Removal Site Evaluation Report to the C-Reactor Seepage Basins

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DISCLAIMER

WSRC-RP-97- 132, Rev. 1

REMOVAL SITE EVALUATION REPORT

FOR THE

C-REACTOR SEEPAGE BASINS (904-066, -067 and -068G) (U)

JULY 1997

WESTINGHOUSE SAVANNAH RIVER COMPANY
SAVANNAH RIVER SITE
AIKEN, SC 29808

1.0 INTRODUCTION

Removal Site Evaluation Reports are prepared in accordance with Section 300.410 of the National Contingency Plan (NCP) and Section X of the Federal Facility Agreement (FFA). The C-Reactor Seepage Basins (904-066G,-067G,-068G) are listed in Appendix C, Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Units List, of the FFA. The purpose of this investigation is to report information concerning conditions at this unit sufficient to assess the threat (if any) posed to human health and the environment and to determine the need for additional CERCLA action. The scope of the investigation included a review of past survey and investigation data, the files, and a visit to the unit.

Through this investigation unacceptable conditions of radioactive contaminant uptake in on-site vegetation were identified. This may have resulted in probable contaminant migration and become introduced into the local ecological food chain. As a result, the SRS will initiate a time critical removal action in accordance with Section 300.415 of the NCP and FFA Section XIV to remove, treat (if required), and dispose of contaminated vegetation from the C-Reactor Seepage Basins. Erosion in the affected areas will be managed by an approved erosion control plan. Further remediation of this unit will be conducted in accordance with the FFA.

2.0 UNIT DESCRIPTION, OPERATIONAL HISTORY, AND WASTE CHARACTERISTICS

2.1 Location

The C-Reactor Seepage Basins are located outside the C-Reactor, but adjacent to the perimeter fence. To reach the basins, travel south on SC State Route 125 and enter the Savannah River Site at the manned barricade just south of the intersection of Route 125 and SRS Road 1. From this point visitors must be properly badged and escorted. Take the Road C turn off (approximately ½ mile from the barricade) and travel south to Road 5. Turn west at Road 5 to the intersection and follow the C-Reactor sign. This road leads to the main gate of C-Reactor, just prior to the gate the road turns sharply to the right and becomes paved/gravel/dirt. Continue to follow this road to the left for approximately ½ mile. The Seepage Basins are on the left (Figure 1, Appendix A). The area is a CERCLA site and marked with orange balls at the fenced corners (Figure 2, Appendix A). The SRS coordinates are: N67347, E44792; latitude is 33.248N and longitude is 81.680W.

2.2 Site Description

The C-Reactor Seepage Basins were designed and constructed as unlined basins. The purpose of the basins was to hold contaminated waste water that was not appropriate for discharge to local streams due to elevated radiological activity. The fenced area measures 400 feet by 200 feet. Inside there are 3 basins. One basin is L shaped and measures 360 feet by 35 feet by 6 feet deep with a total volumetric capacity of 20,000 cubic feet.

The other two basins are rectangular in shape, one of which measures 270 feet by 40 feet by 9 feet deep with a total volumetric capacity of 97,200 cubic feet and the third basin is 135 feet by 80 feet by 12 feet deep with a total volumetric capacity of 129,600 cubic feet (measurements reference top inside of basin berm). The basins and the area immediately surrounding the basins are enclosed by a fence to manage access control. Currently, the basins are surrounded by thick vegetation, open to atmospheric conditions, and contain varying amounts of water.

Most of the basins' area are covered with thick vegetation. This vegetation has become contaminated with radionuclides from the uptake of radiological contaminants in the soil. The total estimated solid volume of contaminated vegetation is 900 cubic feet of trees (with roots) and 28 cubic feet of brush vines and grasses.

Vegetation within the unit fence consists of a pine and mixed hardwood overstory. Rush (*Juncus effusus*), sweetgum, and black willow (*Salix nigra*) are the dominant species present immediately adjacent to the edge of the basin. Wax myrtle (*Myrica cerifera*), blackberry (*Rubus sp.*), broom sedge, black cherry, loblolly pine, and trumpet creeper are the dominant species present within the fenced area of the C-Reactor Seepage Basins.

Numerous species of reptiles, amphibians, and mammals have been documented at SRS (Gibbons and Patterson,1978 and Cothran *et al.*, 1991). Based on observations made during the unit reconnaissance, it is likely the unit provides habitat for birds, small mammals, reptiles, and amphibians. Evidence of white-tailed deer (*Odocoileus virginianus*), squirrel (*Sciurus* sp.), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), feral swine (*Sus scrofa*), and wild turkey (*Meleagris gallopavo*) are observed in the vicinity of the operable unit.

