WETLAND ASSESSMENT FOR THE F- AND H-AREA GROUNDWATER REMEDIATION PROJECT AT THE SAVANNAH RIVER SITE

MARCH 2004

U. S. DEPARTMENT OF ENERGY
SAVANNAH RIVER OPERATIONS OFFICE
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LIST OF ABBREVIATIONS/ACRONYMS

The following is an alphabetized list of the abbreviations and acronyms found within the text of this document:

CAB	-	Citizen's Advisory Board
CFR	-	Code of Federal Regulations
DOE	-	U.S. Department of Energy
DOE-SR	-	DOE Savannah River Operations Office
EIS	-	environmental impact statement
GWPS	-	Groundwater Protection Standard
HWMF	-	Hazardous Waste Management Facility
MWMF	-	Mixed Waste Management Facility
NEPA	-	National Environmental Policy Act
pH	-	potential of hydrogen (acidity-alkalinity scale)
RCRA	-	Resource Conservation and Recovery Act
spp.	-	species
SRS	-	Savannah River Site
USACE	-	U.S. Army Corps of Engineers
WSRC	-	Westinghouse Savannah River Company

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) has prepared this wetland assessment in compliance with DOE requirements (10 CFR Part 1022) for the floodplain and wetland environmental review of the proposed F- and H-Area Groundwater Remediation Project at the Savannah River Site (SRS), located near Aiken, South Carolina (Figure 1-1). DOE is proposing to install underground barrier wall/base injection systems to replace the pump/treat/reinjection systems previously used to remediate the contaminated groundwater associated with the closed F- and H-Area Seepage Basins at SRS. The purpose of these proposed actions is to provide remediation systems that are more passive and more technically feasible than the existing systems, while still meeting the Resource Conservation and Recovery Act (RCRA) permit goals (reduction in the contaminant releases to Fourmile Branch). Both the project sites and the proposed remediation technology were addressed in the environmental impact statement (EIS) "Waste Management Activities for Groundwater Protection" (DOE 1987).

The groundwater from these RCRA-permitted remediation systems outcrops at the seeplines downgradient of both the existing and proposed system locations. This groundwater discharge determines the size and location of a series of slope wetlands associated with the Fourmile Branch drainage corridor (Figure 1-2). Installation of the proposed corrective action systems may affect the volume and location of the outcropped discharge, and therefore the size and/or location of these slope wetlands. In accordance with DOE regulations, DOE has prepared this wetland assessment to evaluate the potential wetland impacts of these proposed actions.

2.0 BACKGROUND

Radioactive materials previously deposited in the F- and H-Area Seepage Basins have continued to migrate via the groundwater and outcrop into Fourmile Branch. The areas around these two facilities, also known as the F- and H-Area Hazardous Waste Management Facilities (HWMF), have been undergoing extensive groundwater monitoring and remediation programs associated with RCRA since the early 1990s. The main contaminants of concern at the F- and H-Area HWMFs are tritium, metals and other radionuclides.

The Phase I RCRA remediation systems at the F- and H-Area HWMFs were designed to intercept and extract contaminated groundwater, treat most of the contaminants through physical and chemical processes (except tritium), and re-inject the tritiated effluent into the shallow aquifer upgradient of the plume. Re-injection of the tritiated water was intended to provide a longer flow path for tritium in the subsurface, allow for radioactive decay (the half-life of tritium is approximately 12 years), and thus minimize the number of curies of tritium that discharge to surface water.

