F.1.12.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

The steps involved in cleanup of the M-Area settling basin and vicinity by closure without waste removal are as follows:

- The remaining liquid in the basin would be decanted by being pumped into the overflow areas and Lost Lake, where enhanced evaporation and infiltration would occur. Pumping rates would not exceed historical overflow rates (750 to 1100 liters per minute), so as not to disturb the underlying sludge layer or overwhelm the retention capacity of the seepage and Lost Lake areas. Entrainment would be minimized by the design of pumping apparatus. Any suspended or dissolved materials carried over during this process would be retained in the shallow sediments after natural evaporation of the water.

- The gelatinous sludge layer in the basin would be stabilized to produce a solid material capable of supporting heavy equipment operation and the overburden load produced by fill and cap materials. A chemically suitable stabilization agent (Type I Portland cement) has been tested and was demonstrated to provide sufficient load-bearing capacity. The stabilization process would be performed in situ by mixing the agent directly with the sludge. The mixture ratio that demonstrated acceptable performance was 0.5 kilogram of agent per liter of sludge. The resulting product would be a layer of solid material covering the basin floor.

- A recharge network would be installed beneath the basin to flush organic contamination in the vadose zone to the groundwater, where in-place recovery systems would remove and treat the water.

  The recharge network would consist of a series of 15-centimeter-diameter perforated PVC pipe placed at 6-meter spacings lengthwise in the basin, connected by nonperforated pipe to a manhole at each end of the basin. This perforated pipe would be laid in 2.5-meter-deep trenches, which would then be backfilled with 0.3 meter of gravel and 2.2 meters of original soil. The 2.5-meter depth would put the recharge system below the metal contamination in the soil to prevent dissolution and migration of waste material.

  The purpose of the recharge network would be to replace the natural infiltration of rainwater, which would be cut off by the low-permeability cover. Clean water would be introduced to the system through a manhole at an infiltration rate of 8 liters per minute. At this rate, the network would simulate a natural recharge that serves to flush vadose zone organic contamination.

- The soils and dried sludge contaminated with metals from the overflow ditch, seepage area, and Lost Lake would be excavated. Also, the process sewer line and manholes would be removed, as would 0.6 meter of soil beneath the sewer line between the basin and manhole No. 1 inside the M-Area exclusion perimeter. The total volume of soil to be excavated is shown below:

Soil/sludge from overflow ditch adjacent seepage area		5,150 cubic meters
Remainder of seepage area		7,500
Lost Lake		16,900
Process sewer, manholes, and soil		840
	Total	≈30,400 cubic meters

All excavated soil and rubble would be placed in the basin and compacted to support the basin cap. Fill dirt would be added if required to level the material at the top of the berm.

- A low-permeability cap would be emplaced (Figure F-2). The cap would be designed and constructed to provide a maximum permeability of 1×10^{-7} centimeter per second. A layer of more permeable material would be placed on top of the cap, and a 0.6-meter-thick layer of topsoil would be added. The cap would be graded and planted to minimize erosion.

- Routine site maintenance would be carried out and a groundwater monitoring program would be maintained quarterly for 1 year and then annually for 29 years.

The current groundwater remedial action program for treatment of chlorocarbons would continue. The recharge network would flush chlorocarbons in the vadose zone to the water table, where the in-place groundwater recovery wells would remove and treat the water.

Additional remedial action may be taken to reduce concentrations of barium, cadmium, nickel, and nitrate constituents that PATHRAE simulations predict would exceed MCLs or other health-based standards in the future under this action (see Table F-8).

Comparison of Expected Environmental Releases with Applicable Standards

The PATHRAE model predicts that the closure actions described above would maintain the groundwater concentration of lead within its MCL. The current groundwater treatment facility is designed to reduce concentrations of chlorocarbons to within MCLs, and the potential additional groundwater treatment is expected to reduce concentrations of nitrate, cadmium, nickel, and barium to within MCLs or other health-based standards. In addition, gross alpha and gross beta constituents, which include radium and most alpha and beta radionuclides, would be reduced to levels within MCLs or ACLs by means of additional treatment. The PATHRAE simulation predicts that concentrations of inorganic constituents in the groundwater outcrop at Tims Branch would be below drinking-water standards. Treated effluent from the in-place groundwater treatment facility would be discharged to a tributary of Tims Branch and would be in compliance with NPDES permit limitations.

The analysis of atmospheric releases described in Section F.1.12.1 was also performed for this action. Releases of carcinogens would be caused by the volatilization of contaminants through the cap on each basin. Risks to the TC

TC maximally exposed individual attributable to these releases were calculated to be less than 1.6 x 10^{-8} for each of the 3 years for each subarea. The hazard index attributable to releases of noncarcinogens was calculated to be much less than 1, with a maximum value less than 1.7 x 10^{-6} for each of the 3 selected years for each subarea. The calculated radionuclide dose is less than 2 x 10^{-2} percent of the DOE limit of 25 millirem for each of the 3 years. The risk associated with this dose would be less than 8 x 10^{-10}.

Potential Impacts (Other Than Releases)

Section F.1.14.2 describes the ecological impacts of no waste removal and closure. Backfilling and capping the M-Area settling basin would eliminate potential impacts associated with exposure to standing basin water and soils. The water in the M-Area settling basin would be pumped into Lost Lake, where it would evaporate and infiltrate. Decreases in groundwater contamination would occur.

After liquids were evaporated from Lost Lake and the top several centimeters of soil were removed, the potential for the direct contamination of wildlife would be reduced. The area would be regraded and planted in either moisture-tolerant trees or pine, depending on elevation. Moisture-tolerant species would include sycamore, red maple, or tulip poplar. After revegetation, the area would be allowed to return to a wetlands environment. Reinvasion by wildlife such as amphibians and turtles should occur.

F.1.12.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

The steps involved in cleanup of the M-Area settling basin and vicinity by waste removal and closure are as follows:

- The remaining liquid portion in the basin would be decanted in a manner identical to that described in Section F.1.12.2.
- The gelatinous sludge layer in the basin would be stabilized to facilitate removal and handling. The sludge would be treated with adsorbents or drying agents to produce a material which could be removed by normal excavation methods.
- Soil and sludge contaminated with metals from the basin, overflow ditch, seepage area, and Lost Lake would be removed, as would the process sewer line, manholes, and 0.6 meter of soil beneath the sewer line between the basin and manhole No. 1 inside M-Area. The extent to which soil removal for metals contamination would be required would depend on results of soil and sludge characterization studies. In general, the depth of soil removal would range from a few centimeters in Lost Lake to 2 meters beneath the basin to remove metal contamination

significantly above background levels. Estimates of the total volume of material to be removed in this step are as follows:

Sludge/soil beneath basin	11,000 cubic meters
Stabilized sludge	4,500
Overflow ditch and adjacent seepage area	5,150
Remainder of seepage area	7,500
Lost Lake	16,900
Process sewer, manholes, and soil	840
Total	45,890 cubic meters

- The soil and sludge removed from the M-Area basin and vicinity would be transported to a waste storage/disposal facility.

