F.2.9 RADIOACTIVE WASTE BURIAL GROUND, BUILDING 643-G

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

F.2.10 F-AREA SEEPAGE BASINS*

F-Area seepage basins (Buildings 904-41G, 904-42G, and 904-43G) are mixed waste management facilities that are presently receiving waste. The three seepage basins were assumed to be a single operating unit for purposes of contaminant migration modeling and remedial action analyses. The history of waste disposal, evidence of contamination, and waste characteristics at the three basins are presented in Appendix B, Section B.3.3.

F.2.10.1 <u>Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)</u>

<u>Description of Action</u>

No action would consist of allowing the basins to drain under natural conditions (i.e., infiltration and evaporation). Once the basins' residual bottom sediments dried sufficiently, the bottom and side slopes would be covered with 15 centimeters of topsoil and hydroseeded with an appropriate grass to protect the slopes from erosion. Approximately 4000 cubic meters of topsoil would be needed to cover the basin sides and bottoms, and approximately 26,200 square meters of seeding would be needed. The area would be fenced, and entrance would be allowed only for maintenance activities. Maintenance activities would consist of inspection for mowing and unacceptable erosion. Groundwater would be monitored quarterly for 1 year, then annually for 29 years.

<u>Comparison of Expected Environmental Releases with Applicable Standards</u>

TC Current groundwater monitoring data indicate that concentrations of chromium, lead, nickel, nitrate, tritium, strontium-90, radium, gross alpha, and gross beta exceed regulatory standards. PATHRAE modeling results indicate that concentrations of lead, nitrate, iodine-129, strontium-90, yttrium-90, americium-241, and uranium-238 would also exceed standards at various times in the future. Table F-14 lists all constituents that currently exceed or are
TE projected to exceed regulatory standards under all closure actions and no action, the corresponding standard for each constituent, and the maximum concentration found or projected to be found in the groundwater near the three F-Area seepage basins.

PATHRAE modeling of surface-water impacts projects that the addition of constituents to Four Mile Creek via the groundwater pathway will not exceed drinking-water standards. Table F-14 indicates that the concentrations of these constituents in Four Mile Creek for no action, no waste removal, and waste removal are all below applicable health-based standards.

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

The nonradioactive constituents were analyzed, using the methodology discussed in the introduction to this appendix and in Appendix I, to estimate public exposure and risk attributable to atmospheric releases from the F-Area seepage basins.

Releases are associated with volatilization of contaminants and wind erosion. Risks due to carcinogenic releases were calculated to be less than 1.2 x 10^{-9} for each of the 3 selected years modeled. The EPA Hazard Index for noncarcinogenic releases would be less than 1 x 10^{-3} for each of the 3 years. TC

Environmental doses and risks to the maximally exposed individual due to radiological releases from the F-Area seepage basins were calculated using the methodology presented in the introduction to this appendix and in Appendix I. The calculated doses are less than 46 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 less than 3.3 x 10^{-6}. TC

Potential Impacts (Other Than Releases)

The maximum annual dose 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 would be 0.19 and 1000 millirem per year for the farm and direct gamma exposure pathways, respectively.

Section F.2.18.1 describes the ecological impacts of no action. The groundwater outcrop concentration for lead, mercury, nitrate, iodine-129, and tritium predicted by the PATHRAE model for year 0 under no action exceed EPA criteria by factors ranging from 1.1 for iodine to 129 for tritium, indicating that the potential exists for adverse effects on the aquatic biota in the relatively unmixed waters of the wetlands adjacent to the groundwater outcrop. Studies of the biological effects of these contaminants indicate that lead would not adversely affect zooplankton or bluegill populations and that tritium concentrations in the groundwater outcrop are well below the no-effect concentration for developing fish embryos; however, mercury would adversely affect fathead minnows and bluegill. TE No toxicity information is available for iodine-129; therefore, the potential aquatic effects due to the outcrop concentration of this contaminant cannot be assessed. The groundwater outcrop concentrations of nitrate are not expected to adversely affect the aquatic biota of Four Mile Creek or adjacent wetlands.

Water-quality parameters of downgradient wells were reviewed (Killian et al., 1987a) to identify those parameters that were higher than the water-quality criteria for aquatic life. TE Gross alpha concentrations were above the aquatic criteria, even after dilution. Therefore, adverse effects on aquatic biota could occur as a result of excessive concentrations of gross alpha in the relatively unmixed waters of wetlands adjacent to the groundwater outcrop.

The groundwater outcrop concentrations of nitrate and tritium exceed the drinking-water standards under all closure actions, indicating the potential for adverse impacts on wildlife consuming the undiluted groundwater outcrop. However, these impacts should be negligible in view of the conservative nature of applying human drinking-water standards to wildlife and the low probability of significant numbers of wildlife consistently drinking water in the area of the outcrop.

Based on available data, limited terrestrial impacts are anticipated for no action via the biointrusion and consumption of contaminated basin waters pathways. The contaminated levels in the basin waters for chromium, lead, tritium, cesium-137, plutonium-239, uranium-238, strontium-90, and yttrium-90 exceed the drinking-water standards, indicating a potential for adverse effects on wildlife consuming the basin waters. However, these effects should be minimal in view of the size of the basins, the conservative nature of human drinking-water standards when applied to wildlife, and the low probability of significant numbers of wildlife consistently drinking water from the basins. Food-chain uptake calculations based on the bioconcentration by aquatic macrophytes of heavy metals from the standing water indicate that the predicted concentrations of heavy metals are well below the concentrations considered toxic to herbivorous wildlife.

The maximum contaminant concentrations in the seepage basin soil for mercury, americium-241, cobalt-60, cesium-137, tritium, iodine-129, plutonium-238, -239, and -240, antimony-125, strontium-90, and uranium-238 exceed the soil criteria, in some cases by large factors, making adverse terrestrial effects probable. The maximum contaminant concentration in the seepage basin soil for mercury exceeds the phytotoxic concentration, indicating that a potential exists for such adverse vegetation impacts as reduced plant growth and increased plant mortalities. However, food-chain uptake calculations indicate that the predicted vegetation concentration for mercury is below the level considered toxic to herbivorous wildlife. Terrestrial impacts would be limited to the general area occupied by the seepage basins.

F.2.10.2 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, backfilling and capping of the basin would consist of five phases:

1. Draining the basins' impounded liquids naturally, through infiltration and evaporation.

2. Stabilizing the sediment in the basins with cement.

3. Backfilling the basins with onsite soils to 0.6 meter above the surrounding ground surface, using controlled placement and compaction procedures. Approximately 114,000 cubic meters of backfill would be needed for the three basins.

TC 4. Covering the backfill with a low-permeability cap covering an area of 11.5 acres (Figure F-2).

TC 5. Hydroseeding the newly placed topsoil with an appropriate grass seed to minimize erosion. The seeding would cover an area of 11.5 acres.