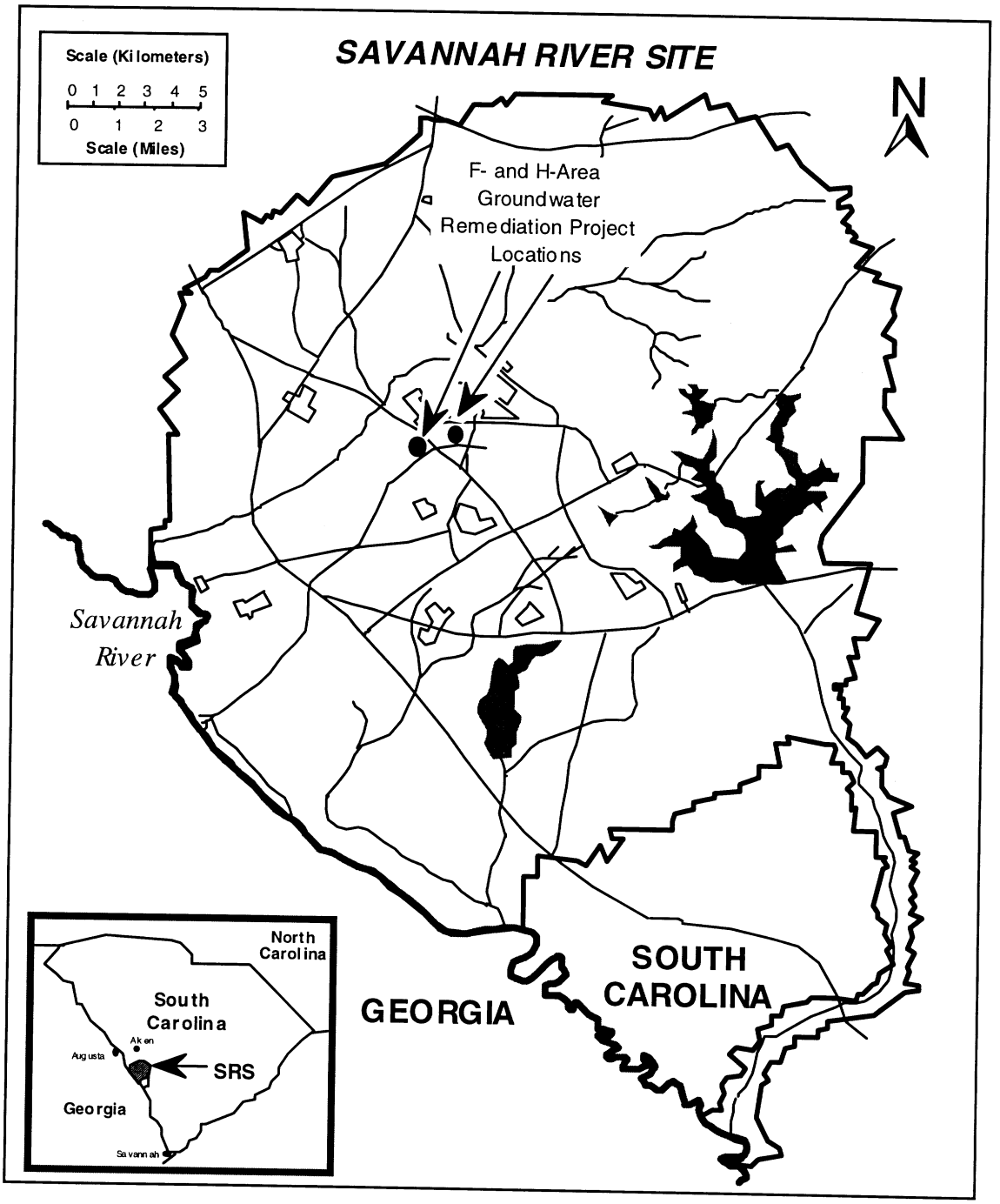

Figure 1-1. F-and H-Area Groundwater Remediation Project locations at the Savannah River Site, South Carolina.

At the F-Area HWMF, the majority of the groundwater contamination is present in the aquifer within localized structural depressions on the top of an impermeable natural geologic barrier referred to as the Tan Clay confining layer. This contamination is discharging to Fourmile Branch through troughs connecting the depressions to the creek. In addition, it has been

determined that the transport of metals and metallic radionuclides is principally controlled by acidic conditions in the groundwater. Acid conditions in the groundwater are the result of acid discharges from the seepage basins. The groundwater contamination at the H-Area HWMF is less widespread and severe than at the other facility. However, as in the other project location, the majority of the contamination seems to discharge toward Fourmile Branch through a shallow depression in the Tan Clay confining layer.

