Earl Haigler Mitigation Site
Goose Creek, Union County

Streambank Enhancement Plan

Prepared for the

North Carolina Department of Transportation Stream Mitigation Program

Transportation Improvement Project R-2420 B

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Abstract—This report details streambank enhancement plans for 250 linear feet of Goose Creek known as the Earl Haigler site, Union County, North Carolina. The streambank enhancement plan is submitted as partial fulfillment of the off-site stream mitigation agreement between the North Carolina Department of Transportation (DOT) and North Carolina Wildlife Resources Commission (WRC) for the R-2420-B University Boulevard construction, Mecklenburg County. The objectives of this project are to stabilize an eroding streambank by creation of a bankfull bench, re-vegetation of the new bank, and to improve in-stream aquatic habitat.

The Goose Creek watershed in Mecklenburg and Union counties contains one of two remaining North Carolina habitats of the federally endangered Carolina Heelsplitter mussel *Lasmigona decorata*. As a result of concern for this species, the North Carolina Division of Water Quality (DWQ), North Carolina Wetlands Restoration Program (WRP), North Carolina Wildlife Resources Commission (WRC), U.S. Fish and Wildlife Service (FWS), and Natural Resource Conservation Service (NRCS) designated the entire Rocky River drainage, which includes Goose Creek, as a priority area for conservation and protection. Because of this concern, when the N.C. Department of Transportation (DOT) proposed construction of the I-485 corridor and a section of University Boulevard, permit conditions (U.S. Army Corps of Engineers, DWQ and FWS) required that DOT mitigate for project impacts by restoring degraded habitat in the Goose Creek watershed. The DOT then entered into an agreement in 1998 with the WRC to do the required stream mitigation. This plan is submitted as partial fulfillment of the off-site stream mitigation agreement between DOT and WRC for the R-2420 B (University Boulevard) construction project. Under this agreement a total of 903 linear feet of stream mitigation is required by the COE (permit No.1998 30022) and DWQ (permit No. 3182). This plan documents existing conditions, objectives of the project and the proposed approach to streambank stabilization and habitat improvement along 200 linear feet of Goose Creek known as the Earl Haigler site, Union County (Figure 1).

Methods

Baseline conditions at the Earl Haigler site on Goose Creek were determined through field investigations on 7 October 2003. A representative cross-section was measured using standard stream survey techniques (Harrleson et al. 1994; Mickey and Hining 2003). A longitudinal profile was not surveyed. The geomorphology of the stream was classified using the Rosgen (1996) Level II classification system. Established stream mitigation restoration/enhancement guidelines were utilized for this project (USACE et al. 2003; Doll et al. 2003).

Topographical maps were used to determine stream drainage area and land use. Soil type was determined from United States Department of Agriculture, Natural Resource Conservation Service soil maps (1980). Regional curve data was determined from piedmont North Carolina stream data (Clinton et al. 1999; Harman et al. 1999; Doll et al. 2002).

Existing Conditions

Morphology

Goose Creek at this location has a drainage area of approximately 21.3 mi^2 (13,362 a). Land use along this stream consists of agricultural fields and small wood lots. Chewacla silt loam (ChA) soils are located along the stream channel (USDA 1992). These soils are deep, nearly level, somewhat poorly drained soils found on 0% to 2% slopes.

At the Earl Haigler site (Figure 1) the stream flows through a wide, flat valley. A 38 ft wide wooded buffer zone exists on the left bank while on the right bank the buffer zone is < 10 ft wide. Shrubs and trees in the buffer zone consist mainly of spicebush *Lindera benzoin*, black walnut *Juglans nigra*, sweetgum *Liquidambar styraciflua*, sycamore *Plantanus occidentalis*, black cherry *Prunus serotina*, boxelder *Acer negundo*, and sugarberry *Celtis laevigata*. One invasive exotic species, Chinese privet *Ligustrum sinense*, dominates portions of the riparian zone and impedes colonization of beneficial native species.

Bankfull was determined using field indicators, primarily a scour line along the bank, point bar height, and using regional curve information (Harman et al. 1999; Doll et al. 2002). Channel dimensions were determined by surveying a run cross-section at the proposed bank stabilization site (Figure 2). Coarse sand (D50 = 1.9 mm) is the bed material and the channel substrate consists of 47% sand and 46% gravel (Figure 3). Based on data collected from the run cross-section, the channel at this site is classified as a C5 stream type (Rosgen 1996). The C5 stream type is characterized by being a slightly entrenched, sand dominated channel with a well developed floodplain. The streambanks are generally composed of sandy material, with streambeds exhibiting little difference in pavement material composition. The C5 stream type is very susceptible to shifts in both lateral and vertical stability caused by direct disturbance and changes in the flow and sediment regimes of the contributing watershed.

The left bank floodplain terrace contains a 38-foot wide mature forest canopy with an understory of small trees, shrubs, and Chinese privet. The right bank floodplain terrace is 3 feet wide. Along the right bank the roots of the existing trees are being (Figure 2). Lateral movement of the streambank has caused the channel to widen at its current elevation and to develop new point bars inside the existing channel. The effects of vertical and lateral instability are primarily the result of high streamflow energy. Most of the trees along the right streambank have the potential to fall into the stream channel due to continued undercutting. Bank erosion is causing adverse water quality conditions.

Stable reference reach streams were difficult to find in the Goose Creek watershed. However, a stable reference reach cross-section was obtained from Stevens Creek, Mecklenburg County (Mickey and Hining 2003) (Appendix 1). This stream has a drainage area of 3.83 mi^2. Dimensionless ratios of measurements taken from the reference reach cross-section were used in the design of this streambank stabilization project.

Mussels

Critical habitat for the federally endangered Carolina heelsplitter *Lasmigona decorata* is located in Goose Creek downstream of the NC 218 bridge. This project is located above the critical habitat area and the Carolina heelsplitter has not been found at this site. However, other mussel species have been observed in this section of Goose Creek (R. Heise and M. Fowlkes, WRC, personal communication).