The area would be fenced, and only maintenance activities would be allowed. Maintenance activities would consist of inspection for unacceptable erosion, mowing, and long-term groundwater monitoring quarterly for 1 year, then annually for 29 years. Site maintenance would be provided for the entire 30-year period. TC

Additional corrective actions (e.g., groundwater extraction and treatment) might be needed to address the constituents already in the groundwater. The selection of any such action would be based on site-specific studies and interactions with regulatory agencies. Some possible technologies are presented in Appendix C.

Comparison of Expected Environmental Releases with Applicable Standards

Levels of nitrate and tritium would not be affected by the described closure actions and would remain above standards (see Table F-14). Treatment by one or more of the technologies described in Appendix C is expected to reduce the PATHRAE-projected environmental releases of nitrate and tritium to within MCLs or ACLs. Lead and strontium-90 levels, although projected by PATHRAE to be within MCLs, currently exceed MCLs, as indicated by groundwater monitoring data. The levels of lead and strontium-90 would also be reduced to within MCLs by the treatment technology. In addition, the gross alpha and gross beta constituents, including radium, would be reduced to levels within MCLs. However, the levels of iodine-129 and uranium-238 might not be substantially reduced by the remedial action, due to the slow migration of these radionuclides through the vadose zone and aquifer.

The analysis described in the air release section of Section F.2.10.1 was also performed for this action. No risks due to carcinogens were calculated, since the seepage basin would be capped. TE Releases due to noncarcinogens in years 2085 and 2985 would result from the volatilization of mercury. The EPA Hazard Index is calculated to be less than 3.4×10^{-6}. No release of radiological constituents is projected, since the seepage basin would be capped. TE

Potential Impacts (Other Than Releases)

The doses due to reclaimed farm and gamma exposure pathways are negligible. TC

The impacts of the no-waste-removal-and-closure action on biological resources at the F-Area seepage basin are expected to be similar to those described in Sections F.2.10.1 and F.2.18.2. This action would eliminate the potential impacts of biointrusion. TE

F.2.10.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

The waste-removal-and-closure action would consist of the following five phases: TE

1. Draining the three basins' impounded liquids naturally, through infiltration and evaporation.

2. Excavating, transporting, and disposing of basin sediments. Based on a preliminary evaluation of soil-coring data, approximately 30 centimeters of material would be removed from all basins, for a total volume of 8000 cubic meters of soil. The materials would be transported in metal boxes and placed in a waste storage/disposal facility.

TE

3. Backfilling the basins with on-site soils using controlled placement and compaction procedures to 60 centimeters above the surrounding ground surface elevations. Approximately 122,000 cubic meters of backfill would be needed for all three basins.

4. Capping the backfill with a low-permeability cap as described above.

TC

5. Hydroseeding the newly placed topsoil with an appropriate grass seed to minimize erosion (11.5 acres).

The area would be fenced, and only maintenance activities would be allowed. Maintenance activities would consist of inspection for unacceptable erosion and mowing. Groundwater would be monitored quarterly for 1 year and then annually for 29 years. Site maintenance would be provided for the entire 30-year period.

TC

It might be necessary to take corrective actions to reduce levels of those constituents already present in the groundwater at these sites. Any such actions would be based on site-specific studies and interactions with regulatory agencies.

Comparison of Expected Environmental Releases with Applicable Standards

The comparison of expected environmental releases with applicable standards that is provided in Section F.2.10.2 is also relevant. However, the action under waste removal and closure, as projected by PATHRAE, would reduce the levels of uranium-238 to within regulatory standards.

The analysis described in the air release portion of Section F.2.10.1 was also performed. Releases of carcinogens are assumed to occur in the first year, 1986, due to earth-moving activities. No releases are assumed to occur in subsequent years since the seepage basin would be capped. Risks to the maximally exposed individual are calculated to be less than 1.8×10^{-13}. Releases of noncarcinogens are assumed to occur in the first year due to earth-moving activities and in future years due to volatilization of contaminants. However, the EPA Hazard Index is calculated to be less than 4.4×10^{-7} in each year modeled.

TC

Releases of radiological constituents in the first year would be due to excavation activities and would be zero in future years, since the basin would be capped. The calculated annual dose to the maximally exposed individual would be less than 0.08 percent of the DOE limit of 25 millirem. The risk associated with this dose would be less than 1.6×10^{-9}.

TC

An analysis of the health risks to the average individual worker attributable to occupational exposure to carcinogens (both nonradioactive and radioactive) and noncarcinogens was performed using the methodology presented in Appendix I. The risk to a worker due to nonradioactive carcinogens was calculated to be less than 2.0 x 10^{-11}. The risk due to noncarcinogens to a worker was TC calculated to be below 1, with a value of 5.0 x 10^{-4}. The total dose to the worker would be 940 millirem, which would produce an incremental risk of 2.6 x 10^{-4}. The total dose to the worker transporting the waste would be 340 millirem, producing an incremental risk of 9.5 x 10^{-5}.

Potential Impacts (Other Than Releases)

The waste-removal-and-closure action at the F-Area seepage basins is expected TE to have similar effects on biological resources as those discussed in Sections F.2.10.2 and F.2.18.3. This action would eliminate potential impacts of biointrusion.

F.2.11 F-AREA SEEPAGE BASIN, BUILDING 904-42G

This seepage basin is discussed in conjunction with the other F-Area seepage basins in Section F.2.10.

F.2.12 F-AREA SEEPAGE BASIN, BUILDING 904-43G

This seepage basin is discussed in conjunction with the other F-Area seepage basins in Section F.2.10.

F.2.13 F-AREA SEEPAGE BASIN (OLD), BUILDING 904-49G*

The old F-Area seepage basin, the first constructed in F-Area, was used for TE effluent disposal from Building 221-F beginning in November 1954 and ending in May 1955. The basin received a variety of wastewater, including evaporator overheads, laundry wastewater, and an unknown amount of chemicals. The history of waste disposal, evidence of contamination, and waste characteristics at the basin are presented in Appendix B, Section B.3.3.

F.2.13.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

Under no action, the site would be left in its present condition. Groundwater TE monitoring with existing wells would be continued quarterly for 1 year, and then annually for 29 years. Upkeep would consist of maintaining a fence and signs around the basin area and controlling the vegetation.

Comparison of Expected Environmental Releases with Applicable Standards

Table F-15 lists all constituents in the groundwater that currently exceed or are projected to exceed regulatory standards for no action. Current groundwater monitoring data indicate that concentrations of lead, nickel, TC nitrate, trichloroethylene (TOH), radium, gross alpha, and gross beta exceed MCLs or health-based standards. Predictions by the PATHRAE model indicate that concentrations of uranium-238, strontium-90, and yttrium-90 will

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

exceed standards at various times in the future, and that peak releases of nitrate and trichloroethylene exceeded MCLs from 1958 through 1965.

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 Upper Three Runs Creek and the Savannah River are projected to be below drinking-water standards. TC

The nonradioactive contaminants were analyzed, using the methodology discussed in the introduction to this appendix and in Appendix I, to estimate public exposure and risk attributable to atmospheric contaminant releases from the old F-Area seepage basin. Releases of carcinogens and noncarcinogens are associated with volatilization and wind erosion. Risks attributable to atmospheric releases of carcinogens are calculated to be less than 1.3×10^{-11} for each of the 3 selected years. The EPA Hazard Index for noncarcinogens would be less than 8.6×10^{-7}. TC

Environmental doses and risks to the maximally exposed individual due to radiological releases from the old F-Area seepage basin were calculated using the methodology presented in the introduction to this appendix and in Appendix I. The calculated doses are less than 0.14 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 9.2×10^{-9}.