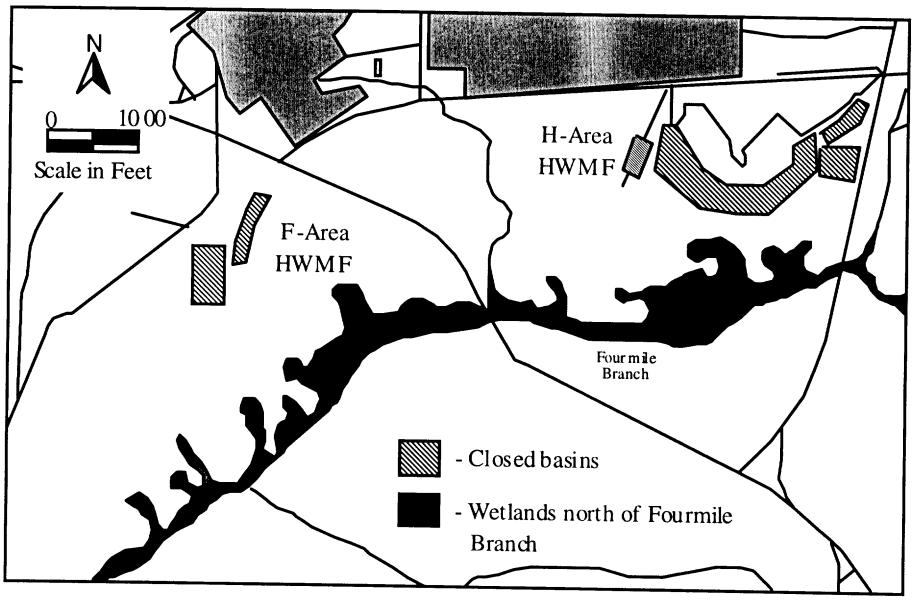

Figure 1-2. Location of the two project sites and the downgradient wetlands associated with the Fourmile Branch drainage corridor. Wetland areas south of Fourmile Branch are not depicted.

DOE has determined that operation of the Phase I pump/treat/reinjection systems was not compatible with the containment approach in limiting the transport of contaminants to the creek and would not support reaching the RCRA permit goals. The Phase I pump/treat/reinjection systems operation appeared to be spreading and mobilizing contaminants (RCRA metals and metallic radionuclides) and had not had a significant influence on the contaminant influx into Fourmile Branch. For these reasons, operation of the Phase I pump/treat/reinjection systems were suspended in October 2003 with South Carolina Department of Health and Environmental Control approval. The Phase 2a goal is a 70 percent reduction in tritium outcropping to Fourmile Branch and a reduction of other contaminants to the Groundwater Protection Standard (GWPS) within five years of the corrective action plan approval. The Phase 2b goal is to reduce contaminant concentrations to below GWPS at the seeplines by 2010.

3.0 PROJECT DESCRIPTION

The proposed Phase 2 action entails the following: (1) install an underground barrier system across the geologic troughs to contain the residual highly contaminated secondary source term,

and (2) install a base injection system between the barrier walls at F Area to immobilize the metals. These underground systems would entail a series of barrier walls (funnels) and openings (gates) that would both contain and direct the underground discharge.

F-Area HWMF – One funnel-gate system, approximately 1,250 feet in length would be constructed downgradient of the F-Area Seepage Basins (Figure 3-1). This would entail three barrier walls or funnels installed at depths up to 60 feet. The barriers would be located in the troughs of the Tan Clay confining layer. The two gates will be constructed within the aquifer where the underlying Tan Clay confining layer represents topographic highs. Base injection solutions will be injected into the aquifer in the gate areas. The basic solutions will neutralize the acidic groundwater and will immobilize metals and metallic radionuclides.

