



Live Stake Harvesting

Bioengineering is the use of living plants to stabilize streambanks, wetlands, floodplains, and other near-stream areas. Bioengineering typically uses an assemblage of species to "jumpstart" what nature would do over time. When conducting stream enhancement/restoration projects, it is essential that these disturbed areas are quickly revegetated with dense native plants. These native adventitious rooting live stakes (i.e., willow, dogwood, sycamore), in addition to rooted stock plants, can be installed perpendicular, parallel to, or in both directions to high flow. These "Living Dikes" create roughness and slow the water so to encourage nutrient uptake, and help seed and sediment to drop out, while providing shade, cover, vertical and horizontal structure, stabilize and/or lower water and air temperatures (microclimates), help maintain dissolved oxygen levels, and to supply carbon to the stream. Essentially, installing these initial pioneer species plants helps to establish positive riparian buffer zone features and ultimately, strengthens the stability and ecological health of the project area. Bioengineering can help shape a project's success by decreasing near-bank and overbank velocities.

Harvesting

There are many factors that will determine how long your live stake harvesting will take. Besides the density of desired species at the harvest site and how many stakes your project needs, the age and experience of volunteers will also affect the length of harvest time needed. Nine adults harvesting, cleaning, and bundling 1250 willow stakes could take 5 hours, whereas a group of 40 student might take 2 ½ hours to harvest 500 stakes.

Materials Needed

- Partners for Clean Streams has a *Live Stake Loaner Box* available for individuals or groups needing to harvest/plant live stakes.
- Materials included for HARVESTING in the *Live Stake Loaner Box* are the following:
 - Loppers (6)
 - Pruners (5)
 - Hacksaw (2)
 - Gloves (many, various sizes)
 - Rakes (3)
 - Safety vests (20)
 - Twine (for making bundles)
 - Marking flags (75)
 - First Aid kits (2)
- To make your harvesting event easier, group are encouraged to also have:
 - Pole saw/chain saw (for initial cutting of plants)
 - Rakes (for cleanup may be available with loaner box)
 - Bug spray
- Those undertaking a harvesting event are encouraged to wear long pants, long sleeves, appropriate footwear (i.e., sturdy footwear, muck boots) and any additional outerwear as needed.

Site Selection

- Select a site with a good supply of appropriately sized and desired species. If you reach out to Metroparks Toledo or US FWS Ottawa National Wildlife Refuge, they usually have some great sites they will allow harvesting at.





- The desired size of live stake is 0.25-inch to 0.75-inch diameter stakes. Some can be larger, but they will be harder to install. If they are any smaller, they will not be able to be "pushed" into planting holes.
- The desired length depends on where they are planted.
 Stakes should be long enough that when installed the base end that will root is at or close to the stream water level. This will assure enough water for the stake to root and grow without routine watering. On average, stakes should usually be harvested 4 to 6 foot in length.



Cutting

Cut plants so that stakes will be the appropriate length
 without waste. It is ok if they are longer than needed, but shorter will not work. If source plants are really tall, the harvested stake can be cut in half and both halves will be usable/plantable.



Longer stakes can be cut half and both pieces are plantable.





Stakes should be bundled with the cut endsSimilfacing the same direction for easierHancmanagement and transport.easie

Similar species should be bundled together. Handles can be tied between straps for easier transport.

Trimming

- During the *growing season*, 90-95% of the leafy material should be removed to encourage new growth when planted. Leaving some leaves at the top end of the stake will help the plant take in needed sunlight.
- During the *dormant season*, there will not be leaves on the plants so this step is not needed and will save time in harvesting.

Bundling

- Live stakes should be place into a pile with the cut ends facing the same direction.



- In order to track how many stakes have been harvested and to facilitating easier distribution at the planting location, it is recommended that stakes of the same species be bundled together in piles of 25.
- By tying bundles at each end, you can then cross tie a handle to make it easier to move the bundles for transport and to secure them for soaking (if needed).

Transporting

- During the *growing season*, bundles should be moved to the soaking location (if different than the planting location). This can be easily done with a pickup truck or on a flatbed trailer.
- During the *dormant season*, bundles should be moved to the planting location provided that site is cool, protected, and out of direct sunlight. You want the plants to stay dormant. It is recommended that dormant stakes be planted within a few days of harvesting.

