# Genesis Crude Oil L.P. Oil Spill, Soso, Mississippi

# Final Restoration Plan

**Mississippi Department of Environmental Quality**
**and**
**the United States Department of the Interior**
**through the United States Fish and Wildlife Service**

**April 30, 2004**

# FACT SHEET

**Genesis Crude Oil, L. P. Oil Spill, Soso, Mississippi**
Final Restoration Plan

Lead Trustee Agency: The Mississippi Department of Environmental Quality
Cooperating Trustee Agency: The United States Department of the Interior through the United States Fish and Wildlife Service

Abstract: On or about November 26, 1999, a subsurface crude oil pipeline owned and operated by Genesis Crude Oil, L. P. ruptured near Soso, Mississippi, discharging approximately 8,000 barrels of crude oil. The spilled oil first flowed overland for about 50 yards, thence into a small wetland, subsequently into two additional wetlands, then into an unnamed tributary which flowed a distance of approximately six to seven miles and entered the Leaf River. A total distance of approximately twenty-seven (27) miles of the Leaf River was oiled to varying degrees. Several natural resources including fish, wildlife, their habitats, wetlands and groundwater were affected. Recreational use of the river was not affected adversely by the oil spill. This Final Restoration Plan presents the Trustees' restoration alternative for making the environment and the public whole for injuries to, or loss of, natural resources resulting from the oil spill. The Trustees sought public comments at a meeting held in Collins, Mississippi on January 29, 2004, and considered comments received in the development of the Final Restoration Plan.

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Comments: A thirty-day public comment period was held ending on January 28, 2004 on the Draft Restoration Plan. The public notice was published in three local newspapers and one statewide newspaper. Public comments also were received at the public meeting held in Collins on January 29, 2004. As explained in the response, the public comments did not cause the Trustees to alter the Draft Restoration Plan.

April 30, 2004

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**Definitions (according to regulations at 15 C.F.R. § 990.30):**

***Baseline*** refers to the condition of natural resources and services that would have existed had the incident not occurred.

***Compensatory restoration*** is any action taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery of natural resources and services to baseline. The more quickly the selected primary restoration action expedites recovery of injured natural resources and/or services, the smaller will be the scale of the linked compensatory restoration action required to compensate for interim losses.

***Injury*** means an observable or measurable adverse change in a natural resource or impairment of a natural resource service. Injury may occur directly or indirectly to a natural resource and/or service. Injury incorporates the terms "destruction", "loss", and "loss of use", as provided in the Oil Pollution Act of 1990, 33 U.S.C. §§ 2701 *et seq.*

***Interim losses/interim lost services (uses)*** refers to the reduction in resources and the services they provide, relative to baseline levels, that occur from the onset of an incident until complete recovery of the injured resources.

***Natural resources*** means land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the Exclusive Economic Zone), any state or local government or Indian tribe, or any foreign government, as defined in section 1001(20) of OPA (33 U.S.C. 2701(20)).

***Primary restoration*** is any action, including natural recovery, that returns injured natural resources and services to baseline. This includes actions to restore, replace, rehabilitate, or acquire the equivalent of injured natural resources or services.

***Services (or natural resource services)*** means the functions performed by a natural resource for the benefit of another natural resource and/or the public.

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## List of Abbreviations

**BGL**: Below Ground Level

**CFR**: Code of Federal Regulations

**COE**: Corps of Engineers, specifically the U.S. Army Corps of Engineers

**DOI**: The United States Department of the Interior

**DRP**: Draft Restoration Plan

**ES$^2$**: Environmental Science Services (Contractor for Genesis Crude Oil, L.P.)

**EIS**: Environmental Impact Statement

**FRP**: Final Restoration Plan

**HGM**: Hydrogeomorphic approach to wetland functional assessment

**MDEQ**: The Mississippi Department of Environmental Quality

**MDWFP**: The Mississippi Department of Wildlife, Fisheries, and Parks

**MMNS**: The Mississippi Museum of Natural Science

**NEPA**: The National Environmental Policy Act

**NPDES**: National Pollutant Discharge Elimination System

**NRDA**: Natural Resource Damage Assessment

**NRDAR**: Natural Resource Damage Assessment and Restoration

**OPA**: The Oil Pollution Act of 1990; sometimes referred to as "The Act"

**REA**: Resource Equivalency Analysis

**RP**: Restoration Plan

**SCAT**: Shoreline Cleanup Assessment Team

**SOP**: Standard Operating Procedure

**TPA**: Trees Per Acre

**U. S. C.**: United States Code

**USEPA**: The United States Environmental Protection Agency

**USFWS**: The United States Fish and Wildlife Service

**Executive Summary:**

This Final Restoration Plan (FRP) has been prepared, pursuant to the Oil Pollution Act of 1990, 33 U.S.C. §§ 2701 *et seq.* (OPA or the Act), and the natural resource damage assessment and restoration regulations at 15 C.F.R. Part 990, by federal and state Natural Resource Trustees to address restoration of natural resources injured by the discharge of crude oil from the Genesis Crude Oil, L.P. (Genesis) pipeline near Soso, Mississippi (SEC. 2, T9N, R14W) on or about November 26, 1999. The purpose of restoration as outlined in this FRP is to make the environment and public whole for injuries to natural resources resulting from the incident by returning injured natural resources to their baseline conditions, and compensating for interim losses of natural resources. For this incident, the Mississippi Department of Environmental Quality (MDEQ) and the United States Fish and Wildlife Service (USFWS) acting on behalf of the Department of the Interior (DOI) (collectively referred to as Natural Resource Trustees or Trustees) have the responsibility to assess the extent of natural resource injuries, plan for appropriate restoration projects, prepare draft and final restoration plans, and implement restoration.

Under Section 1002 of OPA, each party responsible for a vessel or a facility from which oil is discharged, or which poses a substantial threat of a discharge of oil, is liable for natural resource damages resulting from such incident involving a discharge or threat. The measure of damages recoverable by Trustees as defined in Section 1006(d) of OPA (33 U.S.C.§ 2706(d)) equals the sum of: the costs to restore, rehabilitate, replace, or acquire the equivalent of the injured resources; compensation for the diminution in value of injured resources pending their recovery; and the reasonable costs of assessing these damages. All recoveries for the first two elements are to be spent implementing a plan developed by the Trustees to restore, rehabilitate, replace or acquire the equivalent of the injured natural resources.

Based upon the results of assessment work summarized in this report, the Trustees propose a package of restoration actions to restore and enhance natural resources sufficient to compensate the public for damages as outlined above. A thirty-day public comment period took place, followed by a public meeting that was held on January 29, 2004 in Collins, Mississippi. The Trustees have reviewed and considered all written and verbal comments received during the public comment period and at the public meeting. The public comments did not cause the Trustees to conclude that the Draft Restoration Plan should be amended.

# 1. Introduction and Purpose

## 1.1 Introduction

This document summarizes the Trustees' assessment of certain injuries resulting from the crude oil spill that occurred in November-December, 1999, from a pipeline owned and operated by Genesis near Soso, Mississippi. Injuries include those caused not only by the spill, but also by the response necessary to clean up the spill (collectively, the incident). In addition, it sets forth the Trustees' recommendations for restoration projects to restore resources to baseline conditions and to compensate for the interim loss of resources and/or services pending recovery to baseline, along with the associated costs of the projects. The Mississippi Department of Environmental Quality (MDEQ) and the United States Fish and Wildlife Service (USFWS), acting on behalf of the Department of the Interior (DOI), prepared the information included in this final restoration plan.

The regulations for conducting a natural resource damage assessment for incidents such as the one at hand, covered by OPA, are described in 15 C.F.R. Part 990. In accordance with these regulations, the Trustees selected methods for injury assessment and restoration planning that technically are reliable, valid, and cost-effective for the incident. Although further studies could have been conducted to refine the injury estimates and restoration alternatives, the Trustees believe that the information forming the basis of this FRP is adequate to develop a fair and reasonable restoration plan as a basis for quantifying the natural resource damages associated with this incident.

The Trustees investigated several resource injuries caused by the incident and consulted with a variety of experts in relevant scientific and technical disciplines. Based on this work, the Trustees believe the incident significantly injured wetlands, an unnamed tributary to the Leaf River, riparian habitat along affected streams, and wildlife supported by these habitats. The Trustees have evaluated a series of restoration actions, and selected the appropriate actions to make the public and the environment whole. Restoration costs outlined herein include the costs to design, permit, construct, and monitor the selected restoration projects.

The restoration projects described herein are based on the technical expertise, judgment, and experience of the Trustees and other consulting scientists. Following consideration of public comments on a DRP, the Trustees have finalized this plan.

## 1.2 Summary of the Incident

In November-December, 1999, a pipeline owned and operated by Genesis ruptured and released approximately 8,000 barrels of crude oil into the environment, ultimately reaching waters of the United States and the State of Mississippi. The discharge emanated from an eight-inch (8") pipeline running between Soso and Gwinville Junction, Mississippi (Soso-Gwinville Junction Segment). Initially, the release was beneath the surface. During the next four weeks, the crude oil reached the surface, flowed through a six mile stretch of a small unnamed tributary containing three wetland areas (.59 acres),

and ultimately reached the Leaf River approximately three miles above U.S. Highway 84, near Collins, Mississippi (Figure 1). Oil from this incident moved down the Leaf River a total distance of approximately twenty-seven (27) miles. The initial Shoreline Cleanup Assessment Team's (SCAT) assessment, completed December 24-26, 1999 (Appendix 1), indicates that just over thirty-six (36.1) miles of shoreline were oiled. Subsequent SCAT analysis, conducted on January 3-4, 2000 and on January 11-12, 2000, revealed that approximately fifty-six and one-half (56.5) miles of shoreline received some degree of oiling as a result of the release and attendant clean-up activities.

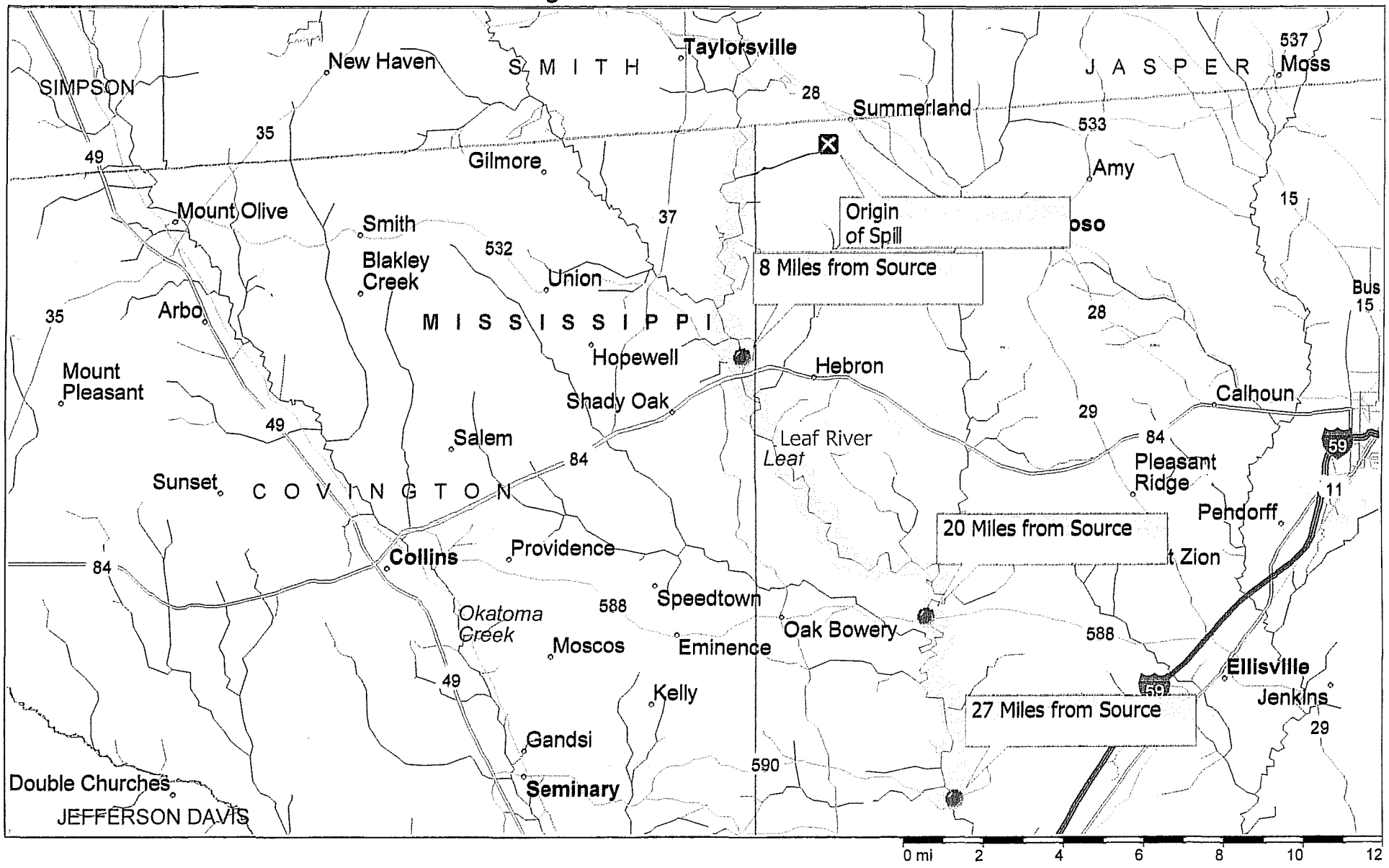
The U.S. Environmental Protection Agency (USEPA), MDEQ, Genesis, and contractors hired by Genesis conducted emergency oil spill response efforts. Cities located on the Leaf River were notified of potential oil contamination, as were local and regional Emergency Management agencies. Genesis, through their contractor Environmental Science Services ($ES^2$), retained Steimle and Associates to conduct water column, sediment and vegetative sampling soon after the incident was reported. Wildlife Rehabilitation and Education of Houston, Texas also was retained. Oil sorbent and containment measures, including booms and pompoms, were situated at numerous locations in the wetlands, along the unnamed tributary to the Leaf River, and along the Leaf River from the confluence within the unnamed tributary to below the Highway 588 bridge (Figure 1). Booms were placed strategically to avoid contamination of in-stream habitat whenever possible.

Recovery efforts were focused at the source of the oil spill, and at various locations along the unnamed tributary and the Leaf River. Vacuum trucks and manual removal of oil were used at the collection sites. Water levels on the Leaf River were low and were not a hindrance to recovery efforts in the early stages of the response. A series of low water dams was constructed on the unnamed tributary to slow or prevent the movement of oil into the Leaf River, and these areas also served as collection areas and later, sampling points.

Natural resource agencies at the federal and state levels were notified of the oil spill shortly after the incident was reported on December 20, 1999. MDEQ, acting as lead administrative trustee, and USFWS, acting on behalf of DOI, coordinated a multi-agency effort to conduct preliminary assessments of the affected areas. Participating with MDEQ and DOI were the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP), the Mississippi Museum of Natural Sciences (MMNS), $ES^2$, and a representative from Genesis. This collaborative effort focused upon documenting the extent to which various natural resources were exposed to oiling, direct mortality of wildlife, and lost or diminished use of natural resources. The preliminary investigation included the following activities:

1. Collection of water column, sediment, soil and vegetation samples by Steimle and Associates, Inc., with samples being split with MDEQ;

# Figure 1. Location of Source



2. Shoreline Clean-up Assessment Team (SCAT) Surveys;
3. Helicopter overflights;
4. Field reconnaissance and photographic documentation of the entire area affected by the oil spill; and
5. Inventory of wildlife mortality noted during the oil spill.

### 1.2.1 Response and Preliminary Natural Resource Damage Assessment and Restoration Activities

Oil spill response activities were conducted by federal and state agencies, including USEPA, MDEQ, Genesis and its contractors. Cities along the Leaf River and local and regional Emergency Management agencies were notified of the spill.

Steimle and Associates, Inc. began sampling the surface water, sediments and vegetation almost immediately after the incident was reported. Steimle and Associates, Inc. submitted a complete collection of duplicate samples, and MDEQ randomly selected samples from those submitted for analysis. Results obtained by Steimle and Associates indicated declining levels of the components of crude oil as the clean-up progressed. Analysis of oil and grease performed by MDEQ showed a similar trend. Levels near background were achieved with samples of surface water collected on February 4, 2000 (Appendix 2), and sampling was terminated. Sediment samples in the main stem of the Leaf River did not indicate contamination by crude oil constituents, and sediment sampling was terminated as of mid-January, 2000.

Immediately after report of the incident, the initial field investigation found minimal apparent oil contamination below a depth of approximately six (6) inches in the stream bottom. All samples that were taken past this depth eventually encountered clay-sand or sandy clay. Thus it initially was believed that there was little potential for groundwater impacts. Further investigation performed by Genesis, however, indicated contamination to groundwater.

During a series of Natural Resource Damage Assessment (NRDA) meetings among the Trustees, responders, scientific experts from other state agencies, $ES^2$, and Genesis, all parties agreed that the preassessment NRDA activities for the main stem of the Leaf River should begin. Potential contamination of the fish tissue, palatability of the fish and damage to the macroinvertebrate community were of special concern to all participants. The USFWS expressed concerns regarding threatened and endangered species in the Leaf River drainage area. These include the yellow-blotched map turtle (*Graptemys flavimaculata*), the Pearl darter (*Percina aurora)* and the Gulf sturgeon (*Acipenser oxyrhynchus desotoi*). Other issues concerning the potential contamination of groundwater resources and culturally/historically/archeologically significant areas also were discussed. Genesis recommended and the Trustees agreed that the wetlands, the unnamed tributary and the associated terrestrial areas should be restored as soon as feasible after clean-up activities were completed.

Like the collection of samples for analytical analysis, Genesis and $ES^2$ initiated assessment of the shoreline oiling almost immediately after the spill was reported. $ES^2$ and the U.S. Coast Guard performed SCAT assessments on December 24-26, 1999; $ES^2$ and MDEQ performed SCAT assessments on January 3-4, 2000. SCAT results showed a rapid decline in the oiling of the shoreline, and this corresponded closely to the progress of the clean-up and recovery activities. The last SCAT survey conducted on January 11-12, 2000 showed only scattered patches of very light oiling, and these were cleaned promptly (Appendix 1).

Aerial reconnaissance occurred at regular intervals during the first weeks following the spill and provided ample opportunity for the Trustees to view the area, search for potential injuries, and evaluate the progress of the clean-up. Trustees also toured the spill area from the ground, and later from the Leaf River. Numerous photographs documenting the ongoing activities were taken. Subsequent tours of the area by boat and on the ground occurred at regular intervals. The Leaf River appears to have recovered naturally from the effects of the incident. Several trips to the ground zero area have been made jointly by MDEQ, USFWS, $ES^2$, and Genesis to monitor recovery of the unnamed tributary.

Genesis and $ES^2$ kept a running tally of reported mortality and injuries to wildlife (Appendix 3). Genesis contracted with Wildlife Rehabilitation and Education for the recovery of injured wildlife. MDEQ Biological Services Section personnel, accompanied by an $ES^2$ representative, collected channel catfish at five (5) sites along the Leaf River and one (1) site on the Bouie River on May 23-24, 2000. Half of the fish collected per site were shipped to Mississippi State University for chemical analysis of the tissue for constituents of crude oil, and the remaining fish were shipped to a certified catfish taster for analysis of flavor. Results of the tissue analysis indicated that no contamination could be attributed to the oil spill that occurred on or around November 26, 1999. Results of the palatability test indicated no adverse effects (Appendix 4).

On June 28-30, 2000, MDEQ's Biological Services Section staff met with $ES^2$ for the purpose of conducting a series of biological assessments of the macroinvertebrate community of the river. Five sites on the Leaf River and one reference site on the Bouie River were assessed to determine the potential damages to the river system as a result of the oil spill. During the course of this investigation, no evidence of oil or sheening was noted. The Leaf River appeared to be recovering naturally from the incident. Analysis of the resultant biological data did not reveal an impact to the benthic community of the Leaf River that could be attributed to the oil spill (Appendix 5).

Personnel from the USFWS and $ES^2$ conducted surveys of sandbars along the Leaf River to evaluate injury to the critical habitat of the yellow-blotched map turtle. It was determined that the sandbars of the Leaf River had received little oiling, and that the turtles likely were unaffected by the oil spill (Appendix 6). Concerns also were expressed regarding the Gulf sturgeon and the Pearl darter. Dr. Todd Slack, Mississippi Museum of Natural Science (MMNS), reported through personal communication that the Gulf sturgeon was documented to exist as far down the Leaf River as Hattiesburg,

Mississippi (where the Bouie River joins the Leaf). Dr. Slack also reported that the Gulf sturgeon may use the Leaf River as far up as Collins, Mississippi, but did not have substantial supporting evidence. Dr. Slack further stated that the Pearl darter is known from the Leaf River drainage, but no specimens have been collected in the area affected by the spill. It also was noted that there were no threatened or endangered mussels in the area.

Groundwater in the vicinity of the pipeline break is contaminated, and a monitoring and active remediation strategy has been implemented to alleviate impact to local groundwater. Continued monitoring will establish whether and when initial natural local groundwater conditions are restored.

Genesis retained the firm R. Christopher Goodwin and Associates, Inc. (Goodwin and Associates), of New Orleans, to address cultural/historical/archeological concerns. Goodwin and Associates reviewed various cultural/historical/archeological record files maintained by the Division of Historic Preservation, Mississippi Department of Archives and History, in Jackson, Mississippi to identify previously completed cultural resource surveys and recorded archeological sites within the area potentially impacted by the spill and clean-up activities. No records were found pertinent to the incident area.

On November 9, 2000, Goodwin and Associates conducted a Phase I cultural resources survey and historical inventory of the roads (both existing and newly constructed) used to complete the clean-up of the spill. No actual or potential resources were identified as a result of the investigation (Appendix 7).

## 1.3 Natural Resource Trustees and Authorities

Natural resource trusteeship authority is designated according to Section 1006(b) of OPA, and Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan. 40 C.F.R. Part 300. Federal Trustees are designated by the President and state Trustees by the Governor. Acting on behalf of the public as Trustees for the living and non-living natural resources affected by the spill, MDEQ and DOI, through USFWS, are responsible for assessing injuries to trust resources resulting from this oil spill incident, and for developing and implementing a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured natural resources (OPA § 1006(c)).

### 1.3.1 Determination of Jurisdiction to Conduct Natural Resource Damage Assessment

Pursuant to 15 C.F.R. § 990.41, the Natural Resource Trustees determined that legal jurisdiction to pursue restoration under OPA exists for this incident. The spill constitutes an "incident" within the meaning of Section 1001(14) of OPA, *i.e.*, "an occurrence or series of occurrences having the same origin, involving one or more vessels, facilities or any combination thereof, resulting in the discharge or substantial threat of discharge of oil." Because the discharge was not authorized by a permit issued under federal, state or

local law, and did not originate from a public vessel or an onshore facility subject to the Trans-Alaska Pipeline Authorization Act, the incident is not an "excluded discharge" within the meaning of OPA § 1002(c). Finally, natural resources covered by the trusteeship authority of the State of Mississippi and DOI have been injured as a result of the incident (natural resource injuries are discussed more fully below). These factors establish jurisdiction to proceed with an assessment under the OPA NRDA regulations. Genesis was notified of this jurisdiction determination in a letter dated February 23, 2000, from MDEQ (*See* Administrative Record).

### 1.3.2 Determination to Conduct Restoration Planning

In accordance with 15 C.F.R. § 990.42, the Natural Resource Trustees for this incident determined necessary conditions existed to justify proceeding with NRDA beyond the preassessment phase. These conditions, discussed more fully below, include: existence of natural resource injuries resulting from the incident; response actions inadequate or inapplicable to restoration of natural resource injuries and losses; and existence of feasible actions to address the injured resources. Thus, the Natural Resource Trustees acted appropriately in proceeding with the damage assessment and restoration and planning process. Genesis was notified of this jurisdiction determination in a letter dated February 23, 2000, from MDEQ (*See* Administrative Record). In fact, Genesis agreed that, with respect to injuries to wetlands, riparian buffer and stream bed of the unnamed tributary, conducting restoration planning was appropriate without significant preassessment activity.

## 1.4 Public Participation

OPA Section 1006(c)(5) requires that the Natural Resource Trustees involve the public in the restoration planning process. The OPA NRDAR regulations interpret this provision as requiring, at a minimum, that Trustees provide the public with the opportunity to comment on a draft restoration plan, and that these comments be considered in finalizing a plan (15 C.F.R. Section 990.55(c)). A DRP was produced and the public informed about the incident. No restoration projects were adjusted based upon public input.

Section 102(2)(C) of the National Environmental Policy Act (NEPA, 42 U.S.C. § 4321 *et seq.*) requires that an Environmental Impact Statement (EIS) be produced by federal agencies for major federal actions expected to have significant impacts on the quality of the human environment. However, certain actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a federal agency in implementation of the Council for Environmental Quality Regulations on NEPA, 40 C.F.R. Parts 1500-1508, may be excluded from the requirement of NEPA compliance. 40 C.F.R. Section 1508.4. USFWS has promulgated categorical exclusions for natural resource damage restoration actions that have negligible impacts on the use of land included in the action. 516 Departmental Manual 6, Appendix 1, Section 1.4 B (11). In this case, USFWS has concluded that the restoration actions will have only a negligible impact on land use and therefore restoration actions need not be analyzed further under NEPA.

The Natural Resource Trustees established a thirty (30) day public comment period for the DRP, and held a public meeting to discuss the DRP and accept comments and/or answer questions. The Trustees considered public comments before finalizing the DRP. Because no substantial changes were made to the DRP based upon public comments, the Trustees did not provide additional opportunity for public review and comment beyond the thirty (30) day public notice period and public meeting held in Collins, Mississippi.

## 1.5 Administrative Record

The Natural Resource Trustees have maintained records to document the information considered by the Trustees as they have planned and implemented assessment activities and addressed restoration and compensation issues and decisions. These records are compiled in an administrative record available for review at the offices of MDEQ in Jackson, Mississippi. The record facilitates public participation in the assessment and restoration process and will be available for use in any administrative or judicial review of the Trustees' actions to the extent review is permitted under applicable laws. Additional information and documents, including public comments received on the DRP, the FRP, and restoration planning documents, will be included in the administrative record as they are developed. A formal written request must be made in order to review documents included in the administrative record. Requests should be directed to the MDEQ Public Records Administrator, P.O. Box 20305, Jackson, MS 39289.

## 1.6 Involvement of Responsible Parties in the Assessment

The participation of responsible parties in a cooperative NRDAR is encouraged under the OPA NRDAR regulations because it increases cost-effectiveness, reduces duplication of effort, and expedites determinations of injured natural resources and services and speeds restoration. Genesis has been a willing and active participant in the NRDAR process. Initially, Genesis sampled affected or potentially affected sediments, vegetation and surface water, splitting samples with MDEQ. Injured wildlife was accounted for on a daily basis. Genesis designed and implemented a sampling network and SCAT assessment to delineate the extent of oiling of resources. Much of the data generated by these actions was used by the Trustees to determine the overall level of injury to affected habitats. Genesis was an observer during the injury assessment studies of the main stem of the Leaf River. Genesis promptly agreed that restoration planning was appropriate for injuries to the unnamed tributary and the wetlands affected by the incident. Genesis has assisted in the identification of potential restoration actions. Genesis also participated in the public meeting held to discuss the DRP.

