

## **Live Staking in Austin, Texas Riparian Zone Restoration Projects SR-12-15, October 2012**

Alex Duncan and Jennifer Klingshirn

City of Austin  
Watershed Protection Department  
Environmental Resource Management Division

### **Abstract**

Enhancement of vegetation in riparian zone restoration projects is a commonly utilized method for stabilizing stream banks, reducing erosion, improving water quantity and quality, minimizing downstream flooding impacts, sequestering carbon, and providing shade and habitat for aquatic and terrestrial organisms. An understanding of which planting techniques and species have the highest probability of success in riparian zone restoration projects is needed to reduce project costs and maximize the ecological benefits achieved. In order to guide riparian planting efforts in Austin, Texas, the City of Austin Watershed Protection Department performed a detailed literature survey to evaluate the potential benefits of live staking riparian trees and shrubs. Results suggest that live staking success can be achieved by utilizing cuttings between 0.5 in. to 3 in. in diameter, performing both planting and harvesting of stakes in the dormant period (December 15 – March 15), and planting at least 75% or more of the length of the cutting below ground (to access ground water during the summer months). Species recommendations, harvesting methodology, storage, and planting techniques are also discussed. When done correctly, live staking in riparian restoration projects can be a low cost, highly successful alternative to conventional methods.

### **Introduction**

The long term success and sustainability of riparian zone restoration projects relies heavily on getting vegetation established in the degraded location. A healthy, diverse assemblage of riparian vegetation has been shown to help stabilize stream banks, reduce soil erosion, improve water quantity and quality, minimize downstream flooding impacts, sequester carbon, provide shade, and create habitat for aquatic and terrestrial organisms (Fischer and Fischenich 2000; Stacey et al. 2006; Richardson et al. 2007; Woolsey et al. 2007; Richter and Duncan 2012). Recent research by the City of Austin has found success (> 62% survival) in planting bare root saplings in riparian zone restoration projects (Duncan and Richter 2012). However, steep slopes and high flows can restrict the use of bare root saplings for some restoration locations (Rossow 1992; Duncan and Richter 2012). Live staking of riparian trees has been shown to be

successful in locations that have received high flows (approximately 12.6 feet per second) (Landphair and Li 2002) and may be used as an alternative planting method. Overall, live staking is an inexpensive method to help control stream bank erosion and increase vegetation cover for small scale projects (Li and Eddleman 2002). The objective of this paper was to review the current literature related to live staking in riparian restoration projects and to develop Best Management Practices for its use. Recommendations on appropriate plant species to use, harvesting methodology, storage, and planting will be discussed.

## Methods and Results

### *Species Selection*

Care must be taken when selecting appropriate species for planting in riparian restoration projects. Previous studies by the City of Austin have shown that differences in ecological region, size of drainage area, light level, and distance from the stream will significantly impact the survivability of selected plant species (Duncan et al. 2011; Duncan and Richter 2012). Therefore, selecting plant species from the same ecological region and similar drainage area, coupled with understanding the relative moisture content and light level of a targeted riparian restoration site, can help to maximize plant survivability and overall success of the project (Duncan *et al.* 2011; Duncan and Richter 2012). This research suggests that the most appropriate plant species for live staking in Austin, Texas, would be those found in both of the local ecoregions, in both large and small drainage areas, and in urban riparian environments. Additionally, they should be shown to have been successfully used in previous live staking projects. Based on these criteria, Table 1 lists appropriate plant species for use in Austin riparian zone restoration live staking projects. Each species has the corresponding shade tolerance, growth rate, height at maturity, and wetland indicator status (USDA 2012) that can help restoration practitioners select appropriate species for a site (Table 1).

**Table 1:** Plant species to be used in riparian zone restoration live staking projects. Each species is listed with its corresponding shade tolerance (Intolerant, Intermediate, and Tolerant), growth rate (slow, moderate, and rapid), mature height (median height of species at maturity), and wetland indicator status.

Common Name	Scientific Name	Shade Tolerance	Growth Rate	Mature Height (ft.)	Wetland Indicator
False Willow	<i>Baccharis neglecta</i>	Intolerant	Rapid	9	FAC
Buttonbush	<i>Cephalanthus occidentalis</i>	Tolerant	Moderate	15	OBL
Roughleaf dogwood	<i>Cornus drummondii</i>	Intermediate	Rapid	20	FAC
American Sycamore	<i>Platanus occidentalis</i>	Intermediate	Rapid	100	FAC+
Eastern Cottonwood	<i>Populus deltoides</i>	Intolerant	Rapid	190	FAC
Black Willow	<i>Salix nigra</i>	Intolerant	Rapid	100	FACW+

