Best Management Practices for Tree and Crop Protection:

A guide for using fencing to coexist with beavers

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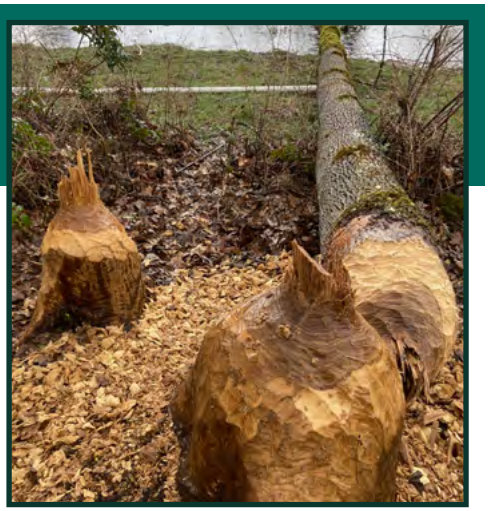
Contents



Introduction

Beavers are famous for cutting down trees and shrubs, a persistent behavior that often frustrates humans who have planted special trees or crops near beaver habitat. Beavers find many of the annual crops we grow tasty, like corn and beets, and can eat a large area down over the course of a season. Trees and shrubs that are native to waterways in the Northern Hemisphere have a long history with beavers and will re-sprout after being cut. In contrast, many of the trees and shrubs we grow in our yards, orchards, and fields don't share this history of coexistence with beavers. For example, an apple tree will die if cut down by a beaver whereas a maple or ash tree will vigorously re-sprout from its stump. We also build structures in and around beaver habitat like homes, roads, and power lines. This infrastructure can be damaged or obstructed by the trees beavers cut down. Conflicts over how vegetation is managed in waterways often leads to humans killing a lot of beavers.

Most beavers trapped by humans are killed because they are cutting down and eating trees or plants that people don't want them to take. However, despite being one of the most common reactions, killing beavers is far from the most effective solution. Beavers are territorial and can quickly recognize and colonize freshly unoccupied habitat. While trapping can remove one beaver family, it leaves behind vacant habitat that other beavers will quickly find. At most, trapping will provide a short window of time where no beavers are present to forage on adjacent trees and shrubs, but it does not protect special trees and crops from the next family of beavers that moves in. As long as high-quality beaver habitat and forage is present, there will be a high likelihood that beavers will reoccupy a site. Killing beavers often becomes a frustrating treadmill of reactive management that degrades the habitat and depletes the local beaver population — while failing to provide a robust solution.

> *"Good fences make good neighbors."*
>
> *– Robert Frost*

A more effective solution is to protect special trees or crops with fencing. This strategy lasts longer and often costs less than trapping. This document is a guide to using fencing to coexist with beavers. Our goal is to empower farmers, landowners, organizations, municipalities, and wildlife professionals with best management practices (BMPs) for protecting individual trees or entire orchards and crops. These BMPs are built on years of diligent trial and error across a community of practice that spans North America and Europe. Their work now empowers you to to bypass frustrating experimentation stages to implement a successful, long-term coexistence strategy.

How to use this guide

This guide is organized into two categories. The **Tree Protection** section provides guidance on protecting special trees, one tree at a time or in small clumps, while the **Crop Protection** section will guide you in protecting a collection of trees, shrubs, or other crops as a single unit. If you follow the fundamentals of these designs while taking your unique circumstances into consideration, you should reach a robust coexistence solution. There are many ways to build a fence and protect vegetation — these practices have been the most successful to date.

Tree protection

When to use tree protection

When beavers start felling trees, the area can look messy and neglected to humans, but these natural changes should not cause alarm. Beavers have been stewarding our waterways for millions of years — since well before humans appear in the fossil record. Native trees and shrubs that live in our riparian forests have coevolved with persistent beaver foraging. These species have come to expect severe pruning by beavers (in addition to damage from flooding and wildfires) and are often healthier when subjected to this natural part of their environment.