- The basin and vicinity would be backfilled and regraded with clean onsite fill material. No cap would be required. An estimated 30,000 cubic meters of fill material would be required. The area would be revegetated with grass and trees to restore the natural state.

- Postclosure monitoring would begin and the cleanup of organic contamination in the groundwater and vadose zone would continue. In-place monitoring wells would be used to define the extent of contamination and evaluate the effectiveness of cleanup activities. These wells would also be used to determine the point at which groundwater cleanup activities could be discontinued.

- Groundwater treatment for removal of organic contamination would be accomplished by means of the in-place recovery well network and air stripping system. Vadose zone contamination would be allowed to migrate via natural recharge to the groundwater, where in-place recovery systems would remove and treat the water.

- Routine site maintenance would be carried out, and a groundwater monitoring program would be maintained quarterly for 1 year and then annually for 29 years.

Potential additional remedial action, as described in Section F.1.12.2, may be required to reduce groundwater concentrations of barium, cadmium, lead, nickel, and nitrate to levels within MCLs. As shown in Table F-8, PATHRAE simulations predict that these constituents will exceed regulatory standards at various times in the future for waste removal and closure.

Comparison of Expected Environmental Releases with Applicable Standards

The discussion presented in Section F.1.12.2 is also relevant to waste removal and closure.

The analysis of atmospheric releases described in Section F.1.12.1 was also performed for this action. Releases in the first year are due to excavation and backfilling. In future years, releases would be caused by volatilization of contaminants. Releases due to emissions from the air stripper are zero for the years 2085 and 2985 since the facility will only operate 30 years. Risk to the maximally exposed individual attributable to releases of carcinogens TC was calculated to be less than 1.6×10^{-8}. The maximum EPA Hazard Index for noncarcinogens was calculated to be less than 1.7×10^{-6}.

The calculated radioactive dose to the maximally exposed individual at the SRP boundary for each of the 3 years is less than 3×10^{-6} percent of the DOE limit of 25 millirem. The risk associated with this dose would be less than 1.4×10^{-9}.

TC An analysis of the average individual worker health risks attributable to occupational exposure to carcinogens (both nonradioactive and radioactive) and noncarcinogens was performed using the methodology presented in Appendix I. The risk due to nonradioactive carcinogens to a worker was calculated to be less than 3.2×10^{-9}. The EPA Hazard Index due to noncarcinogens to a worker was calculated to be 8.7×10^{-4}. The total radioactive dose to the worker was calculated as 47 millirem, which translates to a risk of 1.3×10^{-5}. The total dose to the worker transporting the waste would be 23.3 millirem, which translates to a risk of 6.5×10^{-6}.

Potential Impacts (Other Than Releases)

TE Because of the similarity of this action and the no-waste-removal-and-closure action, impacts would be similar to those described in Section F.1.12.2.

F.1.13 LOST LAKE, BUILDING 904-112G

Lost Lake is discussed in conjunction with the M-Area settling basin and vicinity in Section F.1.12.

F.1.14 POTENTIAL IMPACTS ON BIOLOGICAL RESOURCES IN A- AND M-AREA

This section discusses those generic impacts related to aquatic and terrestrial ecology, as well as endangered species and wetlands, for each closure action. A discussion of site-specific data is presented in the appropriate section above.

There are 13 waste sites located within the A- and M-Area. The motor shop seepage basin contains surface waters, as do the metallurgical laboratory basin, the four SRL seepage basins, the M-Area settling basin, and Lost Lake. The remaining waste sites, the metals burning pit, Silverton Road waste site, miscellaneous chemical basin, and the two A-Area burning/rubble pits are presently backfilled or covered with soil and vegetation. All waste sites within this geographic grouping are either abandoned or inactive.

F.1.14.1 Assessment of No Action (No Removal of Waste and No Remedial or Closure Actions)

Aquatic Ecology

A potential aquatic impact for the A- and M-Area is the release to surface water of groundwater containing materials from the various waste sites in the A- and M-Area. Table F-9 lists those materials in the groundwater that were not modeled using the PATHRAE analysis but do exceed the freshwater biota criteria for each of the waste sites.

Where data are available, it can be determined that the materials listed in Table F-9 are not expected to create new or enhance existing impacts on the aquatic biota of nearby streams. This conclusion was based on the estimated dilution factors (Table F-9), which were calculated by dividing the groundwater flux by the flow rate of the receiving stream. The dilution factor indicates that these materials will be diluted so as not to affect the present water quality of the receiving stream.

Terrestrial Ecology

The potential terrestrial impacts for the waste sites of the A- and M-Areas include the exposure of wildlife and vegetation to surface waters within waste sites, the toxic effects on vegetation of soils containing waste materials, and the consumption of undiluted groundwater at the outcrop. Terrestrial impacts related to these sources of contamination have been addressed on an individual basis above.

Endangered Species

No endangered species were identified in the vicinity of the waste sites of the A- and M-Areas during previous surveys at the SRP, with the exception of an alligator that lives in the M-Area settling basin (Section F.1.12) (see Table F-9). With the exception of the M-Area settling basin, the habitats in the immediate vicinity of the waste sites are not suitable for any Federally endangered species previously reported on the SRP. Therefore, none of the actions proposed for the waste sites of A- and M-Areas would have an effect on endangered species.

Wetlands

The nearest wetlands to the waste sites of the A- and M-Areas are associated with Tims Branch and Upper Three Runs Creek. These wetlands consist primarily of bottomland hardwoods. Table F-9 provides the distances between the waste sites and the wetlands. Potential impacts to wetlands biota are discussed on an individual basis above.

F.1.14.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Aquatic Ecology

The potential aquatic impacts for the waste sites of the A- and M-Areas include direct and indirect contamination of surface water. In some cases, this action proposes to drain the surface water of a waste site directly into a stream. Potential impacts of PATHRAE-modeled wastes are addressed above on an individual basis. Indirect contamination of surface water by non-PATHRAE-modeled wastes from the various waste sites would not create an impact on the existing stream water quality due to the dilution factor, as described in Section F.1.14.1. Also, some closure actions involve backfilling the basin with uncontaminated fill and the use of a low-permeability cap over the waste site. The cap would retard the leaching of soil contaminants into the groundwater, although wastes previously leached to the groundwater would continue to enter streams.