Potential Impacts (Other Than Releases)

Section F.2.18.1 describes the ecological impacts of no action. PATHRAE analysis and simple dilution modeling have been performed on groundwater concentrations of barium, cadmium, chromium, lead, mercury, nitrate, sodium, trichloroethylene, strontium-90, yttrium-90, uranium-238, and plutonium-239. The results indicate that influent concentrations of these elements would be below EPA criteria for freshwater biota for all closure actions. Therefore, no adverse impacts would occur to the aquatic communities of the Upper Three Runs Creek ecosystem and adjacent wetlands, or to wildlife that use these habitats to drink or feed, including the species listed as threatened or endangered. TE

F.2.13.2 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 liquid in the basin would be allowed to dry by natural seepage and evaporation. The basin would then be backfilled and the site capped. There would be no excavation. The backfill would consist of 0.6 meter to 1.2 meters of crushed stone or washed gravel covered by a geotextile filter fabric and a minimum of 1.2 meters of common borrow fill. The low-permeability cap would be as shown in Figure F-2. A groundwater monitoring program would be maintained quarterly for 1 year and then annually for 29 years. Site maintenance would be provided for the entire *30-year period.* TC TC

Additional corrective actions (e.g., groundwater extraction and treatment systems) might be needed to address the constituents already in the groundwater. The action selected would be based on site-specific studies and interactions with relevant regulatory agencies. The groundwater monitoring data in Table F-15 indicate that treatment processes would be required to reduce concentrations of lead, nickel, nitrate, trichloroethylene, radium, gross alpha, and gross beta to levels within regulatory standards. Uranium-238, strontium-90, and yttrium-90 are assumed to be the primary sources of gross alpha and gross beta, respectively. PATHRAE simulations (see Table F-15) indicate that expected peak releases of uranium-238 would exceed its MCL in 2370, and that peak releases of nitrate and trichloroethylene exceeded MCLs from 1956 through 1965.

Comparison of Expected Environmental Releases with Applicable Standards

Based on the results of the PATHRAE simulation, the closure actions described above would be expected to maintain levels of lead, strontium-90, and yttrium-90 within MCLs or ACLs. Levels of nitrate, trichloroethylene, and uranium-238 could be above standards after closure, but remedial actions would be expected to reduce them to within MCLs or ACLs.

The analysis described in the air release portion of Section F.2.13.1 was also performed. Releases are due to the volatilization of constituents. No other releases are assumed, since the seepage basin would be capped. The risks due to carcinogen releases would be less than 1.2×10^{-16} each of the 3 selected years. The EPA Hazard Index for noncarcinogens was calculated to be less than 2×10^{-15} for each of the years modeled. TC

The analysis for radiological releases described in Section F.2.13.1 was also performed. There are assumed to be no releases for all constituents because the basin would be capped.

Potential Impacts (Other Than Releases)

As discussed in Sections F.2.13.1 and F.2.18.2, no adverse impacts on biological resources are expected as a result of this closure action at the old F-Area seepage basin. TE

F.2.13.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

Under the waste-removal-and-closure action, before the site was excavated, the basin would be allowed to dry by natural seepage and evaporation. Contaminated soil would be excavated to a depth of appproximately 1 meter and transported in metal boxes to a waste storage/disposal facility. Approximately 1 meter would be excavated from the basin. It is estimated that no more than 5370 cubic meters of soil would be excavated and placed in containers. The basin would then be backfilled and capped. The backfill would consist of 0.6 meter to 1.2 meters of crushed stone or washed gravel covered by a geotextile filter fabric and at least 0.6 meter of borrow fill. This would be covered by a low-permeability cap, as described above and shown in Figure F-2. TC TE

The corners of the closed basin would be marked with identification pylons. Groundwater monitoring would be conducted quarterly for 1 year and then annually for 29 years. Vegetative growth above the basin would be controlled to protect the infiltration barrier. Site maintenance would be provided for the entire 30-year period. TC

Comparison of Expected Environmental Releases with Applicable Standards

Environmental releases to the groundwater would not be affected appreciably by waste removal, as the mobile chemicals and nuclides have been leached from the basin during the 29 years the basin has been receiving waste. Therefore, the discussion presented in Section F.2.13.2 is also applicable to waste removal and closure. TE

The analysis described in the air release portion of Section F.2.13.1 was also performed for this action. Releases are caused by volatilization of constituents and, in the first year, by wind erosion and excavation activities. Risks caused by releases of carcinogens were calculated as being less than 8.4×10^{-15} for each of the 3 years modeled. The EPA Hazard Index for noncarcinogenic releases would be less than 7.0×10^{-10}. TC

Radiological releases described in Section F.2.13.1 were also determined for 1986; they are due to normal excavation activities. These releases would be zero for future years since the basin would be capped. The dose to the maximally exposed individual at the SRP boundary would be less than 6.4×10^{-4} percent of the DOE limit of 25 millirem. The risk associated with this dose would be less than 4.5×10^{-11}. TE

An analysis of the health risks to the average individual worker 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 as 3.3×10^{-12}. The EPA Hazard Index for worker exposure to noncarcinogens was calculated as 1.4×10^{-5}. The total dose to the worker would be 3.1 millirem, which would produce an incremental risk of 8.7×10^{-7}. The total dose to the worker transporting the waste would be 1.6 millirem, producing an incremental risk of 4.5×10^{-7}. TC

Potential Impacts (Other Than Releases)

As discussed in Sections F.2.13.1 and F.2.18.3, no adverse impacts to biological resources are expected as a result of waste removal and closure at the old F-Area seepage basin.

F.2.14 H-AREA SEEPAGE BASINS*

The H-Area seepage basins (Buildings 904-44G, 904-45G, and 904-56G) are mixed waste management facilities that are presently receiving wastes; basin 904-46G

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

TE stopped receiving wastes in 1962. Background information on the history of waste disposal, waste characteristics, and evidence of contamination are presented in Appendix B, Section B.3.3.

F.2.14.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

No action would consist of allowing the basins to drain under natural conditions (i.e., infiltration and evaporation). The area would be fenced, and only maintenance activities would be allowed. Maintenance activities would consist of mowing and inspection for unacceptable erosion. Groundwater TC would be monitored quarterly for 1 year, then annually for 29 years. Site maintenance would be provided for the entire 30-year period.

Comparison of Expected Environmental Releases with Applicable Standards

Monitoring has revealed that groundwater beneath the H-Area seepage basins is contaminated with heavy metals, inorganics, and radionuclides. In addition, PATHRAE predicts that a number of these constituents will exceed, or continue TE to exceed, groundwater standards. Table F-16 lists these parameters, the corresponding regulatory standards, and the maximum concentrations found, or predicted to be found, in the groundwater near the basins. Only contaminants that exceed, or are predicted to exceed, standards are listed. All other constituents are found at levels below applicable standards.