Conservation Easement

For piedmont streams, a DWQ permit condition requires that the stream restoration or enhancement project have a 50-foot riparian corridor, both banks, placed in a conservation easement (CE). A 100-foot wide conservation easement has been obtained by the Clean Water Management Trust Fund (CWMTF) along each bank of Goose Creek at this site. To qualify for DOT mitigation, the portion of Goose Creek slated for improvements in this conservation easement will need to be purchased from the CWMTF by DOT.

Site Improvements

The objectives of this project are to decrease streambank erosion by converting the unstable existing C5 stream channel to a stable C5 stream channel, to create a stable bankfull bench and to improve in-stream aquatic habitat. This is a streambank enhancement mitigation category (USACE et al. 2003) that generally includes improvements to the stream channel and riparian zone that restore dimension (cross-section) and profile (channel slopes). This category may also include other modifications that improve channel stability, water quality, and stream ecology.

Stream Enhancement

In-stream structures, bank reshaping, and revegetation are the proposed improvements for this stream channel (Figure 4). The channel will be improved to represent a stable C4 channel type (Table 1). No change in pattern is planned. Design considerations are based on reference reach data and on professional judgement and characteristics of a stable C4 channel.

Bank grading is the typical channel cross-section design change planned for this site (Figure 2, Appendix 2.1). The eroding right bank will be graded on a 1.5:1 or 2:1 slope to create a bankfull bench. The purpose of this activity is to reduce streambank erosion and create an area suitable to establish bank vegetation.

Rock vanes and root wad structures will be constructed according to standard guidelines (Appendix 2.2, 2.3). Rock vanes and root wad structures will be used to reduce the near bank stress and direct flows towards the center of the stream. These structures will also improve in-stream aquatic habitat and provide long-term bank stability. Root wads will be collected on site. Eleven trees along the eroding bank that are being undercut and have potential to fall into the stream will be used for the root wad structures.

Root wads will be used to protect the outside of the meander and provide in-stream cover. Rock for vanes will be hauled from a local quarry. Footer rocks will be placed approximately 2 ft below the normal stream bottom where bedrock is not encountered. Rocks average approximately 500 lbs (4 ft^3) to 1000 lbs (8 ft^3) in size. Structures will be built using a track-hoe with a thumb working from the top of the bank.

Riparian Improvements

Bank sloping should reduce undercutting and allow vegetation to become established, resulting in increased bank stability. During construction, small trees and shrubs will be salvaged and stockpiled for later planting along the restored streambank. After the streambank has been sloped it will be reseeded with brown top millet or winter wheat/rye (1 lb/1000 ft^2) and with a WRC native all-purpose grass/wildflower seed mix at the rate of 10 lb/a (Table 2). Woody vegetation, including live stakes and rooted trees, will be planted along all disturbed areas. Understory native woody species such as tag alder *Alnus serrulata*, silky willow *Salix sericea*, silky dogwood *Cornus amomum*, and elderberry *Sambucus canadensis* will be planted along sloped streambanks. At the top of the banks and extending 50 ft into the floodplain terrace, native trees that provide shade and cover and food for wildlife will be planted. Woody plantings will be at the rate of 320 stems per acre as specified in per DWQ guidelines (USACE et al. 2003). The exotic invasive species, Chinese privet, will be cut and stumps treated with a solution of glyphosate (North Carolina Botanical Garden 2001).

Mussels

Before any construction takes place, the site will be surveyed for mussels by qualified personnel (WRC, USFWS, private consultant). Mussels will be identified and relocated out of the project site into similar habitat. If mussels are found during construction, work will be halted and the area searched for additional specimens. An attempt will be made to identify the mussels and they will be relocated out of the project site into similar habitat.

Erosion Control

During construction, equipment will only access the stream when absolutely necessary. For this project, it is anticipated that all track hoe work can be accomplished from the top of the bank. All construction materials including rock, root wads, logs, and erosion control materials will be stockpiled at a central location on the site. To limit disturbance of soils, all equipment will travel along identified travel corridors.

Disturbance of soils will be limited to only what work can be accomplished and stabilized on a daily basis. As a structure is completed, the site will be sloped. Stockpiled soils or disturbed areas on steep slopes will have erosion control fencing installed as needed. Once the banks are sloped, they will be fertilized, limed and hand seeded. The surface of the sloped bank will be covered with excelsior erosion control matting and anchored in place with wooden survey stakes and landscape staples. Disturbed areas on level ground will be seeded and mulched with straw.

Spill Containment

All equipment supplied by the contractor must be in good working order and will not be leaking any fluids that could contaminate the stream or property. In case of an accidental spill of hazardous materials (hydraulic fluids, gas, oil) two Attack Pac emergency spill kits will be on site during construction. Any spills of hazardous materials will be cleaned up immediately with contaminated soils disposed of according to state regulations.

Monitoring

Once the project is complete an as-built survey will be completed. Future monitoring surveys can then be compared to the as-built survey to note if the channel is stable or moving towards an unstable condition. Environmental components monitored at this site will be those that allow an evaluation of channel stability and riparian improvements. Monitoring will be conducted for five years after construction and will follow the "Stream Mitigation Guidelines" for monitoring developed by the COE, DWQ, WRC and US Environmental Protection Agency (2003) for Enhancement Level I projects. It is expected that biological monitoring will not be required at this site.

Conclusion

Stabilization of the streambanks will reduce channel erosion and reduce the amount of sediment being deposited into Goose Creek from this site. Installation of rock vanes and root wads will increase in-stream aquatic habitat diversity. Water quality will be improved through reduced sedimentation and aquatic and wildlife habitat will be improved with the return of a functioning riparian corridor.