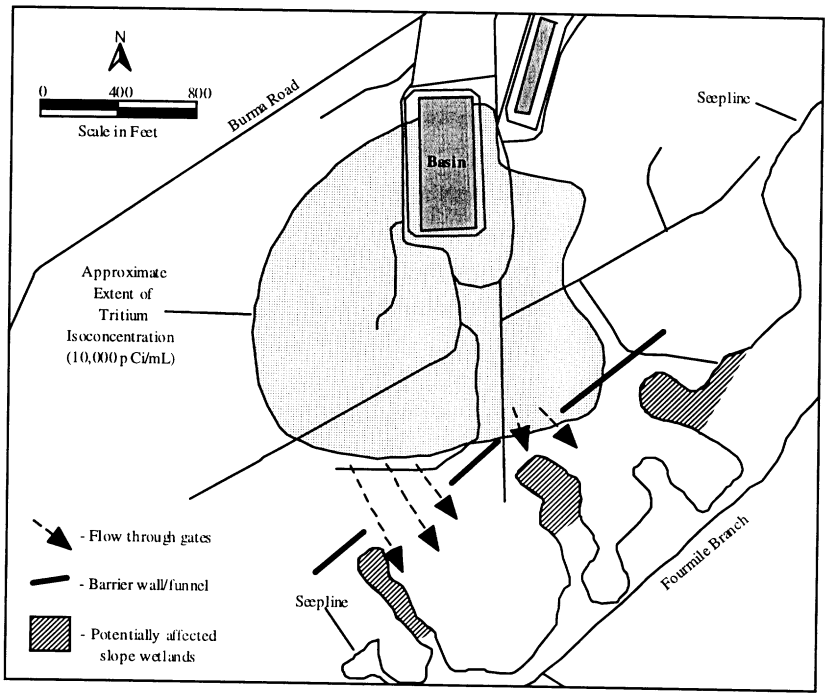

Figure 3-1. Location of the funnel-gate system at the F-Area HWMF.

The funnel-gate system would be located to intercept the highest concentrations of contamination originating from the F-Area HWMF. There are three linear troughs in the Tan Clay confining layer that coincide with local gullies in the surface topography. These troughs crop out at the seepline and correspond to the locations of "tree kill zones" and locations where groundwater with high tritium concentrations and low pH discharges to the seepline. Approximately 80 percent of the tritium outcropping at the seepline is discharged through these troughs and into the tree kill zones. Groundwater flow through the gates would allow continued flow to the seepline. The currently highly acidic water and high concentrations of metals should be significantly reduced due to the effect of the barrier and treatment (base injection at the gates). The base injection wells would use technology tested and demonstrated during pilot testing. The base solution injected will consist of sodium bicarbonate (baking soda) mixed with sodium hydroxide. Monitoring would be performed to assure groundwater pH in the area being treated is maintained

at or near natural values of 5.0-6.0. Base injection is currently underway for pretreatment of the funnel locations, under a RCRA temporary authorization.

H-Area HWMF – Two barrier walls would be constructed: one upgradient of the closed basin, and one along the downgradient side of the basin (Figure 3-2). These barriers would extend into the top of the Tan Clay confining layer. Approximately 2,500 feet of barrier wall would be required. The necessary installation depths would be up to 85 feet. The top of the barrier wall would be located below grade.