Soaking

- During the *growing season*, bundles should be soaked preferably for 7-10 days before planting. It is ok to soak them longer, but less time has shown to yield a much lower survivability rate.
- Bundles can be "rafted" together and tied to shore.
- Make certain the water that plants are soaked in is fresh and oxygenated.
- It is preferable to have the bundles partially submerge to facilitate budding/growth.
- Check on the bundles every couple of days to confirm they are still secure to the shore and have not become food for any critters. You can also rotate the bundles, so all stakes have water contact during the soaking period.
- You may see feather-like roots begin from many points on the stake. This is good!

Questions

If you have questions about these installation methods, harvest site selection, etc. please contact Partners for Clean Streams at <u>admin@partnersforcleanstreams.org</u> or the Maumee AOC Coordinator at <u>Cherie.Blair@epa.ohio.gov</u>.

Bundles rafted together and soaking at the project site before planting.

















Live Stake Planting

Bioengineering is the use of living plants to stabilize streambanks, wetlands, floodplains, and other near-stream areas. Bioengineering typically uses an assemblage of species to "jumpstart" what nature would do over time. When conducting stream enhancement/restoration projects, it is essential that these disturbed areas are quickly revegetated with dense native plants. These native adventitious rooting live stakes (i.e., willow, dogwood, sycamore), in addition to rooted stock plants, can be installed perpendicular, parallel to, or in both directions to high flow. These "Living Dikes" create roughness and slow the water so to encourage nutrient uptake, help seed and sediment to drop out, while providing shade, cover, vertical and horizontal structure, stabilizing and/or lowering water and air temperatures (microclimates), helping maintain dissolved oxygen levels, and suppling carbon to the stream. Essentially, installing these initial pioneer species plants helps to establish positive riparian buffer zone features and ultimately, strengthening the stability and ecological health of the project area. Bioengineering can help shape a project's success by decreasing near-bank and overbank velocities.

Planting

Live stake planting usually requires more time and more people than harvesting. Volunteers need to be able to traverse the stream bank, which is often uneven and/or steep terrain. Working in teams of 2-3 people allows opportunities to trade-off jobs like carrying water or hammering dibble sticks. A group of 50-60 students might take 3-5 hours to plant 300 stakes.

Materials Needed

- Partners for Clean Streams has a *Live Stake Loaner Box* available for individuals or groups needing to harvest/plant live stakes.
- Materials included for PLANTING in the *Live Stake Loaner Box* are the following:
 - Hand sledge (4)
 - Hand trowels (3)
 - Gloves (many, various sizes)
 - Safety vests (20)
 - Marking flags (75)
 - First Aid kits (2)
 - Rebar/Dibble sticks (~3-4 ft long)
 - 0.25 inch diameter (2)
 - 0.5 inch diameter (1)
 - 0.75 inch diameter (2)
- Also needed for your planting event are:
 - Shovels
 - Buckets (for watering stakes)
 - Additional Rebar/Dibble sticks
 - Bug spray
- Those undertaking a planting event are encouraged to wear long pants, long sleeves, appropriate footwear (i.e., sturdy footwear, muck boots) and any additional outerwear as needed. It may be helpful to have hip boots or waders for some volunteers depending on the bank slope, depth of water and location of stake installation.





Planting with Purpose

- Shade and Habitat: To create instream shade and habitat during higher water level events, a row of stakes should be planted parallel to the stream at approximately a 45-degree angle. This encourages the plant to grow out over the stream thus creating shade on the water's edge as the plant grows. This will create habitat for smaller fish and other aquatic species during times of higher water.
- Creating roughness: To slow the velocity of the stream (particularly during flashy, storm events) stakes should be planted in rows perpendicular to the stream. This creates a "soft" barrier for the water to move over and through, thus slowing down the water. Willows are good for this type of feature, as they bend and flex more than some species and can handle the velocity of the high water without breaking.



Live stakes were planted at this site on an angle near the water to hang over the stream and vertical on the adjacent bench.