PATHRAE modeling of surface-water impacts predicts that concentrations of tritium and nitrate in Four Mile Creek will equal or exceed drinking-water standards because of the addition of those constituents from the groundwater pathway. Table F-16 presents concentrations of those constituents in Four Mile Creek for no action, no waste removal, and waste removal.

Nonradioactive constituents were analyzed to estimate public exposure and risk attributable to atmospheric releases from the H-Area seepage basins.

Releases are caused by the volatilization of constituents and by wind erosion. TC The risks due to releases of carcinogens would be less than 1.4×10^{-8}; the EPA Hazard Index for releases of noncarcinogens would be less than 3.7×10^{-3} for each of the 3 selected years. Environmental doses and risks to the maximally exposed individual due to radiological releases from the H-Area seepage basins were calculated using the methodology presented in the introduction to this appendix and in Appendix I. The doses are calculated to be less than 11.6 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 8.2×10^{-7}.

Potential Impacts (Other Than Releases)

Section F.2.18.1 describes the ecological impacts of no action. A potential exists under all closure actions for adverse impacts on the aquatic biota of Four Mile Creek and adjacent wetlands due to elevated groundwater outcrop and diluted stream concentrations of lead, mercury, nitrate, tritium, and iodine-129. The groundwater outcrop concentrations for these constituents predicted by the PATHRAE model for year 0 exceed the EPA criteria for the protection of aquatic life or equivalent values from the technical literature by factors ranging from 5.2 for nitrate to 200 for tritium. Dilution of the groundwater outcrop by Four Mile Creek yields stream concentrations for these constituents that exceed the same criteria by factors ranging from 1.3 for nitrate to 53 for tritium.

Studies of the biological effects indicate that lead would not adversely affect zooplankton and bluegill populations; mercury would not adversely affect fathead minnow and bluegill populations; and tritium concentrations are all below the no-effect concentration for developing fish embryos. No toxicity information is available for iodine-129; therefore, the potential aquatic effects due to the groundwater outcrop and diluted stream concentrations of this constituent cannot be assessed. The groundwater outcrop and diluted stream concentrations for nitrate are not expected to adversely affect the aquatic biota of Four Mile Creek or adjacent wetlands.

TE

To estimate potential impacts of other contaminants, water-quality parameters of downgradient wells were reviewed to identify those that were higher than the water-quality criteria for aquatic life. Zinc, gross alpha, and gross beta revealed well and dilution concentrations greater than the criteria (Table F-17). Therefore, adverse effects could occur on aquatic biota as a result of excessive concentrations of these contaminants in the water of the wetlands adjacent to the groundwater outcrop.

The groundwater outcrop concentrations of nitrate, sodium, tritium, and iodine-129 exceed the drinking-water standards under all closure actions, indicating the potential for adverse effects on wildlife consuming the undiluted outcrop. However, these impacts should be negligible in view of the conservative nature of human drinking-water standards when applied to wildlife, and the low probability of significant numbers of wildlife consistently drinking in the area of the groundwater outcrop.

TE

TC

Examinations of influent and sediment contamination levels indicate that, because of elevated levels of heavy metals and radionuclides, a potential exists for adverse effects on wildlife consuming the basin waters under no action. However, these effects should be negligible in view of the limited basin size and the low probability of significant numbers of wildlife consistently drinking from this one location.

TE

The maximum contaminant concentrations in the seepage basin soil for chromium, lead, mercury, silver, americium-241, curium-244, cobalt-60, cesium-134, and -137, tritium, iodine-129, plutonium-238 and -239, uranium-240, strontium-90, technetium-99, thorium-233, and uranium-234, -235, and -238 exceed the soil criteria, in some cases by large factors, making adverse terrestrial impacts probable. The maximum contaminant concentrations in the seepage basin soil for chromium, lead, mercury, and silver exceed the phytotoxic concentrations, making such adverse vegetation impacts as reduced plant growth and increased plant mortalities probable. However, food-chain uptake calculations indicate that the predicted vegetation concentrations for these constituents are below the levels considered toxic to herbivorous wildlife. Terrestrial impacts would be limited to the general area occupied by the seepage basins.

TE

F.2.14.2 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, backfilling and capping of the basin would consist of four phases: TE

1. Natural drainage of the basins' impounded liquids by infiltration and evaporation.

2. Backfilling of the basins with onsite soils using controlled placement and compaction procedures to 0.6 meter above the surrounding ground surface elevation. (This 0.6-meter layer is for the establishment of vegetation.) Approximately 244,000 cubic meters of backfill would be needed for the four basins.

3. Capping of the basins with a low permeability cap to reduce infiltration of precipitation (Figure F-2). TC

4. Hydroseeding of the newly placed topsoil with an appropriate legume seed to minimize erosion. The seeding would cover an area of 21.3 acres. The area would be fenced, and only maintenance activities would be allowed. Groundwater would be monitored quarterly for 1 year, then annually for 29 years. Site maintenance would be continued for the entire 30-year period. TC

Remedial actions could be required since results of PATHRAE modeling predict that concentrations in the groundwater of nitrate, tritium, iodine-129, neptunium-237, strontium-90, and yttrium-90 would remain above MCLs (see Table F-16). The precise action taken would be determined on the basis of site-specific studies and interaction with regulatory agencies. Some of the possible treatment technologies are presented in Appendix C.

Comparison of Expected Environmental Releases with Applicable Standards

The implementation of this closure/remedial action would reduce all environmental releases to below MCLs or ACLs. Inorganics and radionuclides would be removed from the groundwater to below applicable standards (see Table F-16). In addition, all other environmental releases are projected to be below regulatory concern. TE

The analysis described in the air release portion of Section F.2.14.1 was also performed for this action. There are no calculated risks due to carcinogenic releases since the seepage basin would be capped. The risks due to noncarcinogenic releases in each of the 3 years would be from the volatilization of mercury and phosphate seepage. The EPA Hazard Index associated with these releases was calculated as less than 9.7×10^{-12}. TC

The analysis for radiological releases described in Section F.2.14.1 was also performed. There are assumed to be no releases for any constituents since the basin would be capped.

Potential Impacts (Other Than Releases)

The impact of no waste removal and closure on aquatic resources at the H-Area seepage basins is expected to be similar to that described in Sections F.2.14.1 and F.2.18.2 and would eliminate the potential impacts of biointrusion.

TE

F.2.14.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE

The waste removal and closure action at all four basins in H-Area would consist of the following five phases:

1. Natural drainage of the basins' impounded liquids by infiltration and evaporation.

2. Excavation, transport, and disposal of basin sediments. Based on a preliminary evaluation of soil coring data, approximately 0.3 meter of material would be removed, for a total volume of 20,870 cubic meters of soil. The excavated material would be transported in metal boxes to a waste storage/disposal facility.

TC

3. Backfilling of all the basins with onsite soils to 0.6 meter above the surrounding ground surface, using controlled placement and compaction procedures. Approximately 237,150 cubic meters of backfill would be needed.