References

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FIGURE 1. Earl Haigler bank stabilization site, Goose Creek, Yadkin River drainage, October 2003.

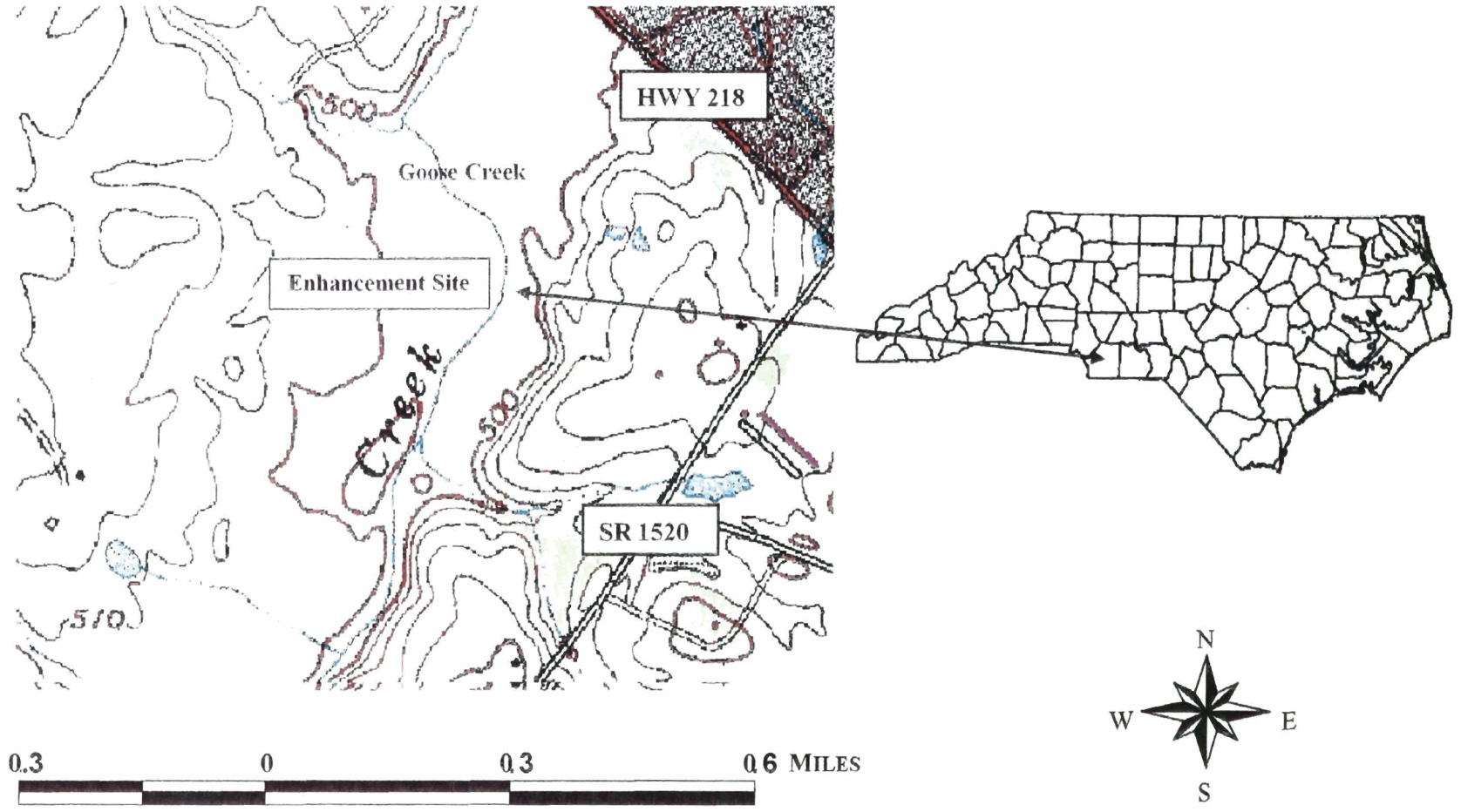


FIGURE 2. Cross-section, Earl Haigler bank stabilization site. Goose Creek, Yadkin River drainage, October 2003.

Looking upstream.

Looking downstream.

	Feature	Type	W/pa	LBKF		ELEVbkf	Wbkf	Dbkf	W/D	Abkf	Dmax	ER
Existing	Riffle	C	LD	40.3	78.0	97.48	37.7	2.8	13.5	105.0	4.4	6.6
Design	Pool	E	250	40.3	85.2	97.48	70.0	2.2	31.9	153.5	6.0	3.6

