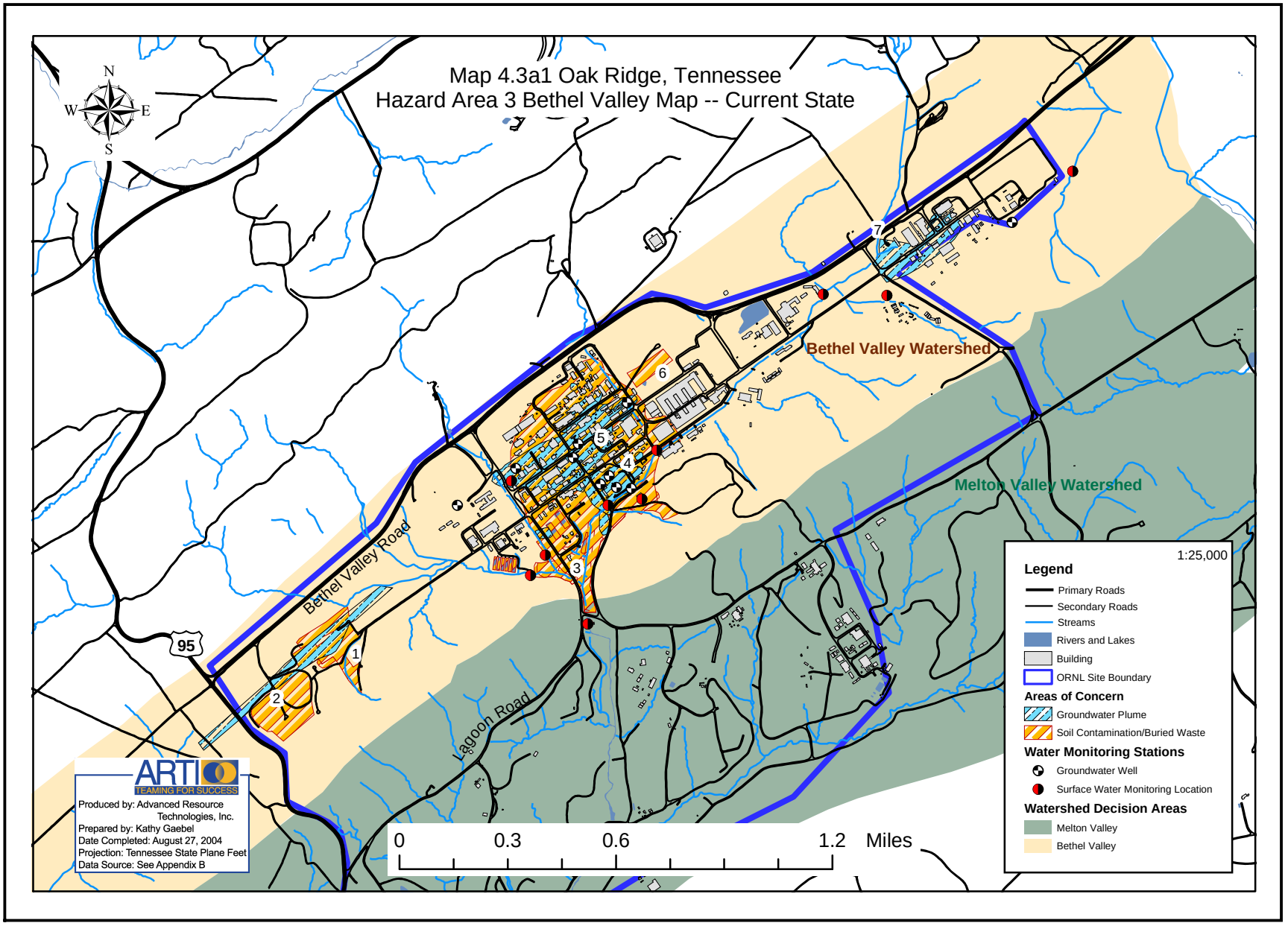

Map 4.3a1 Oak Ridge, Tennessee
Hazard Area 3 Bethel Valley Map -- Current State
N
W
E
S
Bethel Valley Watershed
Melton Valley Watershed
Bethel Valley Road
Lagoon Road
95
1
2
3
4
5
6
7
1:25,000
Legend
Primary Roads
Secondary Roads
Streams
Rivers and Lakes
Building
ORNL Site Boundary
Areas of Concern
Groundwater Plume
Soil Contamination/Buried Waste
Water Monitoring Stations
Groundwater Well
Surface Water Monitoring Location
Watershed Decision Areas
Melton Valley
Bethel Valley
0
0.3
0.6
1.2
Miles
ARTI
TEAMING FOR SUCCESS
Produced by: Advanced Resource Technologies, Inc.
Prepared by: Kathy Gaebel
Date Completed: August 27, 2004
Projection: Tennessee State Plane Feet
Data Source: See Appendix B

