



Riparian Restoration in the Elk Valley: Knowledge Sharing Document



Photo: Evgeni Matveev, Elk River Alliance

Prepared by: Elk River Alliance

Date: 17 July 2025

Please note that this is a working document and we welcome your feedback and input. If you'd like an MS Word version of this report to add information, or make edits or suggestions, please reach out to info@elkriveralliance.ca.

Table of Contents

_Toc225857399

Background and Introduction	3
Geographic Scope	4
Using this Document as Resource	4
Acknowledgements	4
General Considerations Before Beginning Restorative Work	5
Good vs. Bad Years:	5
Selecting Plant Species for Restoration	6
Beyond Planting:	7
Propagation Techniques	8
General Considerations	8
Livestakes	8
Seedlings	10
Cuttings	10
Planting Techniques	12
General Considerations	12
Waterjet Stinger	13
Manual (rebar and shovels)	13
Excavator	14
Horizontal Facines	15
Maintenance	16
Irrigation / Water Retention Techniques	16
Managing Animal Browse (both wild and livestock)	17
Invasive Species and Plant Competition	17
Other Topics of Discussion	18
Debated or New Techniques	18
Climate	18
Recommendations for Future Workshops & Knowledge Sharing	19
Resources	20
Case Studies	21

Background and Introduction

On April 17, 2025, the Elk River Alliance and Kootenay Conservation Program co-hosted a workshop on overcoming the technical challenges of riparian restoration in the East Kootenay region of British Columbia (BC). The workshop provided a collaborative space for restoration specialists and others involved in land stewardship (e.g., invasive plant societies, land trusts, stewardship groups) to share knowledge, ideas, success stories, and lessons learned in the field. The purpose of this workshop was to examine and document first-hand observations in riparian zone planting (i.e., 'planting plants and keeping them alive in challenging conditions'). Ultimately, we aim to improve the efficiency and success rates of future riparian and flood zone restoration projects and develop a resource that can be referenced for these projects in the region and beyond.

The workshop focused on:

- Soil conditions and challenges (e.g., cobble and gravel heavy soils vs. loam/silt/clay soils);
- Planting techniques and where they work best (deep vs shallow livestocking vs. seedlings vs. cuttings);
- Animal browsing challenges; and
- Invasive species management.

The workshop was a hybrid event hosted in Fernie, B.C., with a remote Zoom video conferencing option available for those unable to attend in person. There were 22 participants representing diverse perspectives from non-profit organizations, industry, land trusts, academia, consultancies, and others working in riparian restoration. Workshop participants shared successes and failures, allowing others to learn from their experiences. The workshop was designed for individuals with hands-on experience in riparian and floodplain restoration in the East Kootenay floodplains.

This report outlines the knowledge shared during the workshop and is intended to serve as a resource and living document for those pursuing riparian and floodplain restoration work in the East Kootenay.

Please note that this is a working document and we welcome your feedback and input. If you'd like an MS Word version of this report to add information, or make edits or suggestions, please reach out to info@elkriveralliance.ca.

Geographic Scope

This workshop focused on restoration work specifically in the floodplain and riparian zones throughout the East Kootenay region of B.C., which play a vital role in the area's ecology by providing shade and food for animals, stabilizing river banks, and slowing down floodwaters. These areas have been heavily impacted in the East Kootenay through land-use changes such as urban development, agriculture, and installation of infrastructure. Although workshop discussion focused on the East Kootenay area, some information may be relevant to other locations in B.C. and elsewhere. Further, it is important to note that some techniques, experiences, or levels of success in restoration planting will vary depending on the geographic location and landscapes the work takes place.

Using this Document as Resource

This document is intended to be a 'working document, meaning that the information contained within may be updated as new information becomes available or new information is shared with Elk River Alliance following restoration work or subsequent workshops.

The document is broadly broken down into four main sections: 1) general considerations for restoration (including information related to specific plant species); 2) propagation techniques (including livestakes, seedlings, and cuttings); 3) planting techniques (including using a waterjet stinger, manual techniques, excavator, and horizontal facines); and, 4) maintenance (including irrigation/water retention techniques, managing animal browse, and invasive and other plant competition).