Many of the above referenced plant species produce seed and fruit which are consumed by birds and mammals. Any constituent uptake by these plants could potentially affect local and migrating fauna. Thirty plant species (Knox and Sharitz, 1990) and 10 animal species (Dukes, 1984) on either the Federal or South Carolina lists of threatened or endangered species occur at the SRS.

Data gathered from the South Carolina Wildlife Marine Resources Department (SCWMRD) and Savannah River Forest Station (SRFS) data bases were reviewed and indicate that no endangered, threatened, or rare species exist within 1 mile of the basin.

2.3 Operational History and Waste Characteristics

The basins were active from 1957 to 1970 and again from 1978 to 1987. Process purge water was released to the seepage basins to allow a significant portion of the tritium to decay before the water outcrops to surface streams and flows into the Savannah River. C-Reactor used the seepage basins to dispose of low level radioactive process purge waters from the reactor disassembly basins. Aqueous radioactive wastes included tritium, cobalt-60, cesium-137, and other beta-gamma, beta, alpha emitters from the disassembly basin.

Operational changes in the late 1960s, from continuous purges of reactor area disassembly basins to periodic purges, allowed longer holdup time for decay, some evaporation, and a larger inventory of tritium in the basins. From 1978 to 1987 the process purge water was again discharged to the seepage basins. (Federal/State permits were not required for purges to these basins). There have been no discharges to the basins since 1987. The exact volume of water disposed in the basins is unknown but is estimated to be 27 million gallons (*Environmental Information Document, DPST 85-707, Reactor Seepage Basins*).

3.0 SAMPLING DATA/MONITORING HISTORY

3.1 Soil Sampling Data

Core sampling of soil from the C-Reactor Seepage Basins was conducted in 1978. Analysis of radionuclides in the sixteen soil samples taken from beneath the C-Reactor Seepage Basins are presented in Table 1, Appendix B. Core locations are also given in Figure 3, Appendix A.

The maximum concentration of radioactivity found in the soil cores was 2090 pCi/g of Cesium-137 and 1870 pCi/g of Strontium-90 at a depth of 0-15cm (approximately 0-6 inches).

In 1976, composite soil cores (five, approximately 4 inches deep) were taken from the C-Reactor Seepage Basins. The maximum concentration of Cesium-137 and Strontium-90 was 4,400 pCi/g and 85 pCi/g, respectively.

3.2 Vegetation Sampling Data

Three composite samples of nine randomly selected trees were taken on March 6, 1997. The Analytical Development Section of Savannah River Technology Center conducted radiological screening analysis for alpha, beta, and tritium activity, and gamma spectroscopy analysis. The results indicate the maximum concentrations of 86 pCi/g-tritium, 227 pCi/g-beta, 3 pCi/g-alpha, 54 pCi/g of Cesium-137. The maximum background levels at C- Reactor Seepage Basins are 6.74 pCi/g - alpha, 4.86 pCi/g - beta and 0.21 pCi/g - Cesium-137. The presently proposed exposure limits are 50 microrem/hr or less for Gross gamma, 100 pCi/g or less for Gross beta gamma activity and 250 pCi/g for Gross alpha activity.

3.3 Monitoring History

The Health Protection Department performs a periodic Radiation Survey of the C-Reactor Seepage Basins. Recent surveys conducted in September 1996 found no detectable alpha, but beta-gamma levels were 100,000 dpm. In earlier surveys (1992) the beta-gamma levels have been as high as 200,000 dpm.

4.0 GROUNDWATER PATHWAY

4.1 Hydrogeologic Setting

The SRS is located on the Upper Atlantic Coastal Plain, approximately 20 miles southeast of the Fall Line, which separates the Piedmont and Coastal Plain provinces. The SRS is on the Aiken Plateau, a relatively flat area that slopes southeastward and is dissected by several tributaries of the Savannah River. The SRS is underlain by a 700 to 1,200 ft thick, seaward-thickening wedge of Coastal Plain sediment composed of unconsolidated sands, clayey sands, sandy clays, and lesser amounts of calcareous sediment. These layers are underlain by dense crystalline igneous and metamorphic rock or younger consolidated sediments of the Triassic Period. Within the Coastal Plain sediments, the sandy strata are generally porous and permeable and may form aquifers.