## 1.7 General Description of Injured and Potentially Injured Resources

Six (6) miles of the unnamed tributary were inundated with oil completely. The direct impact of the spill smothered the aquatic habitat, making it uninhabitable by fish, amphibians, macroinvertebrates, and other forms of aquatic life. Additionally, terrestrial organisms (i.e. wood ducks, deer, small mammals and other birds) dependant upon the

tributary as a source of forage and/or refuge were displaced. Because of the heavy oiling of the tributary, a violation of State Water Quality Standards was assumed. Subsequent clean-up activities required the removal of woody debris, scouring of the bed and banks with cleaning equipment, and incorporating sorbent material into the bed sediments. These activities, while necessary, resulted in further injury to in-stream habitat as well as the physical, chemical, and biological integrity of the stream. Because of the severity of the oiling of the unnamed tributary, all parties agreed that the tributary had lost all function.

On both sides of the six (6) miles of the unnamed tributary, the riparian zone has been disturbed as a result of the clean-up activities. In the ground zero area, as much as twenty (20) feet of riparian plants were removed to provide access to the stream to facilitate clean-up. Along much of the remainder of the watercourse, roots of riparian vegetation were oiled and removed during clean-up. This represented approximately 1-3 feet of riparian vegetation removal from either side of the unnamed tributary. Thus, the integrity of this buffer zone essentially was destroyed. Riparian habitat, which is important in water quality functions such as temperature regulation of the water course and in providing energy through the input of materials from annual leaf fall and woody debris, was impacted adversely by the spill and the subsequent response. In addition the riparian zone serves as an important habitat for forage, cover, and migration of terrestrial organisms, including birds and waterfowl, and these functions also were impaired. Due to the proximity of the unnamed tributary to ground zero and the degree of impact from both the oil spill and the subsequent clean-up efforts, all parties agreed that the riparian zone adjacent to the unnamed tributary had lost all function.

Approximately 0.59 acres of wetlands and approximately six (6) miles of the tributary were injured by the oil spill through direct exposure to oil, which filled the areas completely. The unnamed tributary and associated wetlands affected by this spill are located on undeveloped, forested private land. The affected wetlands are Headwater Riverine Wetlands (Brinson 1993) and were dominated by Water Tupelo (*Nyssa aquatica*) and Bald Cypress (*Taxodium distichum*), indicating that the wetlands experience long periods of inundation. The position of the wetlands in the watershed, the limited contributing drainage area, and soils taxonomy indicate that the hydrology in the wetlands is groundwater driven. This indicates that the wetlands were very important to the ecosystem of the tributary, providing base flow to the adjoining stream. Due to the proximity of the wetlands to ground zero and the degree of impact from both the oil spill and the subsequent clean-up efforts, all parties agreed that the wetlands had lost all function.

Groundwater at the point of rupture of the pipeline is contaminated with benzene, and other crude oil constituents may be present. There is a potential for long-term contamination, albeit at low levels, through interface with the surface water regime. Restoration activities have been initiated by Genesis for treatment and monitoring of the groundwater, and will continue under the oversight of MDEQ. Measurable impact to local ecology, surface water, or aquifer recharge has not been detected, and it is

anticipated that restoration through ongoing remediation and monitoring will preclude such impact.

Genesis reported a mortality of eight (8) wood ducks (*Aix sponsa*) that had been oiled. It is probable that additional wood ducks were oiled but not recovered. The loss of wood ducks from the population had the potential to decrease the recreational resource as well as affect the stability of the local population for future generations of wood ducks.

The Leaf River in this area is a shallow, somewhat narrow stream. As a result of the incident, the stretch of the Leaf River from its confluence with the unnamed tributary to the U.S. Highway 84 bridge received substantial oiling. From the Highway 84 bridge to the bridge at Highway 588, lesser amounts of oil were noted on in-stream substrates and on shore. This represents a distance of approximately forty (40) miles of shoreline of the Leaf River that was potentially oiled as a result of this incident. There is much woody debris present in the river, and the shoreline vegetation is mostly mature with few bare areas. The woody debris present provides an important in-stream habitat for macroinvertebrates as well as cover for fish, including game fish. Because of the shallow nature of this river, there was great potential for covering of in-stream habitats such as snags, exposed roots, and leaf accumulations. The river itself serves as habitat for a diverse array of macroinvertebrates, fish and other wildlife, such as amphibians, reptiles, and birds. Of particular concern were several threatened and endangered species known to occur in the Leaf River. The riparian area adjacent to the river provides habitat to organisms that rely on the river for food and/or water. During the clean-up, contractors strategically placed booms to exclude or protect critical habitats of the Leaf River. There was little oiling of undercut bank habitat noted. Much of the large woody debris in the channel of the river did receive minimal oiling; however, it was agreed that these substrates should be washed rather than removed from the river.

The boat ramps at the Highway 84 bridge, the Highway 588 bridge and the Highway 590 bridge are maintained by the MDWFP, and provide access to the river for small boats (i.e. 14 feet or less). During the months of December-April, it is not likely that the Leaf River experiences heavy recreational usage from fishermen using boats. Genesis and their contractors heavily used the MDWFP river access ramps and the associated areas as collection areas, as well as storage areas for clean-up supplies and oiled materials awaiting disposal. Gravel was spread to repair road damage from heavy equipment, and the area was revegetated by Genesis upon completion of the clean-up activities.

During the period of the spill and heaviest clean-up activities (i.e., December-April), it is unlikely that much shoreline fishing occurred along the affected areas of the Leaf River since it was the winter season. Much of the land bordering the river is privately owned, and demographics indicate an insignificant amount of subsistence fishing occurs on the affected area of the river. With the exception of the MDWFP boat ramps, there are no other state or local parks that provide public access or use of the river. Residents undoubtedly use the land surrounding the Leaf River, the unnamed tributary and the wetlands affected by the oil spill for hunting white-tailed deer, dove, squirrel, wild turkey, and other game. The period of the oil spill and clean-up had the potential to

disrupt recreational hunting. As mentioned earlier, however, public access to the lands adjacent to the affected portion of the Leaf River is sparse.

### 1.8 Summary of Natural Resource Damages Claim

The Trustees evaluated injury to a number of natural resources and natural resource services as outlined elsewhere in this FRP. However, ultimately, the Trustees determined to include in their claim for restoration: (1) injury to the stream bed of the unnamed tributary, (2) the riparian buffer zone along the unnamed tributary, (3) the wetlands associated with the tributary, (4) the groundwater, and (5) injury to wood ducks.

Other resources affected by the incident suffered some injury or likely suffered some injury (i.e., the catfish, turtles, deer and rabbit reported by Genesis on the Wildlife Summary Sheet (Appendix 3) on the Leaf River), but the Trustees determined that quantifying and pursuing restoration for these resources would not be cost-effective, and in the case of the Leaf River, the resources had recovered quickly to their pre-incident condition.

The preferred alternative for restoration of injuries and loss of services from the stream bed is the reintroduction of in-stream structure (i.e. woody debris) to replace that removed during clean-up activities, as well as additional morphological modification measures to restore the biological and physical parameters as well as retard bank erosion. This additionally includes restoration of riparian buffers. The preferred alternative to address wetland injuries is to enhance wetlands in a degraded state adjacent to an existing wetland restoration project. Lost services due to the injury to groundwater are not quantified since measurable impact to local ecology, surface water, or aquifer recharge has not been detected to date and since it is anticipated that restoration through ongoing remediation and monitoring will preclude such impact. Finally, the preferred alternative to restore injuries to wood ducks is placing thirty-nine (39) wood duck nesting boxes in the DeSoto National Forest, Jones County, Mississippi (Appendix 8).

## 2.0 Selection of Injuries to Include in the Assessment

### 2.1 Evaluation of Actual or Potential Injuries

The Genesis incident including the response to the spill adversely affected a number of natural resources, including surface water, sediments, riparian vegetation, invertebrates, fish and birds. Trustees may pursue restoration costs to compensate the public for natural resource injury, loss or destruction. The OPA NRDAR regulations define "injury" as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service" (15 C.F.R. Section 990.30). The regulations define "services" as "the functions performed by a natural resource for the benefit of another natural resource and/or the public" (15 C.F.R. Section 990.30). Services provided by the injured resources also were reduced as a result of the spill.

***Surface Waters***: During the course of the oil spill, a large volume of oil filled wetlands and the unnamed tributary of the Leaf River. Oil flowed through six (6) miles of the unnamed tributary into the Leaf River. Oil traveled a distance of approximately twenty-seven (27) miles down the Leaf River from its confluence with the unnamed tributary. Oiled surface waters were likely a source of exposure to organisms using these waters as habitat. During Preassessment NRDA activities, benthic studies (Appendix 5) and fish tissue and palatability studies (Appendix 4) were performed respectively on invertebrates and fish from the main stem of the Leaf River.

***Sandbars of the Leaf River***: The Leaf River is habitat to several threatened and endangered species, including the yellow-blotched map turtle. Sandbars in the river potentially are important habitat for the turtle. These sandbars were surveyed during the pre-assessment phase to insure that no potential adverse impacts to the turtle or the habitat had occurred (Appendix 6).

***Shorelines***: Initial analysis by the SCAT indicated that just over thirty-six (36.1) miles of the shoreline were oiled and affected and that a total of nearly fifty-six and one-half (56.5) miles of shoreline received some degree of oiling as a result of the discharge and clean-up. The shoreline is potential habitat for a variety of species including birds, reptiles, amphibians, and large and small mammals.

***Stream Bed of the Unnamed Tributary***: The oil spill injured approximately six (6) miles of stream and the associated riparian area and soils of an unnamed tributary to the Leaf River. Initially, nearly 100% of the stream flow was crude oil moving downstream. This oiling would have been a likely source of exposure to organisms using the bed as habitat, such as invertebrates. The extraction of the contaminated groundwater around the pipeline rupture point additionally has removed the source of hydrology for the upper reaches of the tributary. Furthermore, a large amount of sorbent material was placed in the tributary and mixed with the bottom substrates. In order to clean up the oil in the tributary it was necessary to construct a series of three dams in the tributary to pond the oil to aid recovery and to keep additional oil from entering the river. Construction of the dams and accessing the stream bed resulted in removal of most riparian vegetation along the stream. Such removal of the riparian vegetation causes a disruption of the energy budget of the stream system through the loss of allochthonous inputs (i.e. annual leaf fall or woody debris entering the stream), and destabilizes the stream banks, possibly leading to increased erosion and sedimentation. The dams also disrupt ecological functioning by blocking migration of fish into and out of the tributary.

***Riparian Buffer Zone/Wildlife Forage Areas***: As stated above, the oil spill injured approximately six (6) miles of stream and the associated riparian area and soils of an unnamed tributary to the Leaf River. Construction of the collection point dams, discussed above, and pathways to provide access to the tributary to work sorbent into the sediments resulted in most, if not all, of the near-shore riparian vegetation being removed. In all, Trustees estimate that a riparian buffer area of twenty (20) feet wide was removed on either side of the tributary which connected the wetland areas, and a buffer area of three (3) feet wide was removed from the remainder of the unnamed tributary. In

addition, water pumped from the Leaf River to flush oil to the collection points in the tributary raised water levels, causing additional injury to the riparian vegetation and soils. The loss of this riparian area adversely affected foraging area for various species, including wood ducks, other birds, and small and large mammals.

***Wetlands***: Approximately 0.59 acres of wetlands were injured by the oil spill through direct exposure to oil, which filled the areas completely. In order to remove the oil from the saturated wetlands, sorbent was worked into the soil with a tractor and plow. This resulted in the removal of most of the vegetation and disturbance of the soil strata. The extraction of the contaminated groundwater around ground zero additionally has removed the major source of hydrology for the impacted wetlands.

***Groundwater:*** Groundwater at the point of rupture of the pipeline is contaminated with benzene above drinking water standards, which is 5 ppb (parts per billion), and a benzene plume is present. Earth Consulting Group (EarthCon), Genesis' consultants, documented impact to groundwater, and reports from August 2000 to September 2001 note contamination of groundwater by benzene in monitoring wells. Local groundwater within approximately 400 feet of the release area, at depths of 40-45 feet below ground level (BGL), shows contamination by benzene (at concentrations of up to 5500 ug/L), and other contaminants. The groundwater contaminant plume is expected to move via the processes of advection and dispersion and is expected to undergo some natural attenuation. Removal, treatment and replacement of the crude oil-contaminated soil that acts as a source area is complete, which is expected to result in limitation of the extent of groundwater contamination. Groundwater present at the site is not known to be a direct source of water for human consumption, but is a significant factor in the maintenance of base flow in the local stream and wetland. It ultimately serves as a recharge source for the regional Catahoula aquifer, used as a public supply water source in the area. Monitoring is necessary and the Trustees will evaluate groundwater contamination for five (5) years. If groundwater quality is not restored, the Groundwater Assessment and Remediation Division ("GARD") of MDEQ may take further action as necessary. The Trustees reserve their right to obtain restoration and compensation for any injury to groundwater.

***Invertebrates:*** The unnamed tributary and the Leaf River provide habitat for a variety of benthic organisms as demonstrated by the benthic community survey performed by the MDEQ Biological Services Section during June 2000 (Appendix 5). The oil in these habitats would have adversely affected the benthos through the oiling of habitat which would preclude colonization and use of the habitat by benthic organisms, thus decreasing the ecological structure and function of the Leaf River and the unnamed tributary. Clean-up operations in the unnamed tributary removed in-stream habitat, and use of and application of the sorbent material also may have adversely affected the benthic population through physical disturbance of the substratum.

***Fish:*** The unnamed tributary and the Leaf River provide habitat for a variety of fish species as demonstrated by the electrofishing study conducted by the MDEQ Biological Services Section in May 2000 (Appendix 4). The oil in these habitats would have

adversely affected the fish, likely causing either direct mortality, or decrease in condition (health) through removal of the benthic invertebrates used as a food source. Other injuries to the fishery would have likely occurred through the loss of refugia and of spawning habitat due to the covering of critical areas by the oil.

***Wildlife:*** Direct injuries to wildlife are set forth in Appendix 3. Along the watercourse of the Leaf River two ducks were seen oiled, but alive; two turtles were seen oiled, but alive; and one dead channel catfish (*Ictalurus punctatus*) was recovered. One green winged teal (*Anas crecca*) was found dead. One deer (*Odocoileus virginioanus*) and rabbit (*Sylvilagus sp.*) were reported dead and oiled, but were never recovered. One snapping turtle (*Chelydra serpentina*) and beaver (*Castor canadensis*) were found dead and oiled. A total of eight oiled wood duck carcasses were collected at the confluence of the Leaf River and the unnamed tributary. It is likely that the total number of birds found is an underestimate of the birds killed by the spill. Birds often sink or may drift downstream after being impacted by oil and die. When stressed, birds seek concealment and if they die, blend with ground cover and therefore are difficult to count (Davis 1970, Finley 1965). Studies have documented that the loss of dead birds to scavengers also tends to reduce initial estimates of mortality (Bunyan et al. 1981, Crawford 1971, Rosene and Lay 1963, Stutzenbaker et al. 1983). During the process of preparing a Resource Equivalency Analysis (REA), the Trustees assumed that a multiplier of 10 was appropriate for un-recovered wood ducks based on the literature and experience with other damage assessments. As a result, as many as 80 wood ducks may have been killed by the spill (Appendix 8).

***Recreational Boating Use:*** The Leaf River in the area affected by the spill is shallow and somewhat narrow. There apparently is no pleasure boating in this area and little canoe use, especially during the time period of the spill and of intense clean-up activities. However, to the extent any such users would have wanted to canoe the Leaf River, the oiling and clean-up would have made it impossible or greatly diminished the enjoyment of such use.

***Recreational Fishing Use from Shoreline and In River***: It is possible to fish the Leaf River in the area affected by the spill both from a boat and from the shore. However, use of the Leaf River for this purpose during the months of November through April would have been small because of the winter climate. Nonetheless, to the extent any such users would have wanted to fish in the Leaf River, the oiling and clean-up would have made it impossible or greatly diminished the enjoyment of such use.

***Recreational Hunting Use:*** Residents undoubtedly use the land surrounding the Leaf River, the unnamed tributary and the wetlands affected by the oil spill for hunting white-tailed deer, dove, squirrel, wild turkey, and other game. The oil spill and clean-up had the potential to disrupt such recreational hunting. However, public access to the lands adjacent to the affected portion of the Leaf River is sparse, therefore, the actual public loss seems likely to be small. Nonetheless, to the extent that any such users would have wanted to hunt in the area of the spill and subsequent clean-up activities, this activity would have been impossible or greatly diminished.

***Cultural/Historical/Archeological Resources:*** As mentioned previously in Section 1.2.1, no cultural resources were identified as a result of a Phase I cultural resources survey and historical inventory. In addition, no historic period standing structures (those 50 years of age or older) were identified adjacent to the various access roads used during clean-up (Appendix 7).

## 2.2 Application of Injury Selection Criteria

The NRDAR regulations for an oil spill at 15 C.F.R. Section 990.51(f) describe several factors to guide Trustees in the selection of potential injuries to include in an assessment. These factors include:

0.1. The natural resources and services of concern;
0.2. The procedures available to evaluate and quantify injury, and associated time and cost requirements;
0.3. The evidence indicating exposure;
0.4. The pathway from the incident to the natural resource and/or service of concern;
0.5. The adverse change or impairment that constitutes injury;
0.6. The evidence indicating injury;
0.7. The mechanism by which injury occurred;
0.8. The potential degree, and spatial and temporal extent of the injury;
0.9. The potential natural recovery period; and
0.10. The kinds of primary and/or compensatory restoration actions that are feasible.

Based upon consideration of the above factors and other factors discussed below, the Trustees chose to include injury to:

1. The stream bed and banks of the unnamed tributary;
2. The riparian buffer zone along the unnamed tributary;
3. The wetlands;
4. The groundwater; and
5. The wood ducks.

While other injuries, as outlined above, actually or potentially occurred, natural recovery of these habitats and resources appears to be well underway. For example, as discussed above, the benthic community in the Leaf River appears to be fully functional (Appendix 5). Fish tissues have not proven to be contaminated either chemically or to taste (Appendix 4). Sandbars either were not oiled or showed no evidence of use as nesting habitat for endangered turtles (Appendix 6). Groundwater impacts are not expected to be detrimental to either human health or the environment and will be addressed through monitoring and remediation (Appendix 9). Wildlife, other than wood ducks, also appears to have recovered to pre-incident conditions or to have suffered such minimal losses as to make restoration not cost-effective (Appendix 3). Because public use of the recreational

services of the Leaf River and unnamed tributary seem to have been minimal during the time of the incident, the Trustees have determined not to quantify or further pursue injuries to these resource services.

## 3.0 Restoration Planning

### 3.1 Injury Assessment, General

The goal of injury assessment is to determine the nature, degree, and extent of any injuries to natural resources and services. This information is necessary to provide a technical basis for evaluating the need for, type of, and scale of restoration actions. Specifically, the Trustees must determine that there is:

1. Exposure, a pathway, and an adverse change to a natural resource or service as a result of an actual discharge; or
2. An injury to a natural resource or impairment of a natural resource service that resulted from the incident.

*See* 15 C.F.R. Section 990.51. Injury determination and injury quantification, are terms used to describe the two basic components of injury assessment. Determination of injury requires the Trustees to demonstrate that the incident caused an adverse effect on a resource. Injury quantification involves determining the severity, extent and duration of that effect. Trustees have the option of quantifying the adverse effect directly and/or quantifying the reduction in services provided by a natural resource as a result of an incident. The natural resource or service change is defined as the difference between post-incident conditions and baseline conditions. Injury assessment techniques used for the natural resource categories chosen by the Trustees for inclusion in restoration planning are discussed individually later in this report.

### 3.2 Selecting a Restoration Plan, General

In selecting preferred restoration projects for each category of natural resource injury or loss, the Trustees identified feasible restoration actions to promote recovery of the resources to baseline (i.e., primary restoration) and to compensate for interim losses of resources or services pending recovery (i.e., compensatory restoration). Primary restoration actions evaluated include natural recovery and one or more restoration actions designed to directly restore natural resources or services to baseline on an accelerated time frame. In order to ensure that the compensatory restoration actions compensate the public for the interim losses, the scale of the compensatory restoration action must be chosen based on knowledge of the interim losses associated with the selected primary restoration action.

The OPA NRDA regulations identify a variety of methods that may be used for scaling compensatory restoration actions. When determining the scale of restoration actions that provides natural resource and/or services of the same type and quality, and of comparable value as those lost, Trustees must consider using a service-to-service scaling approach.

Under this approach, Trustees determine the scale of restoration actions that will provide a flow of natural resource services equivalent in quantity to the lost flow of services, taking into account the different time periods in which the services are provided through the use of discounting. When Trustees determine that the service-to-service approach is not appropriate, Trustees may consider other scaling approaches; however, in this case, the Trustees have scaled all restoration according to the service-to-service approach.

### 3.2.2 Criteria for Evaluating Restoration Alternatives and Environmental Consequences

In accordance with the OPA NRDA regulations, only those alternatives considered technically feasible and capable of being implemented in accordance with applicable laws, regulations and/or permits may be considered for inclusion in a restoration plan. 15 C.F.R. Section 990.53(a)(2). The Trustees evaluated the feasible restoration alternatives for each category of injury or loss according to the following criteria set forth in 15 C.F.R. Section 990.54:

1. The cost to carry out the alternative;
2. The extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
3. The likelihood of success of each alternative;
4. The extent to which each alternative will prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative;
5. The extent to which each alternative benefits more than one natural resource and/or service; and
6. The effect of each alternative on public health and safety.

## 3.3 Injuries and Alternatives

Because the main stem of the Leaf River showed little appreciable injury from the incident (i.e., the macroinvertebrate community was noted to be fully functional, no adverse contamination in the fish tissue or in the palatability of the fish was noted, nor were any deleterious effects noted on individuals or critical habitat of the threatened and endangered species known to be present in the Leaf River), it was determined unnecessary to conduct restoration planning and/or consider restoration projects for the main stem of the Leaf River. As explained below, the Trustees conclude and Genesis agrees that the five injury categories meet the criteria outlined above in Section 3.2.2.

Due to the symbiotic relationship between the stream bed and riparian zone, the Trustees have selected restoration alternatives that would restore the function and services of both the stream bottom and the riparian zone. Although separate injuries, they are considered as one for restoration purposes. The Savannah District Corps of Engineers (COE) Stream Mitigation Standard Operating Procedure (SOP) was used to assess the impacts to the tributary, including the stream bed and riparian zone (Appendix 10). Utilizing the SOP, a system of debits (= injuries) and credits (= restoration actions) has been established and a

restoration plan to offset the lost functions has been developed by The Nature Conservancy (Appendix 11) at the Trustees' request. The plan includes various stream restoration measures, including planting and preservation of a riparian buffer, in-stream structures to provide bed/bank stability, and morphological restoration.

### 3.3.2 Injury to the stream bed and the riparian zone of the unnamed tributary

1. Description of the Injury

Crude oil flowed through approximately six (6) miles of this tributary before it reached the Leaf River. This tributary was inundated completely with crude oil for an unknown period of time prior to the discovery of the leak in the pipeline. During clean-up activities, much sorbent material was mixed with the stream bottom sediments, creating a disruption of the integrity of these sediments. Also, during clean-up, snags and leaf accumulations that were oiled were removed. Additional water was pumped through this tributary to facilitate clean-up, and workers moved through the stream bed cleaning snags and exposed roots, while removing other snags and leaf material.

Construction of the collection point dams, access to the tributary to work sorbent into the sediments, and removal of oiled woody debris resulted in most, if not all, of the near-shore riparian vegetation being removed. In all, Trustees estimate that a riparian buffer area averaging twenty (20) feet wide was removed on either side of the tributary which connected the wetland areas, and a buffer area of three (3) feet wide was removed from the remainder of the unnamed tributary. In addition, water pumped from the Leaf River to flush oil to the collection points in the tributary raised water levels, causing additional injury to the riparian vegetation and soils.

2. Lost Services and Injury Quantification

During the preliminary NRDA meetings between the Trustees and Genesis, Genesis proposed and the Trustees agreed that the incident had caused the stream and riparian area to have lost all function, and that restoration planning should begin with respect to the unnamed tributary. The clean-up activities, although necessary to remove the oil, removed in-stream habitat structures such as woody debris and leaf accumulations, and disturbed the stream bed through the introduction of sorbent material and physical walking of workers through the stream bed. These structures represented most of the available habitat present in the stream, and their removal reduced available refugia and much of the energy base of the stream. This impacted or had the potential to impact aquatic life, such as fishes and invertebrates, and those terrestrial organisms that used the stream as a source of food or water.

The loss of riparian area adversely affected foraging area for various species, including wood ducks, other birds, amphibians, reptiles, and small and large mammals. Small mammals and birds were denied potential nesting areas. Reptiles were denied cover and foraging areas. The removal of the vegetation also affected the water quality of the unnamed tributary through increased erosion and increased temperatures brought about

by the loss of the filtering and shading properties, respectively, of the riparian zone vegetation. This in turn affected the aquatic species living in the unnamed tributary, and affected those species (both aquatic and terrestrial) that used the stream for foraging and as a source of water; for example, amphibians were denied waters of suitable quality in which to reproduce.

3. Primary Restoration Alternatives Considered

The restoration alternatives considered include natural recovery and restoration of the unnamed tributary affected by the incident (to include channel stabilization, re-establishment of the riparian zone with species with high wildlife value, and introduction of natural habitat types to replace that removed by the clean-up activities). Also considered were the conversion of the stream mileage affected to wetland acreage and enhancement with subsequent purchase of additional wetland acreage from The Nature Conservancy's Murrah Preserve (Figure 2); funding of a stream related project or projects on The Nature Conservancy's Murrah Preserve (alone or in conjunction with installation of some grade control structures on the unnamed tributary affected by the incident); and/or purchase of a tract or tracts of land as part of The Nature Conservancy's Upper Pascagoula Connector Project that would connect the Pascagoula Wildlife Management Area to the Leaf River Wildlife Management Area (alone or in conjunction with installation of some grade control structures on the unnamed tributary affected by the incident) (See Figure 2).

4. Evaluation of Primary Restoration Alternatives

Since the unnamed tributary of the Leaf River had lost all function, the Trustees determined that natural recovery was not a viable restoration option.

The Trustees believe that the conversion of stream mileage to wetland acreage and enhancement through purchase of acreage at The Nature Conservancy's Murrah Preserve (Figure 2) does not represent direct replacement of lost resources and resource services, i.e., this "replaces apples with oranges." The derivation or development of a "conversion factor" further confounds this option that would allow for the conversion of stream miles to wetland acres. Searching scientific literature provided no sound basis for the conversion of stream miles into wetland acres for this case.

Trustees met with Genesis and discussed at length the possibility of funding a project or projects to enhance riparian areas on The Nature Conservancy's Murrah Preserve. A visit to this area by MDEQ personnel to identify potential projects that would satisfy Genesis' obligation to the public was made in April 2002. It was determined during this visit that the topography of the Murrah Preserve was mostly lowland swamps and wetlands, and that this area was unsuitable for restoration/enhancement projects to replace lost resources and services from a flowing stream similar to the unnamed tributary affected by the incident. However, extensive areas of riparian buffer were impacted. The restoration/enhancement of these areas could offset the loss of services from the riparian buffer along the unnamed tributary.