Trees may also die from flooding caused by the creation of beaver dams and ponds. This is a sign the beavers are successfully reconnecting the floodplain to the river and is a healthy path forward for the landscape. The snags also provide valuable habitat for many species, particularly birds that nest in cavities. If a beaver pond is flooding out a special tree that must be saved, you can consider using a pond leveler to lower the water level around its roots.

As you consider which trees to protect, think about their size, function, value, beauty, and species (Figure 1). **Which trees are significant to the space (like a public park) or special to you?** Avoid fencing off native trees and shrubs that aren't particularly important to the humans that use the site, since these species are often healthier when trimmed by beavers (even when fully cut down). Most native species have developed a regeneration adaptation (coppicing) that allows them to regrow from their roots. If the tree or shrub is an ornamental or fruiting species that humans have introduced to the site, it is less likely to have this adaptation to help it survive a foraging beaver.

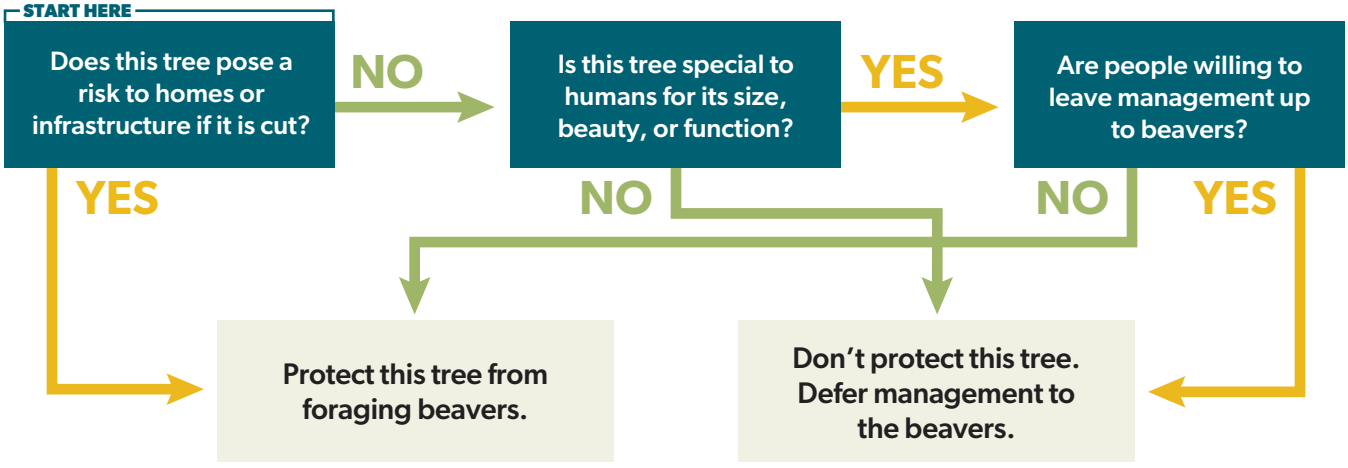
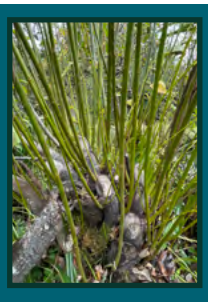


Figure 1. How to decide if a tree should be protected.



Coppicing:

For many native species, cutting a tree to the stump encourages new shoots to grow. This is a regeneration adaptation called coppicing.

How it works

A simple cylinder of wire mesh (tree cage) around the base of a tree is the most secure technique for shielding the trunk from foraging beavers. A typical tree cage is slightly above waist height (~ 3–4 feet or 1 meter) and made from welded wire mesh with openings smaller than a hand could fit through (~ 4 inches or 10 cm). The cage can be supported by cutting and flaring out flanges at its base. There should be at least one fist-width (~ 6 inches or 15 cm) between the fencing and the trunk on all sides. Multiple close trees can be protected within one fence by increasing the length of mesh. Installing wire mesh tree protectors does not require specialized equipment and the materials can be purchased at a local hardware, building, or farm and ranch supply store.