The discussion around propagation, planting, and maintenance was captured in tables. Due to the nature of restoration, some of these sections contain overlapping information. We recommend visiting each of the main sections to familiarize yourself with the scope of information captured and revisiting the various sub-sections as needed. If you have recommendations on how this resource could be improved, or if you have additional knowledge or techniques to share, please reach out directly to Elk River Alliance.

Acknowledgements

Elk River Alliance would like to thank our funding partners who supported this workshop: Columbia Basin Trust, Habitat Conservation Trust Foundation, Trans Canada Trail, Fish and Wildlife Compensation Program, RBC Tech for Nature, and Big Bang Bagels. Kootenay Conservation Program also gratefully appreciates their funding

partners, including: Columbia Basin Trust, Fish and Wildlife Compensation Program, Environment and Climate Change Canada, Habitat Conservation Trust Foundation, Nature Conservancy of Canada, and The Nature Trust of BC, without whom they would not be able to support this type of work.

General Considerations Before Beginning Restorative Work

One of the main themes we heard throughout the workshop was the huge value of planning ahead in riparian restoration. Completing a full site assessment in advance of breaking ground is critical for the success of any restoration project. Part of this preparation is having a clear understanding of the site's natural hydrology, existing plant and wildlife species, and soil conditions (i.e., through observation of reference sites), which will help inform the planning process. This approach was referred to as developing the "path of restoration".

Workshop participants recommended starting with a good understanding of what the ideal conditions are for plant establishment, growth, and longevity, and from there, one can begin to deploy shade for rapid establishment.

It was also recommended to consider the natural successional pathway of the area and the species you're aiming to restore. For example, if an area would naturally begin with cottonwood growth and later develop into a coniferous-dominant site, you may want to skip planting coniferous trees in the beginning and focus on the first successional species. Establishing successional pathways will set up natural systems in a way that enables them to function independently. Many reclamation restoration projects have failed because stakeholders want a variety of species immediately, but this does not mimic natural processes. Further, purchasing or collecting multiple species at once can be costly.

Good vs. Bad Years:

It's important to note that some years will be better than others due to fluctuating weather conditions over time. It's normal to have a rough year every now and then (e.g., low plant success, difficult weather, low precipitation), in particular at the beginning of a restoration project. It is challenging to predict if a year will be good or bad based on climate projections, but if you have a strong understanding of the site, it is easier to emulate those natural conditions in harder years. Ensuring adequate planning and resources for components such as shade and irrigation can also help combat a year of poor growth conditions and carry the project through on its restoration trajectory.

Selecting Plant Species for Restoration

When selecting plant species for your restoration project, try as much as possible to plant the same native species that already exist on the site (e.g., consider the reference conditions for the site and the successional trajectory). Aiming for a variety of species can be helpful as well, but it is often easier and better to emulate natural systems by starting with one species. Different shrub and tree species, such as alder, dogwood, and black cottonwood, all have different roots and will therefore propagate and hold soil together differently. It is recommended to choose what will be best suited for your site conditions and what is already growing at that location. While assessing what is naturally growing on the site, keep in mind unusual weather events and what may have been eaten by ungulates in the area. The following list of plants was discussed in more depth during the workshop:

Alder:

- Note that some technicians have previously avoided using alder
- Will not root from cuttings; seed propagation is better
- Can hold soils together in a more practical function than species like willow; this can make alder a good choice if preventing erosion is a priority
- Some technicians have had success planting them at mine reclamation sites
- They are generally not naturally found right along the water, which doesn't make them ideal for riparian zone restoration

Black cottonwood:

- Can withstand flood events and high water tables
- Can have an extremely high stem density
- One of the most drought-tolerant species, and can survive on dry sites because it can establish roots much faster than other plants
- Resilient and hardy plants that can easily grow roots in conditions that are often hard for root establishment
- Can be sensitive to being too close to the water table

Engelmann spruce:

- Some technicians have tried to plant them in wet soils and had very little success; high water table led to the trees becoming waterlogged

Red-osier dogwood:

- Roots more slowly, which can make propagation / growing cuttings more difficult – they generally need two years of pot growth
 - Potentially adding rooting hormone to the water can help decrease the length of time needed

- Selection of propagules will also have an effect; waxier, younger cuttings with a wider diameter may have more energy stored, which can help with root production
- Some technicians have seen higher success rates with soaking the livestake for 5-6 days, rooting in a shaded tree line rather than a greenhouse, and cutting the livestake close to the ground when propagating
- Livestakes have been recommended over seedlings, as the process for seedlings is even slower
- Typically an understory plant, which is why growing in the shade can yield better results
- May have issues with ungulate browse as they tend to like dogwood
 - May also give a distorted view of what species are naturally growing on the site, as a lot of the growth may have been eaten