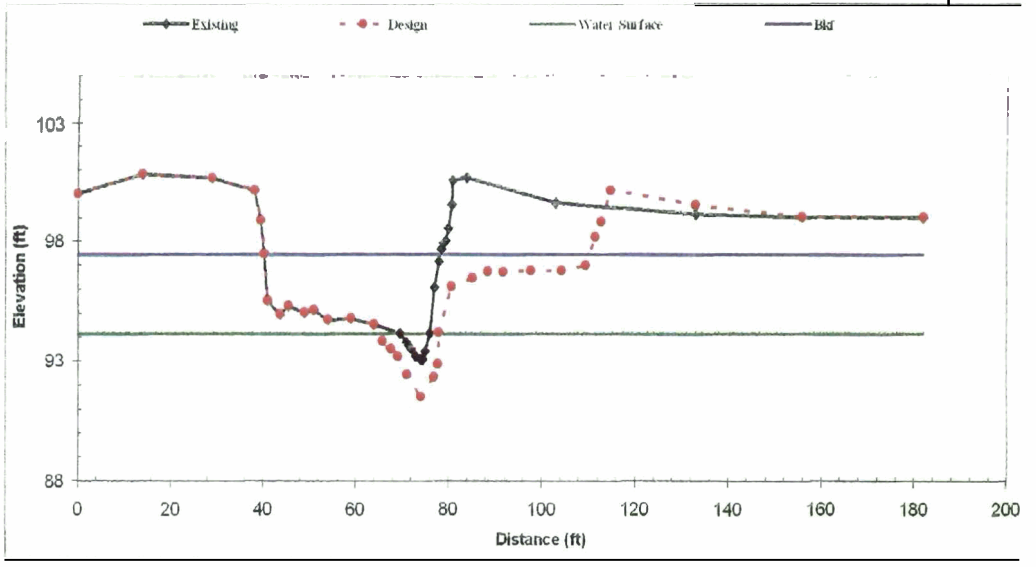
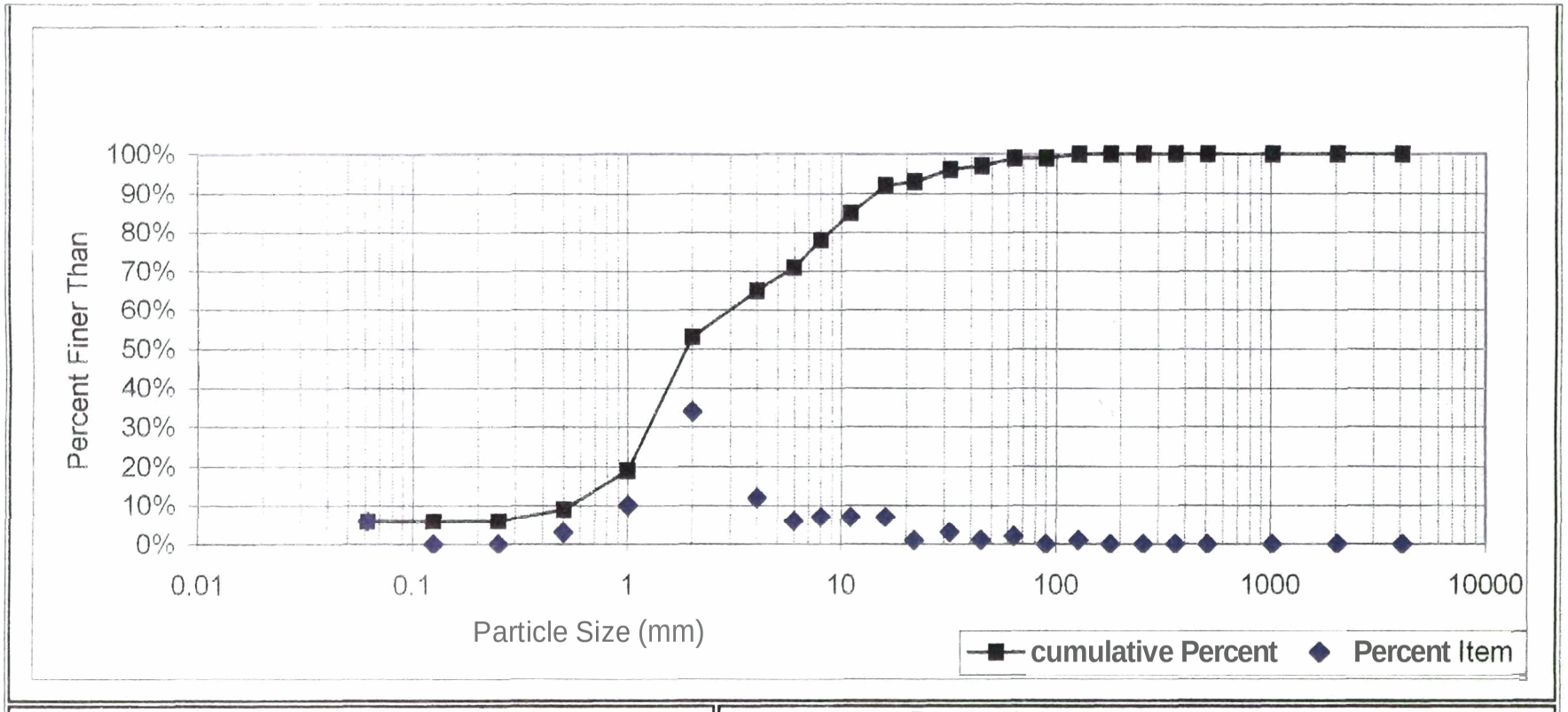


FIGURE 3. Pebble count summary, Earl Haigler bank stabilization site. Goose Creek, Yadkin River drainage, October 2003.



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.812	1.39	1.9	11	28	6%	47%	46%	1%	0%	0%

FIGURE 4. Plan view of streambank improvements planned 250 linear feet of Goose Creek at the Earl Haigler site, Union County, November 2003