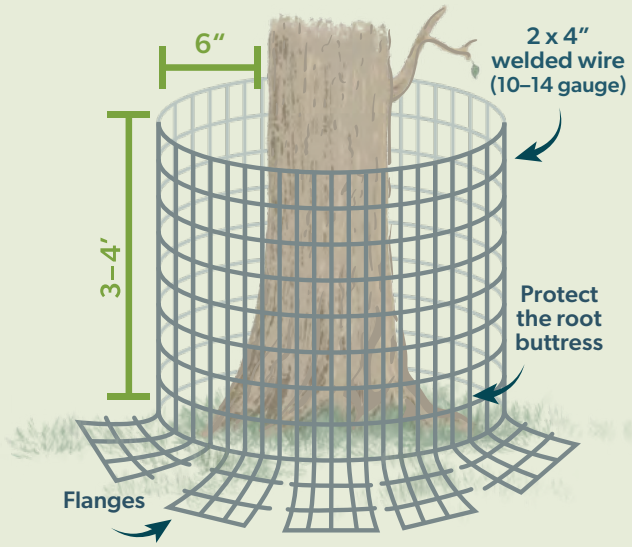


Figure 2. Standard tree cage made from a cylinder of wire mesh. Cages can encircle a single tree or a close group of trees (See special case modifications).

Essential considerations

- **Don't hurt the tree**
  Many tree protection cages installed to protect trees from beavers ultimately kill the trees years later due to improper maintenance. Tree trunks become thicker as trees grow. If the mesh isn't periodically expanded, it can become too tight and girdle the tree. This happens when the tree grows into the wire mesh, severing the cambium just under the bark. How quickly this happens depends on the tree species and climate. Create a multi-year plan to monitor tree protection and increase the diameter of the fence cylinder if the tree grows within a thumb-width from the mesh. Never nail or staple fencing directly to the tree.

- **Protect enough trunk**
  When beavers decide to cut down a tree, they will squat or stand at its base while they cut through the bark and into the wood with their incisors. At their tallest, beavers can chew through a trunk 3 feet from the ground (~ 1 meter). Tree cages must protect both the base of the tree where it flares out into a buttress

or exposed roots and extend far enough up the trunk to keep beavers from reaching over it.

The **cambium** is a thin layer of cells just under the bark that is essential for the tree to grow and transport nutrients and water. Severing the cambium around the entire trunk of the tree will kill it.

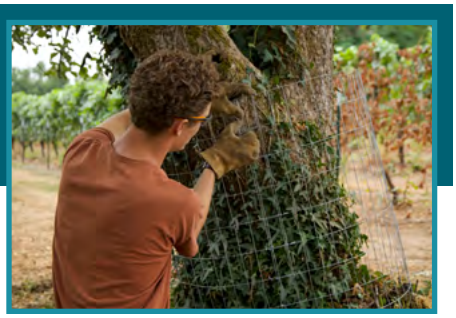
- **Consider snow depth**
  In areas that are prone to snow, beavers can access a tree from on top of the snowpack which allows them to reach higher up the tree. Where feasible, consider extending tree protection at least 3 feet (~ 1 meter) higher than the anticipated snow depth.

- **Use robust materials**
  Adult beavers can regularly weigh as much as 60 pounds or more. The mesh used must be able to withstand them standing on and pushing against it. Unless your mesh material is only 3 feet (~ 1 meter) tall, do not skip cutting the flanges into the base of the mesh. Flanges take advantage of the beaver's own weight to hold the mesh cage in place. Mesh cages without flanges can be more easily pushed against the tree trunk or lifted to gain access from below. Do not use chicken wire!

- **Provide adequate ventilation**
  Trees breathe through their bark in addition to their leaves. Don't smother them or overheat their sometimes-fragile cambium by using old stovepipe or applying thick layers of paint to young trees.

Best management practices

Tree protection cages can successfully facilitate human-beaver coexistence for many years provided that these projects are planned, installed, and maintained correctly. Adhering to the following best management practices will provide the highest chance of long-term success.



Installation plan for standard wire mesh tree protection

Site planning

1. **Determine which trees** and shrubs you are going to protect (Figure 1).