Figure 4.3a1 Continued

Notes for Bethel Valley current state map:

1. Solid Waste Storage Area 3 (SWSA 3) – A 7-acre burial ground used for disposal of radioactive waste from 1946 to 1951; disposal practices used unlined trenches backfilled with soil. Groundwater contamination consists primarily of strontium-90.

2. Contractor's Landfill – Disposal site for construction debris and demolition materials; some materials may be lightly contaminated.

3. Solid Waste Storage Area 1 (SWSA 1) area – This area includes SWSA 1, a 1-acre burial ground used from 1943-1944, the former waste pile area (FWPA), and the nonradiological wastewater treatment plant (NRWTP) debris pile.

4. Surface Impoundments – Remediation completed in FY 2003, including removal and off-site disposal of contaminated sediments.

5. North Tank Farm and South Tank Farm area – Numerous underground storage tanks previously used for storage of radioactive and hazardous chemical wastes; most tanks have been removed or remediated in place; soil contamination and groundwater contamination (primarily strontium-90 and tritium) remains, as well as localized source areas (e.g., Tank W-1A soils for Core Hole 8 plume). Since 1994, DOE has been conducting a series of early actions to minimize the release of contaminated groundwater from the Core Hole 8 plume to surface water, including collection and treatment of contaminated groundwater and removal of a portion of the source.

6. Solid Waste Storage Area 2 (SWSA 2) – A 3.6-acre burial ground in Central Bethel Valley used for disposal of radioactive wastes from 1944 to 1946; SWSA 2 wastes exhumed and relocated to SWSA 3 in 1946; residual soil contamination remains.

7. 7000 Area – VOC contamination in groundwater is the only identified VOC plume in Bethel Valley (groundwater contamination in other areas of Bethel Valley consists primarily of radionuclides, particularly Sr-90 and H-3).