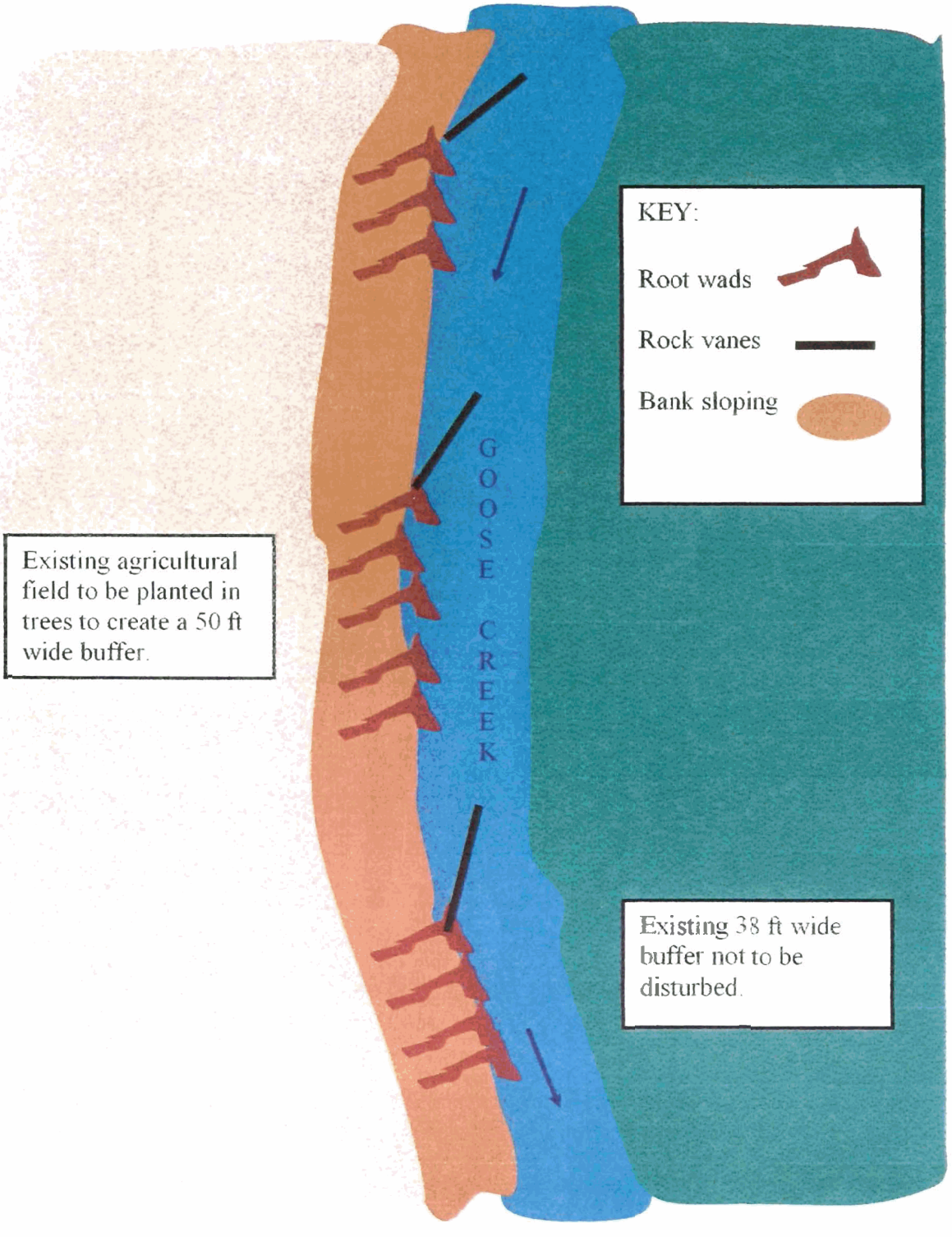


TABLE 1. Stream reach data for the Earl Haigler streambank enhancement project along Goose Creek, Union County, November 2003.

STREAM NAME: Goose Creek Date: 7 October 2003
Basin Name: Yadkin Drainage: 21.3 Mi^2 13,362 Ac.
Location: Above NC 218, heading south along Goose Creek for approximately 2,000 - 2,500 feet. Site located on right bank (facing downstream) in narrow section of soybean field.
Observers: J. H. Mickey, S. S. Hining, NCWRC

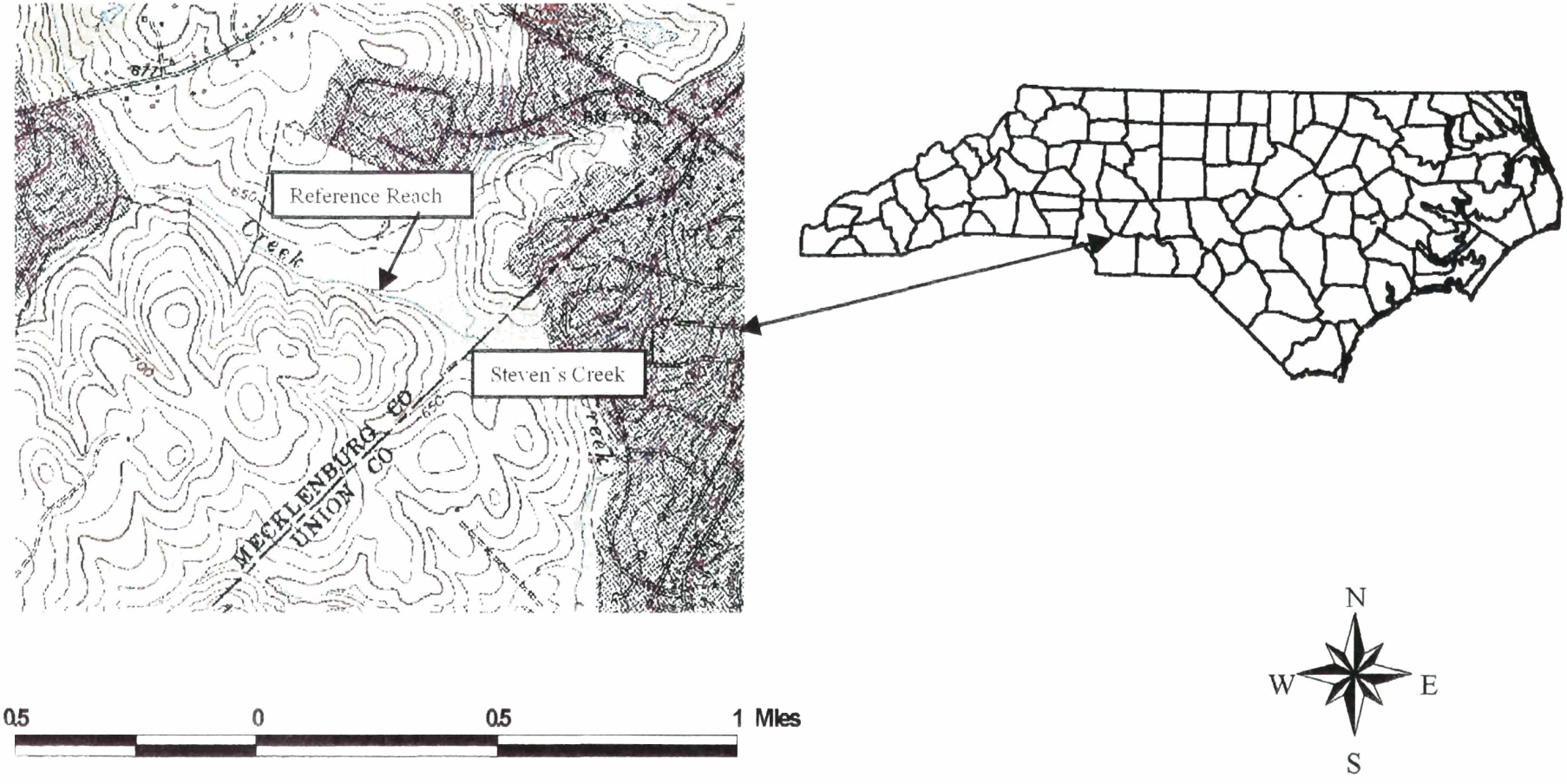
Measurement	Site x-section	Reference x-section[1]	Pool design	Regional curve data[2]
Bankfull width (ft^2):	37.7	21.5	70.2	42
Mean depth (ft^2):	2.8	2.8	2.2	4.0
Bankfull X-sectional area (ft^2):[2]	105	60.5	154	180
Width/depth ratio:	13.5	7.6	31.9	
Maximum depth (ft):	6.0	4.3	6.0	
Width of flood prone area (ft):	250	100	250	
Entrenchment ratio:	6.6	4.7	3.6	
Channel Materials D50 (mm):[3]	1.9	10.4	>2.0	
Water surface slope				
Channel sinuosity:				
Stream type:	C5	C4	C5	