The disassembly purge water seeps downward through the sides and floor of a basin to the shallow groundwater. After mixing with the groundwater, the contaminants generally flow slowly in a horizontal direction, north-northwest, towards a tributary of Four Mile Branch. During its slow travel through the soil, the waste water loses some of its contaminants by precipitation, filtration, adsorption, ion exchange, and radioactive decay. In the immediate vicinity of the C-Reactor Seepage Basins there are six monitoring wells, CSB1A through CSB6A. Wells CSB3A, 4A, and 5A are downgradient. Well CSB2A is a side gradient, well CS1BA is an upgradient, and well CSB6A is sidegradient to upgradient. Chlorinated volatile organic, lead, and copper values were elevated above Drinking Water Standards (DWS) in several of the downgradient and sidegradient wells. Tritium activity was above DWS in all the CSB wells in 1990. Tritium activity has decreased in these wells in the last few years.

4.2 Groundwater Targets

The RFI/RI Report for the C-Reactor Seepage Basins will determine in more detail the potential impacts to these pathways.

4.3 Groundwater Conclusions

The RFI/RI Report for the C-Reactor Seepage Basins will determine in more detail the potential impacts to these pathways.

5.0 SURFACE WATER PATHWAY

5.1 Hydrologic Setting

Surface water drainage in the immediate vicinity of the C-Reactor Seepage Basin is directed into the basin. Rainwater which collects in the bottom of the basins has never been observed to overflow the top of the basins. The rainwater seeps into the ground or evaporates.

5.2 Surface Water Targets

Contamination migration potentially impacts the watershed of Four Mile Branch. Since domestic use of these surface water sources is not allowed within SRS, human receptors are not potential targets via the normal pathways of ingestion, dermal contact, inhalation (shower scenario), or food-chain (irrigation). On-site workers (such as environmental samplers or field biologist) may be potential targets although their exposure would be short. Samplers at the basins are made aware of the potential hazards and are properly protected as required by SRS procedures. Ecological receptors are the primary targets from the tributary to Four Mile Branch. Both aquatic and terrestrial species which live within or adjacent to the tributary or basins could be exposed. Animals passing through or jumping the fence can gain access to the standing water in the basins.

5.3 Surface Water Conclusions

There are no studies which identify an outcropping of tritium contaminated seepage in Four Mile Branch from this unit. Evaluation of possible tritium contamination will be undertaken in further, more definitive reports under the RI/FS program.

Small volumes of rainwater collect in the low point of the L-Shaped basin sporadically throughout the year. Samples collected from radioactive seepage basins, such as the L-Area Oil and Chemical Basin, have indicated that activity is present at levels slightly above detection limits. These small volumes of rainwater provide the additional benefits of minimizing airborne dispersion of basin soils and shielding to minimize personnel exposure. Therefore, based on the low activity levels in the basin water as compared to the activity accumulated in the basin sediments and soils, the basin water will be dispositioned, as required, as part of the final action for this unit.

6.0 SOIL EXPOSURE AND AIR PATHWAYS

6.1 Physical Conditions

Based on previous sampling, soils within the basin, including the berm, are contaminated with radionuclides. In addition, the basin water has been shown to be contaminated and is accessible to small animals and birds. As a result of uptake from contaminated soil, vegetation at the C-Reactor Seepage Basins has become contaminated with radionuclides. These plants are accessible to wildlife and may produce berries edible to local wildlife. In addition, SRS conducted a study in March,1995 which demonstrated that contaminated pine pollen from the C-Reactor Seepage Basins was being released from the basin in measurable, although not health threatening, amounts.

6.2 Soil and Air Targets

Research has shown that there is no prevailing wind at SRS (typical of the lower midlands of South Carolina) which would cause resuspension and transport to off-unit targets. Several soil and air targets exist for the C-Reactor Seepage Basins including on-site workers and workers in nearby facilities.

Entering reactor production areas such as C-Area requires appropriate clearances, further restricting the possible number of on-site workers or employees who would routinely access the site. There are office facilities within 1,500 feet of the C-Reactor Seepage Basins. These personnel have a small potential for exposure via the air pathway through inhalation and dermal exposure to resuspended soil particles. Exposure to these workers will be minimized during the removal action through the use of radiological huts, wind breaks and the use of site procedures to control possible airborne contamination. Exposure to environmental samplers or field personnel from radioactive contaminants could occur if appropriate personal protective equipment is not used.

Ecological receptors include animals feeding on the vegetation or drinking from the basin.