4. Capping of the basins with an impervious cap (synthetic geomembrane and low-permeability cap) to reduce precipitation infiltration. The cap would cover an area of 24.7 acres and be as described in Figure F-2.

TC

5. Hydroseeding of the newly placed cap with an appropriate grass seed to minimize erosion. The area would be fenced, and only maintenance activities would be allowed. Maintenance activities would include inspection for unacceptable erosion and mowing. Groundwater would be monitored quarterly for 1 year, and then annually for 29 years.

Remedial actions could be required because PATHRAE modeling shows concentrations of nitrate, tritium, iodine-129, neptunium-237, strontium-90, and yttrium-90 in the groundwater remaining above MCLs (see Table F-16).

Comparison of Expected Environmental Releases with Applicable Standards

Implementation of this closure/remedial action would reduce all environmental releases to below MCLs/ACLs. Contaminants would be removed from the groundwater to below applicable standards (see Table F-16 for a listing of standards). In addition, all other environmental releases are projected to be below regulatory concern.

The analysis for air releases described in Section F.2.14.1 was also performed. Releases would be caused by excavation activities and volatilization of constituents. Risks due to releases of carcinogens were calculated as being less than 2.2×10^{-12} for each of the 3 years modeled. The EPA Hazard Index values for noncarcinogenic releases were less than 1.7×10^{-6} for the 3 years. TC

Radiological releases described in Section F.2.14.1 were also determined and for 1986 are due to normal excavation activities. There would be no releases for future years since the basin would be capped. The dose to the maximum individual at the SRP boundary was calculated as being less than 0.03 percent of the DOE limit of 25 millirem. The risk associated with this dose would be less than 1.8×10^{-9}. TE

An analysis of the health risks to the average individual worker attributable to occupational exposure to carcinogens (both nonradioactive and radioactive) and noncarcinogens assuming the worker is in all basins was performed using the methodology presented in Appendix I. The risk due to nonradioactive carcinogens to a worker was calculated as less than 8.8×10^{-11}. The EPA Hazard Index for worker exposure to noncarcinogens was calculated as 2.4×10^{-5}. The total dose to the worker was calculated to be 1.1×10^{3} millirem, which would produce an incremental risk of 3.1×10^{-4}. The total dose to the worker transporting the waste was calculated to be 160 millirem, producing an incremental risk of 4.5×10^{-5}. TC

Potential Impacts (Other Than Releases)

This closure action at the H-Area seepage basins is expected to have similar effects on biological resources as discussed in Sections F.2.14.1 and F.2.18.3 and would eliminate the potential impacts of bioaccumulation. TE

F.2.15 H-AREA SEEPAGE BASIN, BUILDING 904-45G

This seepage basin is discussed in conjunction with the other H-Area seepage basins in Section F.2.14.

F.2.16 H-AREA SEEPAGE BASIN, BUILDING 904-46G

This seepage basin is discussed in conjunction with the other H-Area seepage basins in Section F.2.14.

F.2.17 H-AREA SEEPAGE BASIN, BUILDING 904-56G

This seepage basin is discussed in conjunction with the other H-Area seepage basins in Section F.2.14.

F.2.18 POTENTIAL IMPACTS ON BIOLOGICAL RESOURCES IN F- AND H-AREA

This section discusses those generic impacts related to aquatic and terrestrial ecology, as well as endangered species and wetlands for each closure and remedial action. Discussions of site-specific data are given in the appropriate section above. TE

There are 17 waste sites located within F- and H-Area. The F-Area acid/caustic basin is abandoned in place and is a wet-weather pond, as are the H-Area acid/caustic basin, the H-Area retention basin, the old F-Area seepage basin, and one of the H-Area seepage basins. Three F-Area seepage basins, three H-Area seepage basins, and the new radioactive waste burial ground (which includes the mixed waste management facility) are active waste sites. The four remaining sites, the two F-Area burning/rubble pits, the F-Area retention basin, and the old radioactive waste burial ground are backfilled or covered with soil.

F.2.18.1 Assessment of No Action (No Removal of Waste and No Remedial or Closure Action)

Aquatic Ecology

TE TC Impacts of no action on aquatic ecosystems could result from wastes entering the groundwater and subsequently outcropping to either Upper Three Runs Creek or Four Mile Creek. Table F-17 lists those contaminants identified in groundwater monitoring wells at the F- and H-Area waste sites not modeled TE using PATHRAE analyses which exceed EPA water quality criteria for aquatic life. A waste is listed in Table F-17 if the highest average measured value in any well exceeded the criterion. Since groundwater concentrations would be diluted upon entering the receiving water body, a dilution factor is also given in the table. In most cases the diluted concentrations were below the criteria, with the exception of gross alpha in the F-Area seepage basin and zinc, gross alpha, and gross beta in the H-Area seepage basin. These exceptions are discussed separately above in the appropriate sections.

Terrestrial Ecology

Potential terrestrial impacts for the waste sites of F- and H-Areas include exposure of wildlife and vegetation to surface waters within these sites and the toxic effects on vegetation of soils containing waste materials. The terrestrial impacts of those waste sites with standing surface waters and soils containing waste materials are discussed on an individual basis in previous sections.

Endangered Species

TC As indicated in Table F-17, no endangered species are known to reside in the vicinity of the F- and H-Area waste sites. Bald eagles have been sighted in flight near the H-Area waste sites, but this species should not be affected by TE no action. The waste sites, some of which are active, are all located near active facilities; as such, they represent highly disturbed habitats. The area is, therefore, not suitable for any of the endangered species known to occur on the Savannah River Plant. No action would have no impact on endangered species.

Wetlands

Wetlands are found within 1000 meters of each of the F- and H-Area waste sites, and as close as 100 meters from the H-Area seepage basins. Information on these wetlands is presented in Table F-17. Most wetlands are found along Four Mile Creek and its unnamed tributaries, and are more than 400 meters from the waste sites. No action would cause no impacts to wetlands other than those that may be occurring now. There are no surface discharges to wetlands, and no action would not result in any. TE

F.2.18.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Aquatic Resources

No removal of waste and implementation of cost-effective remedial and closure actions at the F- and H-Area waste sites would not cause additional adverse impacts on aquatic ecological resources. Erosion and sedimentation control measures would eliminate the potential for increased sedimentation. Where closure would eliminate open water at waste sites, no adverse effects to aquatic or semiaquatic organisms resulting from use of the open water areas would occur.

Terrestrial Resources

Closure would have no adverse impact on terrestrial ecological resources at the F- and H-Area waste sites. All of the sites are highly disturbed and closely associated with active operations areas, thus providing little or no habitat for terrestrial species. Construction activities associated with closure would not result, therefore, in significant impacts. Where closure would eliminate open water, adverse effects on wildlife resulting from use of the open-water areas would not occur. TE TE

Roots of deep-rooted plants could eventually penetrate the contaminant zone for sites if a low-permeability cap was used, thereby releasing wastes to the environment. However, site maintenance by mowing during the period of institutional control would prevent this potential impact.