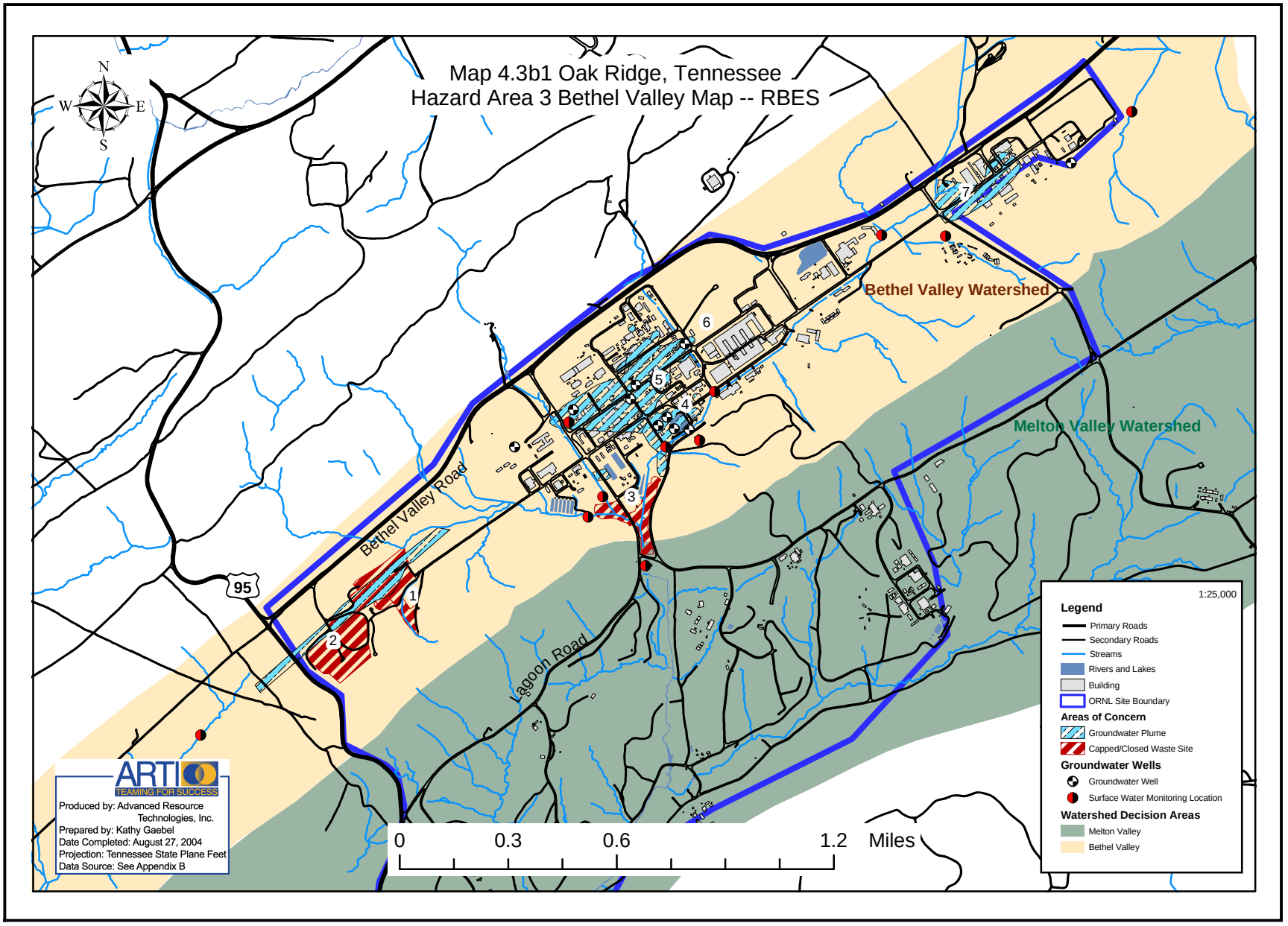

Map 4.3b1 Oak Ridge, Tennessee
Hazard Area 3 Bethel Valley Map -- RBES
N
W
E
S
Bethel Valley Watershed
Melton Valley Watershed
Bethel Valley Road
Lagoon Road
95
1
2
3
4
5
6
7
ARTI
TEAMING FOR SUCCESS
Produced by: Advanced Resource Technologies, Inc.
Prepared by: Kathy Gaebel
Date Completed: August 27, 2004
Projection: Tennessee State Plane Feet
Data Source: See Appendix B
0
0.3
0.6
1.2
Miles
1:25,000
Legend
Primary Roads
Secondary Roads
Streams
Rivers and Lakes
Building
ORNL Site Boundary
Areas of Concern
Groundwater Plume
Capped/Closed Waste Site
Groundwater Wells
Groundwater Well
Surface Water Monitoring Location
Watershed Decision Areas
Melton Valley
Bethel Valley

Figure 4.3b1 Continued

Notes for Bethel Valley End State map:

1. Solid Waste Storage Area 3 (SWSA 3) – Multi-layer cap will be installed over waste disposal area; groundwater contamination will require continuing institutional controls.