[1]Steven's Creek reference based on pool cross-section at station 2+18
[2]N.C. Rural Piedmont Regional Curve Data.

TABLE 2. North Carolina Wildlife Resources Commission's native seed mix used for stream restoration and enhancement projects.

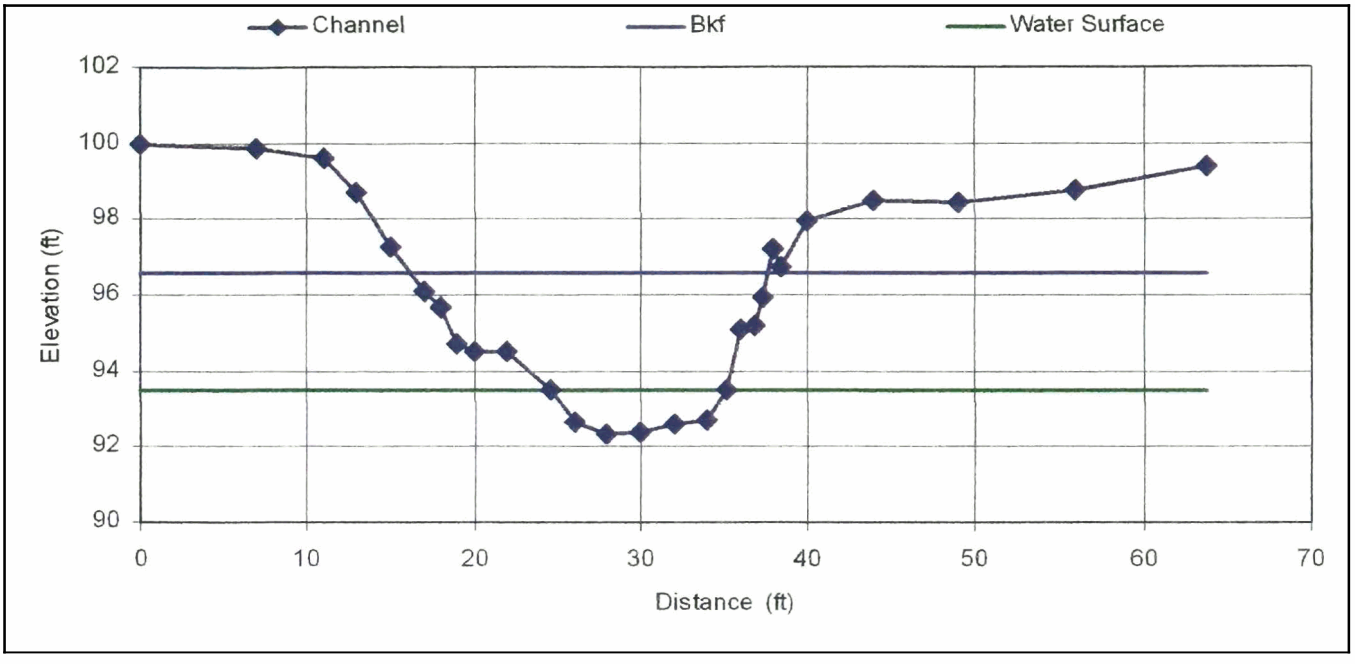
Common name	Scientific name	Percent
Rice Cut Grass	*Leersia oryzoides*	10.0
Va Wild rye	*Elymus virginicus*	10.0
Woolgrass	*Scirpus cypemus*	10.0
Sensetive Fern	*Onoclea sensibillis*	5.0
Green Bulrush	*Scirpus atrovirens*	5.0
Hop Sedge	*Carex lupilina*	5.0
Soft Rush	*Juncus effusus*	5.0
Softstem Bulrush	*Scirpus validus*	5.0
Deertongue	*Panicum clandestinum*	5.0
Lesser Bur-reed	*Sparganium americanum*	5.0
Eastern Gamagrass	*Tripascum dactyloides*	5.0
Elderberry	*Sambucus canadensis*	5.0
Many Leaved Bulrush	*Scirpus polyphyllus*	2.5
Nodding Bur-marigold	*Bidens cernua*	2.5
Squarestem Monkey Flower	*Mimulus ringens*	2.5
Joe Pye Weed	*Eupatorium fistulosa*	2.5
Swamp Milkweed	*Asclepias incarnata*	2.5
Red Chokeberry	*Aronia arbutifolia*	2.5
Silky Dogwood	*Comus amomuin*	2.5
Winterberry	*Ilex verticillata*	2.5
Spicebush	*Lindera benzoin*	2.5
Maple-Leaved viburnum	*Viburnum acerifolium*	2.5
	Total	100.0

Appendix 1. Steven's Creek reference reach. Yadkin River drainage, January 2003.