TE

Terrestrial Ecology

The potential terrestrial impacts for the waste sites of the A- and M-Areas include toxic effects on vegetation caused by contaminated soil and temporary disturbance of the wildlife due to noise and habitat loss created by the closure plan. Closure actions, including use of a clay cap and mowing, would help prevent the establishment of deep-rooted plants and, hence, root penetration into the waste zone. TE

Endangered Species

With the exception of the M-Area settling basin, none of the actions proposed for the waste sites of the A- and M-Areas would have any effect on endangered species. See Section F.1.14.1.

Wetlands

As described in Section F.1.14.1, most of the waste sites of the A- and M-Areas are sufficiently removed from the wetlands that they are not affected by any of the closure actions. However, for those waste sites that are near wetlands, proper erosion control to prevent runoff of sedimentation into the wetlands would prevent significant impacts. TE

F.1.14.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Aquatic Ecology

The potential ecological impacts of waste removal and closure for the waste sites of the A- and M-Area would be similar to those described in Section F.1.14.2, except that the removal of waste material and contaminated soils should further reduce the potential for impacts on aquatic ecosystems.

Terrestrial Ecology

Any potential for impact of plant toxicity would be significantly reduced by the proposed waste removal and closure. Disturbances to wildlife due to closure activities would be temporary.

Endangered Species

With the exception of the M-Area settling basin, none of the actions proposed for the waste sites of the A- and M-Areas would have any effect on endangered species. See description in Section F.1.14.1.

Wetlands

Section F.1.14.1 describes the wetlands that exist within the vicinity of the A- and M-Area. Remedial actions should include soil erosion control to protect those wetlands that are near a waste site.

F.2 ASSESSMENT OF ACTIONS AT F- AND H-AREA WASTE SITES

This geographic grouping of waste sites is about 10 kilometers southeast of A-Area. It is formed by waste sites associated with the Separations (200-F and -H) Areas, which are just north of Road E. Figure F-5 shows the locations of the waste sites within this grouping.

Sections F.2.1 through F.2.17 contain or reference the appropriate section for a discussion of sites 2-1 through 2-17. Section F.2.18 discusses biological impacts that are generically applicable to the F- and H-Area waste sites.

F.2.1 ACID/CAUSTIC BASINS*

There are a total of six acid/caustic basins on SRP, located as follows:

Area	Building
F	904-74G
H	904-75G
R	904-77G

Area	Building
K	904-80G
L	904-79G
P	904-78G

The acid/caustic basins on the SRP are nearly identical physically and received similar waste. Consequently, potential releases and associated environmental effects would be expected to be similar. Therefore, the actions, releases, and impacts described in this section would be applicable to each of these six basins.

The environmental analyses for the six acid/caustic basins were performed only for the L-Area acid/caustic basin (Building 904-79G). That basin has the largest inventory of contaminants and was, therefore, selected for the analysis. It is conservative to assume that the other five basins would behave similarly. To provide a relative scale for the six basins, the estimated disposal mass of contaminants selected for environmental assessment is listed in Table F-10.

F.2.1.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

TE | Under no action, the acid/caustic basins would be left in their current condition. The groundwater monitoring program would continue on a quarterly basis for 1 year, then annually for 29 years. Four monitoring wells would be

*The reference source of information for this section is Ward, Johnson, and Marine, 1987.

Table F-10. Estimated Disposal Mass of Contaminants Selected for Environmental Assessment

	Estimated Disposal Mass (Kilograms)					
	F-Area	H-Area	R-Area	K-Area	L-Area	P-Area
Constituent	(904-74G)	(904-75G)	(904-77G)	(904-80G)	(904-79G)	(904-78G)
Arsenic	-	-	-	-	-	0.6
Chromium	-	-	-	-	2.0	1.0
Copper	-	-	-	4.40	36.0	-
Lead	-	-	7.8	-	29.0	-
Mercury	0.3	-	0.1	-	0.3	-
Phosphate	-	-	-	1.20	-	-
Selenium	-	-	-	0.32	-	-
Sodium	-	-	33.0	4300.00	6200.0	-
Sulfate	-	-	-	9100.00	3300.0	-
Tetrachloro-ethylene	1.0	-	4.02	0.60	1.5	0.3

installed at the H-Area acid/caustic basin and monitored as described above. Site maintenance would be provided for the entire 30-year period. TC

Comparison of Expected Environmental Releases with Applicable Standards

The chemical constituents, or waste materials, selected for assessment at the acid/caustic basins were arsenic, chromium, copper, lead, mercury, phosphate, selenium, sodium, sulfate, and tetrachloroethylene. These constituents were selected because they were found in the groundwater or soil at levels higher than the threshold selection criteria. For the atmospheric pathway, the same 10 constituents were analyzed.

Table F-11 lists the predicted maximum concentration of lead and tetrachloroethylene and the year in which the maximum concentration is expected to occur, based on groundwater modeling. For no action, concentrations of these constituents are predicted to have exceeded applicable standards at the 1-meter and 100-meter wells in the early 1970s. Monitoring data indicate that tetrachloroethylene continues to exceed its health-based standard in the groundwater at the acid/caustic basins. Lead concentrations appear to be within drinking-water standards.

Surface-water quality would not be significantly affected by the addition of potential contaminants from the groundwater pathway from these sites. The resulting concentrations of constituents in L-Lake, calculated from the L-Area acid/caustic basin, are projected to be below drinking-water standards. TE

Estimated environmental risks due to atmospheric chemical releases from the acid/caustic basins for no action are based on the ten chemical constituents found in at least one but not all of the acid/caustic basins. Risks are very low. For example, the highest chemical carcinogenic risk to the maximally exposed individual is less than 1.6×10^{-10}, while the highest EPA Hazard Index value for noncarcinogens is 1.2×10^{-5}. These risks are considered not significant. TE TC

The concentrations for the erosion and biointrusion pathways are all zero, because the length of time that it takes for the constituents to start eroding is well over 1000 years and the depth of the cover material is such that roots of plants intruding onto the waste site will never penetrate the contaminated material.

Potential Impacts (Other Than Releases)

Section F.2.18.1 describes the ecological impacts of no action. PATHRAE analysis for no action at the L-Area acid/caustic basin indicates that the influent water concentrations of chromium, copper, lead, mercury, sodium, sulfate, and tetrachloroethylene would not exceed EPA water-quality criteria for the protection of aquatic life or equivalent numbers from the technical literature. Only lead would approach the water-quality criteria in the undiluted groundwater. On this basis, the contaminants attributable to the L-Area acid/caustic basin are not expected to impact the aquatic communities of the Steel Creek/L-Lake ecosystem and adjacent wetlands or to affect wildlife that use these habitats to drink and feed under any of the closure actions. Because the L-Area basin has the highest concentrations of the largest number of contaminants of the acid/caustic basins, similar conclusions can be assumed for the other basins that were not specifically analyzed. TE

F.2.1.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

Under the no-removal-and-closure action, any liquid found in the basins would be neutralized, if required, and discharged. Approximately 500 cubic meters of soil would be required to backfill the basin to grade. The soil would be compacted to the appropriate density to prevent settling; the surface would be graded to preclude ponding of rainwater and seeded with suitable grass. TE

The groundwater monitoring program would continue on a quarterly basis for 1 year, then annually for 29 years. Four monitoring wells would be installed at the H-Area acid/caustic basin and monitored as described above. If required, groundwater remediation could be implemented to reduce the concentration of any contaminants to below applicable standards. Site maintenance would be provided for the entire 30-year period. TC

Comparison of Expected Environmental Releases with Applicable Standards

With the exception of air releases, the chemical constituents, the consequences of environmental releases, and the pathways associated with this action are the same as those for no action, since contaminants have presumably leached beyond the zone of control (see Table F-11).