### *Harvesting*

Live staking in warmer regions can be challenging due to short rainy winters and the limited time period that vegetation is dormant (Allen and Leech 1997; Landphair and Li 2002). To maximize success and survivability of newly planted live stakes, both harvesting and planting

should occur within the vegetation dormant period (Allen and Leech 1997; Landphair and Li 2002). The Texas Department of Transportation found that cuttings had 6.09 times greater survival when installed in March over May (Landphair and Li 2002). In Texas, plant dormancy generally occurs between December 15<sup>th</sup> and March 15<sup>th</sup> (Landphair and Li 2002). The diameter of harvested cuttings can be anywhere from 0.5” to 3” in diameter (Allen and Leech 1997; Polster 1999; Landphair and Li 2002; Shafer and Lee 2003; Pezeshki et al. 2007) and as long as is necessary to access the water table, especially during summer months (Allen and Leech 1997; Shafer and Lee 2003). Generally, cutting lengths ranging from 1.5’ to 5’ have been successfully utilized (Allen and Leech 1997; Polster 1999; Shafer and Lee 2003; Pezeshki et al. 2007). Cuttings should be harvested from healthy, 2-5 year old branches from trees near the planting site or from a location that experiences similar conditions to the planting site (Solano 2005). The butt end of the branch should be cut at a 45-degree angle with the top cut flat; rough cuts and branch splintering should be avoided (Solano 2005). Cuttings should be trimmed to a single stem, removing all lateral branches and leaves prior to storage (Crowder 1995).

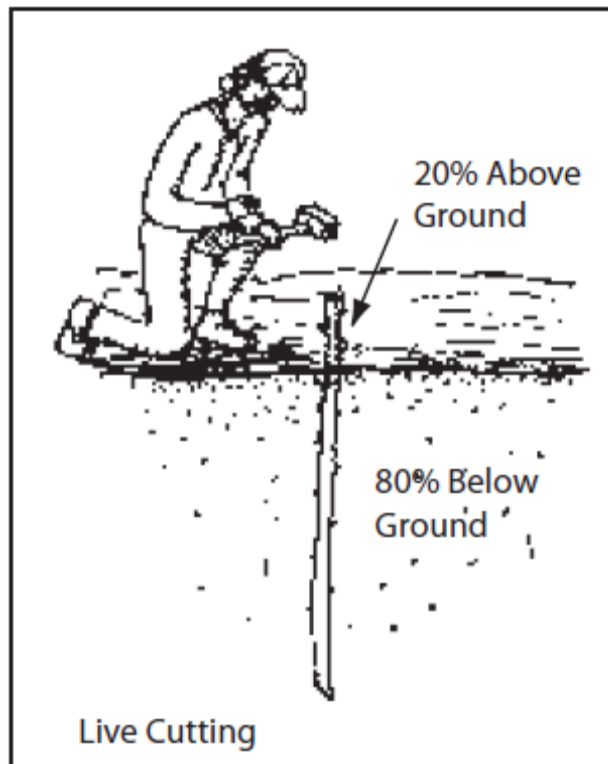
### *Storage*

Once cut, there seems to be little consensus as to the maximum allowable length between collection and replanting. Studies report that regrowth after a storage period (anywhere from 1 week to 6 months depending on the storage conditions) is possible (Landphair and Li 2002; Crowder 1995; Shafer and Lee 2003). However, precise refrigeration is required for extended storage beyond a few weeks (Landphair and Li 2002). Others state that replanting directly after cutting is most favorable for regrowth (Solano 2005). Due to lack of refrigeration facilities and likely transport between harvest and planting locations it seems unlikely that both immediate planting and/ or long term storage is feasible. It has also been suggested that presoaking cuttings in water for a minimum of 24 hours up to 14 days will improve establishment and survival (Allen and Leech 1997; Solano 2005). Therefore, all newly harvested live stakes should be stored in water for a minimum of 24 hours but no more than 10-14 days prior to planting (Allen and Leech 1997; Solano 2005). It is important to remove live stakes from water storage and plant prior to root emergence (Allen and Leech 1997). Landphair and Li (2002) found that damaging the newly formed roots of cuttings can potentially hinder future growth, hence reducing overall survivability. Live stakes should be kept fully submerged during storage, under shade, and in water temperatures of less than 50 degrees Fahrenheit if possible (Shafer and Lee 2003). Stakes should not be allowed to dry out.

### *Planting*

Live stakes should be planted within the same day they are removed from storage. A pilot hole should be created using a small sledge hammer and rebar or a bore hole using a soil auger. The butt end (cut at a 45-degree angle) of the live stake should be inserted into the newly formed hole and gently hammered or twisted into the ground until 75-80% is covered by soil (Figure 1). Several sources reported a depth of planting of at least 75% or more of the length of the cutting (Rossow 1992; Shafer and Lee 2003; Solano 2005). Although planting depth can vary slightly, access to groundwater is vital for plant establishment and survival (Allen and Leech 1997; Shafer and Lee 2003). The soil around the planted stake should be lightly tamped and then heavily watered to eliminate any air pockets that may have formed in the soil around the stake (Solano

2005). Finally, the top of the stake should be trimmed if it has become smashed or split during installation (Solano 2005).