2. Contractor's Landfill – Multi-layer cap will be installed over waste disposal area.

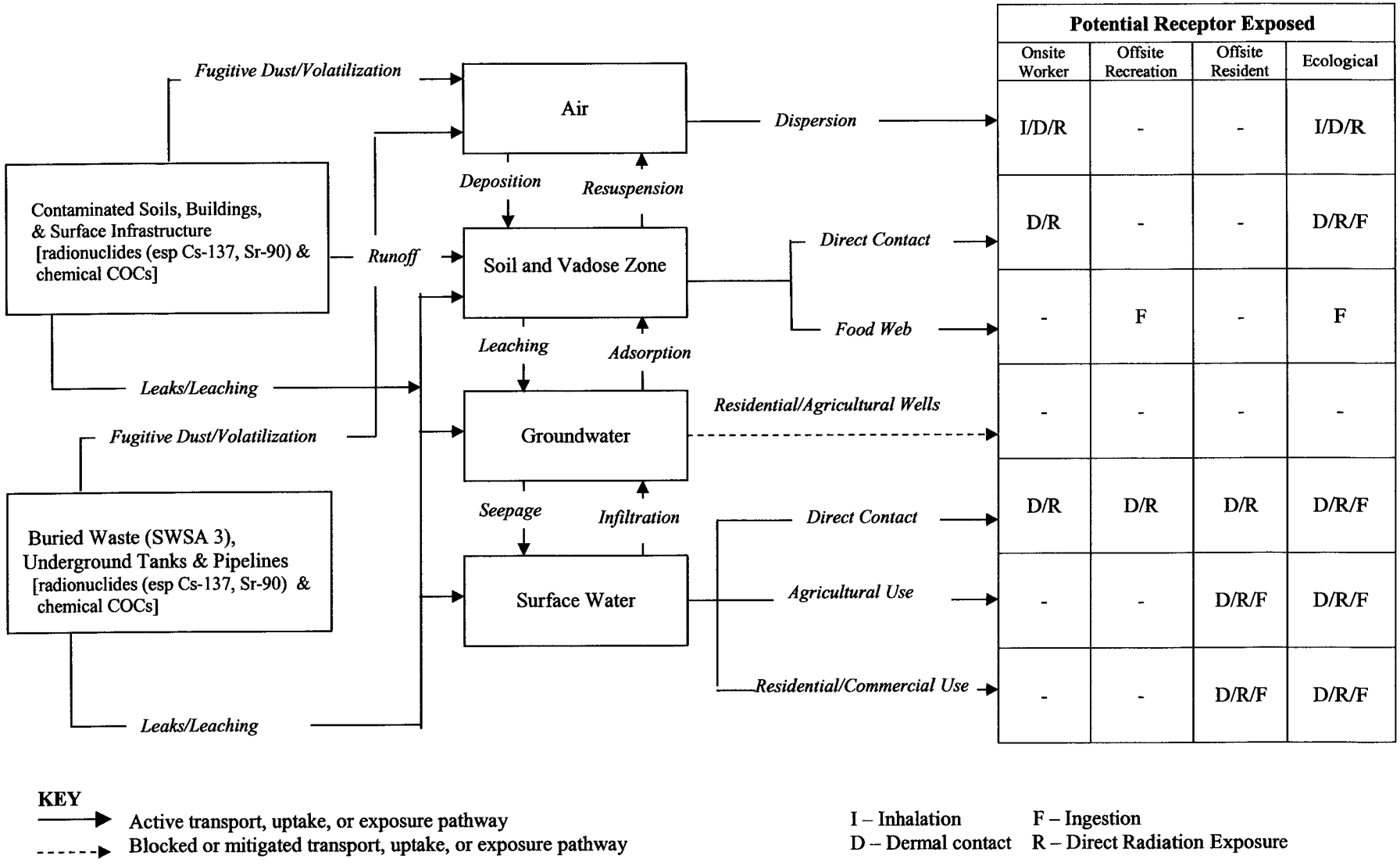
3. Solid Waste Storage Area 1 (SWSA 1) area – Multi-layer caps will be installed at SWSA 1, a 1-acre burial ground used from 1943-1944, the former waste pile area (FWPA), and the nonradiological wastewater treatment plant (NRWTP) debris pile.

4. Surface Impoundments – Remediation completed in FY 2003. All sediment has been removed from the four impoundments and treated; the resulting 981 solidified concrete waste forms have been disposed of either at EMWMF or off-site disposal facilities.

5. North Tank Farm and South Tank Farm area – Tanks and contaminated soils remediated to risk-based criteria for industrial use; source removal actions for the Core Hole 8 Plume will be completed and actions to minimize the release of groundwater contamination to surface water and to minimize further spread of the groundwater plume will continue; groundwater contamination requires continuing institutional controls.

6. SWSA 2 – Residual soil contamination remediated to risk-based criteria for industrial use.

7. 7000 Area – VOC groundwater plume will undergo monitored natural attenuation and require continuing institutional controls.



Potential Receptor Exposed			
Onsite Worker	Offsite Recreation	Offsite Resident	Ecological
I/D/R	-	-	I/D/R
D/R	-	-	D/R/F
-	F	-	F
-	-	-	-
D/R	D/R	D/R	D/R/F
-	-	D/R/F	D/R/F
-	-	D/R/F	D/R/F

Figure 4.3a2, Conceptual Site Model – Hazard Area 3, Bethel Valley – Current State

Narrative:

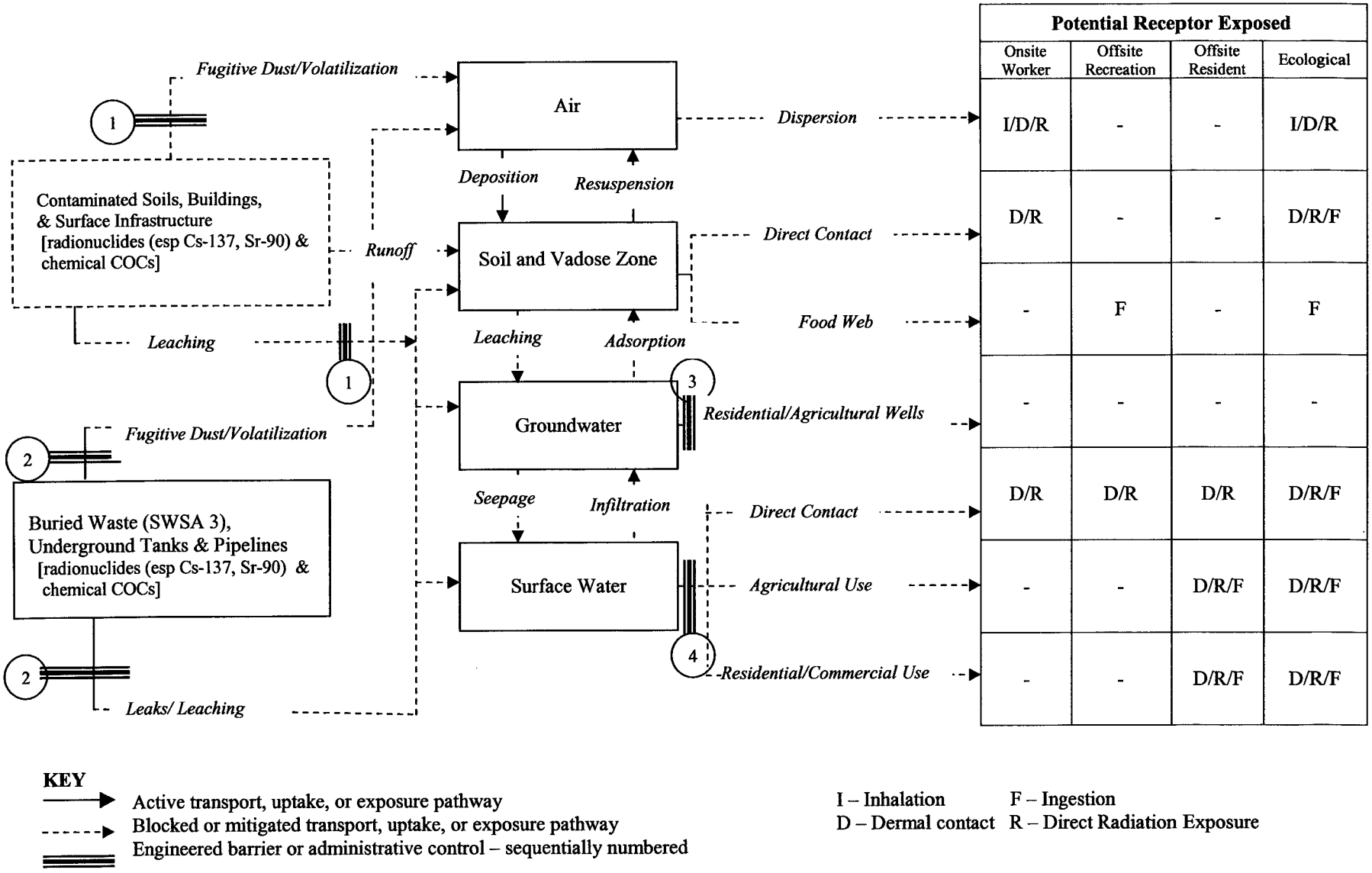
Contaminant Sources:

Bethel Valley includes the main industrial complex of Oak Ridge National Laboratory. Facility operations during the past 60 years have resulted in a large number of sites and facilities contaminated with a variety of radioactive and hazardous contaminants; contaminated sites include numerous buildings, tanks, surface impoundments, reactors, above- and below-ground pipelines and utilities, and buried waste sites. Contaminants of concern include numerous radionuclides and chemicals, particularly Cs-137 and Co-60 in soil and sediments, and Sr-90 in surface water. Under the existing CERCLA ROD approved in 2002, remediation criteria are specified for soils, floodplain sediment, and surface water, based on future industrial use of the site. Remediation criteria for contaminants of concern in soil were derived to limit risks to future industrial workers not to exceed 1×10^{-4} ELCR and HI<3. Remediation goals for surface water are to achieve AWQC, to proctect an off-site resident user of surface water, and to protect the Clinch River to meet its stream use classification. Numerous contaminants (Sr-90, H-3, VOCs) in groundwater exceed MCLs, although there is no current use of groundwater at Bethel Valley. Institutional controls include restrictions on future groundwater and surface water use in Bethel Valley.