TE The estimated environmental risks due to atmospheric releases from F-Area acid/caustic basin for this action are very small. For example, the maximum
TC carcinogenic risk to the maximally exposed individual is less than 1.6×10^{-17}. The EPA Hazard Index value for noncarcinogens is also very low (less than 5.2×10^{-16}). These risks are considered insignificant.

Potential Impacts (Other Than Releases)

Sections F.2.1.1 and F.2.18.2 describe impacts on biological resources of this closure action at the F-Area acid/caustic basin.

F.2.1.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE Under the waste-removal-and-closure action, all basin liquids would be neutralized in place, if required, and discharged, and all sediment in the basins and any chemically contaminated soil to a depth of 0.9 meter (approximately 210 cubic meters) below the original sides and bottom of the basin would be removed prior to backfilling. Any chemically contaminated soil would be removed, placed in metal boxes, and transported to a waste storage/disposal facility. Approximately 700 cubic meters of soil would be required to backfill each basin to grade. The surface would be graded to preclude ponding of rainwater and seeded with a suitable grass.

The groundwater monitoring program already in place would be continued on a quarterly basis for 1 year; the wells would then be monitored annually for 29 years. Four monitoring wells would be installed at the H-Area acid/
TC caustic basin and monitored as described above. Site maintenance would be provided for the entire 30-year period. Additional corrective actions might be needed to address the constituents already in the groundwater. The choice of actions to be taken would be based on site-specific studies and interactions with relevant regulatory agencies.

Comparison of Expected Environmental Releases with Applicable Studies

The chemical constituents of concern, the consequences of environmental releases, and the pathways that may have an impact on human health are the same as for no action. The results of the PATHRAE analyses are listed in Table F-11. The contaminant concentrations in the groundwater for this action are the same as those for no action.

TC Estimated environmental risks due to atmospheric chemical releases from the acid/caustic basins are very low. For example, carcinogenic risk to the maximally exposed individual is less than 3.7×10^{-14}. In 1986 the carcinogenic risk is less than 10^{-12}, and the EPA Hazard Index value for noncarcinogens is less than 5.2×10^{-9}. The risks are considered not significant.

Occupational risks are also low. The calculated occupational carcinogenic risk is 2.2×10^{-9} and the EPA Hazard Index value for noncarcinogens is 2.2×10^{-2}. TC

The expected concentrations for the erosion and biointrusion pathways are zero. In addition, the expected concentrations for the reclaimed farm pathway are also zero because all of the contaminated material has been removed from the site.

Potential Impacts (Other Than Releases)

Sections F.2.1.1 and F.2.18.3 describe impacts on biological resources of this closure action at the F-Area acid/caustic basin.

F.2.2 H-AREA ACID/CAUSTIC BASIN, BUILDING 904-75G

This acid/caustic basin is discussed in conjunction with the other acid/caustic basins in Section F.2.1. However, four new groundwater monitoring wells would be installed and monitored at this site. The ecological effects of this site that relate specifically to the F- and H-Area geographic grouping are discussed in Section F.2.18. TC

F.2.3 F-AREA BURNING/RUBBLE PIT (BUILDING 231-F)

This burning/rubble pit is discussed in Section F.1.6 in conjunction with the other burning/rubble pits. Section F.2.18 describes the ecological effects of this site that relate to the F- and H-Area geographic grouping.

F.2.4 F-AREA BURNING/RUBBLE PIT, BUILDING 231-1F

This burning/rubble pit is discussed in Section F.1.6 in conjunction with the other burning/rubble pits. Section F.2.18 describes the ecological effects of this site that relate to the F- and H-Area geographic grouping.

F.2.5 H-AREA RETENTION BASIN, BUILDING 281-3H*

The H-Area retention basin is a low-level radioactive waste management facility that stopped receiving wastes in 1973. Background information on the history of waste disposal, waste characteristics, and evidence of contamination are presented in Appendix B, Section B.3.2. TC

F.2.5.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

Under no action, the site would remain in its present condition. Two additional wells would be installed and all wells would be monitored quarterly for 1 year, then annually for 29 years. Site maintenance would be provided for the entire 30-year period. TC

*The reference source of the information in this section is Scott, Killian, Kolb, Corbo, and Marine, 1987.

Comparison of Expected Environmental Releases with Applicable Standards

PATHRAE predicts that strontium-90 and yttrium-90 will exceed groundwater standards during the 100-year institutional control period. Table F-12 lists these parameters, the corresponding health-based standards, and the maximum concentrations predicted to be found in the groundwater near the basins. All other constituents modeled were predicted to be below applicable standards.

Surface-water quality is not significantly affected by the addition of potential contaminants from the groundwater pathway from this site, as the resulting concentrations of constituents in Four Mile Creek are projected to be below drinking-water standards.

Environmental doses and risks to the maximally exposed individual due to radiological releases from the H-Area retention basin were calculated using the methodology presented in the introduction to this appendix and in Appendix I. The calculated doses were less than 1.6 percent of the DOE limit of 25 millirem per year for each of the 3 selected years. The risks associated with these doses would be 1.1×10^{-7} or less.

No nonradioactive constituents are released to the atmosphere in the H-Area retention basin.

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways would occur 100 years from the present, at which time institutional control of the SRP is assumed lost. The doses are only 0.22 and 0.68 millirem per year for the farm and direct gamma exposure pathways, respectively. There would be no dose from the consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments, due to the assumed limited plant-root depth.

Section F.2.18.1 describes the ecological impacts of no action. PATHRAE analysis has been performed on strontium-90, yttrium-90, cesium-137, and plutonium-238. PATHRAE-modeled groundwater outcrop concentrations and fluxes are identical for all closure actions. The results indicate that contaminants originating from the H-Area retention basin would not exceed freshwater biota water-quality criteria for any of the closure actions and would not impact the aquatic communities of Four Mile Creek and its associated wetlands or the wildlife that uses these waters to feed or drink.