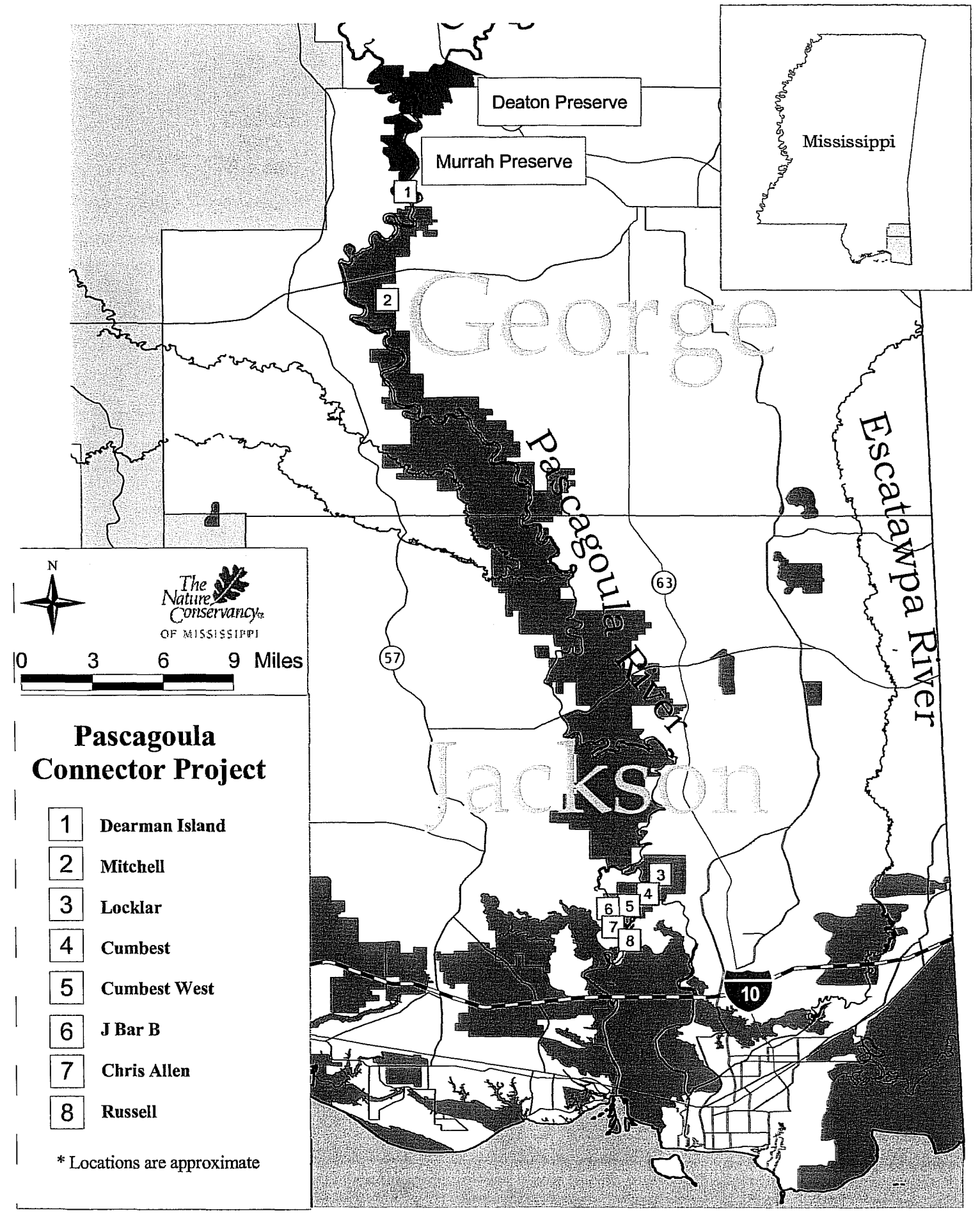



Figure 2. The Deaton Preserve, the Murrah Preserve and the Upper Pascagoula Connector Project

Another restoration alternative considered by the Trustees was the purchase of a tract or tracts of land as part of The Nature Conservancy's Upper Pascagoula Connector Project, thereby providing migration corridors between the Pascagoula Wildlife Management Area and the Leaf River Wildlife Management Area (Figure 2), two large but currently isolated tracts of nature preserve. In addition to providing avenues for migration, this also would add additional acreage for protection of local watersheds, endangered and/or threatened flora or fauna, and further enhance the natural resources and natural resource services of this area. However, this option would not adequately replace many of the site-specific functions of the unnamed tributary, such as habitat for macroinvertebrates, amphibians, birds, or important hydrologic functions such as floodwater attenuation, sediment/toxicant retention and maintenance of base-flow in the receiving water bodies.

Restoration of the unnamed tributary to baseline conditions (to include stream bed restoration, channel stabilization, and re-establishment of the riparian zone with species with high wildlife value, and introduction of natural habitat types to replace that removed by the clean-up activities) also was considered. Restoration of the entire length would not be possible due to the steep terrain and incised nature of the lower section of the unnamed tributary. However, the upper section received the greatest damage from the spill and clean-up activities. In addition, this area drains an active oil field, and was directly fed by the groundwater that was also injured as a result of the spill. In spite of these limitations, the Trustees believe that restoration of the upper reach of the unnamed tributary and associated riparian area offer the greatest restoration benefits. This option further reduces the potential for export of contaminants to the Leaf River through sediment transport and/or groundwater discharge. This option also more directly replaces the site-specific functions discussed earlier in this section.

5. Identification and Scaling of Compensatory Restoration Alternatives Considered

a. Identification of Compensatory Alternatives Considered

As compensatory restoration alternatives for interim losses of stream and riparian zone services, the Trustees have considered restoration of additional riparian areas within The Nature Conservancy's Murrah Preserve in the Upper Pascagoula Basin (Figure 2). Genesis concurs. The preferred restoration plan includes additional restoration actions to offset the interim loss of services.

b. Scaling of Restoration Alternatives

The Trustees have decided that the COE Savannah District SOP for the evaluation of stream impacts and restoration projects will be used as the base functional assessment methodology for interim losses pending restoration and recovery of the stream. This methodology includes scaling of restoration actions necessary to compensate for the loss of services and functions due to the delay between restoration actions and functional maturity (i.e., temporal lag), and is based upon "credits" and "debits" (Appendix 10). An assessment of the damages is conducted and the number of "debits" which must be offset

is calculated. As restoration activities are planned, the number of "credits" resulting from each restoration activity is calculated, such that the number of "debits" is offset by the "credits" from restorations and enhancements. Based upon this method, the Trustees calculated and Genesis agreed that damages to the unnamed tributary and the riparian area of the unnamed tributary requires 81,124 "credits" (Appendix 10, Attachment 1) to make the public and the environment whole.

The Nature Conservancy has been retained by Genesis to conduct the restoration of the unnamed tributary and the riparian zone since this restoration alternative remains the preferred alternative after receipt of public comment. Based upon a plan submitted by The Nature Conservancy for restoration of the unnamed tributary and the riparian zone of the unnamed tributary, 26,437 "credits" (Appendix 10, Attachment 2) can be earned by the proposed restoration. The balance of "debits" will be offset with riparian enhancements within The Nature Conservancy's Murrah Preserve (Figure 2).

6. Evaluation of Compensatory Restoration Alternatives Considered

The Trustees determined, and Genesis agreed, that the COE Savannah District SOP for Stream Restoration includes inherent measures to compensate for both primary and compensatory losses, including temporal lag.

7. Selection of Preferred Primary and Compensatory Restoration Alternatives

As discussed in Part 4 above, neither the acquisition and enhancement of land off-site nor the restoration of the lower portion of the unnamed tributary offered complete compensation to the environment and the public for the services lost as a result of the incident. The Trustees have determined that the primary restoration of the upper section of the unnamed tributary coupled with enhancement of riparian buffers within The Nature Conservancy's Upper Pascagoula Connector Project (specifically the Murrah Preserve) (Figure 2) will bring resources and services back to baseline conditions. This combination of restoration actions replaces the lost functions and services, including the site-specific functions of the unnamed tributary to the greatest extent possible and meets all of the criteria outlined in section 3.2.2 above. Plan specifics are included as Appendix 11.

8. Monitoring of Restoration Actions

As proposed, the restoration will require 5 years of monitoring to include physical parameters, sediment sampling, longitudinal profile, photographic records, survival and recruitment of vegetation, and records of precipitation and stream flow analysis. This monitoring will be undertaken by a contractor to Genesis. Monitoring reports will be submitted to the Trustees for their review and comment. The Nature Conservancy has established a contingency plan in case the monitoring data indicate that the restoration is not maintaining stream structure and function as originally planned (Appendix 11). If monitoring reveals deficiencies, corrective actions will be undertaken. Additional

oversight/monitoring activities on the part of the Trustees will consist of frequent oversight visits during construction of the new stream channel (2-3 times per month), followed by quarterly monitoring during year two of the project. Afterward, the trustees will conduct biannual monitoring for the duration of project.

The reforestation and off-site restoration performance standards for the stream bed and the riparian zone of the unnamed tributary are as follows:

a. By year five, areas intended for reforestation shall contain at least four hundred thirty-six (436) appropriate native trees per acre (tpa) that are at least five feet tall with a minimum of ten (10) tree species per acre;

b. No area of at least 10-foot radius shall be devoid of any such trees;

c. No one tree species shall comprise greater than thirty (30) percent of the canopy cover except in those forest communities with characteristically low tree species diversity (i.e, cypress/tupelo associations); and

d. Invasive exotic species occurring within the project area shall be mechanically or herbicidally reduced to collectively account for no more than five (5) percent areal cover of the total project site.

The action items to be performed to attain these standards for the stream bed and the riparian zone of the unnamed tributary are as follows:

a. Trees used for reforestation shall be selected from those species designated by Clewell (1986) as appropriate native bottomland hardwood species for each area;

b. Trees shall be spaced on approximately 10-foot centers;

c. All areas intended for reforestation that do not meet these standards shall be supplemented with additional plantings; and

d. Annual monitoring shall be conducted by visual determination, supplemented by measurements as needed, during comprehensive reconnaissance on foot of the project sites. Transects will be used to determine species diversity, community structure, planting survival, and ecosystem health. Monitoring reports will be submitted to the Trustees within two (2) months of the assessment each year for five (5) years or until the performance standards have been reached.

8. Costs of Implementation, Oversight and Monitoring

These costs are outlined in the table below:

Table 1. Costs Associated with Restoration and Compensation for Lost Services from Damage to the Stream Bed and the Riparian Zone of the Unnamed Tributary to the Leaf River.

| ITEM | COST ($) |
|---|---|
| On-site restoration of the unnamed tributary (primary restoration) | Genesis will hire a contractor to conduct this restoration. |
| Off-site restoration/enhancement compensatory restoration) | Genesis will hire a contractor to conduct this restoration. |
| USFWS Oversight (20 days over the 5 year project period). | $6,754.80 |
| MDEQ Oversight (20 days over the 5 year project period) | $16,112.80 |
| **TOTAL** | **$22,867.60 plus contractor costs** |

### 3.3.3 Wetlands associated with the tributary

1. Description of the Injury

Approximately 0.59 acres of wetlands were injured by the oil spill through direct exposure to oil. Sorbent was worked into the soil with a tractor and plow to remove the oil from the saturated wetlands, which resulted in the removal of most of the vegetation and disturbance of the soil strata. The extraction of the contaminated groundwater around ground zero also removed the source of hydrology for the impacted wetlands.

2. Lost Services and Injury Quantification

Due to the proximity of the wetlands to ground zero and the degree of impact from both the oil spill and the subsequent clean-up efforts, the wetlands lost all function.

3. Primary Restoration Alternatives Considered

Because the wetlands had lost all function, natural recovery was not considered to be a viable restoration methodology. The primary restoration for the lost wetland functions are to be restored through the restoration of wetlands from The Nature Conservancy's Murrah Preserve (Figure 2).

4. Evaluation of Primary Restoration Alternatives

Since the wetlands lost all function as a result of the spill and clean-up efforts, neither natural recovery nor primary restoration efforts are feasible; therefore, the purchase and enhancement of wetland acres is necessary to offset the loss. The Trustees have

determined that the restoration of 0.59 acres plus compensatory restoration of wetlands on The Nature Conservancy's Murrah Preserve will bring resources and services back to baseline conditions. The wetland restoration will be adjacent to the riparian restoration area discussed previously. A site visit to the Murrah Preserve revealed extensive areas of headwater riverine wetlands with extensive damage due to mechanized timbering activity suitable for restoration. This is a preferred alternative to a smaller scale restoration as this mechanism will enhance and restore a larger portion of the Murrah Preserve, making a more ecologically stable restoration, and hence more valuable to wildlife and the public.

5. Identification and Scaling of Compensatory Restoration Alternatives Considered

a. Identification of Compensatory Alternatives Considered

Additional restoration credits (in the form of the purchase and enhancement of additional wetland acreage) will be added to the Primary Restoration to offset the loss of services endured by the public during the interim.

b. Scaling of Restoration Alternatives

Because of the limited size of the impacted wetlands and the difficulty of performing a scientifically based functional evaluation procedure (HGM, etc.), the Trustees qualitatively assessed the required compensatory restoration using the Ratio Method that is described in Appendix 12. The 0.59 acres of wetlands damaged by this incident are qualitatively assessed as high quality wetlands given their geomorphic position and evidence of vegetative cover prior to the incident. The assigned scaling of compensatory restoration is based on the quality of the resource to be impacted, the magnitude of those impacts, the viability of the restoration proposal, and the best professional judgment of the Trustees. Historical restoration or enhancement ratios for similar impacts have been on the order of 3-5:1. After thorough evaluation of the draft restoration plan, the Trustees have determined that the purchase and restoration of 3.0 acres of wetlands will make the public and environment whole for damages to the wetlands resulting from this incident. This represents 0.59 acres of primary restoration and 2.4 acres of compensatory restoration and is consistent with the ratios used for similar restoration projects.

6. Evaluation of Compensatory Restoration Alternatives Considered

The only alternative considered was to require Genesis to purchase additional credits to offset the loss of services from the incident.

7. Selection of Preferred Primary and Compensatory Restoration Alternatives

The lost wetland functions are to be compensated through the purchase and enhancement of 3.0 acres of wetlands from The Nature Conservancy's Murrah Preserve.

8. Monitoring of Restoration Actions

Monitoring of restoration actions, specifically vegetation composition and recruitment, will be accomplished by a contractor and verified during site visits by MDEQ and USFWS personnel once per year for a five year period to ensure that wetland function has been restored successfully. If monitoring reveals deficiencies, contingencies such as re-planting or additional planting will be initiated in accordance with the reforestation and off-site restoration performance standards for wetlands, which are included as follows:

a. By year five, areas intended for reforestation shall contain at least four hundred thirty-six (436) appropriate native trees per acre (tpa) that are at least five feet tall with a minimum of ten (10) tree species per acre;

b. No area of at least 10-foot radius shall be devoid of any such trees;

c. No one tree species shall comprise greater than thirty (30) percent of the canopy cover except in those forest communities with characteristically low tree species diversity (i.e., cypress/tupelo associations); and

d. Invasive exotic species occurring within the project area shall be mechanically or herbicidally reduced to collectively account for no more than five (5) percent areal cover of the total project site.

The action items to be performed to attain these standards for wetlands are as follows:

a. Trees used for reforestation shall be selected from those species designated by Clewell (1986) as appropriate native bottomland hardwood species for each area;

b. Trees shall be spaced on approximately 10-foot centers;

c. All areas intended for reforestation that do not meet these standards shall be supplemented with additional plantings; and

d. Annual monitoring shall be conducted by visual determination, supplemented by measurements as needed, during comprehensive reconnaissance on foot of the project sites. Transects will be used to determine species diversity, community structure, planting survival, and ecosystem health. Monitoring reports will be submitted to the Trustees within two (2) months of the assessment each year for five (5) years or until the performance standards have been reached.

9. Costs of Implementation, Oversight and Monitoring

These costs are outlined in the table below:

Table 2. Costs Associated with Restoration of Wetland Resources and Services.

| ITEM | COST ($) |
|---|---|
| Purchase of wetland acreage | Genesis will purchase 3.0 acres in the Murrah Preserve |
| Enhancement of wetland acreage | Genesis will hire a contractor to provide enhancements |
| USFWS Oversight (once per year for five years) | $1,711.20 |
| MDEQ Oversight (once per year for five years) | $4,072.76 |
| **TOTAL** | **$5,783.96 plus contractor costs** |

### 3.3.4 Injury to local groundwater

1. Description of the Injury

Release of crude oil in the near subsurface resulted in its adsorption onto soils in the immediate vicinity of the release and for several hundred feet to the north and south. Free phase product in the soil acted as a source area for dissolved hydrocarbon compounds, including benzene and other volatile organic compounds, which have formed a groundwater contaminant plume. Groundwater is contaminated by benzene above the drinking water standard of 5 ppb (parts per billion).

2. Lost Services and Injury Quantification

The primary loss due to groundwater contamination is its effect on local surface waters, namely the adjacent wetland and the local unnamed tributary. Groundwater is responsible for the maintenance of flow in the stream and sources the wetland; it also serves as recharge for the regional Catahoula aquifer. Contaminated groundwater has not, as far as is known at this time, reached stream recharge areas. The Trustees have not quantified lost services and injury because Trustees have determined to rely on ongoing remedial actions to restore groundwater. Genesis will monitor groundwater contamination for five (5) years, and if groundwater quality is not restored, the Groundwater Assessment and Remediation Division of MDEQ will take further action as necessary.

3. Primary Restoration Alternatives Considered

Restoration methodologies for possible consideration included (a) passive, unmonitored natural degradation, (b) monitored natural attenuation, (c) *in-situ* remediation and (d) *ex-situ* treatment of contaminated groundwater.

4. Evaluation of Primary Restoration Alternatives

Of the options listed in Part 3, above, the first three were determined to be inadequate. Option (a), passive natural degradation of groundwater contamination, was removed from consideration since the actual amount of remaining source material was unknown. While natural degradation of hydrocarbon contamination is common, unknown residual sources would have resulted in unknown eventual impact to groundwater. Option (b) was ruled out due to the possible existence of unknown residual source areas. Option (c) was determined to be unworkable in consideration of the circumstances noted above for (a) and (b) and since the extended remediation time frame and the uncertainty as to complete restoration inherent to *in-situ* treatment were thought to be inappropriate in this case. Option (d), *ex situ* remediation, was accepted since it will address source area issues, minimize the volume of groundwater ultimately impacted, effectively remove impacts to groundwater in as short a time frame as possible, and result in the more immediate restoration of the function of local groundwater as a recharge source for both local surface water and regional aquifers. Restoration methodology is to consist of the initial removal, treatment and replacement of contaminated soils, which function as the source area for groundwater contamination, in conjunction with the removal and treatment of contaminated groundwater. Treated groundwater is to be returned to the stream under the conditions of a National Pollutant Discharge Elimination System (NPDES) permit and should thereby nominally regain its function in the maintenance of stream flow.

5. Identification and Scaling of Compensatory Restoration Alternatives Considered

   a. Identification of Compensatory Alternatives Considered- The Trustees have determined that interim compensatory damages should not be assessed for groundwater in this instance since recharge to local surface water has not been detrimentally affected as of this time and since the groundwater remediation alternatives currently underway are expected to preclude any further measurable damage.

   b. Scaling of Restoration Alternatives- unnecessary in this instance.

6. Evaluation of Compensatory Restoration Alternatives Considered

Not Applicable.

7. Selection of Preferred Primary and Compensatory Restoration Alternatives

See Part 4, above.

8. Monitoring of Remedial Actions to Determine Injury and Possible Restoration/Compensation

Evaluation of the groundwater contamination will be carried out for the Trustees by MDEQ through its Groundwater Assessment and Remediation Division and includes inspection of soils removal and treatment, evaluation of treatment effectiveness sampling, and requirement for regularly scheduled groundwater sampling and analysis under MDEQ supervision for such time as is necessary to determine that impact to local groundwater has been eliminated.

9. Costs of Implementation, Oversight and Monitoring

Groundwater remediation is being handled for the Trustees by the Groundwater Assessment and Remediation Division of MDEQ, which includes excavation, transportation and treatment of several thousand cubic yards of soil, installation of a groundwater extraction and treatment system, and installation of a groundwater monitoring system. Such activities will be carried out under the oversight of MDEQ. Oversight costs to MDEQ are based on staff time for review of monitoring data, consultation with entities performing remedial activities, site inspections, split sample collection and administrative functions, and MDEQ laboratory costs. Staff time is estimated to be approximately thirty (30) hours per calendar quarter and laboratory fees at approximately $600.00 per calendar quarter for the initial two years of remediation activity. It is anticipated that oversight costs will drop significantly after this period. The length of time that monitoring and accompanying MDEQ oversight will be required is five (5) years; any additional groundwater monitoring necessary beyond this time will be handled strictly through the Groundwater Assessment and Remediation Division of MDEQ. The Trustees reserve their right to require additional monitoring, oversight costs, restoration, or compensation of groundwater injuries after the five (5) year period.

Table 3. Costs Associated with Monitoring of the Groundwater Resource.

| **ITEM** | **COST ($)** |
|---|---|
| Treatment of the contaminated soils | Genesis will contract with Earthcon to conduct this task |
| Monitoring of the groundwater | Genesis will contract with Earthcon to conduct this task. |
| USFWS Oversight costs (one visit per quarter for a two year period) | $2,737.92 |
| MDEQ staff time [(30 hr./Q)*2 yr.] | $9,124.80 |
| MDEQ laboratory fees [($600/Q)*2 yr.] | $4,800.00 |
| **TOTAL** | **$16,662.72 plus long term oversight costs (if necessary)** |

### 3.3.5 Injury to wood ducks

1. Description of the Injury

Eight (8) wood ducks were found dead and oiled as a result of the incident.

2. Lost Services and Injury Quantification

The reduction in the number of wood ducks equates to the direct loss of 80 wood ducks and the indirect loss of one generation of fledges (Resource Equivalency Analysis (REA) Appendix 8). This loss has the potential to affect those species that prey upon wood ducks, or to reduce the opportunities for or enjoyment of recreational hunting in the vicinity of the incident.

3. Primary Restoration Alternatives Considered

Natural recovery of the wood duck population at the area affected by the oil spill was the only primary restoration alternative considered by the trustees.

4. Evaluation of Primary Restoration Alternatives

The Trustees determined that natural recovery of the wood duck population at the area affected by the oil spill was a viable primary restoration alternative.

5. Identification and Scaling of Compensatory Restoration Alternatives Considered

a. Identification of Compensatory Alternatives Considered

The REA (Appendix 8) indicated that installing 39 wood duck boxes would compensate for the direct loss of 80 wood ducks and for a future generation of wood ducks which would have been potentially born and attained the ability to reproduce. The Trustees considered the following compensatory restoration alternatives: (1) Installation of wood duck nesting boxes in The Nature Conservancy's Murrah Preserve; George County, Mississippi; and (2) Installation of wood duck boxes in the De Soto National Forest, Jones County, Mississippi.

It was determined that installation of this number of wood duck nesting boxes at The Nature Conservancy site (i.e., the Murrah Preserve) would do little to enhance wood duck populations in that area, as there were already a sufficient number of wood duck nesting boxes present. In contrast, at the De Soto National Forest site, there existed ample room for the nesting boxes, and willingness on the part of the U.S. Forest Service personnel to install, maintain, and monitor the boxes. It was determined that enhancement of the wood duck population through nest box installation would restore lost services and

compensate the public for the losses from the incident, and should be chosen for implementation.

b. Scaling of Restoration Alternatives

As discussed in the REA (Appendix 8), the public may be compensated for the lost bird-years lost through three alternatives: (1) manage 77 wood duck boxes for one year, (2) manage 39 wood duck boxes for two years, or (3) manage twenty-six (26) boxes for three years. Alternative 2 is the Trustees' preferred option. This option ensures that the birds use the boxes at the 75 percent rate identified by Bellrose and Holm (1994), because the birds would not likely find all of the boxes in the first year. Also, this option results in a more appropriate number of wood duck boxes to ensure that dump nesting would not become a significant factor. Thus, the Trustees concluded that 39 wood duck nesting boxes should be installed, maintained, and monitored to compensate for wood duck losses.

6. Evaluation of Compensatory Restoration Alternatives Considered

The installation of 39 wood duck nesting boxes was determined to meet all of the criteria outlined in Section 3.2.2 (above), and was the preferred alternative.

7. Selection of Preferred Primary and Compensatory Restoration Alternatives

As stated previously, the installation of a sufficient number of wood duck nesting boxes at the DeSoto National Forest in Jones County, Mississippi to compensate for lost individuals and the services that they provided is the preferred alternative.

8. Monitoring of Restoration Actions

The restoration plan for monitoring success rates of the wood duck nesting boxes calls for maintenance and monitoring for a two-year period. Monitoring the reproductive success of the boxes is necessary to document whether or not the predictions concerning nesting success were achieved, helping to ensure that the public is properly compensated. The information also may benefit similar compensation measures in and out of the area in the future.

9. Costs of Implementation, Oversight and Monitoring

The costs for this project are outlined below:

Table 4. Costs Associated with the Installation of Wood Duck Nesting Boxes.

| **ITEM** | **COST ($)** |
|---|---|
| 39 Nesting Boxes @ $50/box | $1,950.00 |
| Installation of Nesting Boxes @ $85/box | $3,315.00 |
| Maintenance for 2 years @ $5100/year | $10,200.00 |
| Monitoring of Nesting Box success @ $88/box | $3,432.00 |
| **TOTAL** | **$18,897.00** |

## 4.0 References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## 5.0 Appendices

SELECTED APPENDICES TO ATTACHMENT A
APPENDICES 10-12 of the FINAL RESTORATION PLAN dated April 30, 2004

**Appendix 10** - Adaptation of the Savannah District Corps of Engineers Stream Mitigation SOP including the Debit/Credit Worksheets for this Incident

## Compensatory Stream Mitigation
## Definitions of Factors

**Bankfull Discharge**: The bankfull discharge is the flow at which channel maintenance is most effective. It is the discharge that is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and doing work that results in the average morphologic characteristics of channels (Dunne and Leopold 1978). The bankfull stage is the point at which water begins to overflow onto a floodplain. Bankfull may not be at the top of the streambank in incised or entrenched streams.

**Bankfull width** is the width of the stream channel at bankfull measured in a riffle section.

**Buffer Calculations**: The **minimum buffer width** for which mitigation credit will be earned is 50 feet. The buffer width will be measured from the top of the stream bank, perpendicular to the channel. If a stream buffer has more than a 2% slope, 2 additional feet of buffer width are required for every additional percent of slope (e.g., minimum width of a 50' buffer with a +10% slope is 70'). Buffer slope will be determined in 50' increments, beginning at the stream and moving away from the stream. No additional buffer width will be required for negative slopes. For the segment of stream being buffered, degree of slope will be determined at 100' intervals, and averaged to obtain a mean degree of slope for calculating minimum buffer width. This mean degree of slope will be used to calculate the minimum buffer width for the entire segment of stream being buffered.

**Channel Dimension**: The dimension of a stream is its crossectional area (bankfull width multiplied by mean depth at bankfull). Changes in bankfull channel dimensions correspond to changes in the magnitude and frequency of bankfull discharge that are associated with water diversions, reservoir regulation, vegetation conversion, development, overgrazing, and other watershed changes. Stream width is a function of occurrence and magnitude of discharge, sediment transport (including sediment size and type), and the stream bed and bank materials.

**Channel Features**: Natural streams have sequences of riffles and pools or steps and pools that maintain channel slope and stability and provide diverse aquatic habitat. A **riffle** is a bed feature with gravel or larger size particles where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. Pools are located on the outside bends of meanders between riffles. The pool has a flat slope and is much deeper than the average depth. Step/pool sequences are found in high gradient streams. Steps are vertical drops often formed by large boulders or downed trees. Deep pools are found at the bottom of each step.

**Control**:

**Conservancy** means a conservation easement held by a non-profit conservation organization or government agency with natural resource or environmental responsibilities/functions.
**POA-CE** means the mitigation site is protected by a conservation easement held by a property owners association or other formally chartered non-profit organization.
**POA-RC** means the mitigation site is protected by a restrictive covenant held by a property owners association or other formally chartered non-profit organization.
**Private-CE** means the mitigation site is protected by a conservation easement held by a private citizen or business enterprise.
**Private-RC** means the mitigation site is protected by a restrictive covenant held by a private citizen or business enterprise.

## Compensatory Stream Mitigation
## Definitions of Factors

**Subdivided** means the mitigation site is protected by a restrictive covenant and different portions of the mitigation site are owned by different citizens or business enterprises.