Willows:

- Be careful to note the exact type of willow species growing on the site and what you're looking for; sometimes the species of willows in wetland areas are actually not riparian species, and may therefore not be the best to plant
- True riparian willows will root better, can live in standing water for periods of time, and are likely to have strong roots in wet conditions
- Willows are disturbance species and have good moisture retention
- Larger stakes (1 ½ inches) have worked well for willow (at the point where you can still scratch bark and see the green), but don't want to go too big

Beyond Planting:

The implementation of coarse woody debris at restoration sites to create microhabitats was recommended, especially in areas focused on aquatic restoration zones (e.g., fish-centric restoration projects). To consider diversity, some practitioners have used vertical structures with additional wood surrounding them to mimic the depositional process of large woody debris within the floodplain. If or when there is a floodplain inundation event, those structures will recruit additional wood and help deposit organic material, silts, and nutrients into the floodplain.

Abiotic thresholds at the sites were also discussed. If there are conditions that enable a native plant to push through this threshold, soil amendments are likely not required. Where this becomes more challenging (e.g., on mine reclamation sites) is where you have unnatural pH levels, mixed soils, and abiotic conditions that have changed and aren't part of that plant's tolerance. In these scenarios, amendments will likely be

needed to encourage the plant's soil chemistry to transition into a suitable state for growing.

There was also a discussion on the challenges of obtaining the required permits through the Province of BC to carry out riparian restoration work. At the time of writing this document, there is a committee working on regulation changes around the issuing of Section 11 approvals through the Province. If approved, this would make permitting easier for those undertaking restoration work in BC.

Propagation Techniques

General Considerations

It is important to select a method of growth and propagation based on the species you are working with, suited to your site conditions. For example, aspens are a clonal species and would not be grown from seeds. Cottonwood, on the other hand, can be grown through seedlings, cuttings, or both, depending on the specific species of cottonwood (note that a cluster of all males or females is typically clones). Workshop participants were asked to share information on their successes, failures, and other information on various propagation techniques.

Livestakes

Collection and Propagation	• About 1.6 cm in diameter is ideal • Longer cuttings will have more energy stored, which will help with root growth • Some argue that thicker and shorter stakes can focus on root growth • Approx. 1.25 m is a good length and allows for planting deeper into the soil (if soil conditions allow) • Important to select true riparian species that naturally thrive in the environment • Waxier, younger cuttings will have higher success rates • Larger stakes grow more in the first year but can die back later on - sometimes start a new stem
Soil conditions for planting	• Easy in sandy loam • Still possible where sections have some gravel • Caution in wetland areas – anaerobic conditions can lead to lower success rates • Mixing in native soil when planting can be helpful • Sometimes, giving plants good soil at the start can make it

	hard for them to grow in the natural soil later
Notes for planting	Planting depth: • Should aim for what the roots can reach based on the water table where you're planting • Note that the water table will go down after freshet • Want to plant them so the roots are below competing weed or plant roots • Just because the bottom of the stake is wet, doesn't mean capillary action will take place - but as long as propagule has access to the rhizosphere, focus should be on maintaining the moisture regime so that roots can take hold • Depends on species: very rarely you'll have willows and poplars rooted below a conglomerated rhizosphere Techniques: • Using a post pounder can help get larger live stakes into the ground • Purchasing a proper planting bar will be easier than a DIY solution (recommended to get one about 1.5 - 2m with some weight to it and a pointed tip) • Good for fascines • Planting on an angle can increase success as it increases the surface area that the livestake will develop roots on • Plant right at the beginning of the Fall season, so that by springtime, everything is already in place. Often in the spring, by the time you actually plant, you're losing time • Fascine bundles can have an advantage, as growth and propagation triggers are activated; can get much denser planting because of the growth that emerges • Larger 3-4 inch stakes Elk River Alliance used for palisade fences had less growth but still survival • Some have recommended having 80% of the cutting buried in the ground • Organic clustering helps improve establishment
Maintenance	• Watering or irrigation can increase survival in dry conditions but is not always necessary • Trim back new growth of stakes for the first few years to promote root growth