6.3 Soil Exposure and Air Pathway Conclusions

As a result of surface contamination and vegetative uptake the C-Reactor Seepage Basins pose a small risk of radionuclide exposure to on-site workers and the local animal populations. Contamination is currently being introduced into the local ecological food chain through vegetation uptake. In addition, thick bushes and briars at the C-Reactor Seepage Basins provide a habitat for small mammals such as rabbits and mice which can spread contamination to unrestricted environments. Ecological targets are more susceptible due to the higher frequency and longer duration of exposure to contaminated soils and vegetation within the basin. Personnel surveys are required prior to any site worker exiting the contamination area. This practice ensures personnel exit the work area free of contamination. There are no records of exposure to any individual as a result of these basins.

SRS has determined that action to address uncontrolled uptake and release of contaminants by local vegetation is warranted. This action, to be outlined below, will remove the quantity and variety of vegetation including berry producing plants and pollen producing trees. The action will minimize, to the extent possible, the possibility of soil erosion from the basins to unrestricted areas. This proposed removal action initiated at the C-Reactor Seepage Basins will compliment the final remedial action.

7.0 SUMMARY AND CONCLUSIONS

The C-Reactor Seepage Basins are open, unlined basins. Basin 904-067G contains water most of the year. The surface soil at the basin and surrounding areas is contaminated with significant quantities of radionuclides, mainly Cesium-137, Strontium-90, and other beta/gamma, alpha, beta emitters. The basins are fenced and properly posted to warn of radiological hazards. The basins and surrounding area support a variety of vegetation including berry producing plants as well as large trees.

In addition to soil contamination, uptake of radioactive contaminants have caused the vegetation at the C-Reactor Seepage Basins and surrounding area to become contaminated. Contaminated vegetation has increased the radiation doses at the unit as well as introduced radioactive contaminants into the ecological food chain.

As a result of uncontrolled vegetation growth at the C-Reactor Seepage Basins which, in turn, provides a source of contaminants into the ecological food chain, SRS intends to perform a time critical removal action to remove contaminated vegetation and control future growth. This removal action will involve only vegetation and will minimize, to the extent possible, disturbance of basin soils and sediments.

Anticipated activities in the planning phase include vegetation sampling and analysis, development of vegetation removal techniques, identification of vegetation treatment and disposal options, and development of erosion control and future vegetation control plans.

8.0 TECHNICAL SPECIFICATIONS

Vegetation sampling and analysis will be performed to identify vegetation requiring removal as well as appropriate treatment options. Most vegetation impacted by contaminant uptake will be removed from the basin. However, some vines and bushes will be mulched and placed within the unit.

Removal of impacted trees will include the removal of roots. Vegetation removal will be performed to minimize land disturbance and soil erosion. All land disturbances will be addressed in an approved soil erosion control plan which will minimize, to the extent possible, the potential for release of contaminated soil to the surrounding areas and exposure to on-site workers.

Some minor earthwork will be performed as needed to support erosion and sediment control. Vegetation requiring removal from the waste unit will be cut, sectioned, and packaged for transport at the unit.

Appropriate process designs, procedures, and personal protective equipment will be used to ensure radiation exposure during all operations is as low as reasonably achievable (ALARA). If necessary, wind breaks and radiological huts will be employed to reduce the risk from wind blown contamination.
Handling of trees and larger vegetation will be performed remotely, whenever possible, which may include the use of cranes or other mechanized equipment used in the logging industry.

Vegetation with levels of contamination meeting the limits specified in WSRC Manual-1S Waste Acceptance Criteria, will be sent for disposal to the E-Area Engineered Slit Trenches. The E-Area Engineered Slit Trenches are engineered facilities meeting specific performance criteria.

It is anticipated that vegetation that does not meet the Waste Acceptance Criteria for the E-Area Engineered Slit Trenches will be incinerated at either an approved off-unit facility or at SRS's Consolidated Incineration Facility (CIF). Off-unit shipment and treatment of contaminated vegetation will comply with the "off-site rule" under CERCLA. All contaminated ash resulting from incineration will be returned to SRS for final disposal at the burial ground facility. After removal of contaminated vegetation, a follow-up report will be submitted documenting the volume and disposition of all vegetation removed from the unit.

After removal of contaminated vegetation, the C-Reactor Seepage Basins will be routinely monitored for changing conditions. New vegetation growth will be limited to short grasses through seeding and regular application of herbicides.

REFERENCES

1. WSRC, **Environmental Protection Department's Well Inventory (U) (through the Second Quarter, 1994),** ESH-EMS-940518,Westinghouse Savannah River Company, Aiken, SC (1994) pg A-4.