**Types ofCompensatory Mitigation:**

**Stream restoration** means actions taken to correct previous alterations that have destroyed, diminished, or impaired the character and function of riverine systems. Restoration is the process of converting an unstable, altered, or degraded stream channel to its natural or referenced stable condition, considering recent and future watershed conditions. This process may include restoration of the stream's geomorphic dimension, pattern and profile and/or biological and chemical integrity, including transport of water and sediment produced by the streams' watershed in order to achieve dynamic equilibrium.

**Riparian buffer restoration** means implementing stream rehabilitation practices within a riparian buffer zone to improve water quality and/or ecological function. Buffer restoration may include increasing or improving upland buffers or wetlands within or adjacent to riverine systems.

**Stream Relocation** means moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed in the stream's former location. Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions and have at least a 25' buffer from each bank of the stream in order to receive mitigation credit. This 25' buffer will not receive riparian buffer restoration credit.

**Preservation** means the conservation, in its naturally occurring or present condition, of a stream, its banks, and riparian buffers, in perpetuity, to prevent their destruction, degradation, or alteration in any manner not authorized by the governing authority. Channel preservation alone will not be accepted without inclusion of a 25' buffer.

**Conservation Easement**: Conservation Easement means a legally binding, recorded instrument, approved by the Department of the Army's Office of Counsel, that conserves a site in perpetuity.

**Credits: For Non-Banks:**
S*chedule 1* : All mitigation is completed before the impacts occur.
***Schedule 2***: A majority of the mitigation is completed before the impacts, and the remainder is completed concurrent with or after the impacts occur.
***Schedule 3***: A majority of the mitigation is completed concurrent with the impacts, and the remainder is completed after the impacts occur.
***Schedule 4***: A majority of the mitigation is initiated after the impacts occur.
***Schedule 5***: Mitigation will be completed significantly after the impacts occur.

**For Stream Mitigation Banks**: Release of credits for stream mitigation banks will be determined by the Mitigation Bank Review Team on a case-by-case basis.

**Dominant Impact**: Dominant impact is the type of impact proposed that will diminish the functional integrity of the riparian system.

**Fill** means permanent fill of a stream channel.

**Morphologic** alteration means to channelize, dredge, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.

**Impound** means to dam a stream or otherwise convert it to a lentic state. Installation of sediment control structures that modify the stream to facilitate sediment control and/or stormwater management is considered impoundment.

**Culvert** means to route a stream through pipes, box culverts, or other enclosed structures for <100 feet.

**Enhanced culverts** are structures that approximate the stream's width/depth ratio at bankfull discharge and that minimize potential impacts to aquatic fauna movement. Floodplains, if present, should be adequately culverted at an elevation equal to or greater than bankfull to pass flows.

**Standard Culverts** are structures of appropriate size to pass bankfull discharge but that are not specifically designed to approximate the stream's width/depth ratio at bankfull discharge or to minimize potential impacts to fish movements.

**Armor** means to rip-rap, bulkhead, or use other rigid methods to contain stream channels.

**Shading and clearing** means activities, such as bridging or streambank vegetation clearing, that reduce or eliminate the quality and functions of the vegetation within the riparian habitat without disturbing the existing topography or soil stratigraphy. Although these impacts may not be directly regulated, mitigation for these impacts may be required if the impact occurs as a result of, or in association with, an activity requiring a permit.

**Utility crossings** means open cut construction or other pipeline/utility line installation methods that require disturbance of the streambed.

**Duration**: Duration is the amount of time the adverse impacts are expected to last.

**Seasonal** means impacts will be limited to times outside of breeding and growth periods for applicable species (Federally listed species and Species of Management Concern, State Species of Concern, and trout).
**0 -1 year** means impacts will occur within a period of up to one year and recovery of most system integrity will follow the cessation of permitted activity.
**Greater than 1 year** means project impacts will be permanent for most types of construction activities.

**Entrenchment Ratio**: The entrenchment ratio is an index value used to describe the degree of vertical containment of a river channel. It is the ratio of the width of the flood-prone area divided by bankfull width.

**Existing Condition**: The functional state of a stream before any pre-project/project impacts. This is a measure of the stream's natural stability and resilience relative to the physical, chemical and biological integrity of the system.

**Fully functional** means that the physical geomorphology of the reach is stable and is representative of an appropriate stream hydrograph for the topographical setting. The biological community is diverse and

unimpaired by excessive anthropogenic inputs. For purposes of this SOP, a fully functional stream is one that has not been channelized; has no culverts, pipes, impoundments, or other instream manmade structures on site; has 3 or less stream reaches within 0.5 miles upstream that have been culverted, piped, impounded, or otherwise modified by manmade structures; has an appropriate entrenchment ratio and width/depth ratio at bankfull discharge relative to unimpaired stream condition; shows little evidence of human-induced sedimentation; and has a wide riparian buffer of deep-rooted vegetation (>50').

**Somewhat Impaired** means that stability and resilience of the stream or river reach has been compromised, to a limited degree, through partial loss of one or more of the integrity functions (chemical, physical, biological). System recovery has a moderate probability of occurring naturally. For purposes of this SOP, a stream is considered somewhat impaired if the entrenchment ratio and/or width/depth ratio at bankfull discharge is inappropriate relative to unimpaired stream condition; human-induced sedimentation is moderate; a moderate riparian buffer of deep-rooted vegetation is present (minimum of 25 feet); and/or 3-5 reaches within 0.5 miles upstream have been culverted, piped, impounded, or otherwise modified by manmade structures.

**Impaired** means that there is a very high loss of system stability and resilience characterized by loss of one or more integrity functions. Recovery is unlikely to occur naturally without further damage, unless restoration is undertaken. For purposes of this SOP, a stream is considered impaired if the reach has been channelized or if the entrenchment ratio and/or width/depth ratio at bankfull discharge is inappropriate relative to unimpaired stream condition; has extensive human-induced sedimentation; has little or no riparian buffer with deep-rooted vegetation (<25'); has banks that are extensively eroded or unstable; and/or >5 reaches within 0.5 miles upstream have been culverted, piped, impounded, or otherwise modified by manmade structures.

**Flood-prone Area Width:** The width of the flood-prone area is measured in the field at an elevation twice-maximum depth at bankfull. Maximum depth is the difference between the bankfull stage and thalweg elevations in a riffle section.

**Kind**: In-kind mitigation means the lost functions of the impacted stream will be mitigated through restoration or preservation of a stream of the same general order and/or morphological classification. Out-of-kind mitigation means the lost functions of the impacted stream will be mitigated through restoration or preservation of a stream with a different morphological classification or order (> 2 stream order difference).

~~**Location:**~~
**Location** is a factor used to compare the relative location of the mitigation site to the impact site. For Stream Mitigation Banks, Location will be defined for the bank after an assessment of the banking proposal. For mitigation proposals not involving mitigation banks, location categories are as shown below.

**Onsite** means within ½ mile up or downstream of the impact.

**Offsite** means greater than ½ mile from the impact site, and within the watershed (8-digit HUC as mapped by USGS).

**Outside Watershed** means the mitigation site is not within the same watershed as the impacts

**Lost Type:**

**First and Second Order Perennial Streams**
**Greater than Second Order Perennial Streams**
**Intermittent Streams**

**Mean Depth at Bankfull:** Mean depth at bankfull is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.

**Monitoring and Contingencies:** Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include contingency actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period.

**Vegetation monitoring** includes measurement of vegetation survival and growth (height, diameter at breast height, or other biomass measure). **Physical parameters** to be monitored include water temperature, DO, turbidity, pH, substrate characteristics, streambank erosion patterns, and longitudinal and cross sectional profiles at sites above, within, and below the stream mitigation project. **Biological parameters** to be monitored include density and diversity of mammals, birds, reptiles, amphibians, fish, macroinvertebrates and other fauna at sites within the stream mitigation project.

**Minimum Level M&C:**
At least 5 years of vegetation monitoring in restored riparian buffers.
At least 5 years of monitoring physical parameters in preserved/restored/relocated streams.

**Moderate Level M&C Plans (not applicable to preservation/relocation):**
At least 5 years of vegetation monitoring in restored riparian buffers.
At least 5 years of monitoring physical parameters in restored streams.
Snapshop data on physical parameters in the restored stream or riparian buffer before mitigation is implemented.

**Substantial Level M&C:**
At least 5 years of vegetation monitoring in restored riparian buffers.
At least 5 years of monitoring physical parameters in preserved/restored/relocated streams.
Snapshot baseline data on physical parameters in the restored stream or riparian buffer before the mitigation is implemented.
At least 5 years of monitoring biological parameters in preserved/restored/relocated streams.
Simultaneous collection of baseline data on physical and biological parameters in a reference site for 5 years.

**Excellent Level M&C:**
At least 7 years of vegetation monitoring in restored riparian buffers.
At least 7 years of monitoring physical parameters in preserved/restored/relocated streams.
Snapshop baseline data on physical parameters in the restored stream or riparian buffer before the mitigation is implemented.
At least 7 years of monitoring biological parameters in preserved/restored/relocated streams.
Simultaneous collection of baseline data on physical and biological parameters in a reference site for 7 years.

**Net Benefit**: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, and maintenance of the chemical, biological, and physical integrity of the Nation's waters. Stream mitigation within 100' of a culvert, dam, or other project impact to waters of the United States generally will generate only the minimal level of restoration or preservation credit due to upstream and downstream impacts associated with these structures. NOTE: Calculating credit for installation of restorat5ion structures will be based on 3X the length of the appropirate size structure (e.g., 600' for 200' of tree revetment).

**Excellent stream restoration actions include:**
Removing stream impoundments and restoring stream channels to referenced, stable morphologic patterns
Restoring appropriate bankfull discharge width, stream sinuosity, entrenchment ratio, and width/depth ratio to referenced morphologic patterns
Creating floodplains of appropriate dimensions adjacent to streams with inappropriately low width/depth ratios at bankfull discharge.
Construction of off-channel stormwater detention facilities in areas where runoff is accelerating streambank erosion. Off-channel stormwater detention facilities should not be placed in jurisdictional wetlands, forested floodplains, or riparian buffer zones.
Watershed improvement actions, such as sediment reduction (i.e., paving dirt roads sloping to a stream), contaminant reduction, and stormwater surcharge reduction.
Restoring channels for piped or culverted streams (i.e., daylighting) to referenced, stable morphologic patterns
Implementing restoration activities that will improve water quality or reduce sedimentation in State of Georgia primary trout streams or waters with Federal or State listed endangered or threatened species

**Good stream restoration actions include:**
Restoring streambank stability using non-rigid methods in highly eroded areas
Restoring natural channel features (i.e., riffle/run/pool/glide habitat) using methodology appropriate to stream type
Reducing nonpoint pollution sources by methods other than buffering
Implementing restoration activities that will improve water quality or reduce sedimentation in State of Georgia secondary trout streams or waters with Federal Species of Management Concern or State listed rare or uncommon species

**Moderate stream restoration actions include:**
Restoring streambank stability in moderately eroded areas
Constructing fish ladders, where appropriate
Culverting floodplains at existing road crossings to allow more natural flood flows
Adding woody debris to create fish habitat, where appropriate to stream type
Replacing inappropriately sized/designed culverts
Removing checkdams, weirs, and other manmade instream structures where these structures are contributing to bank erosion or scour

**Excellent riparian restoration actions include:**
Restoring vegetated riparian buffers at least 3X as wide as the minimum buffer width on both sides of a stream

Restoring vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species

Fencing livestock from a riparian buffer at least 75' wide on both sides of a stream, if one or more livestock crossings are planned, or from a buffer 50' wide on both sides of a stream if no livestock crossings are planned

**Good riparian restoration actions include:**
Restoring vegetated riparian buffers at least 4X as wide as the minimum buffer width on one side of a stream or 2X as wide as the minimum width on both sides of a stream
Restoring a vegetated riparian buffer of at least minimum buffer width on both sides or at least 2X minimal buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Restoring vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species
Fencing livestock from a riparian buffer at least 50' wide on both sides of a stream, if one or more livestock crossings are planned, or from a buffer 25' wide on both sides of a stream if no livestock crossings are planned

**Moderate riparian restoration actions include:**
Restoring vegetated riparian buffers at least 3X as wide as the minimum buffer width on one side of a stream or 1X as wide as the minimum buffer width on both sides of a stream
Restoring a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Restoring vegetated riparian buffers of at least minimal buffer width on both sides or at least 2X minimal width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species
Fencing livestock from a riparian buffer at least 25' wide on both sides of a stream (with livestock crossings planned) or 75' wide on one side of a stream (no livestock crossings planned)

**Low riparian restoration actions include:**
Restoring vegetated riparian buffers at least 2X as wide as the minimum buffer width on one side of a stream.
Restoring a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species
Fencing livestock from a riparian buffer at least 75' wide on one side of a stream, if one or more livestock crossings are planned, or from a buffer 50' wide on one side of a stream if no livestock crossings are planned

**Minimal riparian restoration actions include:**
Restoring vegetated riparian buffers of at least minimum buffer width on one side of a stream.
Fencing livestock from a riparian buffer at least 50' wide on one side of a stream, if one or more livestock crossings are planned, or from a buffer 25' wide on one side of a stream if no livestock crossings are planned

## Compensatory Stream Mitigation
## Definitions of Factors

**A well-designed relocated stream** has an appropriate geomorphic dimension, pattern and profile, maintains the capacity to transport bedload sediment, and is constructed with at least a 25' riparian buffer on each side of the stream.

**A minimally-designed relocated stream** has an appropriate geomorphic dimension, pattern, and profile and the streambanks are stabilized with tree revetments, willow plantings, or other non-rigid measures. **No mitigation credit is generated for relocated streams that are riprapped, constructed with concrete, or serve as stormwater conduits.**

**Excellent preservation actions include:**
Preserving vegetated riparian buffers at least 3X as wide as the minimum buffer width on both sides of a stream
Preserving vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species

**Good preservation actions include:**
Preserving vegetated riparian buffers at least 4X as wide as the minimum buffer width on one side of a stream or 2X as wide as the minimum buffer width on both sides of a stream
Preserving a vegetated riparian buffer of at least minimum buffer width on both sides or at least 2X minimal buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Preserving vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species

**Moderate preservation actions include:**
Preserving vegetated riparian buffers at least 3X as wide as the minimum buffer width on one side of a stream or 1X as wide as the minimum buffer width on both sides of a stream
Preserving a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Preserving vegetated riparian buffers of at least minimal buffer width on both sides or at least 2X minimal width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species

**Low preservation actions include:**
Preserving vegetated riparian buffers at least 2X as wide as the minimum buffer width on one side of a stream.
Preserving a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species

**Minimal preservation actions include:**
Preserving vegetated riparian buffers of at least minimum buffer width on one side of a stream.
Preserving stream channel, with at least 25' buffers on both sides of stream. No credit for channel preservation if only one bank of the stream has a 25' buffer.

**Non-profit Organization**: Non-profit organization means an entity recognized and operating under the rules of the Internal Revenue Services for non-profit purposes.

**Priority Areas**: These are stream and riverine systems with various levels of functional attributes that contribute to their existing physical, chemical and biological state. They may be systems that also have a high social, cultural, or economic component.

**Primary Priority**: These areas provide important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape or human values. Impacts to these areas should be rigorously avoided or minimized. Compensation for impacts in these areas should emphasize replacement nearby and in the same immediate 8-digit watershed. Designated **primary priority** areas include:

National Estuarine Research Reserves
Wild and Scenic Rivers
Designated shellfish grounds
Outstanding Resource Waters
Essential Fish Habitat
Waters on the 303(d) list
Primary trout streams
Federal or State listed threatened or endangered species waters
Streams in greenways corridors
Anadromous fish spawning habitat
State Heritage Trust Preserves
Waters adjacent to Federal or State protected areas or other mitigation sites
Waters officially designated by State or Federal agencies as high priority

**Secondary Priority**: Secondary priority areas include:

Waters with Federal Species of Management Concern or State listed rare or uncommon species
Secondary trout streams
Stream and river reaches within 0.5 mile upstream or downstream of primary priority reaches
Stream or river reaches within high growth areas that aren't ranked as primary priority systems
Stream or river reaches within 0.5 miles of a groundwater recharge area
Stream or river reaches within 0.5 miles of a drinking water withdrawal site

**Tertiary Priority**: These areas include all other freshwater or tidally influenced lotic systems not ranked as primary or secondary priority.

**Size of Impact**: Cumulative impact means the total linear feet of stream impacted by the project.

**Stable Stream**: A naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not degrade or aggrade. Naturally stable streams must be able to transport the sediment load supplied by the watershed. Instability occurs when scouring causes the channel to incise (degrade) or when excessive deposition causes the channel bed to rise (aggrade).

**Sinuosity and Stream Pattern**: Stream pattern describes the view of a stream channel as seen from above. Streams are rarely straight; they tend to follow a sinuous path across a floodplain. Sinuosity of a stream is defined as the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, streamflow, and the bed and bank materials.

## Compensatory Stream Mitigation
## Definitions of Factors

**Stream Profile**: The profile of a stream refers to its longitudinal slope. At the watershed scale, channel slope generally decreases in the downstream direction with commensurate increases in streamflow and decreases in sediment size. Channel slope is inversely related to sinuosity, so steep streams have low sinuosities and flat streams have high sinuosities.

**Threat**: Threat is an assessment of the level of imminent risk of loss or damage to a system.

**Width/Depth Ratio**: The width/depth ratio is an index value that indicates the shape of the channel cross-section. It is the ratio of the bankfull width divided by the mean depth at bankfull.

## STREAM MITIGATION WORKSHEETS

## ADVERSE IMPACT TABLE

| Factors | Options | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lost Type | Intermittent<br>0.3 | | | >2nd Order Perennial Stream<br>0.5 | | | 1st or 2nd Order Perennial Stream<br>0.7 | | |
| Priority Area | Tertiary<br>0.1 | | | Secondary<br>0.2 | | | Primary<br>0.4 | | |
| Existing Condition | Impaired .....<br>0.1 | | | Somewhat Impaired.....<br>0.5 | | | Fully Functional<br>0.8 | | |
| Duration | Seasonal<br>0.05 | | | 0-1 Year<br>0.1 | | | > 1 Year<br>0.2 | | |
| Dominant Impact | Shade/ Clear<br>0.05 | Utility X-ing<br>0.1 | Armor<br>0.15 | Deten-tion (weir)<br>0.75 | Road X-ing<br>1.0 | Im-pound (dam)<br>1.5 | Morpho-logic<br>2.0 | Pipe<br>2.5 | Fill<br>3.0 |
| Linear Distance | <100<br>0 | 100-200<br>0.05 | 201-500<br>0.1 | 501-1000<br>0.2 | 1001-2000<br>0.4 | 2001-3000<br>0.6 | 3001-4000<br>0.8 | 4001-5000<br>1.0 | >5000<br>N/A |

| Factor | Area 1 | Area 2 | Area 3 | Area 4 | Area 5 |
|---|---|---|---|---|---|
| Lost Type | | | | | |
| Priority Area | | | | | |
| Existing Condition | | | | | |
| Duration | | | | | |
| Dominant Impact | | | | | |
| Linear Distance | | | | | |
| Sum of Factors | M= | | | | |
| Linear Feet Impact | A= | | | | |
| M X A | | | | | |

**Total Mitigation Credits Required = (M X A) = _____**

# STREAM AND RIPARIAN RESTORATION MITIGATION FACTORS FOR RIVERINE SYSTEMS

| Factors | Options | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Net Benefit | Riparian Restoration | | | | | Stream Restoration | | |
| | Minimal 1.2 | Low 1.3 | Moderate 1.4 | Good 1.7 | Excellent 1.9 | Moderate 1.6 | Good 2.0 | Excellent 3.0 |
| Monitoring/ Contingency | Minimal 0.1 | | Moderate 0.2 | | Substantial 0.3 | | Excellent 0.4 | |
| Priority Area | Tertiary 0.05 | | | Secondary 0.1 | | | Primary 0.15 | |
| Location | Outside Watershed 0.1 | | | Offsite 0.5 | | | Onsite 1.0 | |
| Control | Sub-divided 0 | Private-RC 0.05 | | Private-CE 0.1 | POA-RC 0.1 | | POA-CE 0.15 | Conservancy 0.2 |
| Kind | Out-of-Kind 0 | | | | | | In-Kind 0.1 | |
| Credits | Schedule 5 0 | | Schedule 4 0.02 | | Schedule 3 0.05 | | Schedule 2 0.08 | Schedule 1 0.1 |

| Factors | Area 1 | Area 2 | Area 3 | Area 4 | Area 5 |
|---|---|---|---|---|---|
| Net Benefit | | | | | |
| Monitoring/ Contingency | | | | | |
| Priority Area | | | | | |
| Location | | | | | |
| Control | | | | | |
| Kind | | | | | |
| Credits | | | | | |
| Sum Factors | M = | | | | |
| Linear Feet | A = | | | | |
| M X A = | | | | | |

**Total Restoration Credits = (M X A) = _____**

1.9
0.2
0.05
0.1
0
0.25

**Attachment 1.** Worksheet of Debits owed by Genesis as Calculated by the Trustees

## STREAM MITIGATION WORKSHEETS

### ADVERSE IMPACT TABLE

| Factors | Options | | |
|---|---|---|---|
| ostType | Intermittent<br>0.3 | >2nd Order Perennial Stream<br>0.5 | 1st or 2nd Order Perennial Stream<br>0.7 |
| Priority Area | Tertiary<br>0.1 | Secondary<br>0.2 | Primary<br>0.4 |
| Existing Condition | Impaired ..... Somewhat Impaired ..... Fully Functional<br>0.1 | 0.5 | 0.8 |
| Duration | Seasonal<br>0.05 | 0-1 Year<br>0.1 | > I Year<br>0.2 |

| Dominant Impact | Shade/ Clear | Utility X-ing | Armor | Deten-tion (weir) | Road X-ing | Im-pound (dam) | Morpho-logic | Pipe | Fill |
|---|---|---|---|---|---|---|---|---|---|
| | 0.05 | 0.1 | 0.15 | 0.7 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
| Linear Distance | <100 | 100-200 | 201-500 | 501-1000 | 1001-2000 | 2001-3000 | 3001-4000 | 4001-5000 | >5000 |
| | 0 | 0.0 | 0.1 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | N/A |

| Factor | Area I | Area 2 | Area 3 | Area 4 | Area 5 |
|---|---|---|---|---|---|
| Lost Type | 0.3 | 0.3 | 0.7 | | |
| Priority Area | 0.1 | 0.1 | 0.1 | | |
| xisting Condition | 0.1 | 0.5 | 0.5 | | |
| Duration | 0.2 | 0.2 | 0.2 | | |
| Dominant Impact | 2.0 | 1.0 | 1.0 | | |
| Linear Distance | 1.0 | 1.0 | 1.0 | | |
| Sum of Factors | M=<br>3.7 | 3.1 | 3.5 | | |
| Linear Feet impact | A=<br>4354 | 8666 | 10900 | | |
| M X A | 16109.8 | 26864.6 | 38150 | | |

**Total Mitigation Credits Required = (M X A) = 81124.4**

**Attachment 2.** Calculation of Credits earned by Genesis for on-site Stream Restoration Project

STREAM MITIGATION WORKSHEETS

# STREAM AND RIPARIAN RESTORATION MITIGATION FACTORS FOR RIVERINE SYSTEMS

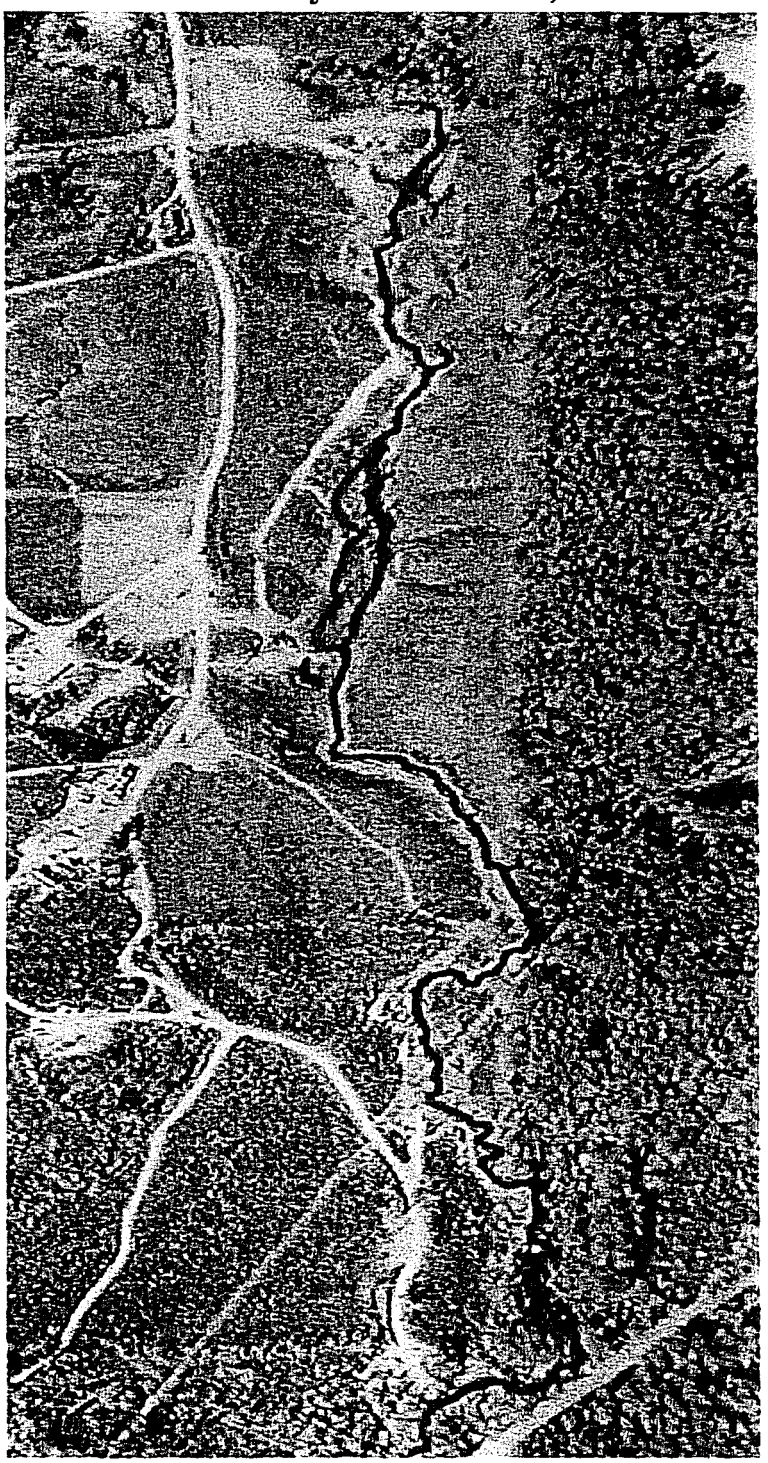
| Factors | Options | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Net Benefit | Riparian | | | | | Stream Restoration | | |
| | Min-imal | Low | Mod-erate | Good | Ex-cellent | Mod-erate | Good | Excellent |
| | 1.2 | 1.3 | 1.4 | 1.7 | 1.9 | 1.6 | 2.0 | 3.0 |
| Monitoring/ Contingency | Minimal 0.1 | | Moderate 0.2 | | Substantial 0.3 | | Excellent 0.4 | |
| Priority Area | Tertiary 0.05 | | Secondary 0.1 | | Primary 0.15 | | | |
| Location | Outside Watershed 0.1 | | Offsite 0.5 | | Onsite 1.0 | | | |
| Control | Sub-divided | Private-RC | Private -CE | POA-RC | POA-CE | Conservancy | | |
| | 0 | 0.0 | 0.1 | 0.1 | 0.15 | 0.2 | | |
| Kind | Out-of-Kind 0 | | | | In-Kind 0.1 | | | |
| Credits | Schedule 5 | Schedule 4 | Schedule 3 | Schedule 2 | Schedule I | | | |
| | 0 | 0.02 | 0.05 | 0.08 | 0.1 | | | |

| Factors | Area 1 | Area 2 | Area 3 | Area 4 | Area 5 |
|---|---|---|---|---|---|
| Net Benefit | 2 | 1.6 | | | |
| Monitoring/ Contingency | 0.2 | 0.2 | | | |
| Priority Area | 0.05 | 0.05 | | | |
| Location | 1 | 1 | | | |
| Control | 0.05 | 0.05 | | | |
| Kind | 0.1 | 0.1 | | | |
| Credits | 0 | 0 | | | |
| Sum Factors | M = 3.4 | 3.0 | | | |
| Linear Feet | A = 5530 | 2545 | | | |
| M X A = | 18802 | 7635 | | | |

**Total Restoration Credits = (M X A) = 26,437**

**Appendix 11** - Stream Restoration Plan developed by The Nature Conservancy for this Incident

# Conceptual Restoration Plan
# For
# Unnamed Tributary to Leaf River, Collins MS.



October 12, 2002/ Edited May 24, 2004

# Table of Contents

# 1.0 Existing Site Conditions

## 1.1. Existing Condition of Subject Watershed

The existing condition of the subject watershed was determined by aerial photo analysis and field visits to the subject site during 2002. The dominant land-use within the subject watershed is Loblolly Pine plantations with a high-intensity rotational harvest / replant cycle. This type of forest management most often causes excessive erosion in moderately steep channels and floodplains, due mainly to changes in the hydrologic regime, changes in sediment discharge, and the amount of coarse organic (woody) debris entering the channel. The second most prevalent land-use that occurs within the subject watershed is petroleum exploration and production. The scale of this land-use can swing wildly with market fluctuations and could become a potential source for future development pressure (land clearing and increased runoff). The subject watershed is entirely in private land ownership and thusly enjoys no restrictive covenants or conservation easements to date. This may greatly reduce the chance for the stream channel to reach a stable (dynamic equilibrium) state for its desired future condition (DFC).