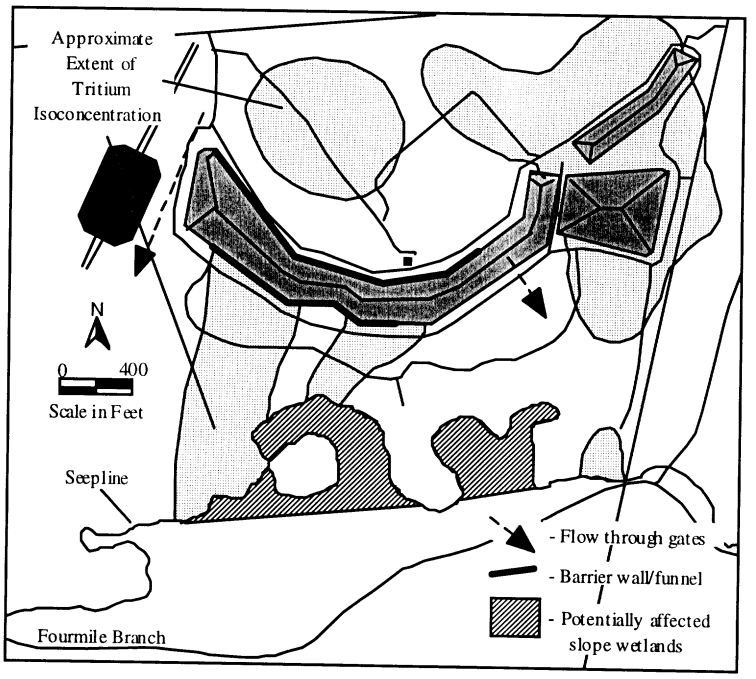

Figure 3-2. Location of the barrier wall system at the H-Area HWMF.

This area of the H-Area HWMF has been targeted because it has the highest plume concentrations and is in the location where the contamination in the soil may be leaching and contributing to groundwater contamination. Because the plume area that is to be impacted by the barrier is rather small, and the groundwater is only moderately acidified, base injection is not planned for the H-Area Seepage Basin at this time. The H-Area basins were covered in 1991 with a low permeability multi-layer cap that controls infiltration of rainwater, most of which is diverted off of these units. Since there is no aquifer recharge under the cap, the barriers would contain the groundwater under the basin. The barriers would decrease the hydraulic gradient of the water table in the vicinity of the basin, thus slowing flow velocity in the groundwater. This would increase the residence time of the contaminants in the aquifer. For radionuclides with short half-lives, such as tritium, increased residence time would allow for greater radioactive decay. For the RCRA metals and radioactive metal contaminants, increased residence time allows greater potential for retardation through interactions with aquifer materials. In addition to containing groundwater contamination between the barriers, the barriers would redirect groundwater flow around the H-4 basin, thus reducing the flow through contaminated soils under

the basin and associated spreading of contamination. These barriers would further increase the protectiveness of the existing low permeability cap. A groundwater monitoring program would also be implemented to evaluate the effectiveness of the remediation plan.

4.0 EFFECT ON WETLANDS

The proposed underground funnel-gate/base injection system would be installed in a portion of the Fourmile Branch watershed. The project location is not within the 100-year floodplain, but does contain jurisdictional wetlands that would likely be impacted by the project. Two separate installations of barrier walls, one in the F-Area HWMF and one in the H-Area HWMF, are planned as described in Section 3.0. The jurisdictional wetlands boundaries associated with both HWMFs were delineated in 1993. That delineation is being used as the baseline starting boundary for this project. That boundary was established using procedures outlined in the 1987 *Corps of Engineers Wetlands Delineation Manual* (USACE 1987).

The soils within the project are mapped as several soil series. The walls themselves are being installed in Udorthents in the H-Area HWMF and in Dothan and Troup sands in the F-Area HWMF. Series encountered moving down slope from the walls are Dothan, Wagram and Vaucluse sands in H Area and Fuquay, Troup, and Blanton sands in F Area. Wetlands near the projects that may be impacted are mapped as Fluvaquents and Pickney, both of which are on the SRS hydric soils list (Rogers 1990).

The wetlands which may be impacted are classified as slope wetlands within the terminology of the hydrogeomorphic method of wetland classification. The hydrology of these wetlands is predominantly supplied through groundwater emergence into the soil profile and by rainfall. Interruption of the continuous groundwater movement to the surface along the wetland boundary by placement of a barrier wall will likely cause alteration of the wetlands below the project sites.