Seedlings

Collection and Propagation	• Storage and transportation costs and logistics can be limiting factors, but could try working with arborists or regional districts, etc. • Relatively cheap to buy and install • Cottonwoods and willows may require more than one season for root growth before planting
Soil conditions for planting	• Example of planting in a very wet location, high water table, seedlings did not do well for Engelmann spruce • Sometimes, giving plants good soil at the start can make it hard for them to grow in the natural soil later
Notes for planting	• Planting Depth: ○ Make sure the plug is deep enough ○ Having them planted too high can lead to too much evaporation • Techniques: ○ If big gap between roots and soil, then it will have too much air and dry out ○ Using a mix of sand, potting mix, and rocks has worked well for some ○ Larger 3-4 inch stakes that Elk River Alliane used for palisade fences had less growth but still survival ○ Some have recommended having 80% of the cutting buried in the ground ○ Organic clustering helps improve establishment
Maintenance	• Typically needs more watering as their roots aren't good at chasing water • Trade off of spending money on irrigation vs equipment/machinery for other types of planting • May need a way to reduce plant competition as seedlings have a smaller biomass

Cuttings

Collection and Propagation	• Need to create a very porous soil mix in bags that are well-watered • Cut branches with growing seeds and plant those; have had success with those growing • Grew in prop tech containers (spelling?) in 8-inch containers with overhead sprinklers
-----------------------------------	---

	• Changing irrigation times based on the stage of growth • Sometimes, spotted plants will become root-bound and not want to grow out of that • 2-gallon pot, 25cm length cutting - stick it to the bottom and fill it with water (1 inch diameter) - Thor • 1m 1/2 length rooted can allow vegetated growth to outcompete canary grass etc. - John • Some said they don't put cutting all the way to the bottom
Soil conditions for planting	• Put out a lot of root and shoot growth in the first season, and by the end of season, they are sucking pots dry very quickly - make sure individual systems for watering pots (used high volume watering wand) • Also let them fully dry out after watering to encourage root growth • Don't want to leave them in the pots for more than a season really – can get root bound if in pot for too long (especially willow and cottonwoods) • Will often use sandy substrate • Don't want clay soil • Want air in the soil (native soils can get compacted and lose their air)
Notes for planting	• Depth: ◦ Plant cuttings close to the surface where the soil is aerobic • Techniques: ◦ Fascines are good on wet sites ◦ If you plant horizontal, you get roots across the whole thing, if you plant on an angle, you get roots growing along one end (45° angle is better) ◦ Organic clustering helps improve establishment ◦ Can disturb the soil area more before planting, so the soil is looser and it's easier for roots to grow out into the new soil
Maintenance	• Need to water sufficiently – they put out a lot of root and shoot growth in the first season, and by the end of season, they are sucking pots dry very quickly - make sure individual system for watering pots (used high volume watering wand) • Douglas fir bark mulch can be good for adding porosity • When watering, need to make sure there's true saturation down to the bottom of the pot

- | | |
|--|--|
| | <ul style="list-style-type: none"> • Put pots in a tray and then water the tray (bottom watering) |
|--|--|

Planting Techniques

General Considerations

When planting, it is once again best to aim for replicating the natural conditions of the site. In doing this, you may not be able to control the growing conditions, but you can control aspects such as shade and irrigation that will help with restoration success. The water and temperature conditions in the year you are planting will have a significant impact on the growth and survival of the plants, which may lead to the need to irrigate in tough, drier years. You may also find that the pH of the soil does not align with natural site conditions, and you may require soil amendments to return the soil chemistry to a more natural state. This will be a more likely scenario if restoration areas have experienced a heavy human impact, such as is the case on mine reclamation sites. Other amendments, such as adding older logs or root balls, can help provide stability, nutrients, and invertebrates, etc.

Note that when planting, it is considered best to space plants randomly rather than in a consistent, even layout to help emulate natural growth systems. Seasonal timing of planting is another important consideration; planting can be done in spring and fall, but some have suggested fall is the optimal time for planting. As for planting distance, 1.5 to 3 meters was generally recommended. When dealing with competing plant species, a higher density for planting will give shrubs and trees a better chance of survival. An 80% crown closure is recommended.

Workshop participants were asked to share information on their successes, failures, and other information on various planting techniques.