Endangered Species

Closure would result in further disturbance of areas that are already highly disturbed and unsuitable as habitat for endangered species known to occur on the Savannah River Plant. With the exception of bald eagles, which have been observed in flight near H-Area, no endangered species are known to exist in the vicinity of F- and H-Area waste sites. Closure would have no significant impact on endangered species, although construction disturbance could temporarily discourage eagles from flying over a site undergoing cleanup. TE

Wetlands

As described in Section F.2.18.1, wetlands are found within 1000 meters of each of the F- and H-Area waste sites. Closure would cause no impacts on wetlands because they would not be disturbed by the action. The potential for increased sedimentation exists but would be checked by erosion and sedimentation control measures. TE

F.2.18.3 Assessment of Removal of Waste to the Extent Practicable and Implementation of Cost-Effective Remedial and Closure Actions as Required

Aquatic Ecology

TE In addition to wastewater removal and treatment, this action includes removal of contaminated waste material, sediment, and soil from the waste sites. Closure would be accomplished by backfilling and installation of a TE low-permeability cap, eliminating the sources of contamination, and causing no additional adverse impacts to aquatic ecological resources. Closure of the waste site would eliminate adverse effects on organisms resulting from the use of open-water areas at the waste site.

Terrestrial Ecology, Endangered Species, and Wetlands

TE For the reasons described in Section F.2.18.2, there are no adverse impacts on terrestrial resources, endangered species, or wetlands.

F.3 ASSESSMENT OF ACTIONS AT R-AREA WASTE SITES

This geographic grouping is approximately 6 kilometers east of H-Area. As shown on Figure F-6, it contains R-Reactor and waste sites that are typical of the SRP reactor areas.

Sections F.3.1 through F.3.12 contain or reference the section that contains a discussion of sites 3-1 through 3-12. Section F.3.13 discusses biological impacts that are generically applicable to the waste sites in this geographic grouping.

F.3.1 R-AREA BURNING/RUBBLE PIT, BUILDING 131-R

This burning/rubble pit is discussed in conjunction with the other burning/rubble pits in Section F.1.6. The ecological effects of this site that relate to the R-Area geographic grouping are discussed in Section F.3.13.

F.3.2 R-AREA BURNING/RUBBLE PIT, BUILDING 131-1R

This burning/rubble pit is discussed in conjunction with the other burning/rubble pits in Section F.1.6. The ecological effects of this site that relate to the R-Area geographic grouping are discussed in Section F.3.13.

F.3.3 R-AREA ACID/CAUSTIC BASIN, BUILDING 904-77G

This acid/caustic basin is discussed in conjunction with the other acid/caustic basins in Section F.2.1. The ecological effects of this site that relate to the R-Area geographic grouping are discussed in Section F.3.13.

F.3.4 R-AREA BINGHAM PUMP OUTAGE PITS*

There are a total of seven Bingham pump outage pits located in four reactor areas:

Area	Building	Area	Building
R	643-8G	L	643-2G
R	643-9G	L	643-3G
R	643-10G	P	643-4G
K	643-1G		

The actions described in this section would be applicable to each of these outage pits.

Because the L-Area pits are situated closer to surface and subsurface waters, the total environmental releases and resulting impacts from the two L-Area pits would be greater than from the pits in the other areas. For this reason, the Bingham pump outage pits in the L-Area were chosen for detailed transport and pathway modeling and risk analysis. Environmental impacts associated with the L-Area outage pits are presented in this section. For purposes of this EIS, the total impacts from the pits in each reactor area are assumed to be the same as the total impacts from the two L-Area outage pits.

F.3.4.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

The Bingham pump outage pits are currently receiving minimum control or upkeep. Annual inspections are made for signs of soil subsidence. Any sunken areas would be filled as required. Radiation surveys have revealed slightly elevated although very low concentrations of radioactivity in vegetation above the outage pits. The natural growth of trees around and onto the site has continued since 1958 and would be permitted to do so under this closure action. Under no action, at least four groundwater monitoring wells would be installed and groundwater monitoring would be conducted quarterly for 1 year and then annually for 29 years. Site maintenance would be continued for the entire 30-year period.

TC

TC

Comparison of Expected Environmental Releases with Applicable Standards

The two L-Area outage pits' contents were combined to define a single effective pit. All environmental releases are projected to be below applicable standards for no action.

TE

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 Pekkala, Jewell, Holmes, and Marine, 1987a.

Surface-water quality would not be significantly affected by the addition of potential contaminants from the groundwater pathway from this site. The resulting concentrations of constituents in Pen Branch, calculated from the L-Area Bingham pump outage pits, are projected to be below drinking-water standards. TE

No radionuclides would be released to the atmosphere, because the pits have all been backfilled.

Potential Impacts (Other Than Releases)

The maximum annual doses resulting from the reclaimed farm and direct gamma exposure pathways occur 100 years from the present. The doses would only be 6.9×10^{-3} and 6.8×10^{-4} millirem per year for the farm and direct gamma pathways, respectively. The dose would be zero for the pathway involving consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments, due to the assumed limited plant-root depth.

Section F.3.13.1 describes impacts to ecological resources from no action that could affect aquatic resources as a result of wastes entering the groundwater with subsequent outcrop to Par Pond. No groundwater monitoring data are available for the R-Area Bingham pump outage pits. PATHRAE analysis and simple dilution modeling performed on the two L-Area Bingham pump outage pits are considered to be representative of other pump outage pits. The levels of groundwater outcrop contamination predicted by PATHRAE and dilution modeling are ecologically insignificant for all closure actions, indicating no potential for adverse effects on the aquatic biota or adjacent wetlands and no adverse effects on wildlife that consume the undiluted groundwater at the outcrop. TE TE

Based on the small amounts of radioactivity disposed of at the outage pits, any terrestrial impacts should be negligible for all closure actions. The levels of radioactivity in the vegetation growing above the outage pits are ecologically insignificant, although these levels are slightly elevated in comparison to the vegetation growing at the SRP perimeter. Because of the depth at which the waste is buried (4 meters), any effects via the biointrusion pathway should be negligible. TE

F.3.4.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

Because of the small amount of radioactivity buried at the Bingham pump outage pits, no activities would be needed other than site surveillance and groundwater monitoring, as described for no action.

Comparison of Expected Environmental Releases with Applicable Standards

All PATHRAE-modeled environmental releases are projected to be below applicable standards for closure. Because no-waste-removal-and-closure action would be the same as those for no-action, Section F.3.4.1 applies here. TE

Potential Impacts (Other Than Releases)

TE Because no action is the same as the no-waste-removal-and-closure action for the Bingham pump outage pits, Section F.3.4.1 also applies here.

As described in Sections F.3.4.1 and F.3.13.2, no significant adverse impacts
TE to biological resources are expected as a result of closures at the R-Area Bingham pump outage pit (643-8G).

