

SITE RESTORATION: RESTORING LOST LAKE, A CAROLINA BAY AT THE SAVANNAH RIVER SITE

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ABSTRACT

The Savannah River Site (SRS) in Aiken, SC, is part of the U.S. Department of Energy complex for production of materials for U.S. Government defense activities. From 1958 to 1985 mixed wastes (wastes which are both hazardous and radioactive) generated by aluminum forming/metal finishing processes at SRS were discharged to a settling basin with overflow directed to an adjacent Carolina bay known as Lost Lake. Use of the basin system was discontinued in 1985, and physical closure in situ began in 1988. The project's Closure Plan required that Lost Lake be restored to a "natural wetland system." An on-site interdisciplinary team designed the restoration project to demonstrate the effectiveness of various levels of active remediation of Carolina bays as well as restoring Lost Lake. Closure was completed in August 1991, and the site will be maintained for at least 30 years.

INTRODUCTION

Over the years, Lost Lake was contaminated by overflow from the M-Area Settling Basin which contained solvents, cleaning fluids, and heavy metals. A contamination profile was developed for the 113,000 m² (28 acre) lake, and contaminated soil was removed prior to the initiation of restoration activities. Much of the solvents and cleaning fluids evaporated, and the remainder seeped into the water table. This remaining portion is being treated and removed as part of a separate project; these contaminants and their treatment do not affect the restoration of Lost Lake. Heavy metals were physically removed from the lake before beginning restoration of the lake.

An interdisciplinary team planned and implemented the restoration of Lost Lake to provide erosion control, mitigate unavoidable impacts to wetlands, evaluate the effectiveness of various levels of remediation of Carolina bays, and provide an opportunity to study the success of using aerial imagery to monitor the reestablishment of the plant community. The restoration site will be actively maintained for at least 30 years.

This certified closure - part of the environmental restoration at SRS - is the result of a plan developed and implemented in accordance with South Carolina Department of Health and Environmental Control standards under the Resource and Conservation Recovery Act (RCRA).

SITE DECONTAMINATION

The "Closure Plan for the M-Area Settling Basin and Vicinity at the Savannah River Site" detailed a decontamination process for the heavy metals in the lake and committed to restore Lost Lake to a "natural wetland system." Site preparation was necessary before beginning decontamination and restoration activities.

As a Carolina bay, Lost Lake drained a small watershed and usually contained standing water. During the contaminant removal operation, this waste water was removed using a pumping system, settling pools, and a spray field. Additionally, the perimeter was bermed to inhibit runoff water entering the area during decontamination.

Following dewatering, the heavy metal contaminated soils were removed from Lost Lake. Vegetation in the lake was burned, and the residual ash was placed in the M-Area Settling Basin which was closed and capped. The lake area was characterized for depth of contamination in the soil, and excavation contours ranging from 0.025 to 0.30 m (2 to 12 inches) were developed based on the characterization. The contaminated soil was excavated and relocated to the M-Area Settling Basin. After the removal of the excavated soil, decontamination of the lake was complete and the berm around the area was removed.

REVEGETATION STRATEGY AND IMPLEMENTATION

As the closure work neared completion, an onsite interdisciplinary team was formed to plan and implement a reclamation program for Lost Lake. The team consisted of specialists from the U.S. Department of Energy, Savannah River Field Office; U.S. Forest Service, Savannah River Forest Station; U.S. Soil Conservation Service; University of Georgia, Savannah River Ecology Laboratory; and Westinghouse Savannah River Company, Savannah River Laboratory. The team designed upland and wetland planting schemes and an implementation plan that would meet the requirements of the Closure Plan and serve as a research project in the restoration of a Carolina bay. The strategy emphasized restoration of hydrology and use of only native species.

Hydrology was restored by filling in an old drainage ditch near Lost Lake. The team decided not to control the water level in the lake artificially but to design the restoration to accommodate the fluctuating water level that would result from the area's hydrology. In addition, the waterway leading from the basin to Lost Lake was reshaped, grassed with bermuda, 8.97 E-4 kg/m^2 (8 lbs/acre); bahia, 3.36 E-3 kg/m^2 (30 lbs/acre); lespedeza, 2.80 E-3 kg/m^2 (25 lbs/acre) and fertilized (10-10-10), 5.60 E-2 kg/m^2 (500 lbs/acre).

The Lost Lake area was divided into eight treatment areas, four treatments in duplicate (Fig. 1). The subsoil had been compacted by heavy equipment during decontamination, and there was little organic matter in the subsoil. Two of the treatments included disking as well as the addition of gypsum, 4.48 E-1 kg/m^2 (2 tons/acre) for pH adjustment, plants, and fertilizer (10-10-10), 8.97 E-1 kg/m^2 (4 ton/acre). The addition of topsoil was also included in one of these treatments. The third treatment consisted of only the addition of gypsum, plants, and fertilizer. The fourth treatment was no treatment. The planting plots for these treatments were arranged to facilitate future monitoring and to test aerial monitoring techniques.