A1.1. Location map of reference reach.

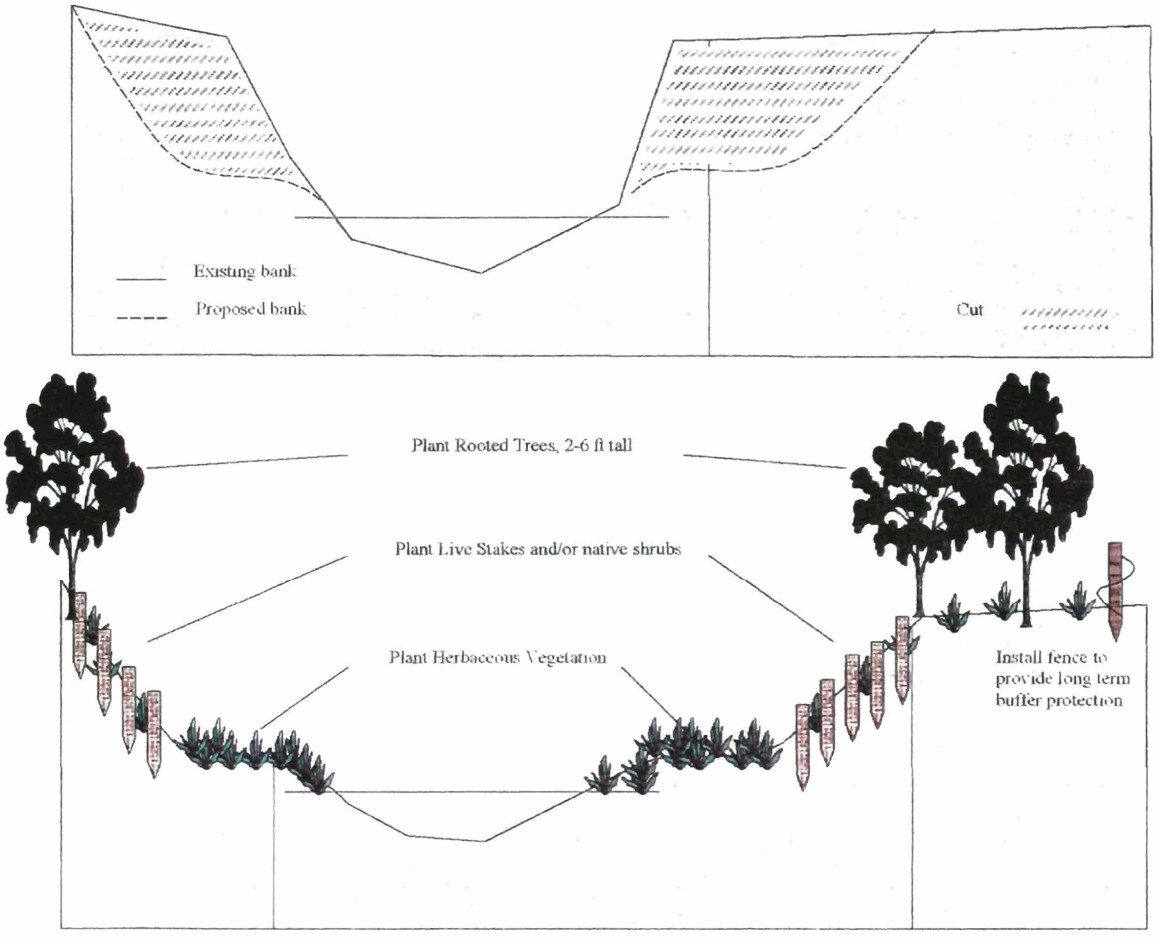
Appendix 1. Continued.



A.1.2. Pool cross-section at station 2+18, looking upstream at reference reach.