Current State Exposure Pathways and Receptors:

Under current conditions, potentially complete exposure pathways for onsite workers include: inhalation of resuspended particulates or volatiles; and direct exposure to contaminants in soils, waste and surface water. While Bethel Valley is not normally accessible to recreational users, potentially complete exposure pathways to off-site recreationists include direct contact with surface water and ingestion of fish. Ecological receptors potentially may be exposed to contaminants in air, soil, surface water and the food chain. Surface water in Bethel Valley enters White Oak Creek and flows through Melton Valley to White Oak Lake, where it exits the ORR. Potentially complete exposure pathways to offsite residents include direct contact with surface water after exiting the ORR, fish ingestion, and use of surface water for irrigation of home gardens. There is no current use of groundwater or surface water in Bethel Valley for residential, commercial, or agricultural purposes.

Figure 4.3a2, Conceptual Site Model – Hazard Area 3, Bethel Valley – Current State



Potential Receptor Exposed			
Onsite Worker	Offsite Recreation	Offsite Resident	Ecological
I/D/R	-	-	I/D/R
D/R	-	-	D/R/F
-	F	-	F
-	-	-	-
D/R	D/R	D/R	D/R/F
-	-	D/R/F	D/R/F
-	-	D/R/F	D/R/F

KEY

Active transport, uptake, or exposure pathway

Blocked or mitigated transport, uptake, or exposure pathway

Engineered barrier or administrative control – sequentially numbered

I – Inhalation F – Ingestion

D – Dermal contact R – Direct Radiation Exposure

Figure 4.3b2, Conceptual Site Model – Hazard Area 3, Bethel Valley – End State

Narrative:

Contaminant Sources:

Under both current life-cycle baseline and Risk-Based End State conditions, the Bethel Valley watershed will continue to be used for the operation of Oak Ridge National Laboratory, i.e. DOE-controlled industrial use. Contaminants of concern include Cs-137 and Co-60 in soil and sediments, and Sr-90 in surface water. Remediation criteria for contaminants of concern in soil and other media were derived to limit risks to the future industrial workers not to exceed 1×10^{-4} ELCR and HI<3. Institutional controls include restrictions on access to the waste management areas and restrictions on future groundwater and surface water use throughout Bethel Valley.

Risk-Based End State Barriers/Interventions:

The steps taken to mitigate or remove these hazards are as follows:

1. Contaminated buildings and soils within Bethel Valley will be remediated such that contaminants of concern do not exceed risk-based remediation criteria for industrial use. Contaminated media above remediation criteria generally will be removed for disposal at the EMWMF disposal facility. Inactive buildings and facilities will be demolished and removed. Residual contaminant levels will be below levels of concern for fugitive dust emissions/volatilization or direct radiation exposure. While the ROD specifies that soil will be remediated to a depth of 2 ft in some areas and 10 ft in others, under the RBES conditions, the depth of soil remediation is taken to be 2 ft throughout Bethel Valley.
2. Most underground tanks and pipelines will be contained in place via grouting , use of cover systems and other hydraulic controls. The SWSA 3 burial ground will be hydraulically isolated via installation of a multi-layer engineered cover system. The engineered containment systems will preclude unacceptable exposures to workers or releases of contaminants to the environment above levels of concern. Institutional controls will be maintained in perpetuity to restrict access to the grouted or capped sites.
3. Future land use within Bethel Valley will be restricted to industrial use, and institutional controls will prohibit groundwater use. The ongoing groundwater extraction project for the Corehole 8 Plume will be completed to minimize further impacts to groundwater and to protect surface water from contaminated discharges. Long-term stewardship and institutional controls will ensure continuing protectiveness of the remedy. Surveillance and maintenance will include monitoring of surface water and groundwater, with periodic maintenance and replacement of groundwater wells and ongoing maintenance of capped areas as required.
4. As noted in the discussion for Melton Valley, remediation of surface water and sediment in White Oak Creek has been generally deferred to a future CERCLA decision. It is anticipated that the actions described in items 1 and 2 above, along with other remedial actions for Bethel Valley, will significantly reduce the flux of contaminants into surface water of White Oak Creek and White Oak Lake, which are ultimately discharged to the Clinch River upon exiting the ORR. Institutional controls include restrictions on current use of surface water within Bethel Valley.

Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment. These reviews will evaluate any failure of remedial measures and the sustainability of the remedy. Potential failure modes could include breaches of capping and containment systems or unauthorized land use.

Figure 4.3b2, Conceptual Site Model – Hazard Area 3, Bethel Valley – End State