F.3.4.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE In the waste removal and closure action, the earthen cover would be removed from each waste site and retained for later use as backfill. The solid radioactive waste and surrounding soil would be excavated 0.3 meter below the original bottom of the outage pit. This excavation should reduce the residual contamination in the soil beneath the outage pit to near-background levels, so that no restrictions on site use would be needed after the pit was backfilled with clean soil, compacted, graded, and seeded for erosion control. Surveys would be made of the basin floor for residual radioactive contamination; the results might require additional excavation below the 0.3-meter depth in order to achieve acceptable results.

A total of approximately 27,000 cubic meters of exhumed waste would be exca-
TE vated from the pits and placed in metal boxes or bagged as necessary and trucked to a waste storage/disposal facility. The bulky components of the waste (ladders, concrete, drums, pallets, piping, etc.) would require special
TE care and equipment for exhumation, packaging, transport, and placement in the storage/disposal facility.

The corners of each closed outage pit would be marked with identification pylons. Should soil analyses show that elevated concentrations of waste remain in the soil after excavation, four groundwater monitoring wells (one upgradient, three downgradient) would be installed around the outage pits in each of the four areas. Groundwater would be monitored quarterly for 1 year and then annually for 29 years. Site surveillance would be maintained and vegetative growth above the waste sites would be controlled.

Comparison of Expected Environmental Releases with Applicable Standards

All environmental releases are projected to be below applicable standards for closure.

The PATHRAE model 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.

Surface-water quality would not be significantly affected by the addition of potential contaminants from the groundwater pathway from this site. The resulting concentrations of constituents in Pen Branch, calculated from the L-Area Bingham pump outage pits, are projected to be below drinking-water standards. TE

Radionuclide releases to the atmosphere would take place only during the time that waste is being removed from the outage pits.

The annual dose to an individual resulting from the release of these radionuclides to the atmosphere would be only 1.92×10^{-5} percent of the 25 millirem per year DOE limit. The risk associated with this dose would be 1.34×10^{-12}.

An analysis of the average individual worker health risks 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 2.4 millirem, which would produce an incremental risk of 6.7×10^{-7}. The total dose to the worker transporting the waste was calculated as 1.2 millirem, producing an incremental risk of 3.4×10^{-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 dose would be 1.4×10^{-8} millirem per year for the farm pathway. The dose from the direct gamma exposure would be *essentially zero* ($\sim 10^{-20}$ millirem per year). The dose would be zero for the pathway which involves consumption of crops potentially contaminated as a result of biointrusion of subsurface sediments. Such contamination is precluded due to the assumed limited plant-root depth. TC

For the reasons described in Sections F.3.4.1 and F.3.13.3, no adverse impacts on biological resources are expected as a result of closure at the R-Area Bingham pump outage pit (643-8G).

F.3.5 R-AREA BINGHAM PUMP OUTAGE PIT, BUILDING 643-9G

Potential impacts for this outage pit are discussed in conjunction with the other Bingham pump outage pits in Section F.3.4.

F.3.6 R-AREA BINGHAM PUMP OUTAGE PIT, BUILDING 643-10G

Potential impacts for this outage pit are discussed in conjunction with the other Bingham pump outage pits in Section F.3.4.

F.3.7 R-AREA REACTOR SEEPAGE BASINS*

The R-Area reactor seepage basins consist of six sites (904-103G, 904-104G, 904-57G, 904-58G, 904-59G, and 904-60G). Purge water from the disassembly basins in the reactor building was pumped to the seepage basins from the late

*The reference source of the information in this section is Pekkala, Jewell, Holmes, and Marine, 1987b.

1950s until 1964. The seepage basins have been inactive since 1964 and were backfilled. R-Area basins are contiguous; therefore, they are considered as one site for evaluation and assessment analyses. The surface stream nearest to these R-Area basins is Mill Creek. No hazardous chemical constituents are believed to have been discharged to these basins.

F.3.7.1 Assessment of No Action (No Removal of Waste, and No Remedial or Closure Actions)

Description of Action

The R-Area seepage basins are currently backfilled and receive only minimal upkeep. Radiation surveys are conducted periodically, and herbicide or asphaltic covering is applied infrequently. However, groundwater is extensively monitored for radioactive contamination. Under no action, those activities would be continued, with quarterly groundwater monitoring for 1
TC year and annual monitoring for 29 years. Pylons would be installed to identify the corners of the backfilled basins, and vegetative growth would be controlled and surveyed periodically for radiation.

Comparison of Expected Environmental Releases with Applicable Standards

The regulatory standards and measured or estimated maximum concentrations of constituents which are of concern for regulatory requirements or health risk are presented in Table F-18. Most maximum concentrations are based on PATHRAE modeling, either because no measured values were available or because the calculated concentration was greater than that of the measured concentration.

The maximum estimated concentrations presented in Table F-18 correspond to the calculated peaks. In most cases these peaks occurred prior to the base year. Although the site is not receiving wastes presently, the peak concentrations, in the absence of base year (0 year) concentrations, would conservatively serve as the design basis of the remedial actions. Table F-18 indicates that concentrations of cesium-137, tritium, strontium-90, and yttrium-90 are estimated to exceed the standards at the 1-meter well. Cesium-137 and tritium would exceed standards at the 100-meter well.

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

The annual dose and associated risks to an individual resulting from the atmospheric radionuclide releases for the no-action alternative would be
TC negligible when compared to the DOE limit of 25 millirem per year. The dose to the maximum individual would be 4.1×10^{-9} millirem; the risk associated with this dose is 1.2×10^{-25}.

Potential Impacts (Other Than Releases)

The doses resulting from the erosion and biointrusion pathways were all zero. The maximum annual doses for the reclaimed farm pathway and the direct gamma exposure pathway are calculated as 4.5 and 2.3×10^{-6} millirem per year, respectively.

Section F.3.13.1 describes impacts to ecological resources from no action. Potential impacts resulting from no action at the R-Area seepage basin (904-57G) are expected to be similar to those described in Section F.3.13.1. PATHRAE analysis and simple dilution modeling based on radionuclide inventories for the R-Area seepage basins indicate that stream concentrations after mixing would remain within water quality guidelines for all closure actions for all years.

Based on available data, limited terrestrial impacts are expected at the R-Area seepage basins under no action via the biointrusion pathway. The soil concentrations for strontium-90 and cesium-137 exceed DOE's Threshold Guidance Levels criteria by factors of about 1200 and 73,000, respectively. Because these soil criteria are based on human health concerns, they are conservative. Terrestrial effects under no action would be limited to the general area of the waste site (approximately 5.5 acres) and would be mitigated by the depth of the existing backfill (3 to 5 meters).

F.3.7.2 Assessment of No Removal of Waste and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

In the no-removal-and-closure action, no contaminated soil would be removed. However, the surface soil over the 27-acre area shown in Figure F-7 would be removed down to approximately 1 or 2 meters below the original ground surface. The area of removal would include the six basins, the contaminated section of the abandoned sewer, and major areas of groundwater contamination. A low-permeability infiltration barrier cap would then be installed over this area (Figure F-2). The capped site would be graded and seeded for erosion control, and culverts or equivalent structures would be installed around the site to receive surface and subsurface drainage. The culverts would discharge into natural drainages to Mill Creek. Site maintenance, groundwater monitoring, placement of identification pylons, and radiation surveys would be carried out as described above.