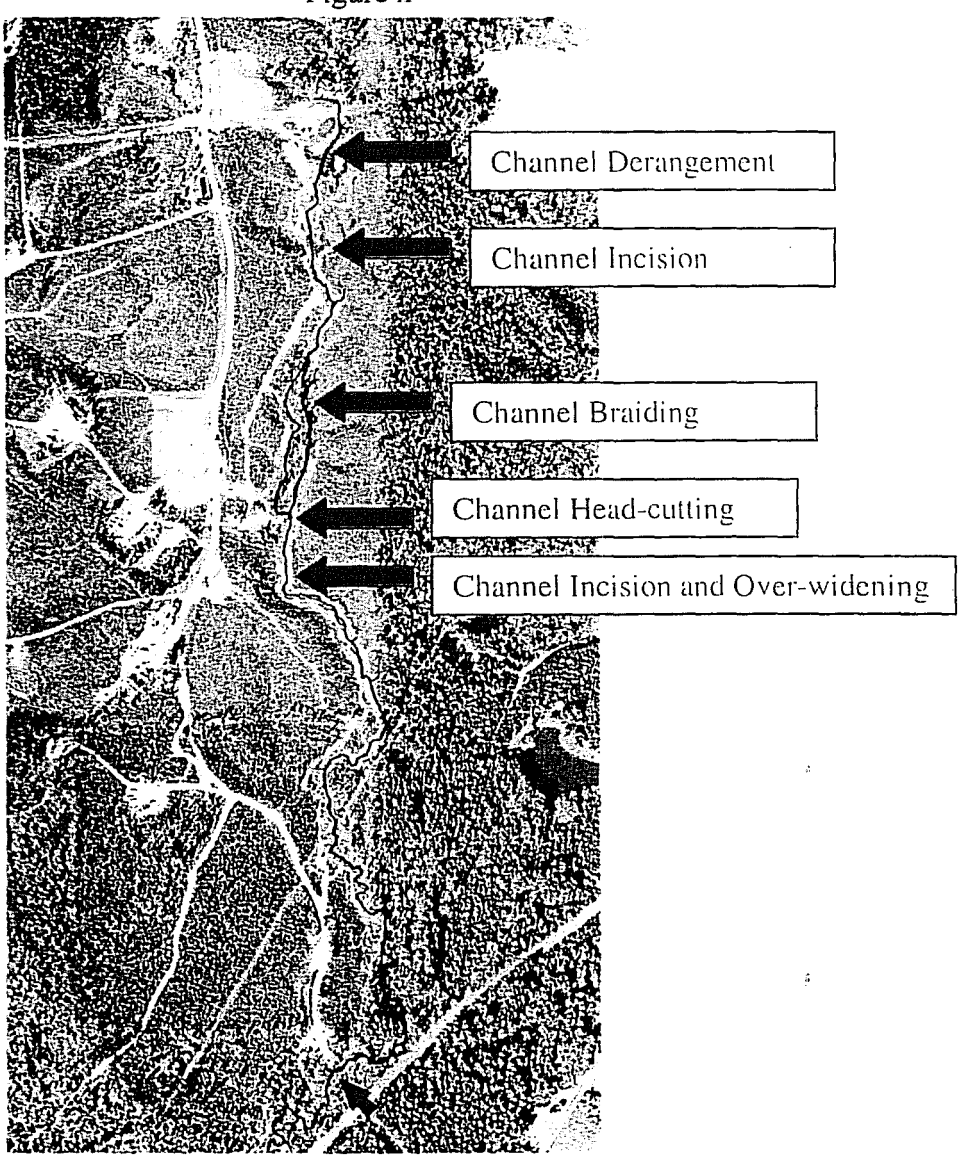
Figure 1.1.a

Figure 1.1.b

## 1.2 Existing Condition of Subject Channel Reach

The existing condition of the subject channel reach was determined by site visits and a pedestrian survey of the entire channel length during 2002. While conducting the pedestrian survey we performed a coarse scale assessment of the subject channel's geomorphic stability. We found the subject stream channel to be in very unstable condition. We recognized the following five major exhibitions of geomorphic instability: 1.) Channel derangement, 2.) Channel braiding, 3.) Channel incision, 4.) Rotational bank failure, 5.) Head-cut migration. The most severe perturbation to the subject channel within our study reach is the head-cut migration. We surveyed the entire channel from the headwater area down to the subject channel's confluence with the Leaf River. We observed many head-cutting knick-points that are eroding headward (in the upstream direction) as the subject stream works to flatten its gradient (slope along the longitudinal profile). Please refer to attached Power Point Slides for additional site photographs.

Figure x



# 2.0 Conceptual Restoration Strategies

## 2.1 Prescribed Conceptual Operational Plan for the Restoration of Subject Stream Reach

The prescribed conceptual restoration strategies for the subject stream reach will be implemented using the following three phase operational plan:

Phase 1.

- Locate and Measure Stable Reference Stream Reach with the similar watershed landuses and watershed properties as the Subject Stream Reach.
- Develop Preliminary Construction Design Plans
- Submit 30% Design Plans to Regulatory Agencies and Incorporate Agency Feedback
- Submit 60% Design Plans to Regulatory Agencies and Incorporate Agency Feed back
- Submit 90% Design Plans to Regulatory Agencies and Incorporate Agency Feedback
- Finalize Design Plans and Submit Plans to Agency and Contractors

Phase 2.

- Salvage and depot any existing vegetation to be transplanted post construction
- Divert Stream Flow to a stabilized diversion ditch for the duration of the construction phase and implement erosion control measures to reduce and abate site runoff to the downstream reach
- Conduct earth work operations to grade and cut the subject stream reach and floodplain to design plan specifications
- Install bioengineering treatments to channel and floodplain
- Relocate the transplanted vegetation to appropriate areas and reforest the remaining riparian buffer zones
- Conduct as-built post construction survey and establish monumented cross-sections and longitudinal profiles for the restored channel and floodplain

Phase 3.

- Route the stream flow through newly constructed channel and observe channel adjustments to flow
- Conduct post construction monitoring of the stream channel geomorphic stability
- Prepare a condition report each year for a five year duration

## 2.2 Discussion of Prescribed Restoration Strategies and Techniques

The goal of the restoration plan is to realign and construct a channel and floodplain with the appropriate planform, profile, and cross-sectional area to remain stable overtime. The prescribed treatment is to use heavy construction equipment to grade an adequate floodplain (width, gradient, and features) that allows for the reestablishment of appropriate sinuosity of the stream channel. To enhance the hydraulic residence time for the watershed there will be additional high-flow channels constructed offline from the main channel that will connect constructed oxbows with the main channel during high flow events. As presented in the watershed land-use discussion, the stream channel will be subjected to significant disturbance at an average thirty-year frequency due to high intensity forestry practices. During site visits with Agency personnel, we discussed offline channel water features (oxbows or floodplain pools) to enhance ecosystem functions and to provide additional habitat for wildlife. A major function of the floodplain pools would be the addition of flood flow storage. These features while

providing habitat will also store floodwaters and attenuate flows allowing more treatment time of sediment-laden waters. This benefit will assist the riparian buffers in mitigating for the excessive sediment and increased water runoff that will result from future timber clear-cuts within the subject watershed. Using the floodplain pools to slow flows down in consortium with using bioengineering treatments such as log J Hook Cross Vanes and log Grade Stabilization Structures will greatly enhance the subject stream reach's ability to remain stable. native hardwood logs will be used to provide grade stabilization along the longitudinal profile and root-wads will be used where appropriate to increase the surface roughness of the channel banks.

Live staking will be used on the banks of the newly constructed channel to stabilize the disturbed soil. The typical live staking treatment for the type of soils that we will be working with is a one-foot by one-foot spacing with willow bundles set horizontally to interface the bankfull flow elevation. A native seed mix along with transplanted sedges and rushes will be used to quickly stabilize the channel edges and top of banks. The establishment of vegetation and the reforestation efforts will be scheduled with sufficient time to establish roots prior to the redirecting of stream flow to the newly constructed channels and floodplain pools.

The riparian buffers will be planted in accordance with the guidelines set forth by the USACE Savannah Stream Mitigation Standard Operating Procedure regarding buffer widths to generate stream restoration credits. The designated riparian zones will be reforested (hand planted) with an appropriate native hardwood community with a stand stocking density of eight foot by eight foot centers.

With proper adjustments to channel planform, profile, and cross-section along with the proper application of bioengineering treatments and riparian buffer establishment the subject stream reach is fully expected to reach a level that approaches geomorphic stability. Although it will be highly unlikely that the subject stream reach will attain a state of dynamic equilibrium given the repetitive disturbance of clear-cutting. We predict that the rates of channel bed and bank erosion measured on the newly constructed channel will be equal to or less than the natural streams in the surrounding area and watershed that are experiencing similar landuses and landcover perturbations.

# 3.0 Stream Mitigation Credit Production

## 3.1 Methodologies Used

The methods used to determine stream restoration credit production for the conceptual restoration plan was the USACE Savannah District SOP-Stream Mitigation Worksheet.

## 3.2 Estimated Credits Produced by the Conceptual Restoration Plan

The prescribed conceptual restoration plan for the subject stream reach will result in the restoration of 5,530 linear feet of Priority One geomorphic restoration and 2545 linear feet of Priority Three geomorphic restoration. The prescribed restoration scenario will produce a total of 26,437 stream restoration credits. The restoration of the mainline subject channel and the creation of the offline high flow channels and floodplain pools will produce approximately 18,802 stream restoration credits. The restoration and stabilization of the channels in area two will produce an additional 7635 stream restoration credits. The stream credit production summary is depicted in table 3.2.a.

Table 3.2.a

**Stream Mitigation Worksheets**

**Stream and Riparian Restoration Mitigation Factors For Riverine Systems**

| Factors | Options | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Net Benefit | Riparian Restoration | | | | | Stream Restoration | | |
| | Minimal 1.2 | Low 1.3 | Moderate 1.4 | Good 1.7 | Excellent 1.9 | Moderate 1.6 | Good 2.0 | Excellent 3.0 |
| Monitoring/ | Minimal 0.1 | | Moderate 0.2 | | Substantial 0.3 | | Excellent 0.4 | |
| Priority Area | Tertiary 0.05 | | | | Secondary 0.1 | | Primary 0.15 | |
| Location | Outside Watershed 0.1 | | | | Offsite 0.5 | | Onsite 1 | |
| Control | Subdivided 0 | | Private-RC 0.05 | | Private-CE 0.1 | POA_RC 0.1 | POA-CE 0.15 | Conservancy 0.2 |
| Kind | Out-of-Kind 0 | | | | | In-Kind 0.1 | | |
| Credits | Schedule 5 0 | | Schedule 4 0.02 | | Schedule 3 0.05 | Schedule 2 0.08 | Schedule 1 0.1 | |

| Factors | Area 1 | Area 2 | Area 3 | Area 4 | Area 5 |
|---|---|---|---|---|---|
| Net Benefit | 2 | 1.6 | | | |
| Monitoring / Contingency | 0.2 | 0.2 | | | |
| Priority Area | 0.05 | 0.05 | | | |
| Location | 1 | 1 | | | |
| Control | 0.05 | 0.05 | | | |
| Kind | 0.1 | 0.1 | | | |
| Credits | 0 | 0 | | | |
| Sum of Factors (M) = | 3.4 | 3 | 0 | 0 | 0 |
| Linear Feet Impact (A) = | 5530 | 2545 | | | |
| M(A) = | 18802 | 7635 | 0 | 0 | 0 |
| | | | Total Restoration Credits = M(A) = | | 26437 |

# GENESIS STREAM RESTORATION
Construction Plans for Restoration Activities

## Phases:

Construction of all restoration activities shall be conducted in phases. The site is currently set up to include five phases. *Phase 1* shall be devoted to excavating the ground water treatment oxbow in vicinity of station 2+50 and the large oxbow lake in vicinity of station 31+00. These lakes will serve multiple purposes throughout construction implementation. The ground water treatment oxbow lake at station 2+50 will receive NPDES dischare from the ground water treatment system. *Phase 2* will include all construction of bom the new stream channel and all structures between the new stream channel stations 31+50[1] and 47+60. Any activities involving the pipes at the end of the project area shall be implemented during this phase. *Phase 3* shall include all construction/restoration activities between new stream channel stations 0+00 and 17+00. *Phase 4* continues beyond phase 3 beginning at station 17+00 and ending at station 31+50. Activities include bank stabilization, new channel construction and bioengineering. During phase 4, the new tributary and all structures associated with the oxbow lake will also be constructed. *Phase 5* will include all construction/restoration activities beyond station 47+60. Activities include bank stabilization and bioengineering.

## Water Diversion:

A water diversion plan shall be implemented to allow any and all construction/restoration activities to be conducted in the driest conditions possible. This includes the new stream channel and the new tributary channel and all structures associated with these channels to be constructed to for the purpose of minimizing erosion and sedimentation. The proposed diversion technique is currently phased to provide drier conditions throughout construction. *Phase 1* of the water diversion will be to reactivate an abandoned channel and will be located between stations 5+00 and 20+00. *Phase 2* of the water diversion includes routing water into the existing channel at station 20+00 and then flows into a trench that is connected to the oxbow lake. *Phase 3* of the water diversion involves creating a channel in such a manner that all water is routed into the previously constructed oxbow lake. The existing stream channels shall be "plugged" with impervious select material to divert water into any trenches and the lake. The water shall then be pumped from the lake to a downstream location beyond the construction phase 2 working limits. A settling basin shall be placed at the end of all diversions to trap sediment before water re-enters the lake or stream. All trenches shall be lined with filter fabric to reduce erosion.

## Grading/Staging Areas:

[1] Station numbering (37+50, 41+20, etc.) corresponds to the "stream stations" ( 3750', 4120', etc.) as depicted on Map Page 3 of 3.

Several areas have been designated to provide the project site with staging areas for materials and equipment. These areas include may need additional grading for the purposes of increasing the floodplain boundary or for any material needed to fill the existing channels. Not all staging areas will need to be graded.

**Clay Source Areas:**

Clay material shall be needed throughout construction and used as impervious select material to prevent the new stream channel from reoccupying the existing (degraded) channel. The designated areas have been verified in the field and shall be used as needed.

**Stream/Diversion Crossings:**

Two crossings will be needed to complete construction. One shall be placed near station 9+00 to provide equipment access to the adjoining clay source and phase 1 of the water diversion. Another crossing will allow access of heavy equipment to cross phase 3 of the water diversion. This crossing will consist of water flowing through a pipe large enough to support the weight of heavy equipment.

**Tributaries:**

Two tributaries flow into the project stream; one located at station 16+50 and the other at station 45+50. The confluence of each tributary shall be adjusted to match the grade of the newly constructed stream channel.

**Oxbow Lake:**

The oxbow lake shall be immediately excavated before any stream construction begins. This lake will serve multiple purposes. Two depth elevations are planned for the lake. The deepest area of the lake shall be up to 12 feet in depth. The shallow water area shall be at a depth of one foot or less to allow growth of emergent wetland vegetation.

**Structures:**

The new stream channel will be constructed with various structures placed strategically to protect he integrity of the new channel and to provide the stream with additional habitat. Currently, a palette of five "hard" structures are planned to be used as follows:

1. *Rootwads--* This provides the stream with bank slope protection in the meanders, energy dissipation, and habitat for invertebrates and small fish.
2. *Log sills--* Sills will be used to maintain grade in the new channel.
3. *J-Hook Vanes--* These will be used to control grade, dissipate energy, prevent streambank erosion, and to provide pool habitat.
4. *Cross Vanes--* Cross Vanes will be used to maintain grade where all tributaries are located.

5 *Notched Log Sill*-- This will be used at station 25+00. This allows the constructed tributary to be accessed during flooding.

**New Stream Channel:**

The new stream channel planned to be constructed is approximately 4800 linear feet and the new tributary channel is approximately 620 linear feet in length. Typical cross sections of the new stream and tributary channel are included. Two stream types will be constructed. Prior to station 31+50, the channel shall correspond to the parameters of the Rosgen classification of an "E". Below station 31+50, the "E" channel will transition into a "B" channel before eventually becoming a "Bc".

**Existing Channel:**

The existing channel shall be abandoned and filled with material excavated from the new channel. Impervious plugs shall be strategically placed along the new channel to prevent the new stream from re-occupying the previous channel.

**Bioengineering:**

Bank stabilization shall include a combination of techniques using native plants, biodegradable materials, and log structures to prevent erosion. Various techniques shall be used throughout the project as needed. Stone shall not be used in any of the construction involving the stream channel, tributary channel, or the oxbow lake. Stone may be used at the settling basins and at the pipe structures at the end of the project site.

**Post Construction Monitoring:**

*Hydraulic/ Hydrologic Data*:
There will be an established hydrologic monitoring network consisting of a pressure transducer surveyed in and utilized as a stage discharge gauge. There also will be an established rain gage with an in situ digital data logger to collect hydrologic runoff data.

*Geomorphic Monitoring*: (ChannelPlanform, Thalweg Profile, Channel Cross Section)
There will be 10 monumented channel cross sections established for the purpose of demonstration of stream restoration success and overall channel geomorphic stability. The channel cross section locations are referenced on the plan set. Thalweg profiles will tie into and reference each cross section set (such as Pool X Section 1-Riffle X Section 1). The thalweg profile will begin one full meander arc length upstream of each cross section set such as Pool X Section 1 and will end one full meander arc length downstream of the lower cross section of the cross section set such as Riffle X Section 1. Planform mapping will be conducted in the detailed study reaches where the cross sections and thalweg profiles are located.

*Photographic Monitoring*:
There will be twenty fixed point panoramic photographic stations established with two of the stations being established within each of the five thalweg profile study reaches. The photography will be conducted biannually and referenced in project reporting.

*Sedimentological Monitoring*:
There will be pebble counts conducted within each of the five study reaches following the project's post construction completion date. The pebble counts will be conducted at a frequency of years one, three, and five. The purpose of the pebble counts is to demonstrate the trend of coarse to fine sediments during channel stabilization and vegetation establishment.

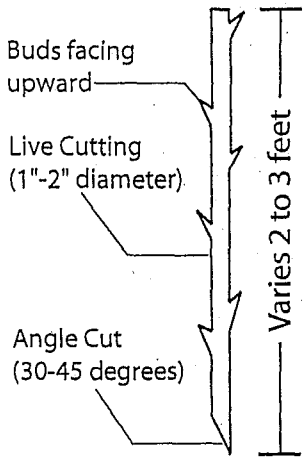
*Vegetation Survival and Recruitment Monitoring:*
There will be five vegetative sampling belt transects established, one within each study reach that crosses perpendicular to the thalweg profiles. Along each belt transect 15 square feet sampling plots will be established and monumented. The vegetation communities and densities will be sampled annually for the purpose of project success reporting and documentation.

**Remedial Action Plan**:

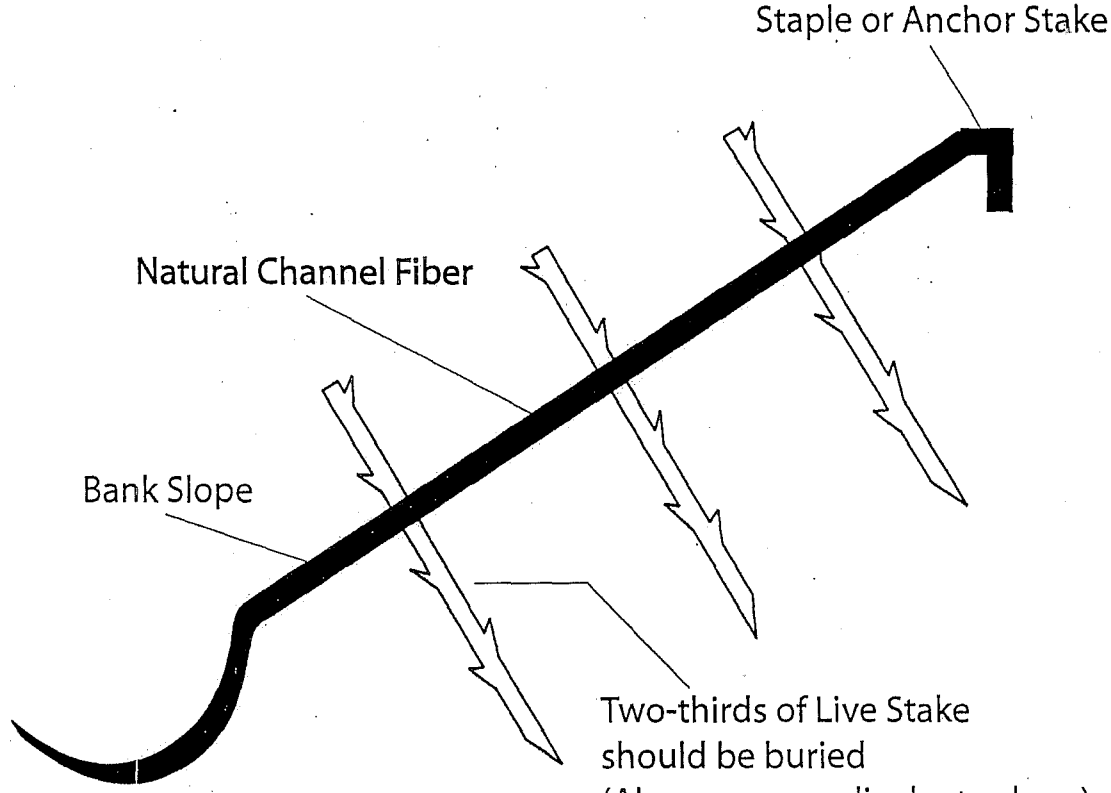
Remedial actions would begin following the discovery of structural failures and or failure in bioengineering treatments. Once structural failures were identified corrective actions would begin within sixty days of discovery or notification. Vegetation transplantation or reestablishment will be conducted during the dormant season following problem notification. All corrective actions will be situational dependant on the threat severity, the weather conditions, etc... The remedial action plan will be funded by a trust fund that was estimated at twenty percent of the project construction budget. This will ensure that post construction touch up work will be completed. The fund will also assist with the costs associated with post construction monitoring and reporting.

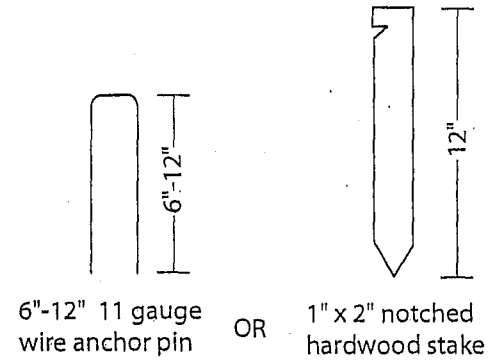
**Anticipated Work Schedule:**

All phases of construction, planting, and bioengineering treatment installation shall have a four month window to complete work. This includes any days lost due to inclement weather conditions, poor site conditions, or equipment failure. Any changes to the design plans made following the date of final approval are subject to increase the window of time for completion.