Notes on Rooting Depth:

It is important first to understand the hydrology of the planting site. The general depth for planting will vary based on the site conditions and water table. Restoration plans should also take into consideration the seasonal changes in water level that naturally occur. The seedling or livestake does not necessarily need to be in a submerged state where it is hitting the water table, as the roots will grow down to reach the water, but the closer the better. It is also helpful to get the roots below those of any competing grass or plants to increase its chances of survival.

Waterjet Stinger

[Chad to insert link to stinger construction document]

Best soil type	• Will work best on softer soils (loam) free of large stones • Will become harder or, at times, impossible when you start hitting rocks/cobbles (small gravel content usually okay)
Livestake or seedling	• This method is geared towards livestakes • Some recommend planting in tight, randomly spaced groups
Materials required	• Need the actual waterjet stinger attachment, hoses, water pump, and water source • There is an attachment piece for gallon pots that can be effective • An auger can also work well with 1-gallon pots
Cost effectiveness	• Cost varies, self-assembly around \$1,000-2,500 • Requires a metalworker for the stinger tip
Depth	• Ideal to have 80% of the stake in the ground • Depth required may vary depending on the water table of the site • If the site is really moist, it may not require planting as deep • Where conditions are aerobic, planting closer to the surface may be better
Additional notes	• Plant cuttings on an angle (45 degrees) to allow for more opportunity for rooting • Water use permitting can be difficult ◦ Getting a Section 11 permit has been said to be the hardest part ◦ Also may need short-term use permit (Section 10)

Manual (rebar and shovels)

Best soil type	• Easiest in soft, loamy, or sandy soils • Very challenging on gravel bars
Livestake or seedling	• Most manual labour methods will work for either livestakes or seedlings

Materials required	• A large planting bar (like a crowbar, but straight at the end) is recommended ◦ Option to buy mechanic bars at a general shop, 1.5 m long, or can work with a local welder to get them to weld rectangular handles on top to help leverage ◦ Can be worth getting something custom-made that works for your application (round bar with a rounded pointed tip) • A gas-powered post pounder can also be used to get into the soil quickly • Shovels • A post pounder can be used for livestakes, or similarly, a rubber mallet can be used (the damaged ends from the impact can be cut off afterwards) • Can use a gas-powered drill with a long drill bit
Cost effectiveness	• The equipment needed for manual methods is generally cheaper; however, labour costs will likely be increased due to longer planting times required
Depth for Planting	• Planting depth should again be based on the water table and site conditions, although it may be more difficult to get deeper holes manually
Additional notes	• Can have issues with compacting the soils around the edges and getting the soil to properly close around the livestake/cutting • Using peat instead of a mud slurry to fill in gaps after planting can be better

Excavator

Best soil type	• Good for dry sites, so you can get stakes down deeper • Spike can't get through some rocky soils (plan for it to break)
Livestake or seedling	• Livestakes (1.6m cuttings)

Materials required	• Rental or ownership of an excavator • Auger/spike attachment
Cost effectiveness	• More expensive to rent equipment, but can result in faster planting times
Depth for Planting	• Roughly 1.5 m deep is recommended
Additional notes	• Can scrape the sod back before digging your hole for planting, which helps clear competing vegetation • Need an operator who knows what they're doing • Plan for the spike to break at some point in rocky soils • Can use a walk-behind auger machine as a cheaper alternative

Horizontal Facines

Best soil type	• Moist soils, not suited to dry sites - Thor • Look at reference sites and soil horizons - soil moisture regime is critical • Use on moisture sites/drainage areas. Because they're shallow, they won't work in dry spots - Thor
Livestake or seedling	• This planting method exclusively works for livestakes
Materials required	• Either an excavator or shovels to dig the facine holes
Cost effectiveness	• No comments
Depth for Planting	• They're going to be more shallow by the nature of the planting type (i.e., shallow long holes)
Additional notes	• Having stakes in bundles is helpful ◦ Gives a higher chance of some of them rooting and growing chutes, which can get denser planting/growth • Never just lay stakes horizontally in a trench; leave a bit of the top of the stakes out above ground • Technique derived from soil bioengineering; able to

	pop something in the ground and have it grow, slowing the seasonal inundation • These can sort of happen naturally with a tree falling over and then growing stems up from that, so they do mimic natural conditions • Could grab rotten wood (hugel mounds) and add to the facine to help retain extra moisture
--	--

Maintenance

Workshop participants were asked to share information on the various irrigation and water retention techniques they have used in the past (e.g., what has worked and what has not worked, cost effectiveness, etc.), how they manage ungulate browse, as well as techniques for managing invasive species and other plant competition.