The habitat down slope from the projects towards the wetland boundaries is dominated by planted loblolly pine (*Pinus taeda*) and mixed pine-hardwood stands. Hardwoods in the mixed stands include sweetgum (*Liquidambar styraciflua*), blackjack oak (*Quercus marilandica*), turkey oak (*Q. laevis*), dogwood (*Cornus* spp.), and American holly (*Ilex opaca*). Very little understory or shrub layer is present in this habitat, and generally represents reproduction of the overstory species. The habitat is fairly xeric, as inferred by the well drained soil series present and the species composition.

The habitat type within the wetland areas is predominantly a mixed hardwood, bottomland forest occupying a mesic headwater drainage basin. Because of the length of the wetland boundary involved, a general description characteristic of the wetland community is provided. Predominant overstory species within the wetlands include loblolly pine, sweetgum, yellow poplar (*Lireodendron tulipifera*), laurel oak (*Quercus laurifolia*), and hickory (*Carya* spp.). Other components encountered in the wetlands below the projects include sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), swamp tupelo (*Nyssa sylvatica* var. *biflora*), and water oak (*Q. nigra*). The mid-story component in these areas includes reproduction of the

overstory and also includes American holly, red bay (*Persea borbonia*), and wax myrtle (*Myrica cerifera*). Understory species include seedlings of the previously mentioned species, with areas of jasmine vines (*Gelsemium sempervirens*), blackberry (*Rubus* spp.), and lesser areas of greenbrier (*Smilax* spp.). The herbaceous layer, when present, is dominated by sensitive fern (*Onoclea sensibilis*) and rushes (*Juncus* spp.). The wetlands nearest the project area are characterized by groundwater seeps providing water to a wet bottom. The wetlands transition into the floodplain of Fourmile Branch as they continue down slope. The hydrology supporting this wetland system is provided primarily through groundwater seeps and, to a lesser extent, storm water runoff from the surrounding higher elevation lands.

Small wetland areas within both project boundaries identified as tree kill zones have been previously studied and described (Friday 1997, Nelson 2000). Revegetation of the areas after the initial mortality events and prior to the current remediation program, and the influence of the groundwater extraction and injection remediation program have each been described in other documents. As the water table subsided, vegetation characteristic of drier habitats was beginning to establish itself on these previous wetland areas. Water table subsidence within the wetlands has been influenced by the groundwater pumping operation and a regional drought.

Construction associated with the project is not anticipated to be within the boundaries of the wetlands of Fourmile Branch. No operation of construction equipment in the wetland areas is therefore expected. Short-term impacts in wetland areas are not anticipated. Silt fences and other erosion control structures, as needed, would be installed to ensure no deposition occurs in the wetlands in the down slope areas. Impacts due to erosion would be expected to be small and temporary. An erosion control plan will be developed in accordance with applicable State and local floodplain protection standards and followed to ensure that no additional impacts to wetlands would occur due to erosion and sedimentation. Best management practices would be employed during construction and maintenance activities.

In the F-Area HWMF, placement of the barriers with base injection upgradient of the wetlands is not expected to have an impact greater than the previous pump/treat/reinjection systems (WSRC 2003). Approximately 10,000 linear feet of wetland boundary is potentially within the project impact area. Effects of the previous system and drought on lowering of the groundwater level in the wetlands have been monitored through piezometer installations in the wetlands affected by the original installation and at reference sites near the impact areas (Halverson 2003). Results have routinely indicated that operation of extraction wells are closely tied to groundwater subsidence in the slope wetlands of Fourmile Branch near the remediation project. Evaluation of vegetation in the F-Area tree kill zone indicated that predominantly upland species had begun to revegetate the area due to drier conditions (Nelson 2001).

Installation of the barrier wall is expected to cause a diversional delay of water movement of up to five years due to the increased path and resistance of water movement to the slope wetland. The gates between the walls would allow water to flow around the barriers and at equilibrium may increase water discharge into the slope wetlands below the gates. Primary potential impacts to the wetlands would be due to shifting of the seepline and the associated wetlands resulting from the altered subsurface flows of water caused by the barrier walls. This shift will be most

rapidly seen in changes of the annual herbaceous community of the slope wetlands. These species tend to be most sensitive to alterations in soil moisture level and duration, and can give an early indication of hydrologic change in the wetlands. Assessment of potential wetland impacts and loss will be evaluated at the end of Phase 2a. The results will be compared to the 1993 wetland boundary to determine if any wetland loss has occurred, and determine appropriate mitigation and compensation required under the DOE no-net-loss policy for wetlands.