2. Holmes, W.G, Pekkala, R.O., **Environmental Information Document, Reactor Seepage Basins,** DPST-85-707, E. I. Du Pont Nemours & Co., Aiken, SC (1986).

3. Lang, J.M., **Site Evaluation Report for the C-Reactor Seepage Basin,** WSRC-RP-93-360, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC (1993).

4. Cothran, E.G, M.H. Smith, J.O. Wolff, and J.B. Gentry, **Mammals of the Savannah River Site,** SRO-NERP-21, Savannah River Ecology Laboratory, Aiken, SC (1991).

5. Dukes, E.K., **The Savannah River Plant Environment,** DP-1642, E.I. du Pont de Nemours and Company, Inc., Savannah River Plant, Aiken, SC (1984).

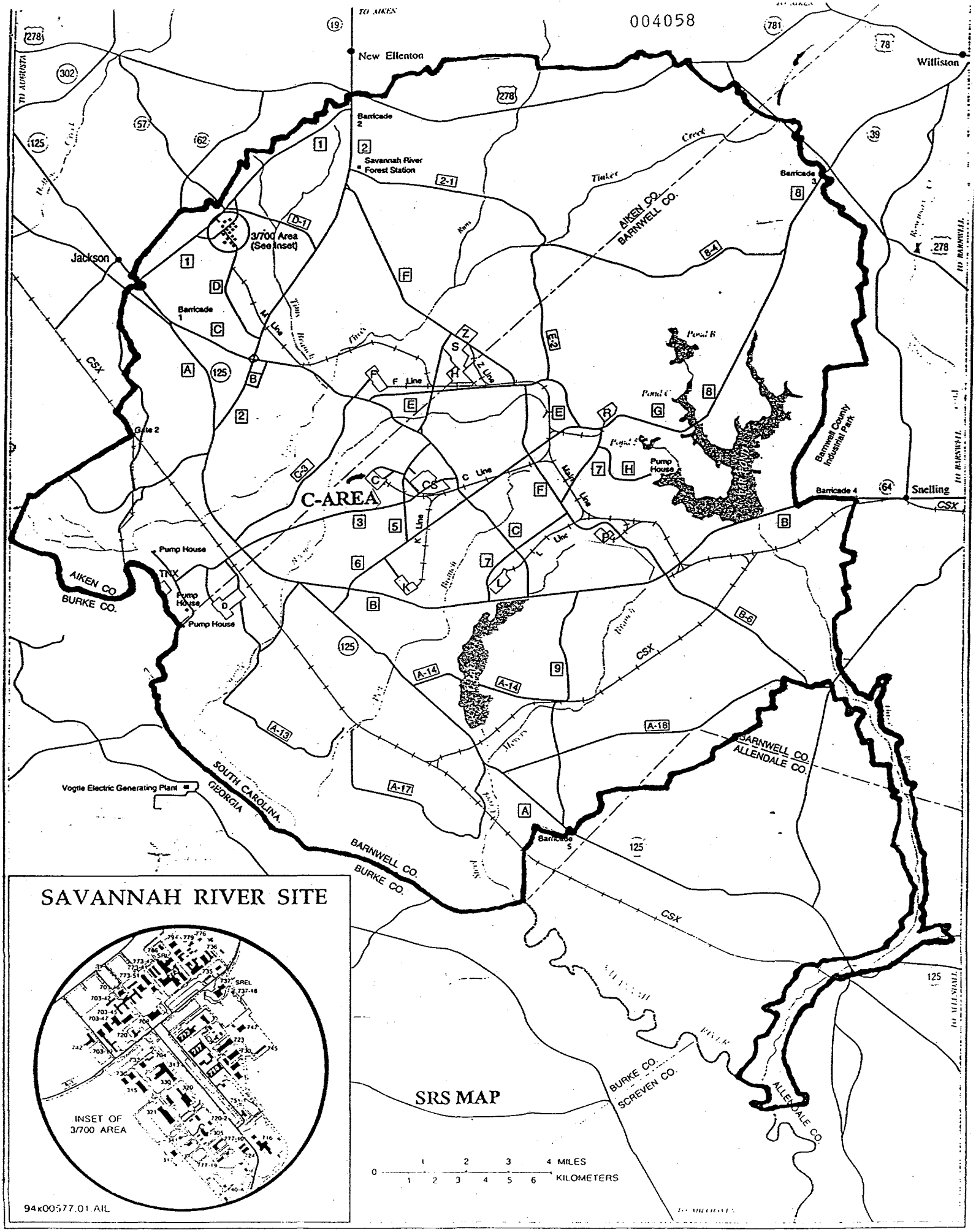
6. Knox, J.N. and R.R. Sharitz, **Endangered and Rare Vascular Flora of the Savannah River Site,** SRO-NERP-20, Savannah River Site, Savannah River Ecology Laboratory, Aiken, SC (1990).