The H-Area retention basin would contain standing water underlain by contaminated sediments under no action. Analysis of water currently in the H-Area retention basin indicates that cesium-134 and -137 are present at levels that exceed the EPA water-quality criteria for the protection of aquatic life or equivalent values from the technical literature. However, cesium at concentrations of 1×10^{7} picocuries per liter (50,000 times the comparison criterion) caused no effect on the development of fish embryos. Thus, aquatic organisms using the basin and wildlife visiting the waste site should not receive adverse impacts. However, calculated average basin sediment concentrations of cesium-137, strontium-90, and plutonium-238 exceed soil criteria by several orders of magnitude. Under no action, these contaminated sediments would be exposed at the basin surface, where they are readily available to plant roots. Thus, the possibility exists of biointrusion and subsequent food-chain transport after the onset of natural succession.

F.2.5.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE

Under the no-removal-and-closure action, standing water would be removed and
disposed of in the operating H-Area retention basin (281-3H). The basin would
be backfilled to 0.3 meter above the land surface, with about 2.4 meters of
TE borrow fill. The amount of fill needed would be 5360 cubic meters. The fill
would be covered with a low-permeability cap (Figure F-2). Two additional
groundwater monitoring wells would be installed and all four wells would be
monitored quarterly for 1 year, then annually for 29 years. Site maintenance
TC would be provided for the entire 30-year period. The modeling results
indicate that remedial actions could be required.

Additional actions might be needed to address the constituents already in the groundwater. The choice of action would be based on site-specific studies and interactions with regulatory agencies. Some potential treatment technologies are discussed in Appendix C.

Comparison of Expected Environmental Releases with Applicable Standards

PATHRAE predicts that strontium-90 and yttrium-90 will exceed groundwater standards during the 100-year institutional control period. Table F-12 lists these parameters, the corresponding health-based standards, and the maximum concentrations predicted to be found in the groundwater near the basins. All other constituents modeled were predicted to be below applicable standards.

Appropriate treatment technologies would be employed to reduce the concentrations of radionuclides to below regulatory limits.

Releases to surface water associated with this action would not differ from those of no action (Section F.2.5.1).

There would be no releases to the atmosphere because the retention basin would be backfilled and capped.

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways would occur 100 years from the present, at which time institutional control of the SRP is assumed lost. The doses are only 3.4×10^{-5} and 2.4×10^{-11} millirem per year for the farm and direct gamma exposure pathways, respectively. There is no dose from consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments, due to the assumed limited plant-root depth.

Closure is expected to result in no adverse impacts on biological resources at the H-Area retention basin, as described in Sections F.2.5.1 and F.2.18.2. It also is expected to eliminate potential adverse impacts to organisms from standing water and biointrusion. TE

F.2.5.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

The basin, which is southwest of the H-Area perimeter fence, has been out of service since 1973. Under the waste-removal-and-closure action, standing water would be drained from the basin and removed to the operating H-Area retention basin (281-8H). The depth of soil to be excavated from the basin would be 2.6 meters. A 930-square-meter area outside the basin would be excavated to a depth of 0.3 meter. The soil removed from the basin and the 930-square-meter area would be transported in metal boxes and disposed of in a waste storage/disposal facility onsite. The basin would be backfilled to 0.3 meter above the ground surface with borrow fill. The amount of backfill required would be 11,500 cubic meters. The fill would be covered with a low-permeability cap (1900 cubic meters each of clay, sand, and topsoil) and seeded with grass over a 3160-square-meter area. Two additional groundwater monitoring wells would be installed and all wells would be monitored quarterly for 1 year, then annually for 29 years. TE

Comparison of Expected Environmental Releases with Applicable Standards

PATHRAE results for waste removal and closure of this site indicate that radionuclide concentrations would be reduced at the 1-meter well. PATHRAE predicts that strontium-90 and yttrium-90 will exceed groundwater standards during the 100-year institutional control period. Table F-12 lists these parameters, the corresponding health-based standards, and the maximum concentrations predicted to be found in the groundwater near the basins. All other constituents modeled were predicted to be below applicable standards.

Surface-water quality would not be significantly affected by the addition of potential contaminants from the groundwater pathway from this site, as the resulting concentrations of constituents in Four Mile Creek are projected to be below drinking-water standards.

The analyses described in Section F.2.5.1 were also performed for this action. Radionuclide releases to the atmosphere would take place only during the time that waste is being removed from the retention basin. The releases are associated with the excavation activities and are assumed to occur during the first year of waste removal and closure. TE

The annual dose to an individual resulting from the release of radionuclides to the atmosphere would be only 1.5×10^{-3} percent of the DOE limit of 25 millirem per year. The risk to the maximally exposed individual is 1.03×10^{-10}. TC

No nonradioactive constituents would be released to the atmosphere in the H-Area retention basin; therefore, no risk assessments were performed.

An analysis of the health risks to the average individual worker that would be attributable to occupational exposure to radioactive carcinogens was performed, using the methodology presented in Appendix I. The total dose to the worker was calculated to be 600 millirem, which would produce an incremental risk of 1.7×10^{-4}. The total dose to the worker transporting the waste was 240 millirem, producing an incremental risk of 6.7×10^{-5}.

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways occur 100 years after waste removal and closure, at which time institutional control of the SRP is assumed lost. The doses would be only 9.8×10^{-6} and essentially 0 millirem per year for the farm and direct gamma exposure pathways, respectively. There would be no dose from the consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments, due to the assumed limited plant-root depth.

TE | DOE does not expect this action to produce adverse impacts on biological resources at the H-Area retention basin, as described in Sections F.2.5.1 and F.2.18.2. It should eliminate potential adverse impacts to organisms attracted to the wet-weather pond in the basin and biointrusion.

F.2.6 F-AREA RETENTION BASIN, BUILDING 281-3F*

TC | The F-Area retention basin (Building 281-3F) is a low-level radioactive waste management facility that stopped receiving wastes in 1973. Background information on the history of waste disposal, waste characteristics, and evidence of contamination are described in Appendix B, Section B.3.2.

F.2.6.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

TE | For no action the site would remain in its present condition. Four groundwater monitoring wells would be installed and monitored quarterly for 1 year,
TC | then annually for 29 years. Site maintenance would be provided for the entire 30-year period.

Comparison of Expected Environmental Releases with Applicable Standards

All environmental releases are projected to be below applicable standards for no action.

The releases are expressed in terms of radionuclide concentrations for both a well 1 meter downgradient of the retention basin and a well 100 meters downgradient. The PATHRAE predicts that groundwater quality would not be affected significantly by the addition of potential contaminants from this waste management unit. All constituents should be found at levels below applicable health-based standards.

*The reference source of the information in this section is Scott, Killian, Kolb, Corbo, and Marine, 1987.

Surface-water quality would not be significantly affected by the addition of potential contaminants from the groundwater pathway from this site, as the resulting concentrations of constituents in Four Mile Creek are projected to be below drinking-water standards.