Irrigation / Water Retention Techniques

- Adding irrigation in low water table areas or drier sites can help boost survival
 - If you can't reach the capillary zone, irrigation may be useful
- Good for plugs
- May not be necessary in sites that get a lot of rain
- Some arguments have been made towards drip irrigation training plants to keep their roots high rather than driving them down to reach the water table
- Broadcast sprinkling has been said to be ineffective as it requires so much water - need a drip system, or watering tubes (PVC) instead
 - Only about 70% of water will actually hit the surface with broadcast sprinkling
 - If considering broadcast watering, you also need to consider the competition and invasive plants; watering at the base of the plant can limit supporting invasive species or other plant competition
- If drip irrigating, have to wrap your head around how long you need to run it to make sure you water below to rhizosphere (must understand where you want roots to be)
- Deploying fibre mats can help limit evaporation and focus on maintaining water regime
- Moving the drip line around can help encourage the plant to 'chase' the water
- It is important to find a good balance between supporting the plant with drip water, and getting it to support itself (don't want to result in shock or failures when you remove the irrigation)
- Paying to irrigate may potentially be more cost-effective in the end if you have a higher success rate
- Consider controlled irrigation at different frequencies and volumes at different times of year to mimic natural moisture patterns

- Like planting sites, each site is different and will need a custom approach for installations; one size does not fit all
- Bottom watering can be risky, as it may create anaerobic soil conditions
- Hand watering can be effective if you can concentrate the water right at the plant, but you need to put a lot of water on each plant; should hold at least a 20L bucket of water
- Fully saturating is key
- Hand watering is not cost-effective for vegetation establishment on a scale (anything more than 100 plants)
- Take ¾-inch PVC pipe and dig it down a bit for hand watering, so the tube carries the water deeper down has been recommended

Managing Animal Browse (both wild and livestock)

- Dogwood is very popular for ungulates and they will knock it out of the system very quickly
 - This can impact your view of the site and what succession looks like
 - May impact your decision on which species to plant
- Some have planted “decoy” plants as sacrifices for the beaver outside of their exclusion fencing
- Animal exclusion fencing with either wire or soft netting can work
 - Longer but shorter fences can be more effective
 - Electric fencing is keeping elk out on some sites
- In wetland areas, some have installed emergent plants with waterfowl protection (a “grid” of branches) to deter or make it harder for geese or other waterfowl to pull the roots out of the ground.
- Some suggest that repellents don’t work well
- Some people are experimenting with GPS collar options on livestock - collar keeps animals in or out of an area, but you have to collar most of the herd, not just the lead cows

Invasive Species and Plant Competition

- Reed canary grass has been a significant issue for those working in the East Kootenays
- Can be helpful to use an excavator to scrape back the soil and create a 1m x 1m square without grass, then put your pocket in the middle in the bare soil
- Biodegradable hemp squares have been recommended to keep weeds at bay until the installed plant is established
- Having a longer livestock stake out of the ground can allow it to reach the sunlight, but it can actually reduce the survivorship of stakes - more area above ground, the higher chance of death
- Planting in groups/ communities has had higher chance of success rather than spreading them out for outcompeting plants
- Closed canopies are good options for shading out the invasive species
- Tactics can depend on what kind of invasives you’re dealing with, some have

deep roots and can outcompete water sources, whereas others are outcompeting light sources

- Cardboard squares with mulch on top have helped to weigh down the grass around the plants
 - Some people, however, have had issues with animals ripping mulch up
 - Fibre mats to help with water retention can be used as an alternative to mulch
- Plastic tarp that is UV stabilised has been most effective for some (silage tarp)

Other Topics of Discussion

Debated or New Techniques

- **Cabling livestake stems together:**
 - This is becoming an out-of-date practice as some restoration practitioners have seen the technique fail. Instead, using root balls can be used as an alternative method. It is argued, however, that cabling the stems can prevent wood mobilization around infrastructure, while noting that it is best practice not to cable outside of a municipal context. Pinning down logs with angled wooden posts can be another alternative for those who wish to prevent movement without cabling.
- **Using older growth cottonwoods that have been cut down:**
 - Elk View Resources includes coarse woody debris in floodplain restoration work. It is necessary to acknowledge the temporal lag between the recruitment of that wood and stream function. This includes vertical structures that create vertical diversity within the ecosystem and helps with the successional process by adding nutrients.
 - Leaf Ninjas have buried a portion of cut-down trees and have been able to re-grow some of them. The ones that were half-buried with some light exposure rooted whereas the ones that got fully buried just served as coarse woody debris.
 - Note: there could be high machinery costs associated with this method as well as storage and transportation costs, which can become limiting factors.