7. Gibbons, W. And Patterson, K.K., **The Reptiles and Amphibians of the Savannah River Plan,** Savannah River Plant National Environmental Research Park, Aiken, SC (1978).

8. WSRC, **Removal Site Evaluation (SE) Report for the H-Area Retention Basin,** WSRC-RP-95-1533, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC (1993).

APPENDIX A

SITE MAPS


TO AIKEN
New Ellenton
Williston
Barricade 2
Savannah River Forest Station
Barricade 3
AIKEN CO.
BARNWELL CO.
Jackson
3/700 Area (See Inset)
Barricade 1
Gate 2
CSX
C-AREA
Pump House
TNX
AIKEN CO.
BURKE CO.
Pump House
Pump House
Pump House
Pond B
Pond C
Barnwell County Industrial Park
Barricade 4
Snelling
F Line
Z Line
C Line
K Line
L Line
M Line
Vogtle Electric Generating Plant
SOUTH CAROLINA
GEORGIA
BARNWELL CO.
BURKE CO.
Barricade 5
BARNWELL CO.
ALLENDALE CO.
BURKE CO.
SCREVEN CO.
ALLENDALE CO.
SRS MAP
0 1 2 3 4 MILES
0 1 2 3 4 5 6 KILOMETERS
SAVANNAH RIVER SITE
INSET OF 3/700 AREA
94k00577.01 AIL