There would be no releases to the atmosphere under no action, because the retention basin has been backfilled with dirt and covered with grass. TE

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways would occur 100 years from the present. The doses would be only 9.1×10^{-7} and 7.0×10^{-13} millirem per year for the farm and direct gamma exposure pathways, respectively. The dose would be zero for the pathway which involves consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments, since any such contamination is assumed to be precluded due to the limited plant root depth.

Section F.2.18.1 describes the ecological impacts of no action. PATHRAE analyses have been performed on cesium-137, strontium-90, and yttrium-90. PATHRAE-generated groundwater outcrop concentrations and fluxes are identical for all closure actions. None of the radionuclides modeled exceed the EPA water-quality criteria for the protection of aquatic life or equivalent numbers from the technical literature. These results, therefore, indicate that constituents originating from the F-Area retention basin would have no impact under any of the postulated closure actions on the aquatic communities of Four Mile Creek and its associated wetlands or wildlife that use these waters to feed or drink.

Analysis of soil cores taken after the basin was backfilled in 1979 indicate that cesium-137 and strontium-90 are present in sediments underlying the backfill at levels exceeding the soil criteria. Thus, biointrusion impacts via root penetration and subsequent food-chain transport after the onset of natural succession are possible under no action. TE

F.2.6.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

Under the no-removal-and-closure action, the basin would be covered with a low-permeability cap (Figure F-2). TE Four groundwater monitoring wells would be installed around the basin and monitored quarterly for 1 year, then annually for 29 years. Site maintenance would be provided for the entire 30-year period. TC

PATHRAE analyses predict that all modeled constituents would be present in the groundwater at levels below MCLs for no waste removal and closure. Therefore, no further remedial action would be necessary.

Comparison of Expected Environmental Releases with Applicable Standards

All environmental releases are projected to be below applicable standards for the no-waste-removal-and-closure action. Releases to groundwater and surface water would not differ from these of no action (Section F.2.6.1).

There would be no releases to the atmosphere because the retention basin has already been backfilled.

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways would occur 100 years from the present, at which time institutional control of the SRP is assumed lost. The doses are only 1.2×10^{-5} and 1.2×10^{-16} millirem per year for the farm and direct gamma exposure pathways, respectively. There would be no dose from the consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments, due to the limited plant-root depth.

TC The ecological impacts of this closure action would be similar to those described in Sections F.2.6.1 and F.2.18.2. This action is expected to eliminate potential impacts of biointrusion.

F.2.6.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE Under the waste-removal-and-closure actions, the depth of the original backfill (2.1 meters) would be excavated along with 2 meters from the basin floor, for a total of 4.1 meters. The total volume of soil to be removed TC would be 9153 cubic meters. The soil would be transported in metal boxes and disposed of in a waste storage/disposal facility. The basin would be backfilled to 0.3 meter above the ground surface with borrow fill. The amount of backfill required would be 9824 cubic meters. The fill would be covered with a low-permeability cap (1340 cubic meters each of clay, sand, and top soil) and seeded with grass over an area of 2233 square meters. Four groundwater monitoring wells would be installed around the basin and monitored TC quarterly for 1 year, then annually for 29 years. Site maintenance would be provided for the entire 30-year period.

TE PATHRAE analyses predict that all modeled constituents would be present in the groundwater at levels below MCLs for the waste removal and closure action. Therefore, no further remedial action would be necessary.

Comparison of Expected Environmental Releases with Applicable Standards

TE All environmental releases are projected to be below applicable standards for the waste removal and closure action.

The peak concentrations for the 1-meter and 100-meter wells are the same as those presented in Section F.2.6.1. All constituents should be found at TC levels below applicable health-based standards at the 100-meter well, but strontium-90 and yttrium-90 would exceed their respective MCL values.

Surface-water quality would not be significantly affected by the addition of potential contaminants from the groundwater pathway from this site, as the resulting concentrations of constituents in Four Mile Creek are projected to be below drinking-water standards.

Environmental doses and risks to the maximally exposed individual due to radiological releases from the F-Area Retention Basin were calculated using the methodology presented in the introduction to Appendix F and in Appendix I.

Radionuclide releases to the atmosphere would take place only during the time that waste was being removed from the retention basin. The releases would be associated with the excavation activities and are assumed to occur during the first year of waste removal and closure.

The calculated annual dose to an individual is less than 8.4×10^{-5} percent of the per year DOE limit of 25 millirem. The risk associated with this dose would be less than 6.0×10^{-12}.

No nonradioactive constituents would be released to the atmosphere in the F-Area Retention Basin, and therefore no risk assessments were performed.

An analysis of the average individual worker health risks from occupational exposure to radioactive carcinogens was performed using the methodology presented in Appendix I. The total dose to the worker was calculated to be 1 millirem, which would produce an incremental risk of 2.8×10^{-7}. The total dose to the worker transporting the waste was calculated as 0.52 millirem, producing an incremental risk of 1.5×10^{-7}.

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways would occur 100 years after waste removal and closure, at which time institutional control of the SRP is assumed lost. The doses would be only 1.2×10^{-7} and essentially 0 millirem per year for the farm and direct gamma exposure pathways, respectively. There would be no dose from the consumption of crops potentially contaminated as a result of biointrusion of surface sediments, due to the assumed limited plant-root depth.

The ecological impacts of this closure action would be similar to those described in Sections F.2.6.1 and F.2.18.2. This action should eliminate potential impacts of biointrusion. TC

F.2.7 RADIOACTIVE WASTE BURIAL GROUNDS*

The radioactive waste burial grounds consist of three sites: the "new" (currently operating) low-level radioactive waste burial ground (643-7G), the mixed waste management facility (643-28G), and the "old" (inactive) radioactive waste burial ground (643-G). TE The latter site was used from 1952 to 1972 and is considered to be a mixed waste site; the former two sites began operation in 1972. The mixed waste management facility is no longer operating. TC The sites are essentially contiguous; accordingly, for the purposes of assessment analysis, they are considered as one. More information on the history of waste disposal, waste characteristics, and evidence of contamination is presented in Appendix B.

F.2.7.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

No action is defined as continuing operations until SRP activities cease, followed by a period of institutional control generally considered to last for 100 years. Present operations of the filled portions of the solid waste
TE disposal facility (burial grounds) consist of:

- Maintaining present fencing and surface drainage patterns
- Correcting trench subsidence as it occurs by backfilling with clean soil
- Reseeding as required with a shallow-rooted grass cover
- Frequently mowing to prevent onset of deep-rooted vegetation
- Monitoring for chemicals and radioactivity in the existing perimeter wells and well clusters
- Maintaining control of access to the facility (security)

The maintenance operations described above would be applied to the entire 195
TE acres of the facility during the 100-year institutional control period. Further subsidence in the first-used section, 643-G, is expected to be infrequent.