Climate

- Questions arose around whether addressing climate change and post-fire impact changes the way that restoration is planned and executed

Recommendations for Future Workshops & Knowledge Sharing

Based on the high level of engagement and enthusiasm demonstrated during the one-day riparian restoration workshop, it is recommended that future workshops be planned to continue this valuable exchange of knowledge. Participants expressed a clear interest in sharing their experiences and learning from others, highlighting the wealth of expertise in the group. Follow-up sessions could build on this momentum by delving deeper into specific techniques discussed, exploring new topics identified by participants, and incorporating more interactive elements such as field demonstrations or problem-solving exercises. Establishing a regular schedule for knowledge-sharing gatherings, either in-person or virtually, could also help sustain the collaborative spirit of the workshop and support ongoing learning and capacity-building within the riparian restoration community.

Topics that were identified for future discussion included:

- Planting in rip-rap
- Passive restoration ideas
- Reed canary grass management
- Climate and fire considerations for restoration
- Kickstarting restoration in disturbed sites
- Planning and developing the path of restoration
- Successional pathways for restoration
- More collaborative approaches to projects from the start and full-rounded teams between clients, growers, contractors, designers, etc.

Resources

The following resources were shared by workshop participants:

- Pollock A, Grant KR, Schoonmaker A. Size Influences on the Survival of Willow Cuttings Under Operational Field Conditions. Ecol Evol. 2025 Jan 9;15(1):e70835. <https://pubmed.ncbi.nlm.nih.gov/39803210/>
- Hoag, J.C. (2006). The pot planter: a new attachment for the Waterjet Stinger. Native Plants Journal 7(1), 100-101. <https://dx.doi.org/10.1353/npj.2006.0008>.
- Stream Hydrology: An Introduction for Ecologists, 2nd Edition. <https://www.wiley.com/en-ca/Stream+Hydrology%3A+An+Introduction+for+Ecologists%2C+2nd+Edition-p-9780470843581>
- Leaf Ninjas portfolios: <https://leafninjas.ca/pages/portfolio>
- Low Tech Process Based Restoration Manual: <https://lowtechpbr.restoration.usu.edu/> (Dave at Leaf Ninjas can share a PDF if wanted dave@leafninjas.ca)
- Examples of using a nematic post pounder to drive posts in to help stabilize plantings, example here: <https://leafninjas.ca/pages/low-tech-process-based-restoration#BDA>
- Jason at Leaf Ninjas also said yes to using him as a resource: jason@leafninjas.ca
- Thor Smestad has some information on his website: www.treebearplants.ca
- Leaf Ninjas is happy to share photos of our tools & innovations for success, as well as methods
- East Kootenay Invasive Species Council website is full of resources: <https://www.ekisc.com/>
- Examples of facinae on Cranstone, Clode and Sunset portfolio projects at: <https://leafninjas.ca/pages/portfolio>

Case Studies

- Could add a list of specific projects and provide what did or didn't work (including location, soil type, species, planting method, etc.)
- For example, ERA Cottonwood Restoration Program - Big Ranch:
 - Elk Valley, BC - North of Sparwood
 - Loamy soils with some cobbles
 - Using a waterjet stinger was effective
 - A team of 3 field technicians were able to plant on average 600 cottonwood livestakes per day
 - Limited maintenance needed - don't need to water directly after planting
 - ERA has taken red osier dogwood cuttings and jammed them into the ground with an excavator - roughly 70% survival (not sure if that was just because it was a good year, as in theory, they shouldn't have survived that well)
 - Liz is looking at scraping the land and taking local seeds off alders and spreading them
 - Have tried using bear poop and mixing it into a slurry for planting
 - John has used this as well, but says it's probably not scalable