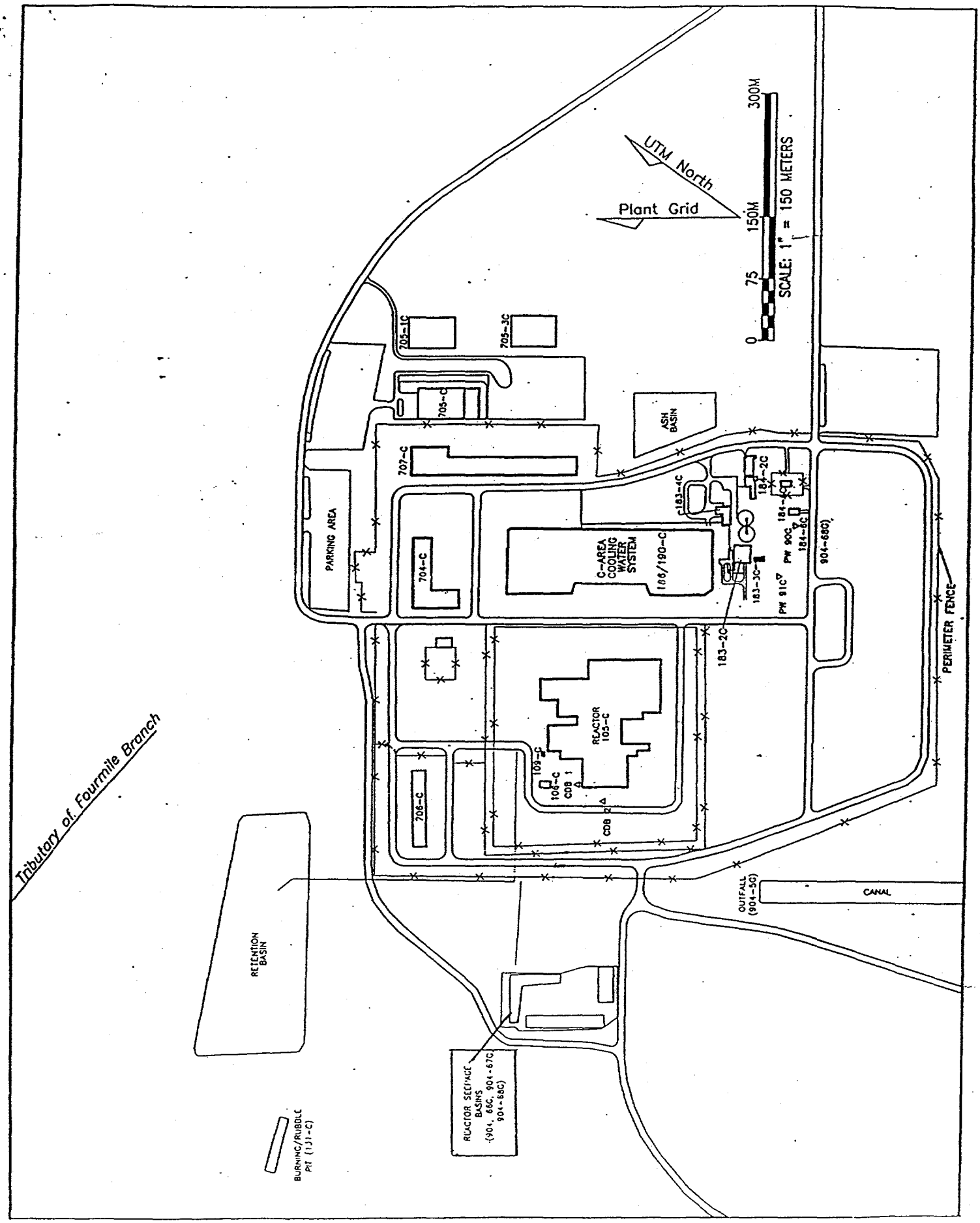


Figure 2 - C-Reactor Seepage Basins

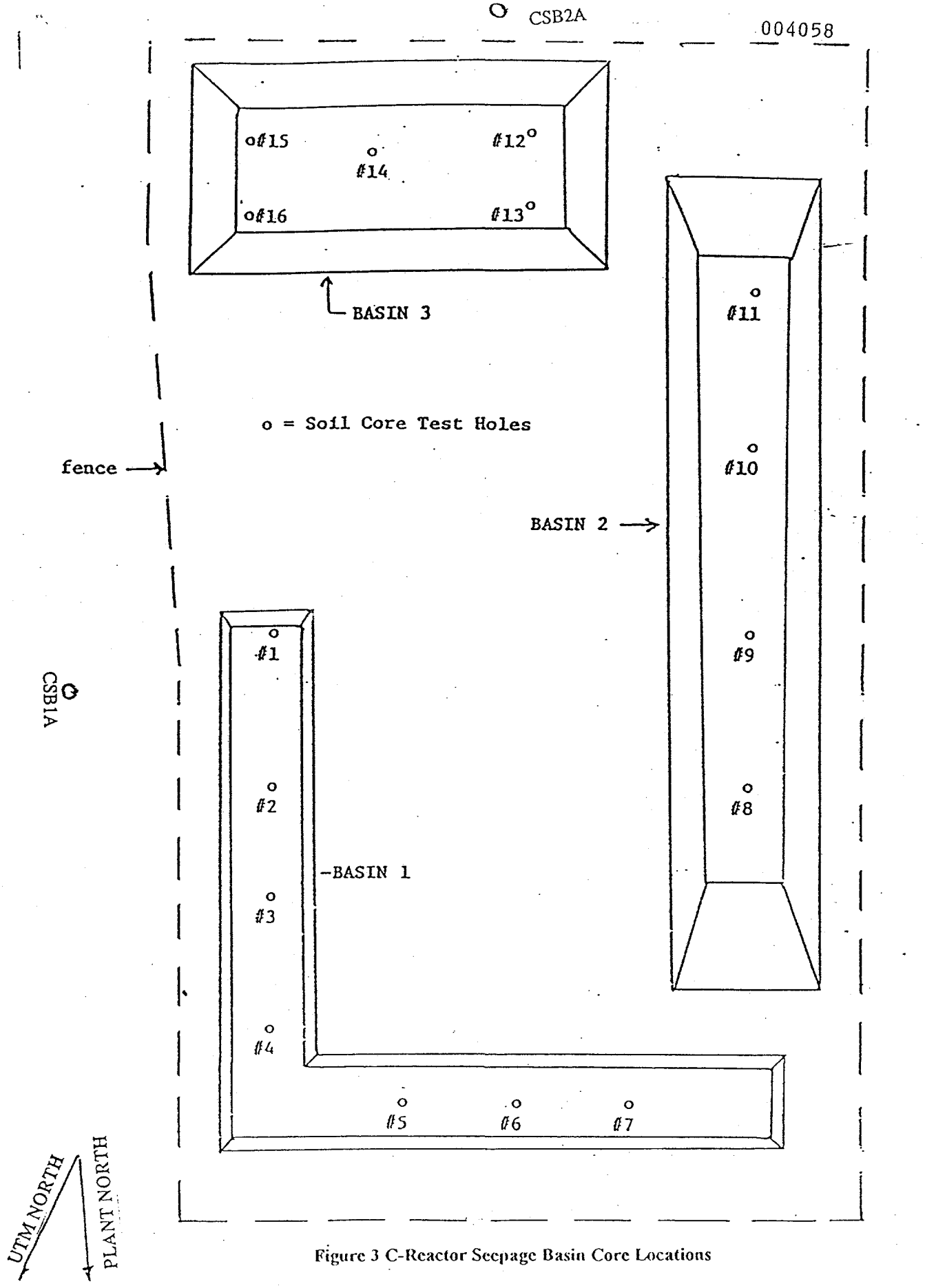


Figure 3 C-Reactor Seepage Basin Core Locations

APPENDIX B

SAMPLING RESULTS

Table 1-Radioactivity in C-Reactor Seepage Basins Soil (pCi/g-Dry)

Sample Depth	Isotope	Basin 1 Sample Location 1	2	3	4	5	6	7	Basin 2 Sample Location 8	9	10	11	Basin 3 Sample Location 12	13	14	15	16
0–15 cm	^{137}Cs	30	9	4	0.5	250	710	2,090	25	40	610	60	5	2	11	2	4
	^{60}Co	9	ND	ND	ND	30	1,870	1,660	ND	ND	20	ND	ND	ND	ND	ND	ND
	^{90}Sr		5				70			140					2		
15–30 cm	^{137}Cs	560	300	120	60	150	40	450	80	40	13	310	10	2	0.3	2	0.6
	^{60}Co	410	ND	ND	ND	510	90	130	ND	ND	5	4	ND	ND	ND	ND	ND
	^{90}Sr		5				140			5	105				2		
30–45 cm	^{137}Cs	74-0	60	60	16	1,130	4	13	70	40	4	800	0.5	<0.2		0.3	0.8
	^{60}Co	890	ND	ND	ND	1,020	4	3	ND	ND	ND	30	ND	ND	ND	ND	ND
	^{90}Sr		90	ND			4			0.8	140				ND		
45–60 cm	^{137}Cs							120	100		6	24		1		0.7	1
	^{60}Co							40	ND		ND	ND		<0.2		ND	ND
	^{90}Sr										85			ND			
105–120 cm	^{137}Cs	490	6	60	470	50	6	2	260	0.4	0.8	3	0.4	1	<0.2	0.7	1
	^{60}Co	230	ND	90	50	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr																
165–180 cm	^{137}Cs	3	5	80	6	0.5	4	0.5	3	0.3	0.5	0.7	0.6	0.5	0.2	0.7	1