Source control and groundwater cleanup might be required for no waste removal. It can be seen from the estimated concentrations presented in Table F-18 that the concentrations in groundwater of tritium, cesium-137, strontium-90, and yttrium-90 would exceed the applicable radionuclide concentration standards. One of the possible corrective actions would be to pump the water from groundwater extraction wells and treat it further. The selection of an action plan would be based on site-specific studies and interaction with the regulatory agencies concerned. Treatment technologies are discussed in Appendix C.

Comparison of Expected Environmental Releases with Applicable Standards

The implementation of this closure remedial action would reduce all environmental releases to below MCLs or ACLs. Radionuclides would be removed from the groundwater to below applicable standards (see Table F-18). All other environmental releases are projected to be below regulatory concern.

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 Mill Creek are projected to be below drinking-water standards.

No radionuclides would be released to the atmosphere and individual doses would be zero.

Potential Impacts (Other Than Releases)

The doses due to erosion and biointrusion would all be zero. The calculated doses for the reclaimed farm pathway and direct gamma exposure would be 8.1 x 10^{-4} and 2.4 x 10^{-10} millirem per year, respectively. TC

Closure would be accomplished with a low-permeability cap covering a total of 27.2 acres. While this is a relatively large area, it is adjacent to operations areas and is not habitat for terrestrial species. Also, because erosion and sedimentation measures would be used, no adverse impacts on terrestrial ecological resources are expected as a result of this closure action at the R-Area seepage basins. Terrestrial impacts from biointrusion would be mitigated by the depth of the backfill and the installation of the infiltration barrier, and would be limited to the general area of the waste site. Other ecological impacts would be similar to those discussed in Section F.3.13.2.

F.3.7.3 Assessment of Removal of Waste to the Extent Practicable, and Implementation of Cost-Effective Remedial and Closure Actions as Required

Description of Action

TE In the waste-removal-and-closure action, each of the six backfilled basins in R-Area would be excavated to remove contaminated soil indicated by the zone of elevated dose rates shown in Figure F-8. The thickness of the radioactive zone and the amount of contaminated soil expected to be recovered are shown in Table F-19. During the waste recovery phase, contaminated sections of the abandoned construction sewer would be removed and associated contaminated soil would be recovered. After excavation, each basin would be backfilled with compacted clean soil to approximately 1 or 2 meters below the original ground surface.

The contaminated soil recovered during the excavation phase (7080 cubic meters) would be packaged in metal containers and trucked to a waste storage/ disposal facility at the SRP. TE

Following the recovery of contaminated soil, the remaining surface soil over the 27-acre area shown in Figure F-7 would be removed down to the datum plane identified above. This area includes the six basins, the contaminated section of the abandoned sewer, and major areas of groundwater contamination. A low-permeability infiltration barrier would then be installed over the 27-acre area. About 7000 cubic meters of clean backfill would be required in addition to the clean soil excavated. The capped site would be graded and seeded for erosion control, and culverts or equivalent structures would be installed around the site to receive surface and subsurface drainage. The culverts would discharge into natural drainages to Mill Creek. TE

Table F-19. Volume of Radioactive Soil To Be Excavated at the R-Area Reactor Seepage Basins in the Waste Removal and Closure Action

Site	Building	Thickness of Contamination (m)	Contaminated Soil (m^3)
Basin 1	904-103G	1.8	1630
2	904-104G	1.5	1080
3	904-57G	1.2	710
4	904-58G	1.2	560
5	904-59G	1.2	1090
6	904-60G	1.2	1590
Abandoned sewer		0.6	420
		Total	7080

Groundwater monitoring wells at selected locations that would be removed during installation of the infiltration barrier would be replaced and groundwater monitoring would be continued, quarterly for 1 year and then annually for 29 years. Pylons would be installed to identify the corners of the previous basins, and vegetative growth would be surveyed periodically and controlled to protect the infiltration barrier.

Remedial action may be required since PATHRAE modeling predicts that the concentrations in groundwater of tritium, cesium-137, and strontium-90 would exceed the recommended radionuclide concentration standards (see Table F-18). The potential remedial action would be similar to that discussed in Section F.3.7.2. Final selection of an action would be based on site-specific studies and interactions with regulatory agencies.

Comparison of Expected Environmental Releases with Applicable Standards

The regulatory standards and measured or estimated maximum concentrations of all contaminants of concern from a regulatory and health risk viewpoint are presented in Table F-18 for waste removal and closure without further remedial action. By comparison with waste removal and closure (see Table F-18), the extent and concentration of groundwater contamination by strontium-90 and yttrium-90 would be significantly reduced as a result of the waste removal. For example, the peak concentrations of strontium-90 and yttrium-90 would be reduced by a factor of 100 at the 1-meter well, with yttrium-90 reduced to below its regulatory standard. However, modeling predicts that cesium-137, tritium, and strontium-90 concentrations have exceeded or will exceed the standard; therefore, remedial action might be required.

The implementation of this closure/remedial action would reduce all environmental releases to below MCLs or ACLs. Radionuclides would be removed from the groundwater to below applicable standards (see Table F-18). All other environmental releases are projected to be below regulatory concern.

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

Radionuclides would be released to the atmosphere during the first year only for this action. | TE

The total annual maximum individual dose due to atmospheric releases would be less than 0.022 percent of the DOE limit of 25 millirem per year. The risk associated with this dose would be 1.6×10^{-9} or less. | TC

An analysis of the average individual worker health risks 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 4200 millirem, which would produce an incremental risk of 1.2×10^{-3}. The total dose to the worker transporting the waste was calculated as 300 millirem, producing an incremental risk of 8.4×10^{-5}. | TC

Potential Impacts (Other Than Releases)

The doses due to erosion and biointrusion would all be zero. The calculated doses for the reclaimed farm pathway and direct gamma exposure doses would be negligible.

For the reasons described in Sections F.3.7.1 and F.3.13.3, no adverse impacts on aquatic or terrestrial resources, endangered species, or wetlands are expected as a result of this closure action at the R-Area seepage basins.

F.3.8 R-AREA REACTOR SEEPAGE BASIN, BUILDING 904-58G (BASIN 4) | TE

This waste site is discussed in conjunction with the other R-Area seepage basins in Section F.3.7.

F.3.9 R-AREA REACTOR SEEPAGE BASIN, BUILDING 904-59G (BASIN 5) | TE

This waste site is discussed in conjunction with the other R-Area seepage basins in Section F.3.7.

F.3.10 R-AREA REACTOR SEEPAGE BASIN, BUILDING 904-60G (BASIN 6) | TE

This waste site is discussed in conjunction with the other R-Area seepage basins in Section F.3.7.

F.3.11 R-AREA REACTOR SEEPAGE BASIN, BUILDING 904-103G (BASIN 1)

This waste site is discussed in conjunction with the other R-Area seepage basins in Section F.3.7.

F.3.12 R-AREA REACTOR SEEPAGE BASIN, BUILDING 904-104G (BASIN 2)

This waste site is discussed in conjunction with the other R-Area seepage basins in Section F.3.7.