Comparison of Expected Environmental Releases with Applicable Standards

Monitoring and analysis indicate that groundwater beneath and around the radioactive waste burial grounds is contaminated with radionuclides, metals, and organic chemicals. Table F-13 indicates the regulatory standards and the calculated maximum concentrations for constituents that exceed regulatory standards. Monitoring results are not presented, because data from protocol monitoring wells are not presently available. In most cases the peaks are modeled to have occurred in the past, after the inception of waste emplacement; however, because the site is continuing to receive wastes, they generally indicate present concentrations.

TC The radionuclides tritium, nickel-63, cobalt-60, technetium-99, strontium-90, yttrium-90, cesium-134, cesium-137, neptunium-237, uranium-238, and plutonium-238 and -239 all are estimated to have exceeded their standards at the 1-meter well in 1957. PATHRAE results indicate that strontium-90 will exceed its standard again in 2185. Neptunium-237 should exceed its standard in 2420.

Of the chemical constituents, lead and mercury are estimated to have exceeded their standards at the 1-meter well in 1957. PATHRAE results also indicate

*The reference source of the information in this section is Jaegge et al., 1987.

that cadmium and xylene will exceed their standards at the 1-meter well in 2235 and 2056, respectively.

After 200 years, the groundwater concentrations would be below health-based standards except for the slow-moving neptunium-237, strontium-90, cadmium, and xylene. Because they move so slowly, these constituents would be out of compliance only in the immediate vicinity of the burial grounds.

The burial grounds waste constituents leave the aquifer at the groundwater outcrop and enter the site streams. Because the waste site straddles a groundwater divide, the waste would enter both Upper Three Runs Creek and Four Mile Creek. The calculations assume that all of the wastes are transported toward the groundwater outcrop nearest the waste site. This outcrop, 1000 meters downgradient from the site, results in waste entering Four Mile Creek and, ultimately, being transported to the Savannah River.

Incremental concentrations in Four Mile Creek can be calculated by multiplying the peak Savannah River concentrations by the ratio of Savannah River flow rate to Four Mile Creek flow rate (830). All Savannah River and Four Mile Creek concentrations would be well within the applicable standards for no action.

The nonradioactive constituents were analyzed, using the methodology discussed in the introduction to Appendix F and in Appendix I, to estimate public exposure and risk attributable to releases of constituents into the atmosphere from the radioactive waste burial grounds.

No releases of carcinogens are expected, because the waste site is capped. TE
Releases of noncarcinogens are associated with volatilization of constituents. The EPA Hazard Index values attributable to atmospheric releases are less than 10.4×10^{-7}. TC

Environmental doses and risks to the maximally exposed individual due to radiological releases from the radioactive waste burial grounds were calculated using the methodology summarized in the introduction to Appendix F and presented in Appendix I. The calculated doses were less than 8×10^{-8} TC
percent of the DOE limit of 25 millirem per year for each of the 3 years. The risks associated with these doses would be less than 5.2×10^{-15}. TC

Potential Impacts (Other Than Releases)

Section F.2.18.1 describes the ecological impacts of no action. Potential exists for adverse effects on the aquatic biota of Four Mile Creek and adjacent wetlands under all closure actions. The levels of groundwater outcrop contamination predicted by the PATHRAE model for year 100 for lead, mercury, tritium, and plutonium-238 exceed the EPA criteria for the protection of aquatic life or equivalent values from the technical literature by factors ranging from 1.2 for plutonium-238 to 232 for lead under no action. Dilution of the contaminated groundwater outcrop by Four Mile Creek yields contaminant concentrations for lead, mercury, and tritium that exceed EPA criteria by factors ranging from 5.4 (tritium) to 35 (lead). Dilution modeling indicates that the introduction of contaminated groundwater outcrops into Four Mile Creek will elevate existing stream concentrations for lead, mercury, and tritium. Studies on the biological effects of such contaminants revealed that tritium would be well below the no-effect concentration for developing fish embryos, while lead concentrations would be sufficient to produce adverse effects on zooplankton populations, but not to bluegill populations.

The groundwater outcrop concentrations for lead, tritium, and plutonium-238 exceed drinking-water standards under all closure actions, indicating a potential for effects on wildlife consuming the undiluted groundwater at the outcrop. However, any such effects should be negligible in view of the conservative nature of human drinking-water standards and the low probability of significant numbers of wildlife consistently drinking water in the area of the undiluted groundwater outcrop.

TC

Based on the calculated radioactivity concentrations in the disposed waste, the potential exists for limited terrestrial impacts such as reduced plant growth, increased plant mortalities, and food-chain transport to herbivorous wildlife under no action via the biointrusion pathway. Terrestrial impacts would be limited to the general area surrounding the burial grounds.

TE

F.2.7.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE

The no-removal-and-closure action consists of leaving the waste in place and closing the site using low-permeability caps on areas 643-G and 643-7G, which would cover approximately 200 acres. The caps would consist of:

- 0.6 meter of topsoil (K = 7×10^{-4} centimeters per second), over
- 0.3 meter of sand (K greater than or equal to 1×10^{-3} centimeters per second)
- 0.15 meter of sand, over
- 20-mil (0.51 millimeters) membrane, over
- 0.15 meter of sand, over
- 0.6 meter of compacted clay (K less than 10^{-7} centimeters per second)

TC

This cap (or equivalent) would be covered with shallow-rooted vegetation. The volumes of material that would be required are: 4.8×10^5 cubic meters of topsoil, 2.4×10^5 cubic meters of drainage sand, 2.4×10^5 cubic meters of buffer sand, 8×10^5 square meters of 20-mil plastic liner, and 4.8×10^5 cubic meters of compacted clay.

The site would remain fenced and current engineered drainage would continue. Reseeding and mowing would be carried out as needed. Grade would be reestablished and the cap repaired following any subsidence. Existing perimeter wells and well clusters would be used for monitoring groundwater. RCRA wells would be installed. Institutional control would continue for 100 years following closure. Site maintenance and groundwater monitoring would continue for this entire period, as required.

TC

As shown in Table F-13, further remedial action might be required for this action, since PATHRAE modeling predicts that the concentrations of several constituents would exceed regulatory standards. The radionuclides (other than tritium) and metals that exceed regulatory standards could be removed by pumping, and the contaminated groundwater could be treated to reduce concentrations to acceptable levels. The treated water could then be discharged to a site stream or reinjected into the ground.