	^{60}Co	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr																
225–240 cm	^{137}Cs	2	1	16	0.6	1	4	0.5	4	<0.1	0.3	1	0.7	1	ND	2	1
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr																
285–300 cm	^{137}Cs	1	1	<0.2	1	0.3	5	0.2	0.4	<0.1	0.2	1	0.4	0.8	0.4	0.8	0.8
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr		6				1			<0.1					<0.8		
345–360 cm	^{137}Cs		0.8				1			<0.1					0.4		
	^{60}Co		ND				ND			ND					ND		
	^{90}Sr																
415–430 cm	^{137}Cs		0.2				0.4			<0.1					2		
	^{60}Co		ND				ND			ND					ND		
	^{90}Sr																

ND=nondetect

Table 1-Radioactivity in C-Reactor Seepage Basins Soil (pCi/g--Dry) (Continued)

Sample Depth	Isotope	Basin 1 Sample Location 1	2	3	4	5	6	7	Basin 2 Sample Location 8	9	10	11	Basin 3 Sample Location 12	13	14	15	16
465–480 cm	^{137}Cs		1				<0.2			<0.1					<0.2		
	^{60}Co		ND				ND			ND					ND		
	^{90}Sr																
525–540 cm	^{137}Cs		3				0.4			<0.1					1		
	^{60}Co		ND				ND			ND					ND		
	^{90}Sr																
585–600 cm	^{137}Cs		0.6				0.2			<0.1					0.2		
	^{60}Co		ND				ND			ND					ND		
	^{90}Sr		12				<0.8			<0.8					<0.8		

(source: interoffice memorandum from E.W. Rabon to D.I. Ross, Depth Profile of Radioactivity in Soil from 100-C and 100-P Seepage Basins, June 30, 1978))
ND = nondetect