Approximately 5,000 linear feet of wetland boundary is potentially within the project impact area of the H-Area barrier. A delay in water movement to the surface discharge of three to five years is expected after installation due to reduced velocity and increased residence time. Redirection of the water around the barriers may have similar impacts to that expected for F Area, with regions near the edges of the barriers receiving increased water discharge and those below the barriers receiving reduced water discharges. This may tend to move the wetland boundary from its current location. As with the F-Area installation, assessment of wetland impacts and loss will be evaluated at the end of the Phase 2a permit period (fall of 2007). The results will be compared to the 1993 wetland boundary to determine if any wetland loss has occurred, and determine appropriate mitigation and compensation required under the DOE no-net-loss policy for wetlands.

5.0 ALTERNATIVES CONSIDERED

Evaluations of the previous pump and treat groundwater remedial systems indicated that it was no longer effective and continued operation was likely to spread contamination and accelerate the transport of contaminants to Fourmile Branch. Because of this situation, continued operation of the previous systems were determined to not be appropriate.

DOE examined the following alternatives to the proposed action: (1) no action, continue to use the existing pump/treat/reinjection systems, and (2) continued extraction with no injection and install irrigation systems to disposition the tritiated water.

One alternative to the proposed action is to take no action. This would consist of SRS continuing to use the existing systems in both HWMFs. The no action alternative would not change the operational impacts to wetlands beyond that caused by the pump and treat system. However, ongoing problems of increased outcropping to Fourmile Branch and spreading of contaminants would continue. Selection of this alternative would result in the site not meeting the RCRA permit goals.

A second alternative would involve the installation of an irrigation system similar to that implemented at the Southwest Plume of the Mixed Waste Management Facility (MWMF) at SRS to manage the extracted tritiated water. In employing this technology, extracted tritiated water is used to irrigate pine trees and is not injected back into the groundwater. The pine trees then evapotranspire the tritiated water to the atmosphere as water vapor. While the alternative could help to achieve permit goals, it would further lower the water table and impact the seeplines that support the slope wetlands. The alternative was determined to be problematic at F- and H-Area

HWMFs because the treatment of groundwater prior to land application is not effective enough to eliminate contaminant loading of surface soils with radionuclides. In order to achieve acceptable soil loading levels, an irrigation plot of approximately 4,850 acres (encompassing approximately 7 million irrigation heads) would be needed for both F- and H-Area HWMFs. In addition, iodine-129, carbon-14 and technicium-99 would move rapidly to the water table, eventually forming an undesirable dilute groundwater plume. Because of these contamination issues, land application via spray irrigation has been determined to be an inappropriate remedial alternative at the F- and H-Area HWMFs (WSRC 2003).

The barrier systems that are proposed for the F- and H-Area Seepage Basins are the only reasonable alternatives that have been identified that could meet the Phase 2a RCRA permit goals. The base injection that is to be employed within the gates of the F-Area system is designed to help achieve the Phase 2b RCRA permit goals.

6.0 DETERMINATION

Based on the analyses in this wetland assessment, DOE has determined that the proposed F- and H-Area Groundwater Remediation Project could impact the slope wetlands located along Fourmile Branch. Because of this potential, DOE will monitor these wetlands to evaluate changes in size and/or location due to the implementation of proposed remediation. Pursuant to DOE's no-net-loss policy for wetlands, any decrease in wetland acreage will be compensated through either the SRS Wetland Mitigation Bank or other wetland mitigation processes.

Signed in Aiken, South Carolina, this 9th day of March, 2004.

Jeffrey M. Allison
Manager
Savannah River Operations Office

7.0 REFERENCES

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