The removal of tritium would be more difficult because the tritium (hydrogen) isotope is chemically part of the water. Four actions to consider are detritiation, evaporation, direct discharge to onsite streams, and reinjection. Detritiation would be extremely expensive; evaporation would change the dose pathway from the groundwater to the atmosphere. TE

Direct discharge to onsite streams (e.g., Four Mile Creek) would rely on dilution of the tritium to acceptable concentrations. The concentration due to the groundwater in the stream would depend on the flow rate of the discharge (essentially the flow rate of the extraction wells). Assuming discharge into Four Mile Creek (0.22 cubic meter per second) at the maximum groundwater concentration (2.9 curies per cubic meter), the maximum allowable discharge rate to meet the concentration standard of 8.7×10^{-5} curies per cubic meter would be only 6.7×10^{-6} cubic meters per second. Therefore, direct discharge to onsite streams could not meet regulatory criteria if a practical groundwater extraction rate (e.g., 0.02 cubic meter per second) were employed.

Reinjection would require the water (treated for all contaminants except tritium) to be reinjected into the ground. Tritium would then decay naturally in the shallow aquifers. The injection location would be chosen to maximize the efficiency of the extraction wells.

Comparison of Expected Environmental Releases with Applicable Standards

The no-waste-removal-and-closure action would not correct the groundwater-contaminant situation at the radioactive waste burial grounds; the contaminants are already in the water in concentrations that exceed regulatory standards. Closure would slow the rate at which contaminants enter the water table and would be effective in reducing concentrations of slow-moving constituents that had not yet reached the water table in significant concentrations (i.e., neptunium, cadmium, and xylene). This closure action would reduce concentrations of the constituents below the health-based standards (see Table F-13). TE

Strontium-90 and cadmium are slow-moving constituents that are predicted to exhibit secondary concentration peaks in the future for no action. This closure action would reduce these secondary peaks significantly below the concentration criteria. TE

As described in Section F.2.7.1, all Savannah River and Four Mile Creek incremental concentrations would be within applicable health-based standards.

The analysis described in Section F.2.7.1 was performed for this action. There would be no releases of carcinogens, since the facility would be capped. Releases of noncarcinogens would be due to volatilization of contaminants. Risks attributable to these releases are calculated to be below 1, TE

TC with a maximum value less than 7 x 10^{-12} for each of the years modeled. The calculated dose due to radiological releases was less than 2.8 x 10^{-23} percent of the DOE limit of 25 millirem for each of the 3 selected years. The risk associated with this dose would be less than 2.0 x 10^{-30}.

Potential Impacts (Other Than Releases)

TE The ecological impacts of the closure action would be similar to those described in Sections F.2.7.1 and F.2.18.2. Closure would eliminate the potential impacts of biointrusion.

F.2.7.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE Waste removal and closure of this site would include excavation of contaminated materials and capping of the area. Excavation of the waste disposal area would involve either removing the waste and soil from the waste trenches and placing it in another disposal/storage facility, or removing the waste from the waste trenches, processing it by sorting, size reduction, and stabilization, and redisposing of the treated waste at a mixed waste disposal/storage facility.

TE Excavation would proceed as follows: machines, operated either remotely or by personnel in shielded cabs, would excavate waste along known trench lines. The excavation would be larger and deeper than the original trench in order to assure that possibly contaminated adjacent soil would also be excavated. The entire area would be graded and covered to keep rainwater away from the excavated waste.

The estimated length of trench to be excavated is 64,000 meters, based on 50 percent utilization of the burial ground area. About 3 x 10^{6} cubic meters of waste and contaminated soil would have to be excavated. Partial excavation would result in less waste removed, but current data and technologies are inadequate for determining how much less. Partial excavation, however, would leave residual radionuclide concentrations in excess of DOE guidelines for unrestricted sites.

After excavation, the waste-soil mixture would be sent to a process area where the mixture would be sorted, assayed, reduced, stabilized, and packaged for transport and disposal. The sorting process would take place on a number of conveyor belts and would be accomplished by remote sorting with manipulators. Small pieces and soil could be removed by a sorter such as a bouncing ball screen arrangement that is part of the conveyor system. Waste treatment would include processes such as incineration, shredding, compaction, and stabilization with grout. Waste and soil with very low levels of radioactivity could be returned to the original waste disposal area. The trigger value for the concentrations would have to be determined - a de minimis value for low-level waste does not currently exist.

TE Residual waste following treatment and sorting would be placed in metal disposal boxes and transported to an appropriate disposal/storage facility. The disposal volume to be evaluated should be 3 x 10^6 cubic meters; uncertainties regarding treatment and handling prevent estimation of any volume reduction. After excavation, the original waste disposal area would have to be closed, using a low-permeability cap as described above. The site would remain fenced and engineered drainage would continue. Reseeding and mowing would be carried out as needed. Grade would be reestablished and the cap repaired following any subsidence events. Existing perimeter wells and well clusters would be used for monitoring groundwater quarterly for 1 year and then annually for a minimum of 99 years. Institutional control would continue for 100 years following closure. TC Site maintenance would be provided for the entire institutional control period.

The possible corrective actions would be the same as those described for no waste removal and closure.

Comparison of Expected Environmental Releases with Applicable Standards

Groundwater and surface water releases would be the same as those for no waste removal and closure (Section F.2.7.2). TC

The analysis described in Section F.2.7.1 was performed for this action. Carcinogenic risks were calculated for 1986 due to wind erosion and excavation activities. These risks were calculated to be zero in future years, since the basin would be capped. Noncarcinogenic risks due to wind erosion and excavation activities were also calculated for 1986. Risks due to volatilization and seepage were calculated for 2085 and 2985. Risks due to carcinogen releases would be less than 1.5 x 10^{-12}. TC The EPA Hazard Index for noncarcinogenic releases would be less than 1.1 x 10^{-7} for each of the 3 years modeled. The calculated dose to the maximally exposed individual due to radiological releases is less than 2.8 percent of the DOE limit of 25 millirem for each of 3 years. The risk associated with this dose would be less than 2.0 x 10^{-7}.

An analysis of health risks to the the average individual worker attributable to occupational exposure to carcinogens (both nonradioactive and radioactive) and noncarginogens was performed using the methodology presented in Appendix I. The risk to a worker from nonradioactive carcinogens was calculated as less than 3.9 x 10^{-12}; the EPA Hazard Index for noncarcinogens was 3.8 x 10^{-7}. The total dose to the worker would be 4.2 x 10^3 millirem, TC producing an incremental risk of 1.2 x 10^{-3}. The total dose to the worker transporting the waste would be 2.2 x 10^3 millirem, producing an incremental risk of 6.2 x 10^{-4}.

Potential Impacts (Other Than Releases)

The ecological impacts of this action would be similar to those discussed in TE Sections F.2.7.1 and F.2.18.3. This action would eliminate the potential impacts of biointrusion.

F.2.8 MIXED WASTE MANAGEMENT FACILITY, BUILDING 643-28G

This site is discussed in conjunction with the other radioactive waste burial grounds in Section F.2.7.