**Figure 1:** Plant live stakes up to 80% below the ground in order to access groundwater.

## Conclusions

When appropriate species (Table 1) are properly harvested, stored, and planted, live staking may be an effective method for increasing vegetation cover in riparian zone restoration projects in the Austin area. In order to ensure success the following Best Management Practices should be followed.

- Only attempt to use False Willow, Buttonbush, Roughleaf dogwood, American Sycamore, Eastern Cottonwood, or Black Willow during live staking projects.
- Harvest and plant all live stakes during the winter dormant period of December 15<sup>th</sup> through March 15<sup>th</sup>.
- Cuttings should have a diameter range of 0.5” to 3.0”, a length range of 1.5’ to 5’, be harvested from 2-5 year old branches, and be cut at a 45 degree angle at the butt end.
- It’s helpful to harvest cuttings near to the planting site if possible.
- All harvested cuttings should be stored fully submerged in cold, shady water for 1-14 days and removed prior to root emergence.
- Live stakes should not be allowed to dry out and should be planted the same day they are removed from storage.

- Although planting depth can vary, it's important for at least 75% or more of the cutting to be covered by soil. Additionally, the butt end should have access to groundwater, especially during the dry summer months.

## Recommendations

Prior to widespread implementation the methodology discussed in this paper should be field tested. Studies of species survivability and testing of the viability of the harvest, storage, and planting methods are needed.

## References

- Allen, H.H. and J.R. Leech. 1997.** Bioengineering for Streambank Erosion Control. U.S. Army Corps of Engineers: Environmental Impact Research Program.
- Crowder, W. 1995.** Collecting Willow, Poplar, and Redosier Dogwood Hardwood Cuttings for Riparian Site Plantings. Plant Materials 29.
- Duncan, A. and A. Richter. 2012.** Sapling Survival Assessment: Prioritizing Native Tree Species to use in Riparian Zone Restoration in the City of Austin, Texas. City of Austin Watershed Protection Department, Environmental Resource Management. SR-12-11.
- Duncan, A., S. Wagner, M. Scoggins, and A. Richter. 2011.** Riparian reference condition: Using regional plant composition to guide functional improvements in the City of Austin. City of Austin Watershed Protection Department, Environmental Resource Management. SR-11-13.
- Fischer, R.A. and J.C. Fischenich. 2000.** Design recommendations for riparian corridors and vegetated buffer strips. U.S. Army Engineer Research and Development Center, Environmental Laboratory. Vicksburg, MS.
- Landphair, H.C. and M. Li. 2002.** Investigating the Applicability of Biotechnical Streambank Stabilization in Texas. Texas Department of Transportation Report 1836-1.
- Pezeshki, S.R., and S. Li, F.D. Shields, L.T. Martin, L.T. 2007.** Factors governing survival of black willow (*Salix nigra*) cuttings in a streambank restoration project. Ecological Engineering 29:56-65.
- Polster, D.F. 1999.** Soil Bioengineering for Steep/Unstable Slopes and Riparian Restoration. Watershed Restoration Technical Bulletin 4(4).
- Richardson, M. D., and P.M. Holmes, K.J. Esler, S.M. Galatowitsch, J.C. Stromberg, S.P. Kirkman, P. Pysek, R.J. Hobbs. 2007.** Riparian vegetation: degradation, alien plant invasion, and restoration prospects. Diversity and Distributions, 13: 126-139.
- Richter, A., and A. Duncan. 2012.** Riparian Functional Assessment: Choosing Metrics that Quantify Restoration Success in Austin, Texas. City of Austin Watershed Protection Department, Environmental Resource Management. SR-12-12

**Rossow, M. 1992.** Soil bioengineering for upland slope protection and erosion reduction. Engineering Field Handbook.

**Shafer, D. and A.A. Lee. 2003.** Willow stake installation: Example contract specifications. EMRRP Technical Notes Collection: U.S. Army Engineer Research and Development Center.

**Solano Conservation and Restoration Manual. 2005.** Live Staking and Pole Planting. Pg. 101-102.

**Stacey, P. B., and A. Jones, J.C. Catlin, D.A. Duff, L.E. Stevens, C. Gourley. 2006.** User's Guide for the Rapid Assessment of the Functional Condition of Stream-Riparian Ecosystems in the American Southwest. Wild Utah Project.

**Woolsey, S., and F. Capelli, T. Gonser, E. Hoehn, M. Hostmann, B. Junker, A. Paetzold, C. Roulier, S. Schweizer, S. Tiegs, K. Tockner, C. Webber, A. Peter. 2007.** A strategy to assess river restoration success. *Freshwater Biology* 52:752-769.

**US Department of Agriculture, Natural Resource Conservation Service. 2012.** The PLANTS Database (<http://plants.usda.gov>, 24 September 2012). National Plant Data Team, Greensboro, NC 27401-4901 USA.