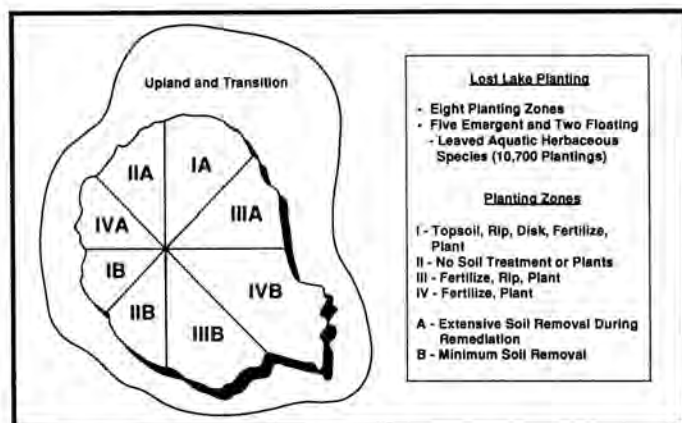


Fig. 1. Lost Lake restoration planting plan.

One month prior to planting, the upland area was limed, 2.24 E-1 kg/m^2 (1 ton/acre), fertilized (10-10-10), 8.97 E-2 kg/m^2 (800 lbs/acre), and seeded in Winter rye, 5.04 E-3 kg/m^2 (45 lbs/acre). In January, ten woody tree and shrub species (Table I) from regional nursery stock were planted on the upland areas. The upland species were planted in identifiable groups to aid in the interpretation of future photographs.

Two floating-leaved and five emergent herb species (Table I) from aquatic habitats on the Savannah River Site were planted in the wetlands portion of the Lost Lake area. Placement of the plants was especially crucial since the water level of Lost Lake fluctuates naturally. Difficulty was encountered in transplanting lotus from root stocks. Initially seeds were used; however, both seeds and transplants were used due to ducks constantly feeding on the seeds.

MAINTENANCE AND MONITORING

The restoration of Lost Lake will be maintained for at least 30 years. Grassy areas will be mowed periodically. There

TABLE I

Upland and Aquatic Plants

Upland Plants
Water Oak (<i>Quercus nigra</i>)
Sparkleberry (<i>Vaccinium spp.</i>)
Pond cypress (<i>Taxodium distichum</i>)
Dogwood (<i>Cornus florida</i>)
Redbud (<i>Cercis canadensis</i>)
American Holly (<i>Ilex opaca</i>)
Winged Sumac (<i>Rhus copallina</i>)
Southern Red oak (<i>Quercus falcata</i>)
Wax Myrtle (<i>Myrica cerifera</i>)
Black Gum (<i>Nyssa sylvatica</i>)
Aquatic Plants
Spikerushes (<i>Eleocharis spp.</i>)
Lotus (<i>Nelumbo lutea</i>)
Water Lily (<i>Nymphaea odorata</i>)
Pickerelweed (<i>Pontederia cordata</i>)
Maidencane (<i>Panicum hemitomon</i>)
Bulrush (<i>Scirpus cyperinus</i>)
Duck Potato (<i>Sagittaria latifolia</i>)

are no plans at present to resupply fertilizer or gypsum due to the effect on the pH. Finally, diseased or dead plants will be replaced as needed.

At the present time, plans are for fixed wing aircraft to take aerial photographs on an annual basis. Baseline photographs were taken in April in 2.29 E-1 m (9 inch) vertical format, normal and false color at 6.1 E+2 m (2000 feet). Future photographs will be examined to assess growth and detect problem areas; these assessments will be compared to ground observations for validation. The success of the different treatments are being observed on an ongoing basis, with analysis planned on a 5-year cycle.

CONCLUSIONS

Revegetation activities were completed in April 1991, and the closure was officially completed in August 1991. Already Lost Lake is beginning to resemble a natural Carolina bay. Although it is too early to determine the differences in the effectiveness of the different treatments, both the wetland and upland plant communities have been established and are thriving.

There is an 80-90% initial survival with excellent growth of the deep water species. The survival rate of the drier species (ie. bulrushes) is somewhat lower. There is heavy cattail infestation in the area, especially in the areas of disturbed soils. There is also an initial invasion of woody species, probably seed or rootstock (button bush and sagittaria) brought in with soil stock.

The basin closure is part of the Site's first certified closure under RCRA, demonstrating a major achievement in the Department of Energy's strong commitment to environmental responsibility. The result of additional restoration projects may provide comparative opportunities.