2. **Estimate how much wire mesh you will need.** Use Figure 3 to determine the length required for each tree, then calculate a total length. This type of fencing is typically sold in 50-foot or 100-foot rolls.

3. **Acquire materials**
   - **A mesh made from wire** with a minimum 14-gauge thickness to prevent beavers from chewing through (when shopping for wire remember that wire gets thinner as the gauge numbers increase). The size of the openings in this mesh should be smaller than you can fit your hand through. We

recommend using 2 x 4 inch (~ 5 x 10 cm) 14-gauge welded wire mesh when available. Using woven poultry netting of any size is not recommended as it can be crushed down by beaver or snow. Buy a roll that is at least 4 feet tall, as this will give you 1 foot for the stabilizing flanges. A 5-foot-tall roll is ideal for slopes as this enables you to cut 1.5 foot flanges (leaving a 3.5-foot-tall cage).

- **Hog rings and hog ring pliers** for closing the sides of the wire mesh together into a circle. Alternatively, you can use wire to attach the mesh back on itself (no need for hog rings and special pliers). Plastic zip-ties are not recommended as they will degrade in the sunlight over time.

How much wire mesh do you need?

$$C = \pi d$$

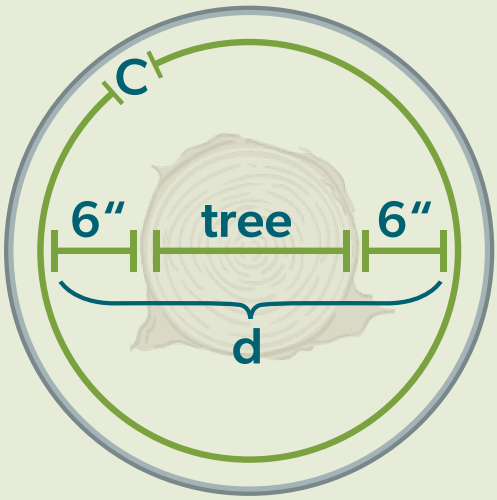


Figure 3. Use the equation C =πd (C = circumference, π = 3.14, d = diameter) to determine how much wire mesh to purchase. The cage should be at least 1 foot in diameter larger than the tree trunk to allow for tree growth and to limit the beaver's ability to reach through the mesh (this means a minimum of 6 inches open space on all sides). Ensure that all your measurements are in either inches or feet but not both. To find the length of fencing required for a clump of trees or shrubs replace the diameter of the tree with the approximate diameter of the entire clump.

Installation

1. **Cut a piece of wire mesh** the required length for a specific tree, clump of trees, or shrubs, using Figure 3 to determine the length. Cut the mesh flush at one side, leaving the other side of your seam with long ends of wire to use for fastening the fence to itself. Bend the mesh into a circle.

2. **Position this circle of fencing around the tree**, clump of trees, or shrubs, and close the ends back onto themselves. Attach the ends to each other by twisting the cut end around the mesh (or using hog rings) every few inches along the seam.

Maintenance

- Check on trees and shrubs that have been protected from foraging beavers once every few years.

Pro Tips:

- Cut your length of fencing extra-long so that it overlaps at the seam (by at least 1 foot or ~ 30 centimeters). This will enable you to expand your cage when the tree grows without adding more fencing.

- When attaching the mesh into a circle, only wire every 3rd row or so and leave extra fencing so the initial wrap can be unfastened easily, expanded and refastened later if the tree grows without need to cut off or use new fasteners.

- When the distance between the fence and the tree is less than a thumb width (~ 1 inch), open a seam in the mesh fencing and attach an extension strip (with twisted wire or hog rings) large enough to provide 6 inches of space all the way around the tree between the trunk and the wire.