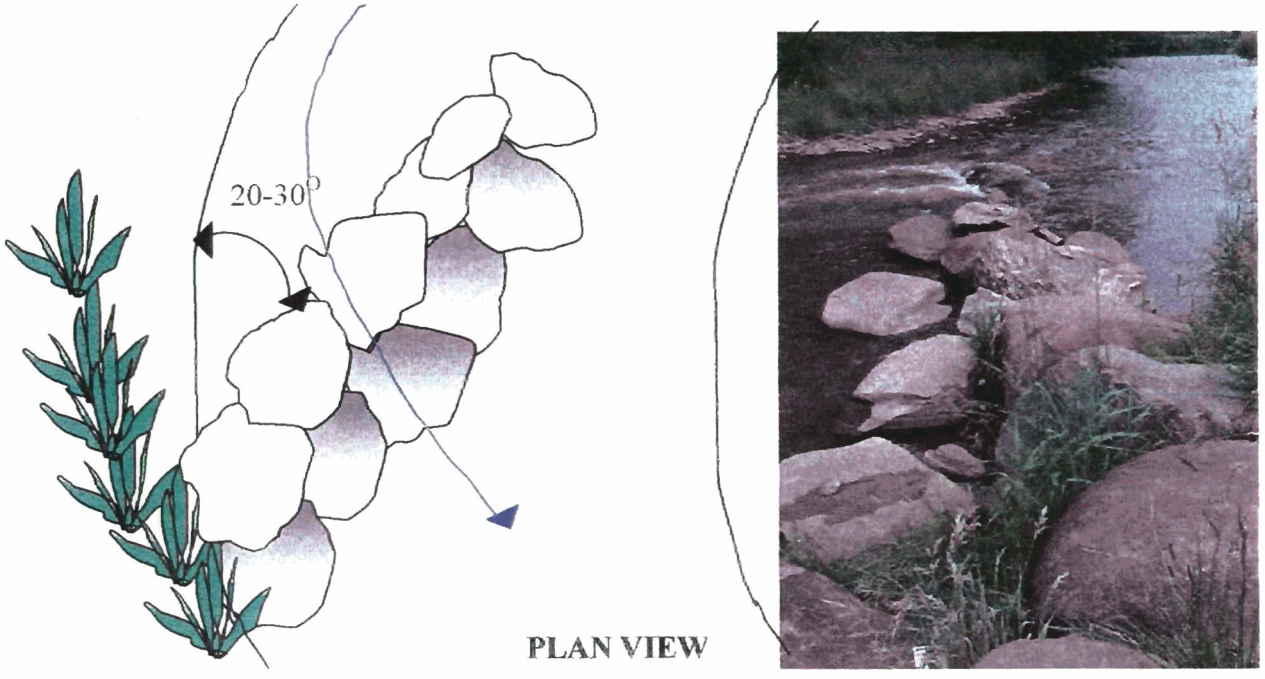
Appendix 2. Bank sloping and typical in-stream structures.

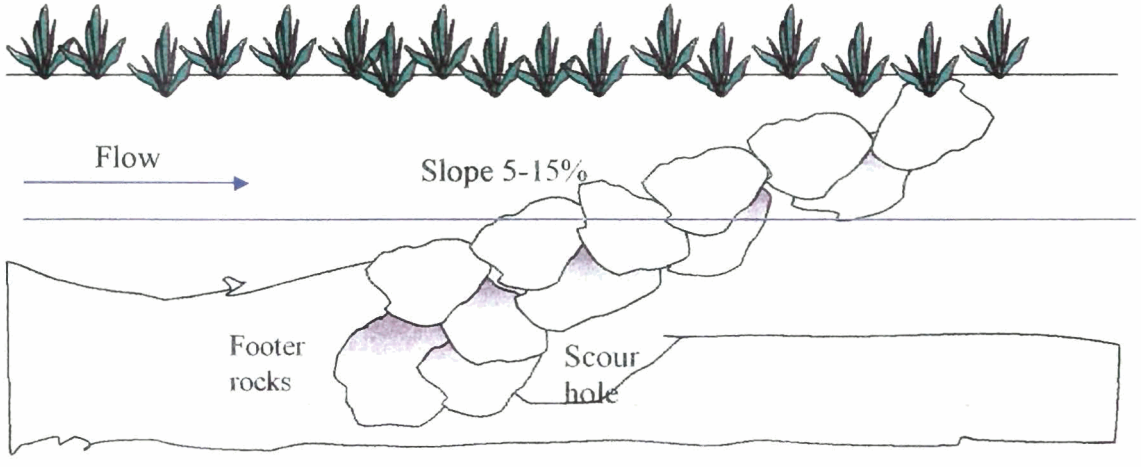
A.2.1. Typical bank grading and revegetation.

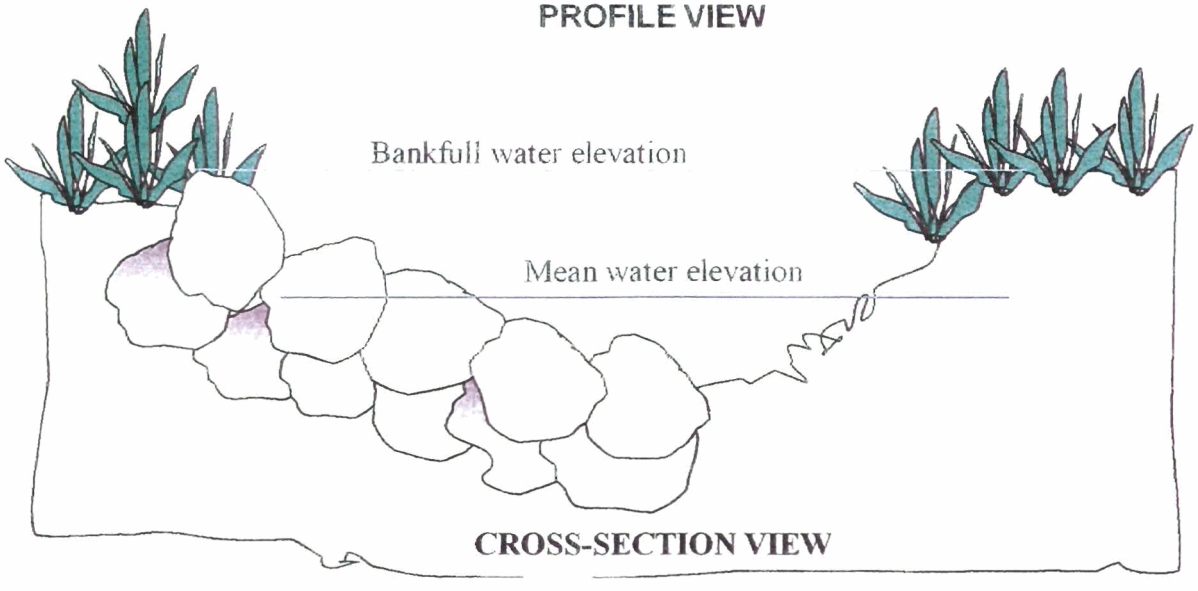


Appendix 2. Continued.

A.2.2. Typical rock vane structure showing plan, profile, and cross-section views







Appendix 2. Continued.
A.2.3. Typical root wad structure showing plan and cross section views.