LIVE STAKE



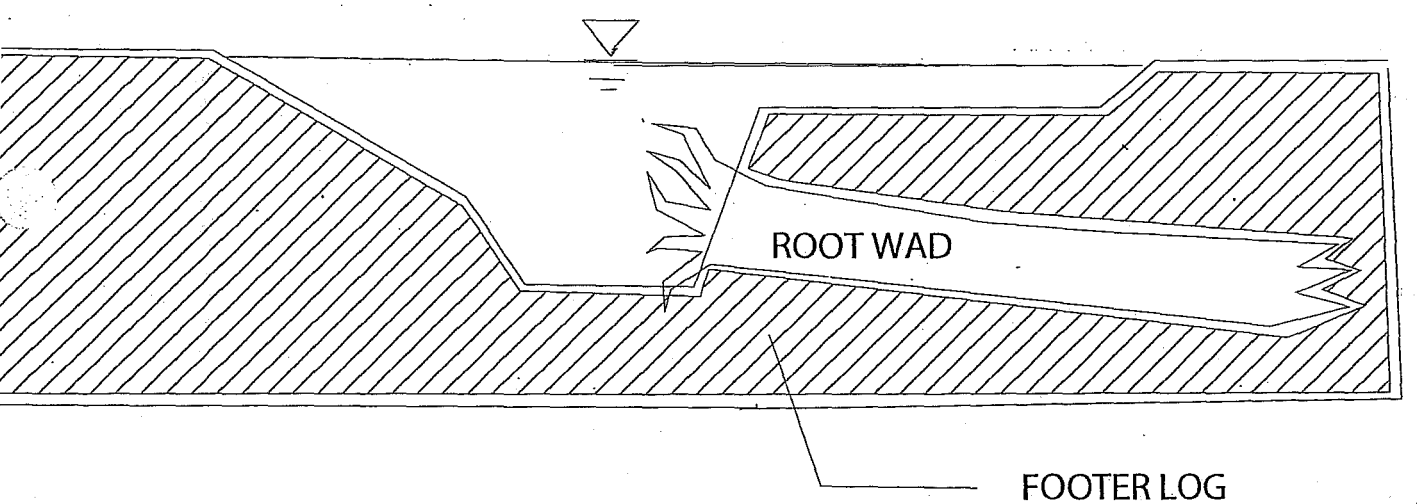




Anchoring

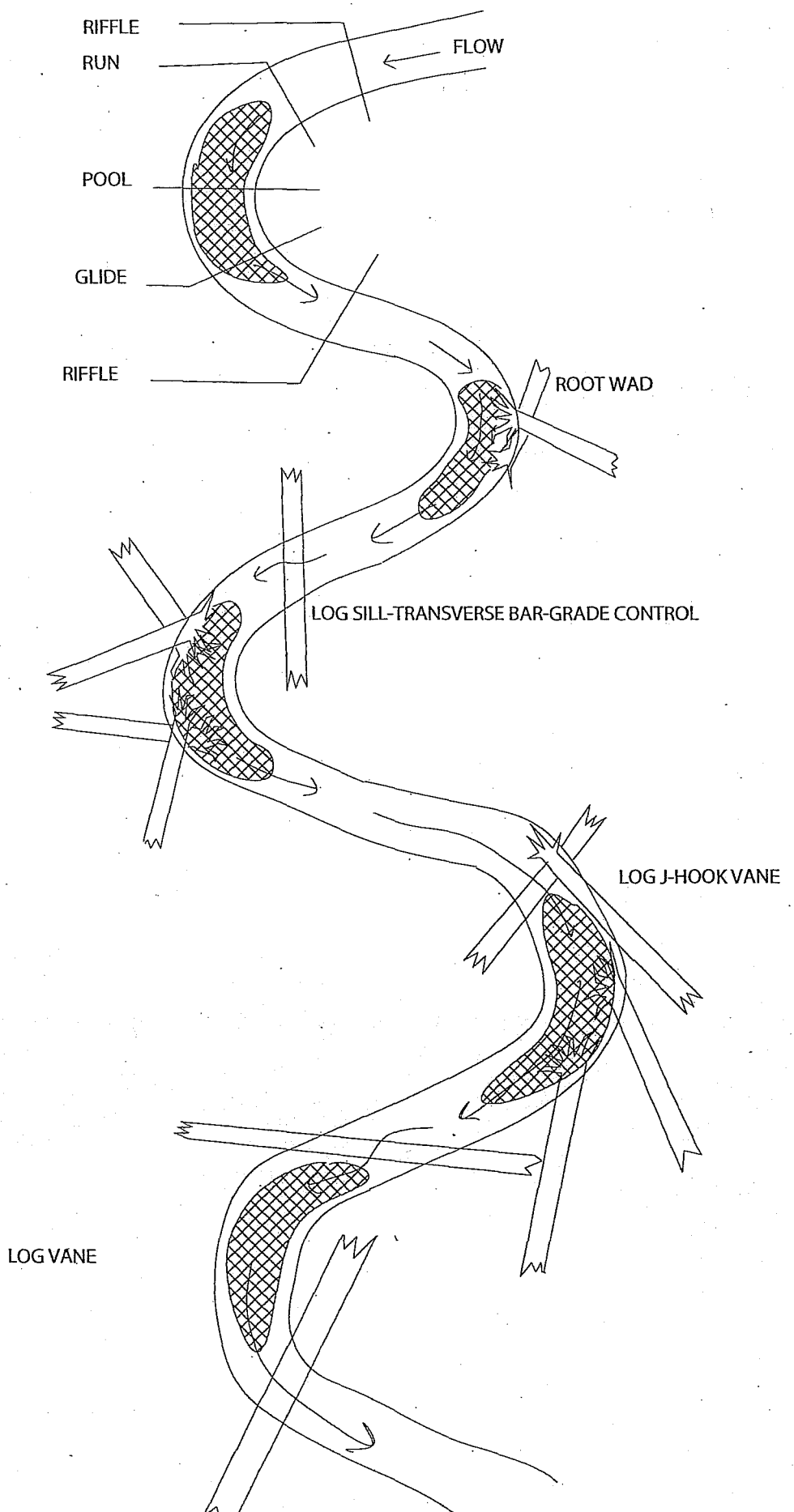
# LIVE STAKES

Scale: N.T.S.

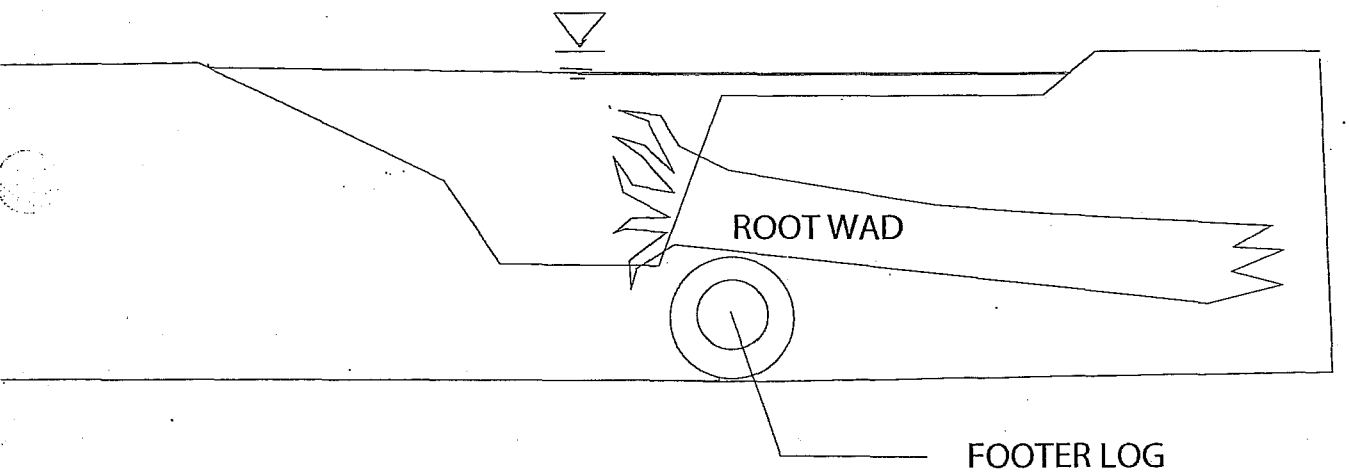
CROSS SECTION VIEW OF ROOT WAD WITHOUT FOOTER LOG



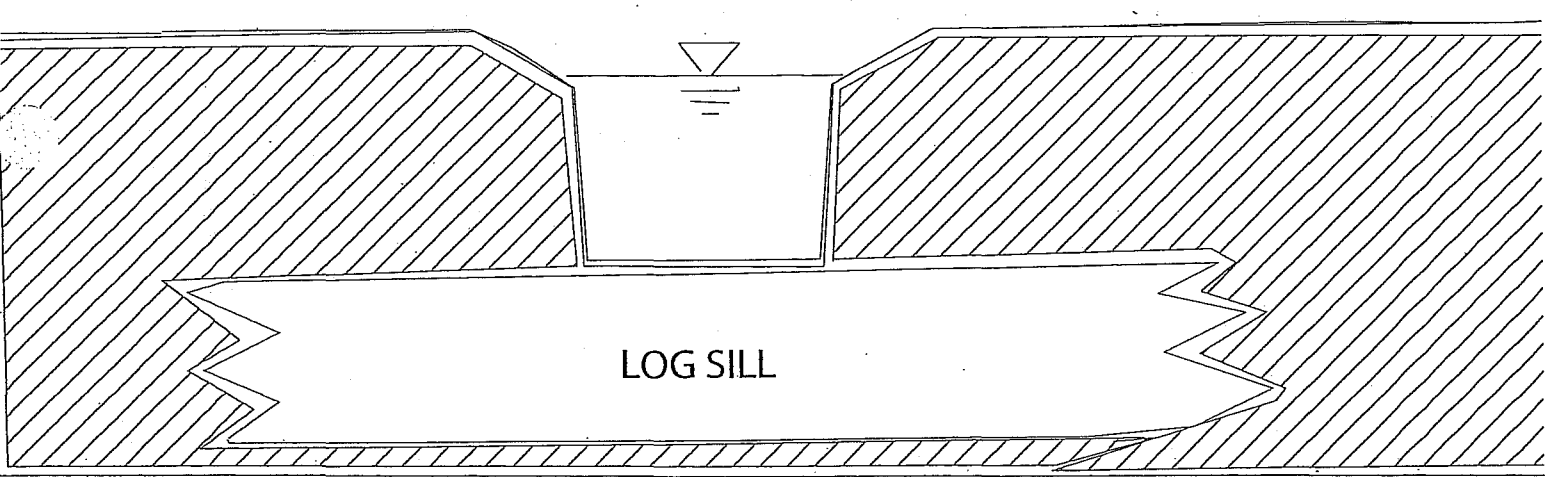
PLAN VIEW OF RESTORATION STRUCTURES

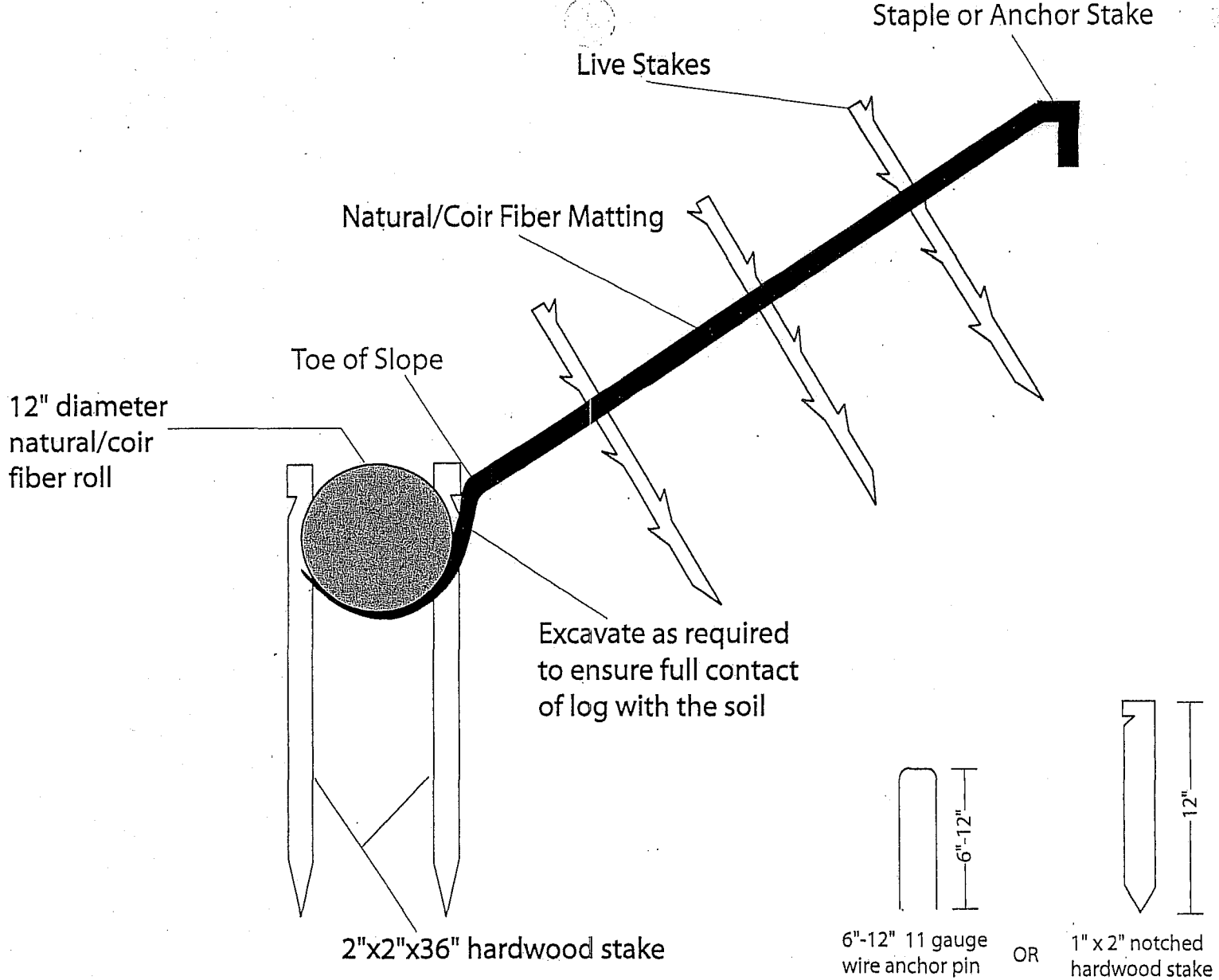


CROSS SECTION VIEW OF ROOT WAD WITH FOOTER LOG



CROSS SECTION TYPICAL FOR LOG SILL









Anchoring

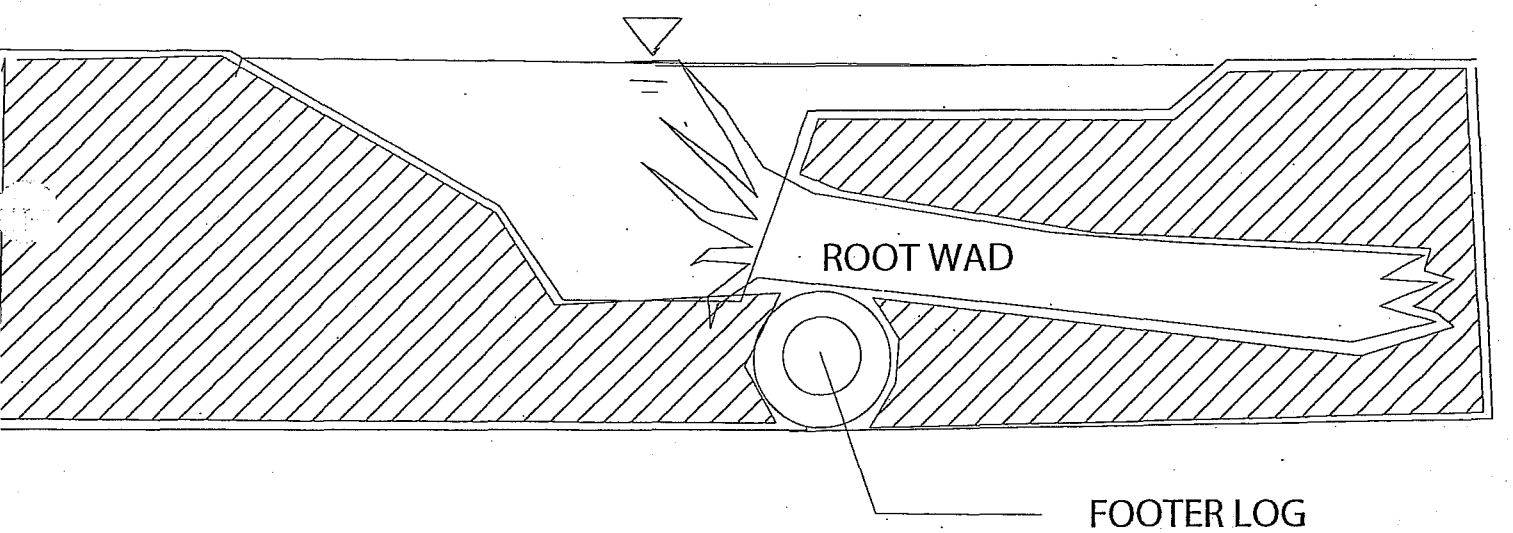
Note:

1. Stakes should be evenly spaced throughout length of the log 2 feet apart.
2. Stakes shall be driven flush with the fiber roll.

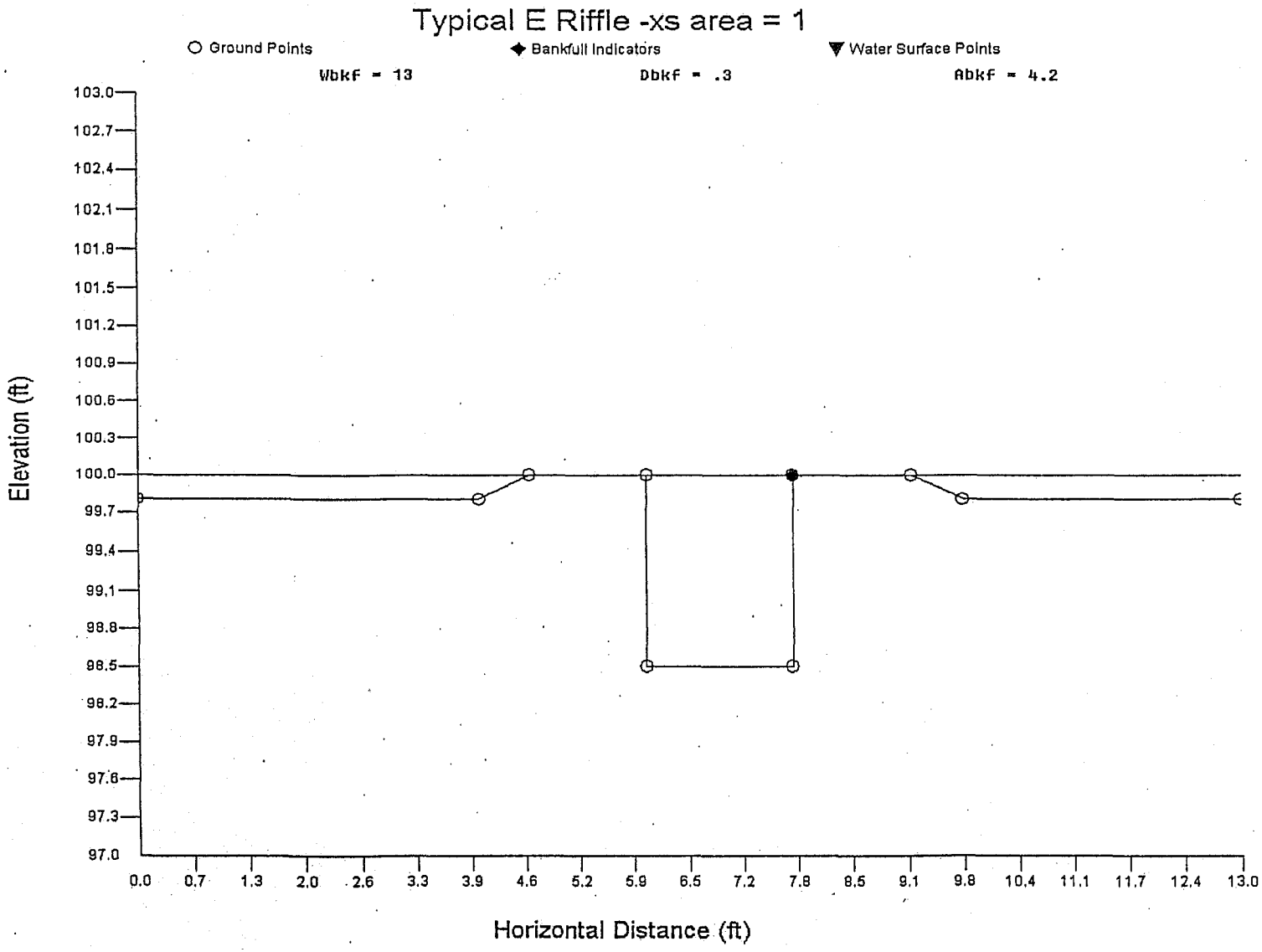
# NATURAL/COIR FIBER ROLL

Scale: N.T.S.

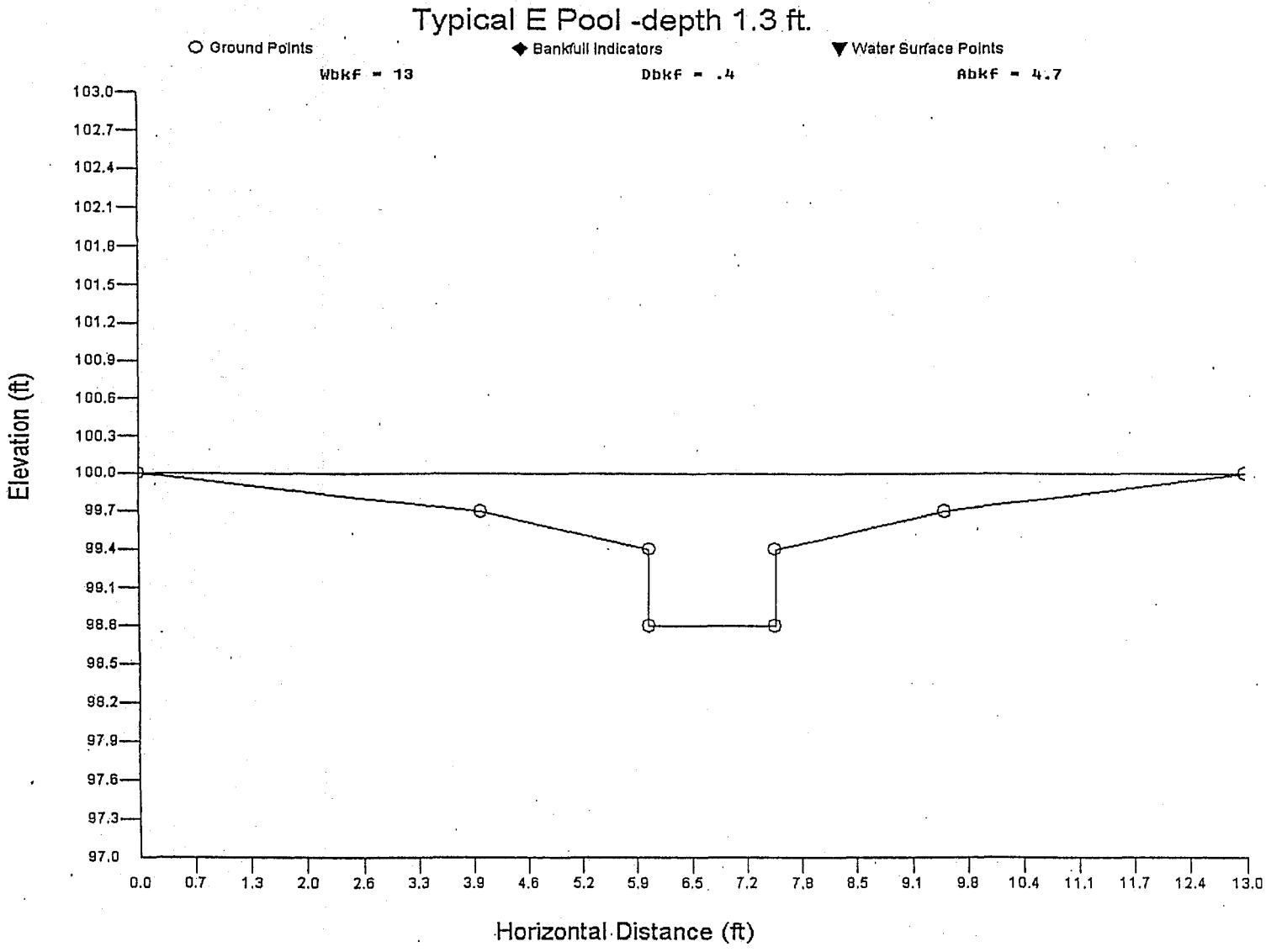
CROSS SECTION VIEW OF ROOT WAD WITH FOOTER LOG



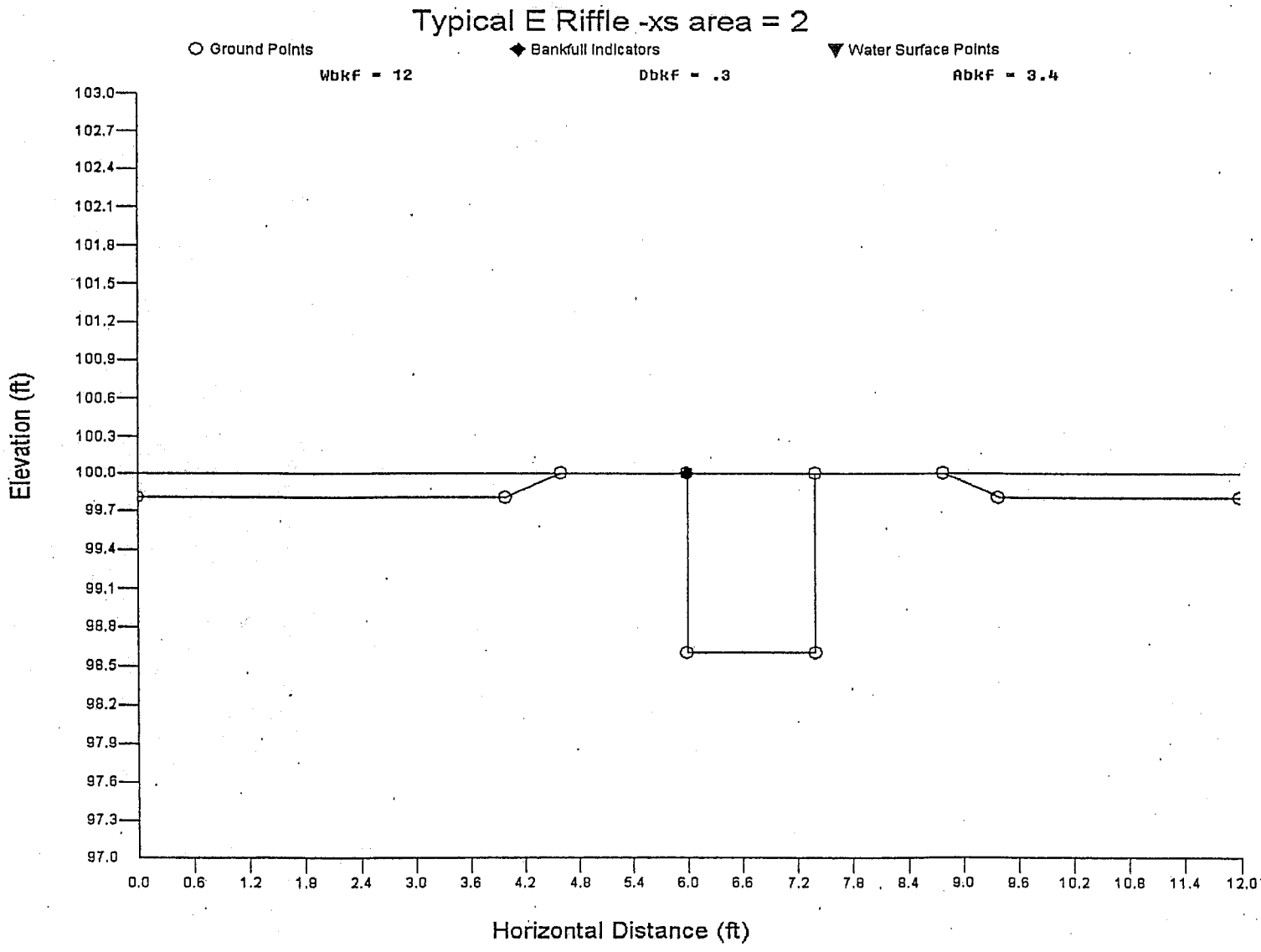
*Corresponds to Monitoring Cross Section : Riffle XS 4*
*See Map*