- Erosion control: To reduce erosion, stakes can be planted vertically into the ground, parallel to the stream but further up the bank and/or on an adjacent floodplain bench. Make certain the live stakes are planted deep enough so the bottom of the stake is near water level elevation. The above two planting approaches will also reduce erosion as the plants advantageously root to hold the soil in place.

Installation

- Determine where you will be planting live stakes and in what "pattern".
- Mark the areas to be planted and the approximate locations with marking flags.
- Dig a small hole with a shovel or hand trowel. *NOTE: This step is meant* to help start the hole and make the hole deeper for the live stake. It may not be required in sandy or mucky soil that is very soft.
- Use hand sledge to hammer dibble stick (rebar) into the ground. This should be deep enough that the bottom of the hole is close to the water elevation.
- Wiggle the rebar to increase hole size, and ease removal from the hole. NOTE: Leave enough rebar out of the ground that you can remove it. If you hammer it too deep, water suction will make it difficult to remove.
- Remove rebar and place live stake into hole.
- Gently press/push stake down into hole as deep as it will go.
- Pour water in the hole to help soil collapse into the hole and onto stake. *NOTE: You do NOT want to have air trapped in the hole. This will prevent root growth.*
- Backfill the small hole that was dug and compress/compact the soil around the live stake by stepping on it and water again.









Dig a small hole to begin planting.



Hammer rebar/dibble stick into the hole and remove.



Push stake into the hole created by the rebar and water to collapse soil.

Survivability

Bioengineering practices can be detrimentally affected by a number of different factors. Weather, wildlife, and people all play a factor in whether or not you'll need to replant or otherwise repair any of these practices. Low lying

and near shore plants could be subject to inundation or flooding, deer and other wildlife might negatively affect your work through grazing or antler rub. Depending upon the species you plant, what time of year, how long plants were soaked, if they were dormant, etc. will all affect how long it takes for your live stakes to sprout new growth. Some mortality is always expected, so don't be surprised if all of the stakes don't sprout. Sometimes they will initially sprout and then die; other times there will be late bloomers and then do really well. Close monitoring of the project within the first few years will help to gauge the need for additional work. If visible growth or sprouting doesn't occur after the first growing season, understand why plants are not growing, redesign as needed, and consider replanting.



Sprouting willow live stakes after being planted dormant.



New spring growth of dogwood live stakes after being planted dormant.

Questions

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Live Stake Loaner Box in memory of Dave Derrick

Dave Derrick was a hydrologic engineer from 1978 to 2013 with the U.S. Army Corps of Engineers. After retirement Dave continued to work to restore stream and improve our environment with River Research and Design, Inc.

until he passed away in June 2023. Dave worked on hundreds of projects across the entire United States, including several in the Maumee AOC.

Dave collaborated with many local partners on Maumee AOC restoration efforts. He was a mentor that guided stream restoration projects and taught many in the area his techniques and methods. Dave worked on the *Restoring Ottawa River Wetlands and Habitat at Camp Miakonda Project* in Sylvania, Ohio, as well as The University of Toledo's *Ottawa River Habitat Restoration Project, Highland Park Dam Mitigation Project*, and the Toledo Botanical Gardens' *Lake and Stream Restoration Project*.

To learn more about Dave's techniques, methods or some of the projects he worked on, please visit the Partners for Clean Streams (PCS) (<u>https://www.partnersforcleanstreams.org/</u>) or Maumee AOC (<u>https://maumeeaoc.org/</u>) websites or visit PCS's YouTube channel to see videos of Dave sharing his knowledge in his own words. Links are provided below are for the convenience of those using this fact sheet in printed hard copy:

- Miakonda Project: https://www.partnersforcleanstreams.org/projects/camp-miakonda-stream-restoration
- Stream & Habitat Restoration Methodologies & Techniques Guidebook and Fact Sheets: <u>https://maumeeaoc.org/resources/</u>
- Dave Derrick Methodology at Camp Miakonda:
 - o Video 1: <u>https://www.youtube.com/watch?v=5eTSreZh3FY</u>
 - Video 2: <u>https://www.youtube.com/watch?v=o5CNhFsCmsE</u>





This Live Stake Loaner Box was made possible through contributions in memory of Dave.