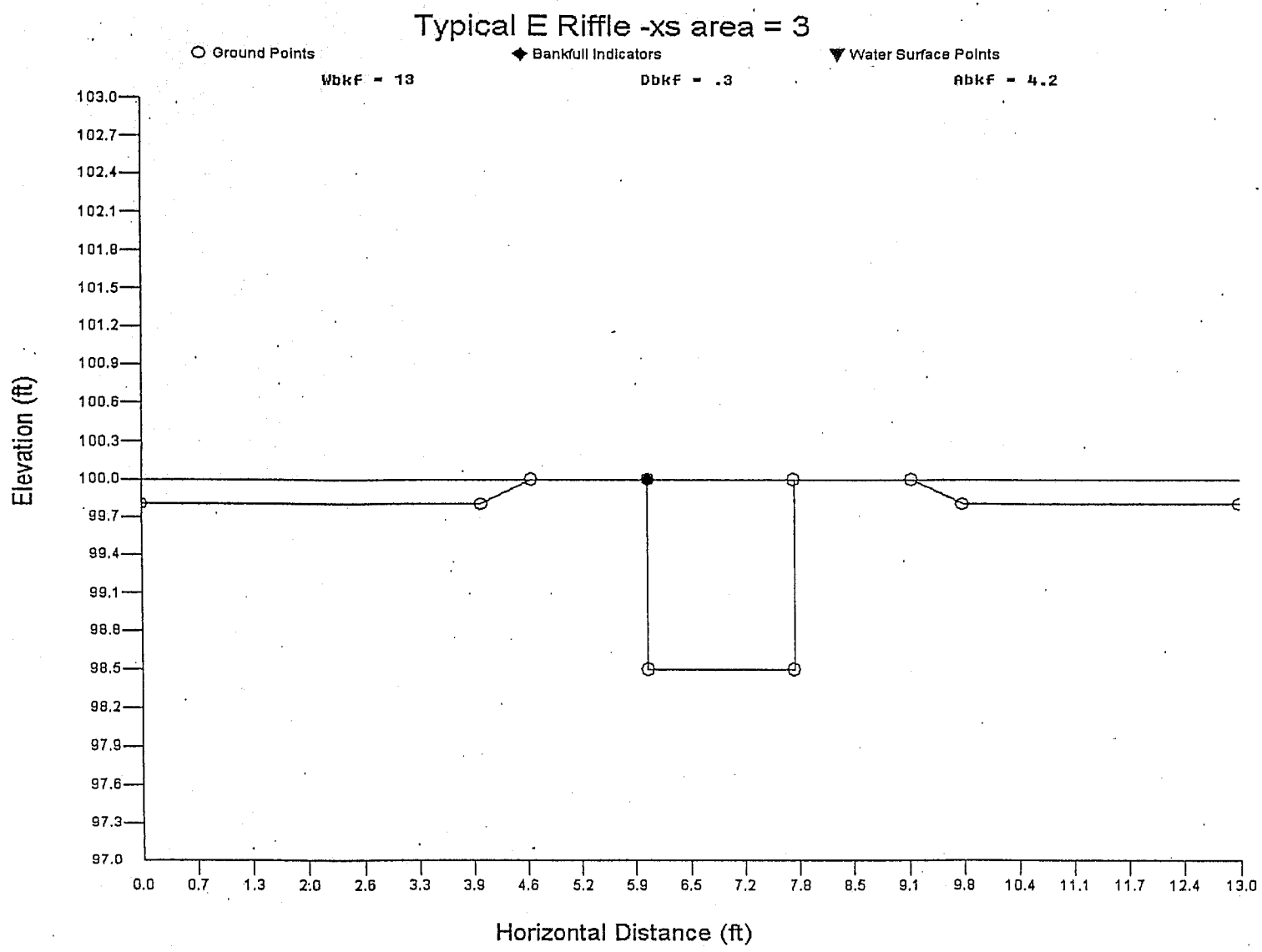
*Corresponds to Monitoring Cross Section : Pool XS 4*
*See Map*

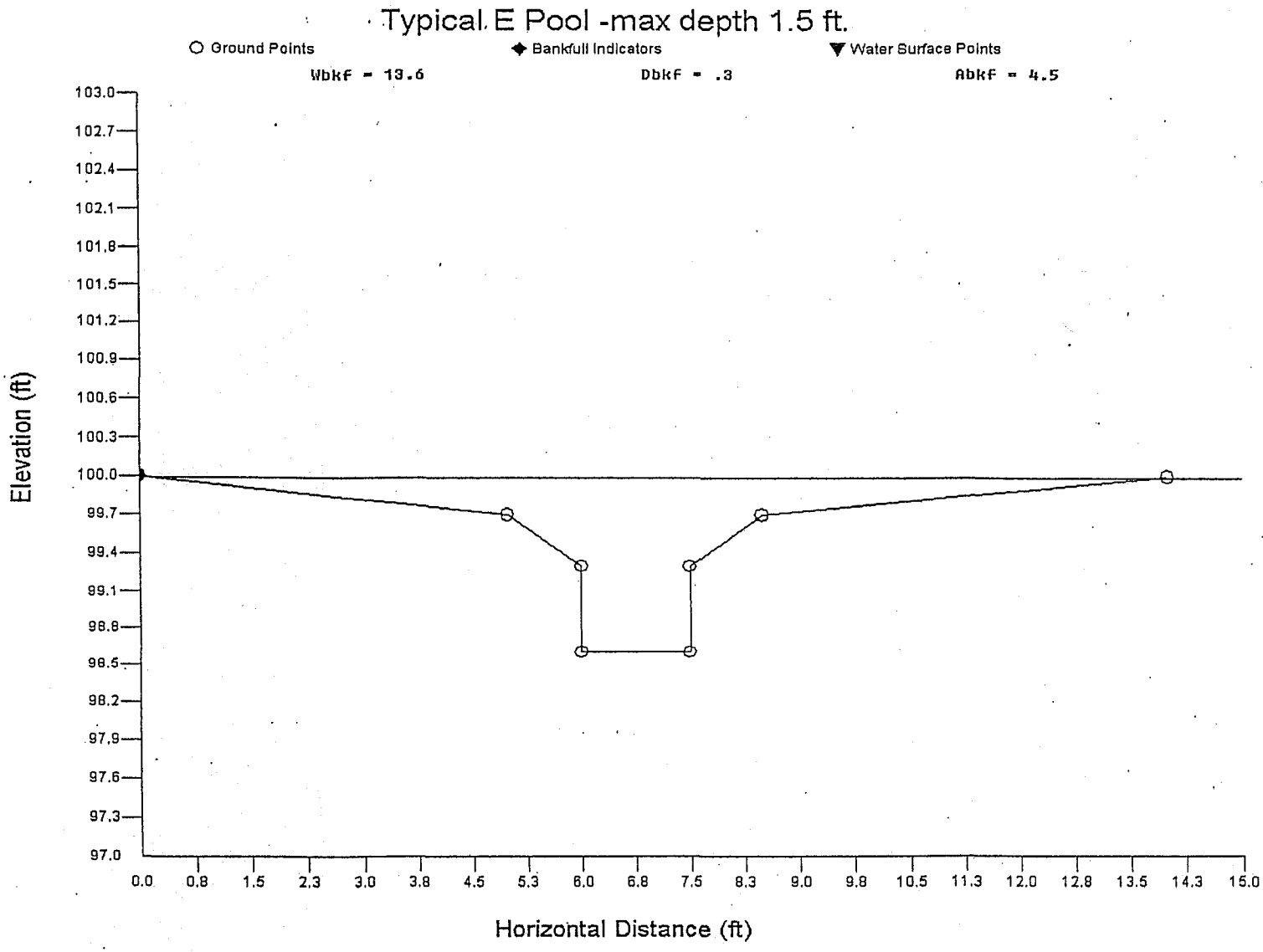


*Corresponds to Monitoring Cross Section : Riffle XS 1*
*See Map*

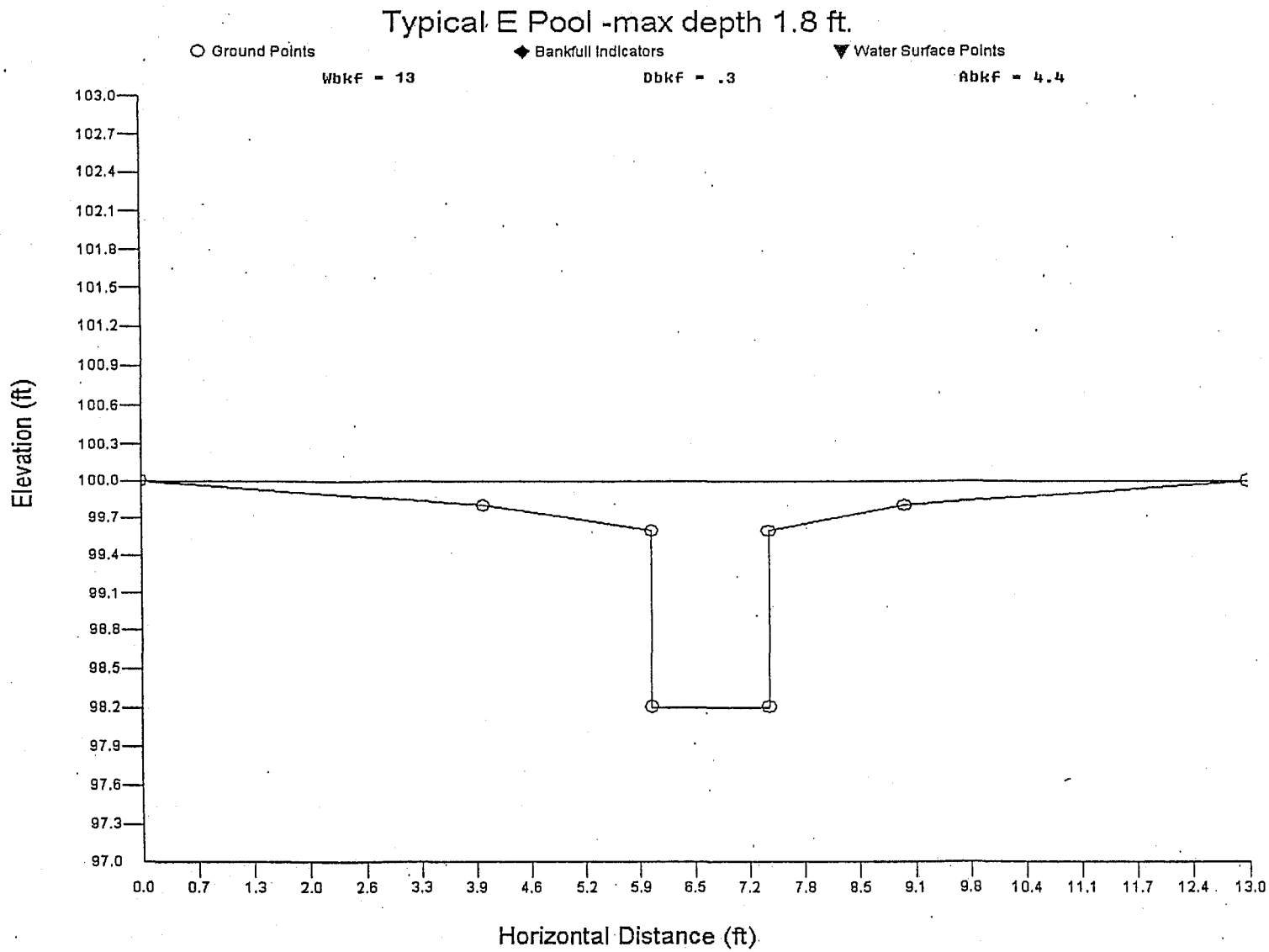


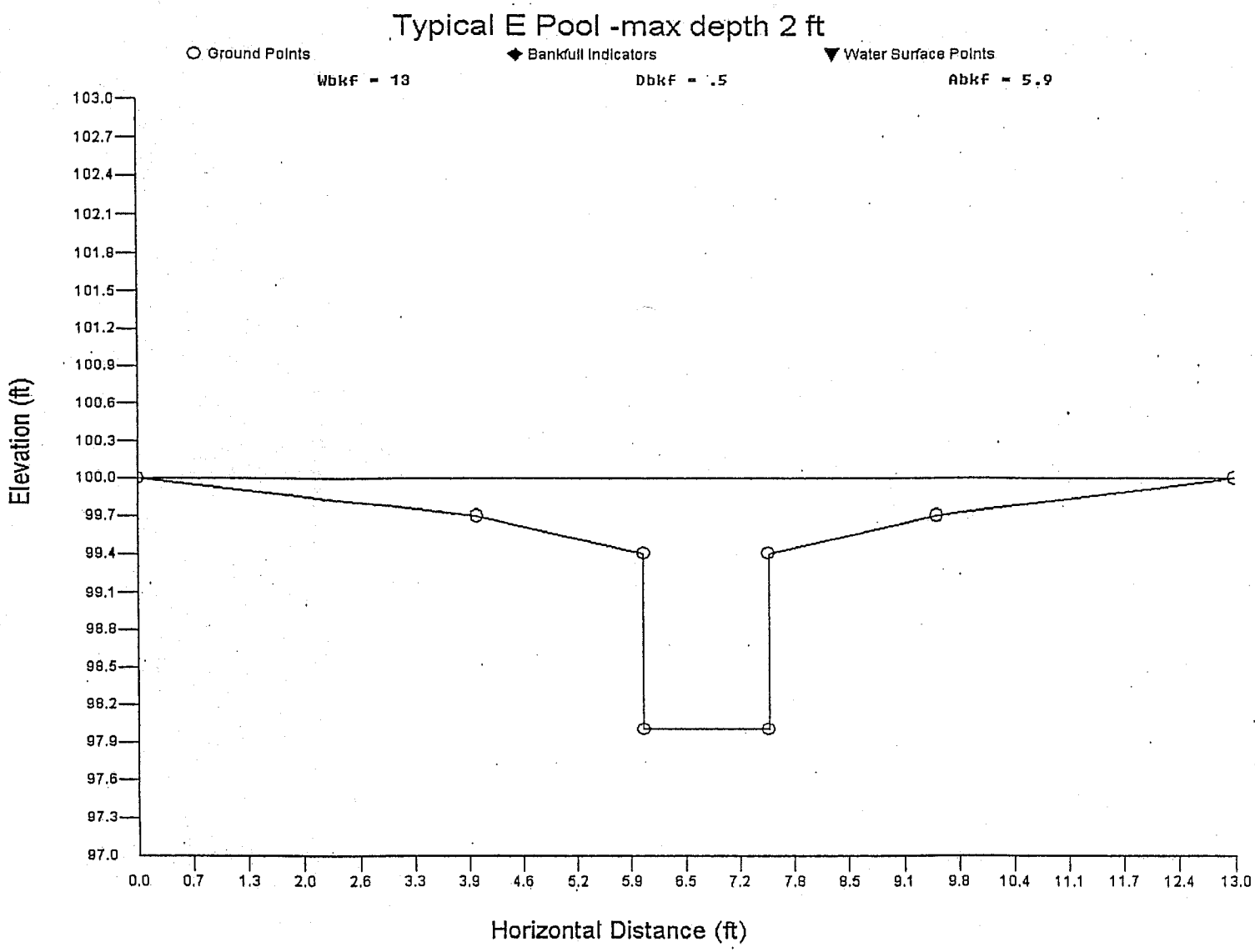
*Corresponds to Monitoring Cross Section : Riffle XS 3*
*See Map*



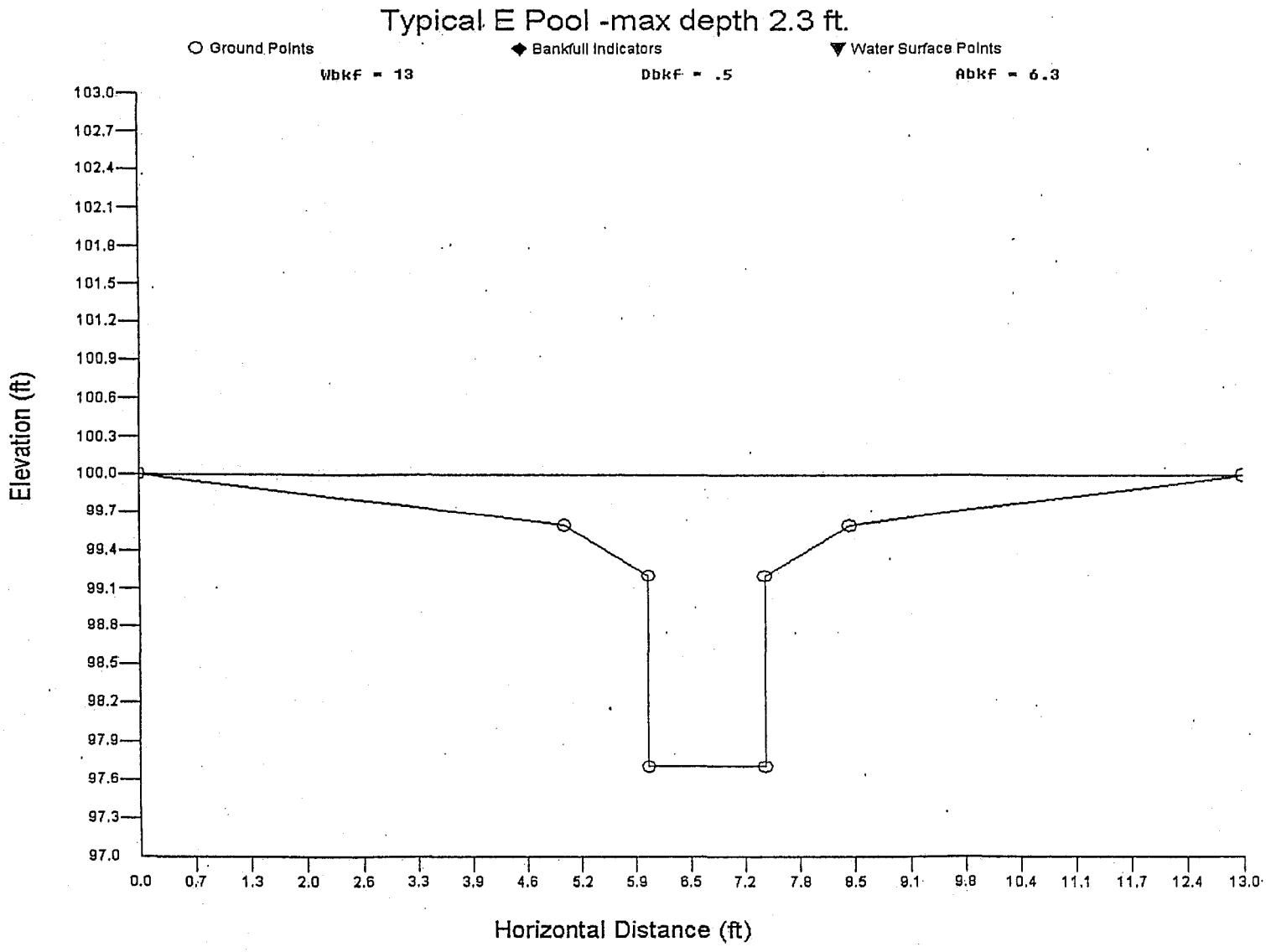

Typical E Pool -max depth 1.5 ft.
Ground Points
Bankfull Indicators
Water Surface Points
WbkF = 13.6
DbkF = .3
AbkF = 4.5
Elevation (ft)
103.0
102.7
102.4
102.1
101.8
101.5
101.2
100.9
100.6
100.3
100.0
99.7
99.4
99.1
98.8
98.5
98.2
97.9
97.6
97.3
97.0
0.0
0.8
1.5
2.3
3.0
3.8
4.5
5.3
6.0
6.8
7.5
8.3
9.0
9.8
10.5
11.3
12.0
12.8
13.5
14.3
15.0
Horizontal Distance (ft)

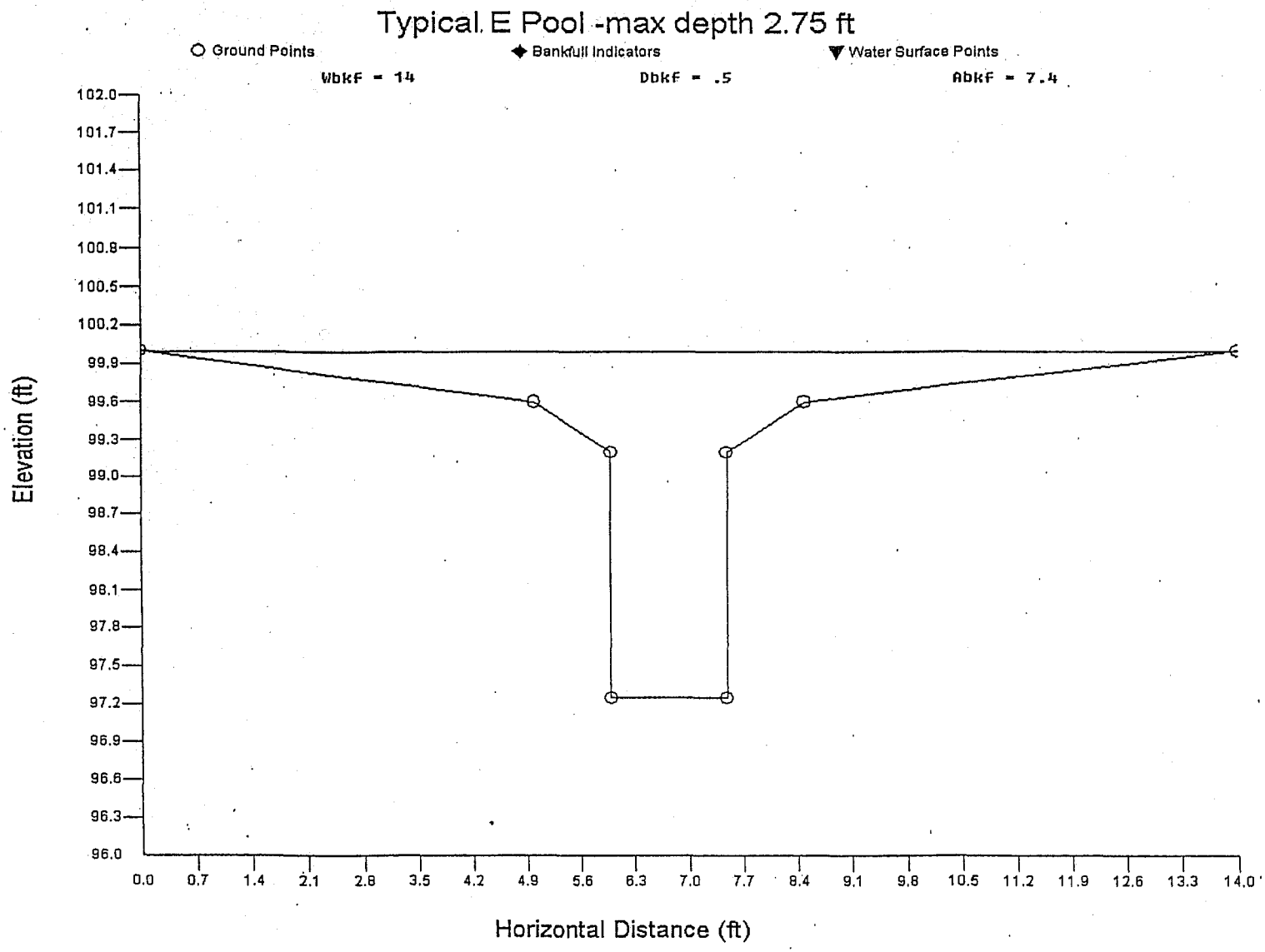
*Corresponds to Monitoring Cross Section : Pool XS 2*
*See Map*



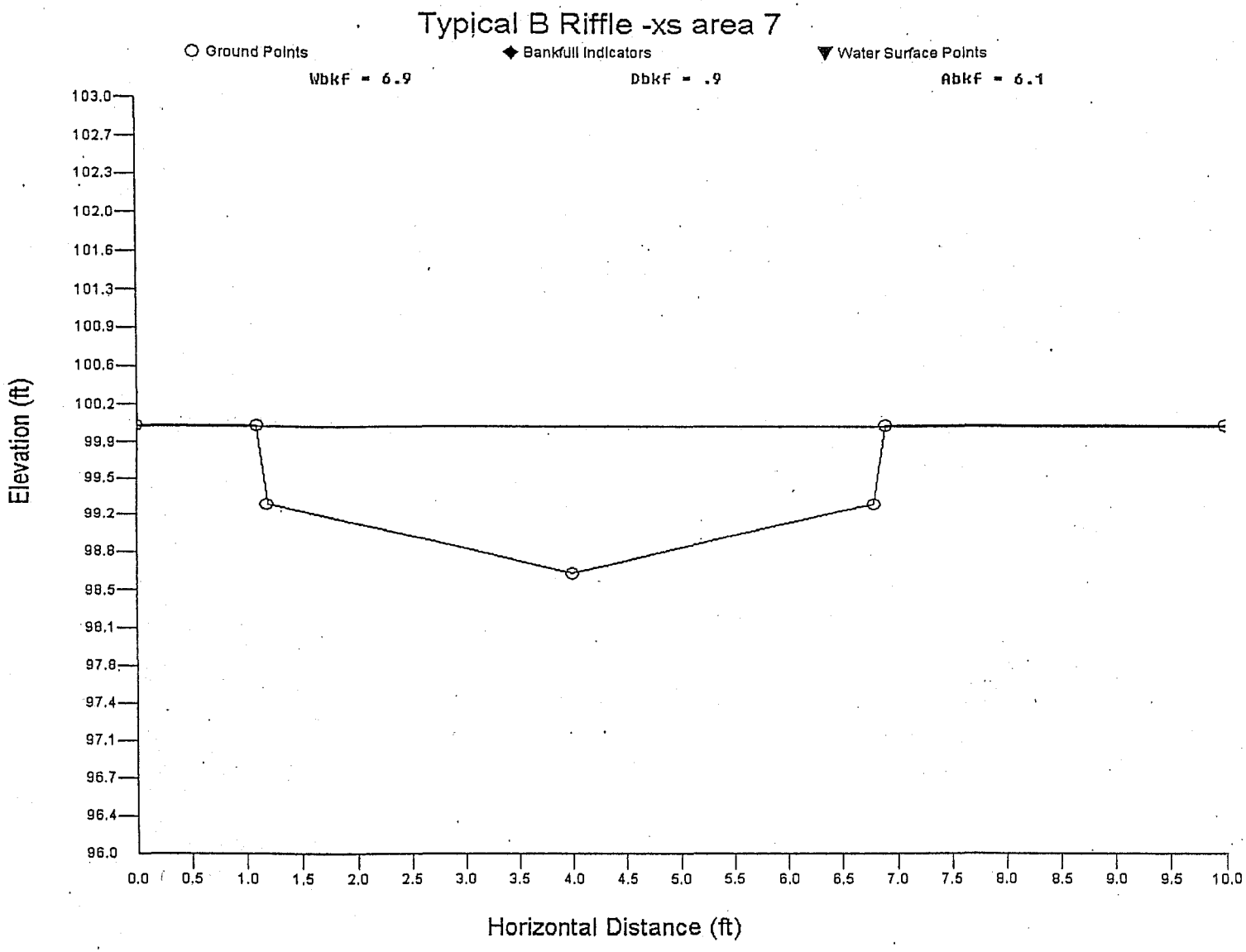

Typical E Pool -max depth 2 ft
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 13
Dbkf = .5
Abkf = 5.9
Elevation (ft)
103.0
102.7
102.4
102.1
101.8
101.5
101.2
100.9
100.6
100.3
100.0
99.7
99.4
99.1
98.8
98.5
98.2
97.9
97.6
97.3
97.0
0.0
0.7
1.3
2.0
2.6
3.3
3.9
4.6
5.2
5.9
6.5
7.2
7.8
8.5
9.1
9.8
10.4
11.1
11.7
12.4
13.0
Horizontal Distance (ft)

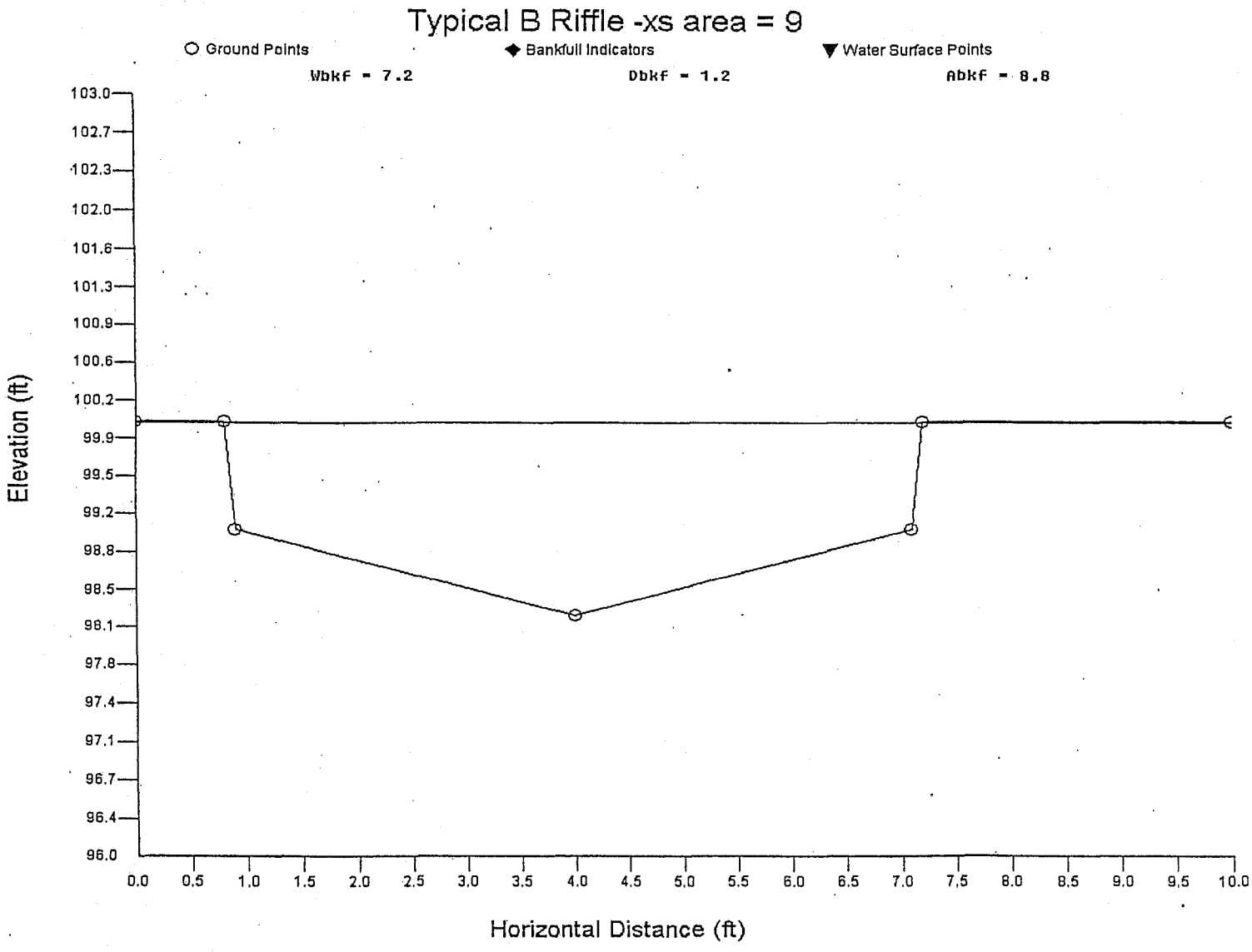
*Corresponds to Monitoring Cross Section : Pool XS 3*
*See Map*

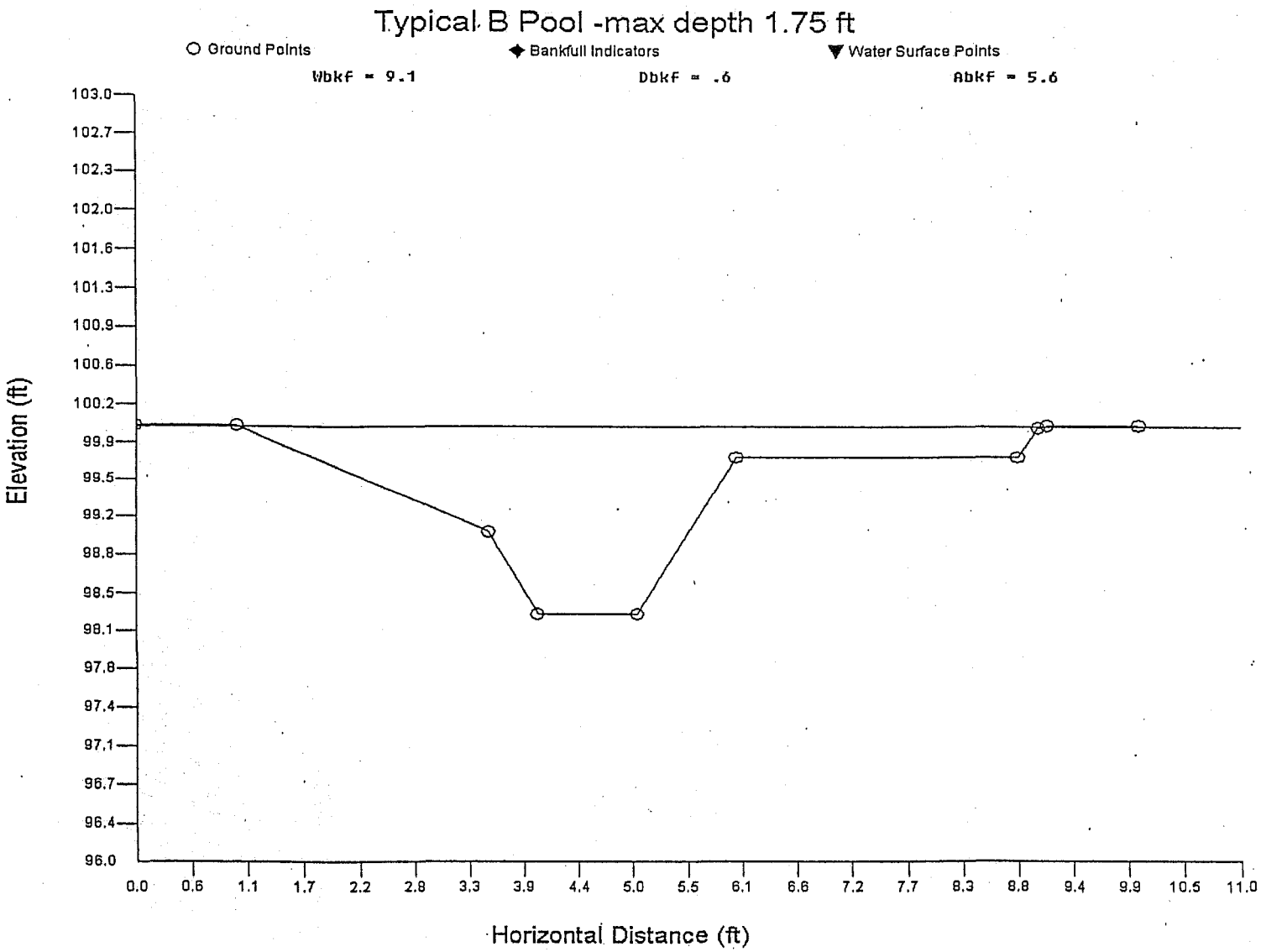



Typical E Pool -max depth 2.75 ft
Ground Points
Bankfull Indicators
Water Surface Points
WbkF = 14
DbkF = .5
AbkF = 7.4
Elevation (ft)
102.0
101.7
101.4
101.1
100.8
100.5
100.2
99.9
99.6
99.3
99.0
98.7
98.4
98.1
97.8
97.5
97.2
96.9
96.6
96.3
96.0
0.0
0.7
1.4
2.1
2.8
3.5
4.2
4.9
5.6
6.3
7.0
7.7
8.4
9.1
9.8
10.5
11.2
11.9
12.6
13.3
14.0
Horizontal Distance (ft)

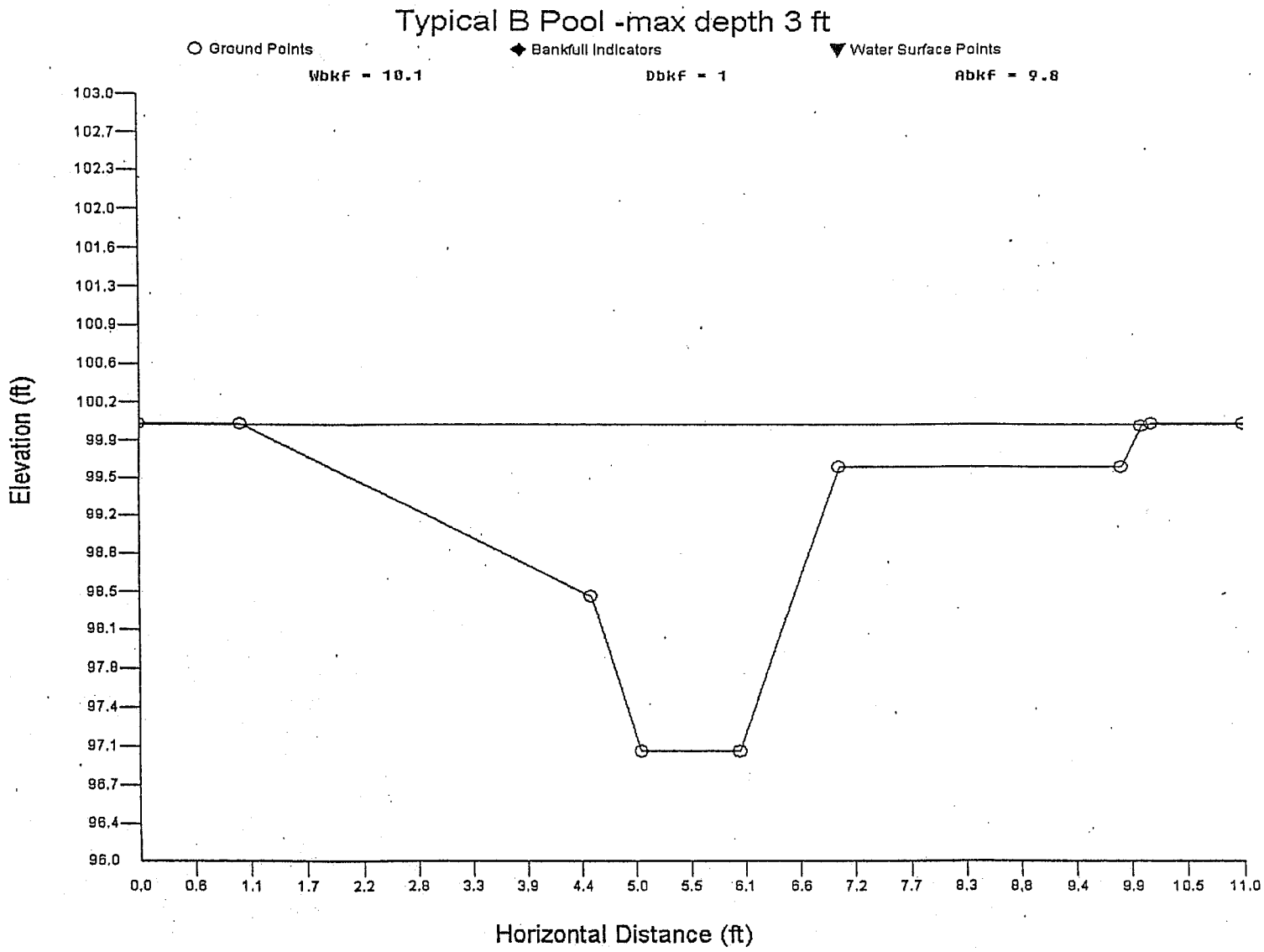
*Corresponds to Monitoring Cross Section : Riffle XS 5*
*See Map*

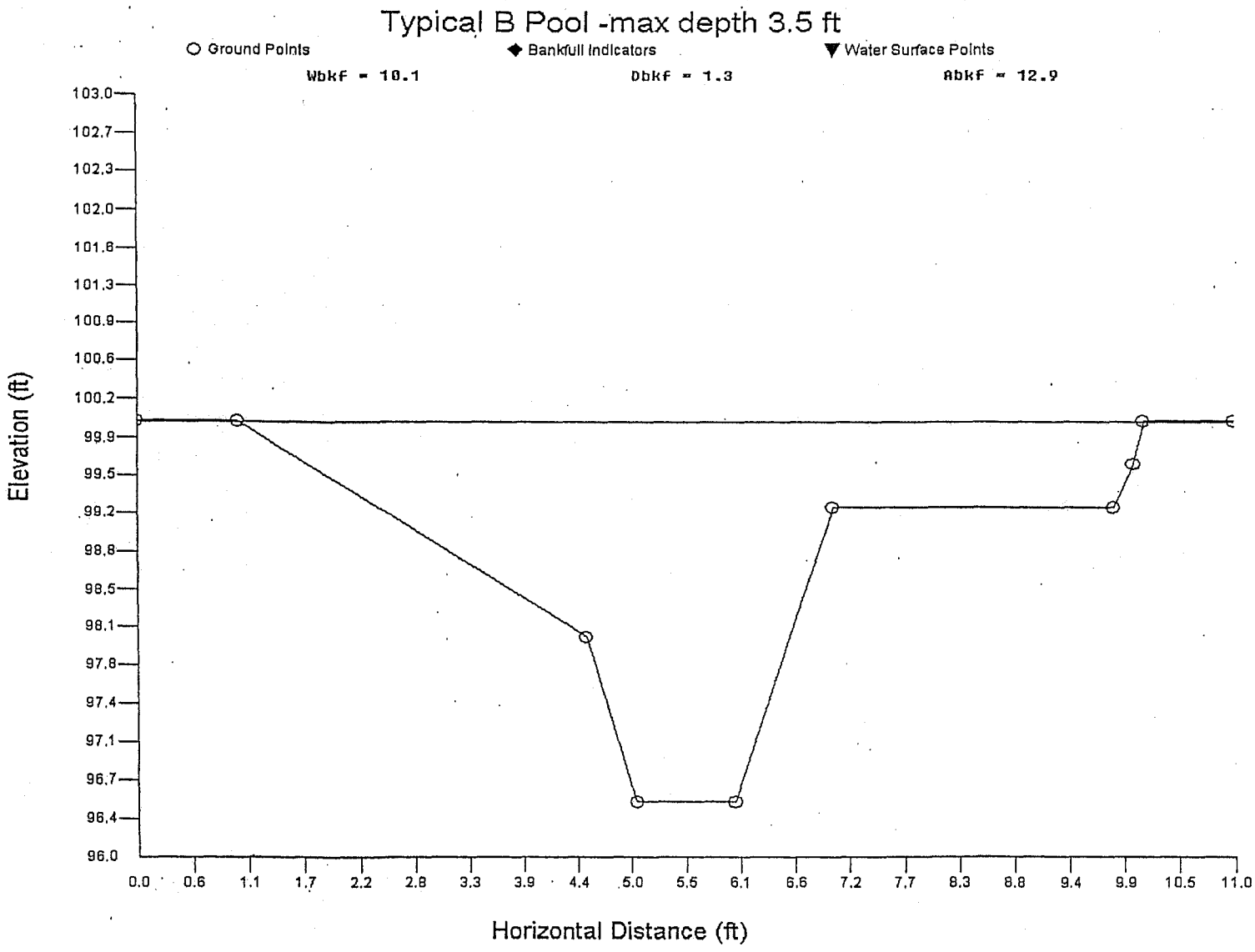



Typical B Riffle -xs area = 9
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 7.2
Dbkf = 1.2
Abkf = 8.8
Elevation (ft)
103.0
102.7
102.3
102.0
101.6
101.3
100.9
100.6
100.2
99.9
99.5
99.2
98.8
98.5
98.1
97.8
97.4
97.1
96.7
96.4
96.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
Horizontal Distance (ft)


Typical B Pool -max depth 1.75 ft
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.1
Dbkf = .6
Abkf = 5.6
Elevation (ft)
103.0
102.7
102.3
102.0
101.6
101.3
100.9
100.6
100.2
99.9
99.5
99.2
98.8
98.5
98.1
97.8
97.4
97.1
96.7
96.4
96.0
0.0
0.6
1.1
1.7
2.2
2.8
3.3
3.9
4.4
5.0
5.5
6.1
6.6
7.2
7.7
8.3
8.8
9.4
9.9
10.5
11.0
Horizontal Distance (ft)

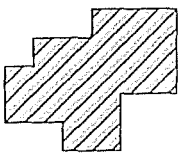
*Corresponds to Monitoring Cross Section : Pool XS 5*
*See Map*




Typical B Pool -max depth 3.5 ft
Ground Points
Bankfull Indicators
Water Surface Points
WbkF = 10.1
DbkF = 1.3
AbkF = 12.9
Elevation (ft)
103.0
102.7
102.3
102.0
101.6
101.3
100.9
100.6
100.2
99.9
99.5
99.2
98.8
98.5
98.1
97.8
97.4
97.1
96.7
96.4
96.0
0.0
0.6
1.1
1.7
2.2
2.8
3.3
3.9
4.4
5.0
5.5
6.1
6.6
7.2
7.7
8.3
8.8
9.4
9.9
10.5
11.0
Horizontal Distance (ft)

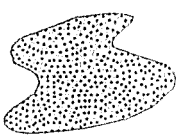
# Legend

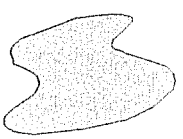

Phases of Construction


Grading and Staging Areas


Water Diversion


Tributary Planform Alignment


Groundwater Treatment Oxbow


Oxbow Lake


Tributary Stations

Stream Planform Alignment


Stream Stations

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

**Genesis Stream Restoration Plan**

**Appendix 12** - Ratio Method for Establishing Compensatory Ratios

# JOINT FEDERAL/STATE PROCEDURES FOR THE ESTABLISHMENT AND OPERATION OF WETLAND MITIGATION BANKS IN THE U.S. ARMY CORPS OF ENGINEERS MOBILE DISTRICT

**Guidance Process Developed by the Following Agencies on the Mitigation Bank Review Team**

U.S. Army Corps of Engineers – Mobile District
U.S. Environmental Protection Agency – Region IV
U.S. Fish and Wildlife Service – Daphne, Alabama
U.S. Fish and Wildlife Service – Jackson, Mississippi
Mississippi Department of Marine Resources
Alabama Department of Environmental Management
Mississippi Department of Environmental Quality

Last Revised:
May 2002

*The Ratio Method is included as a sub-part of a larger document including the guidance process as described above, but only the relevant, applicable Ratio Method section is included in this Appendix as the remaining portion of the document is not applicable to the case at hand. The document in its entirety is available for viewing at the Mississippi Department of Environmental Quality or at https://samribits.sam.usace.army.mil/ribits/pdfs/ALMS%20MBRTGUIDE%205-14-02.pdf.*

# Ratio Method

The Ratio Method (RM) is a qualitative approach to determining the amount of credits available at a proposed wetland mitigation bank. The RM has historically been utilized to determine credits at mitigation banks when other more quantitative methods, such as HGM or WRAP, have not been available. The RM utilizes the following set of Base Ratios:

| Type of Mitigation | Value of Impacted Wetland | | |
|---|---|---|---|
| | Low | Medium | High |
| Restoration | 1:2 | 1:3 | 1:4 |
| Enhancement | 1:3 | 1:5 | 1:9 |
| Preservation | 1:7 | 1:12 | 1:23 |

These ratios qualitatively consider 1) the different levels of functional lift associated with different types of mitigation, 2) the time required for the mitigation site to reach maturity or target condition, 3) the risk of the mitigation not achieving functional replacement, and 4) an appropriate consideration of the loss of function over time.

The following example illustrates how the RM would be applied to determine the number of available credits and the Compensatory Ratios at a proposed bank.

The first step in applying the RM is to determine what percentage of a proposed bank are wetland restoration, wetland enhancement, and wetland preservation (as defined in the Federal Banking Guidance) and what portion of the bank consists of non-wetlands. For example, a theoretical proposed 1300-acre wetland mitigation bank consists of:

| Mitigation Action | Affected Area (acres) | Percent of Total Area |
|---|---|---|
| Restoration | 1000 | 77 |
| Enhancement | 200 | 15 |
| Preservation | 50 | 4 |
| Non-wetland | 50 | 4 |
| Totals | 1300 | 100 |

Since non-wetlands compose only a small fraction of the total acreage of this bank, the bank has a total of 1300 [acre] credits and each [acre] credit represents 77% wetland restoration, 15% wetland enhancement, 4% wetland preservation, and 4% upland preservation. The Base Ratios are then utilized to determine the bank's Compensatory Ratios:

| Type of Mitigation | Area Affect (AA) | Value of Impacted Wetland = BR (base ratio) x AA | | |
|---|---|---|---|---|
| | | Low BRxAA | Med BRxAA | High BRxAA |
| Restoration | 0.77 | 1:2 = 1: 1.54 | 1:3 = 1: 2.31 | 1:4 = 1: 3.08 |
| Enhancement | 0.15 | 1:3 = 1: 0.46 | 1:5 = 1: 0.77 | 1:9 = 1: 1.38 |
| Preservation | 0.4 | 1:7 = 1: 0.27 | 1:12 = 1: 0.46 | 1:23 = 1: 0.88 |
| *Non-wetland | 0.4 | N/A | N/A | N/A |
| Total | | 1: 2.27 | 1: 3.54 | 1: 5.35 |

*As non-wetlands compose only a fraction of the total acreage of this bank, they were not included in determining Compensatory Ratios.

Thus, in this example, the proposed bank has 1300 [acre] credits and the bank's Compensatory Ratios are:

| Low Quality Wetland Impacts | Medium Quality Wetland Impacts | High Quality Wetland Impacts |
|---|---|---|
| 1:2 | 1:3.5 | 1:5 |

Therefore, if the Corps determined that a project within the service area of this proposed bank needed mitigation for impacts to 3 acres of medium quality wetlands, then 10.5 credits from this bank would be necessary to compensate or off set those wetland losses.

ATTACHMENT B

# Department of the Interior
# Natural Resource Damage Assessment and Restoration Fund
# Assessment and Settlement Deposit Remittance Procedures

The Department of Interior's Interior Service Center has established procedures with the Department of Treasury to provide two electronic options for remitting payments to the Natural Resource Damage Assessment and Restoration Fund. Procedures for using these processes are attached.

The preferred electronic method is the Department of Treasury's Automated Clearing House (ACH)/Remittance Express. If your bank does not have ACH deposit transmission capabilities, then Treasury's Federal Wire (Fed Wire) Transfer procedure is the required alternative. Use the attached forms to assist in preparing your remittance.

All remitters are encouraged to use these electronic methods. Non-electronic remittances (checks) should be payable to the Department of Interior and forwarded to:

DOI Restoration Fund
NBC Division of Financial Management Services
Branch of Accounting Operations
Mail Stop 1313
1849 C St. NW
Washington, D.C. 20240



Revised April 13, 1999

# Department of the Interior
# Natural Resource Damage Assessment and Restoration Fund
# Assessment and Settlement Deposit Remittance Procedures

In order to accomplish electronic transfers, in addition to other settlement or billing information, please provide the following information to the remitter:

**Preferred method of electronic transfer:** Automated Clearing House (ACH)

| | |
|---|---|
| **Receiver name:** | DOI Restoration Fund<br>ALC 14010001 |
| **Receiver Tax ID Number:** | 53-0196949 |
| **Receiver address:** | 1849 C St. NW<br>Mailstop 1313<br>Washington, D.C. 20240 |
| **Receiver bank:** | Federal Reserve Bank<br>New York, NY<br>ABA # 051036706 |
| **Receiver ACH Account No.:** | 312024 |
| **Receiver Fedwire Acct No.:** | Treasury NYC 021030004 |

(To be used only for Fedwire transfers)

**Payment Related Data:** Should at a minimum reference site location

Attachments I-3 and I-4 provide more technical specifics which can be provided to the remitters banking institution. Questions concerning electronic deposit procedures should be directed to Robert (Bob) White at 303-969-7170.

# Department of the Interior
# Natural Resource Damage Assessment and Restoration Fund
# Assessment and Settlement Deposit Remittance Procedures

The following information is provided to assist Remitters in giving complete and accurate data to their financial institution for use in originating Automated Clearing House payments. The industry name for the following format is CCD+.

ACH CCD+ Format

| Data Element Name | Contents | Size | Position |
|---|---|---|---|
| | | | |
| *Record Type Code* | *'6'* | 1 | 01-01 |
| *Transaction Code* | *'22'* | 2 | 02-03 |
| *Receiving ABA* | *'05103670'* | 8 | 04-11 |
| *Check Digit* | *'6'* | 1 | 12-12 |
| *Account Number* | *'312024'* | 17 | 13-29 |
| Payment Amount | | 12 | 30-41 |
| Identification # | | 13 | 42-54 |
| *Receiver Name* | *DOI Restoration Fund* | 22 | 22-76 |
| Discretionary | N/A | 2 | 77-78 |
| *Addenda Indicator* | *'2'* | 1 | 79-79 |
| Trace Number | Assigned by Remitters Bank | 15 | 80-94 |
| | | | |

**ACH Addenda Record Format**

| Data Element Name | Contents | Size | Position |
|---|---|---|---|
| | | | |
| *Record Type Code* | *'7'* | 1 | 01-01 |
| *Addenda Type Code* | *'05'* | 2 | 02-03 |
| Payment Related | | 80 | 04-83 |
| *Sequence Number* | *'0001'* | 4 | 84-87 |
| Addenda Trace | Assigned by Remitters Bank | 17 | 88-94 |
| | | | |

The data items in bold must be provided to the bank by the Remitter. Those items bolded and italicized must be provided verbatim. The **Payment Amount** is the judgement or settlement amount being remitted; dollars and cents must be separated by a decimal point, do not use commas or any other punctuation. The **Identification Number** is the case Court Number. The **Payment Related** data should include the paying potentially responsible party(ies) name, site or case name and site location.

# Department of the Interior
# Natural Resource Damage Assessment and Restoration Fund
# Assessment and Settlement Deposit Remittance Procedures

## Federal Wire (FedWire) Transfer

The following information is provided to assist Remitters in giving complete and accurate data to their financial institution for use in originating FedWire payments. The industry name for the following format is FedWire Transfer Format.

**Required Fields and Tags**

| Field Tag Name | Field Tag Number | Field Tag Contents |
|---|---|---|
| | | |
| Message Disposition | (1100) | Assigned by Federal Reserve Bank |
| Acceptance Time Stamp | (1110) | Assigned by Federal Reserve Bank |
| OMAD | (1120) | Assigned by Federal Reserve Bank |
| IMAD | (1520) | Assigned by Remitters Bank |
| **Amount** | **(2000)** | |
| Sender FI | (3100) | Assigned by Remitters Bank |
| Sender Reference | (3320) | Assigned by Remitters Bank |
| ***Receiver FI*** | ***(3400)*** | ***'Treasury NYC 021030004'*** |
| ***Beneficiary*** | ***(4200)*** | ***'DOI Restoration Fund ALC 14010001'*** |
| **Ref for Beneficiary** | **(4320)** | |
| **Originator** | **(5000)** | |
| Originator Financial Institution | (5100) | Assigned by Remitters Bank |
| **Orig to Beneficiary** | **(6000)** | |
| | | |

The data items in bold must be provided to the bank by the Remitter. Those bolded and italicized must be provided verbatim. The **Amount** is the judgement or settlement amount being remitted; dollars and cents must be separated by a decimal point, do not use commas or any other punctuation. The **Reference for Beneficiary** is the case Court Number. **Originator** is the paying potentially responsible party(ies). **Originator to Beneficiary** should include the site or case name and site location.

ATTACHMENT C

PROPOSED PROPERTY FOR LAND ACQUISITION AND CONSERVATION
SUPPLEMENTAL ENVIRONMENTAL PROJECT

The 1,312-acre McNeal tract which is proposed for the Supplemental Environmental Project is in the northwest corner of George County, Mississippi, about 12 miles northwest of Lucedale and about 50 miles north of the city of Pascagoula. The property is one mile west of the junction of the Leaf and Chickasawhay Rivers, where they form the Pascagoula River. The property's northern boundary is the Salem-Merrill Road, and it is in Township 1 South, Range 8 West. The property, which is in the Leaf River watershed and near the DeSoto National Forest, possesses significant wildlife, fish, and plant habitat, and significant scenic and open space values. It contains bottomland hardwood flood-plain forests and cypress/tupelo gum sloughs and ponds which contain potential habitat for Osprey, Gopher tortoise, Swallow-tail kite, Gulf sturgeon, Pearl darter, Louisiana black bear, Yellow blotched and Alabama map turtle, Southern hickorynut, Florida flame azalea, Silky camellia and the Green fly orchid. The approximately 450-acre cypress / tupelo gum swamp forms the headwater of Big Creek, a stream whose primary reach is protected within The Nature Conservancy's Murrah Preserve as it connects to the Pascagoula River.