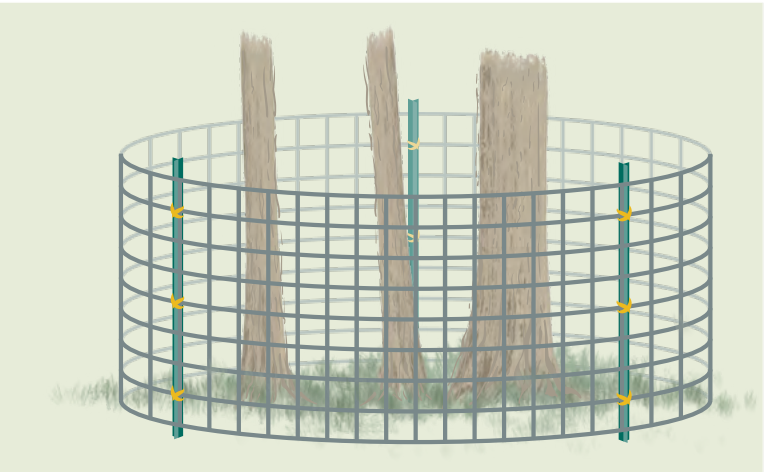
What **NOT** to do:

Photo: Alison Zak

Photo: Alison Zak

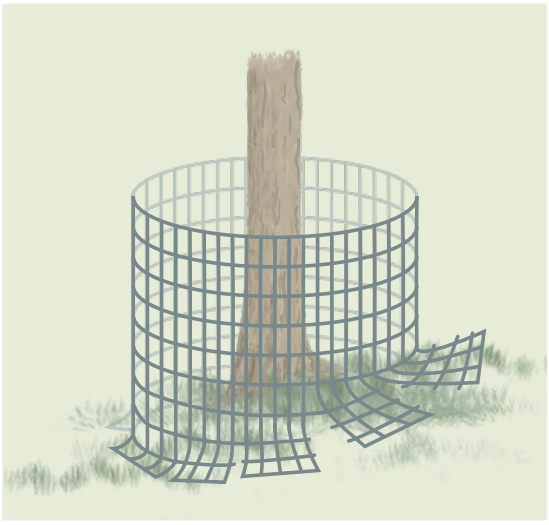
Figure 4. Examples of bad tree protection. (Left) The mesh cage was not expanded as the tree grew. (Center) Chicken wire was used to protect this tree which was crushed to the ground by beavers. In addition, a post was installed too close and not moved as the tree grew. (Right) Mesh cage was installed too close to the tree, allowing beavers to reach through.

Special Case Modifications



Modification 1: Protecting clumps of trees

A single mesh fence can be used to protect a clump of closely spaced trees or shrubs. Add T-posts to stabilize the mesh if building a cage with a diameter larger than 6 feet (~ 2 meters).



Modification 2: Protecting trees on a slope

When installing on a slope, stabilizing flanges can be cut from the bottom of the mesh. Flanges take advantage of the beaver's own weight to hold the mesh cage in place.

Instructions: Fasten the mesh into a circle around the tree, then on the uphill side only, cut a 16-inch vertical line through the horizontal wires starting from the bottom of the mesh (if using 5-foot-tall mesh) or 12 inches (if using 4-foot-tall mesh). Cut shorter vertical lines on the sides of the cage that will be oriented side-hill (e.g. 8 inches), then short cuts in the front (e.g. 4 inches). Bend these flanges out and away from the cage at angles to match the slope so that they sit flat on the ground — holding the cylinder of mesh up upright. Adjust the size of your flanges (by cutting them a little longer) as needed.

Modification 3: Mowing adaptation

Tree cages can be lifted up and temporarily tied to a low branch for mowing.

Instructions: Attach a short length of wire to the top of the tree cage. When mowing, simply pull the cage up the tree truck and hook the end of the wire over a low branch. Un-hook this wire and let the cage back down once you no longer need access to the base of the tree.

Modification 4: Securing against floods

Tree cages can be damaged or swept away during natural cycles of high-water and should be secured in place.

Instructions: Pound 2-3 steel posts just inside of the tree cage and wire firmly in place.

Experimental approaches

Sand and paint

Some people have started to experiment with painting a mixture of sand and paint to protect individual trees from foraging beavers. Because beavers will often avoid chewing through this layer of abrasive paint, this method has been successful in protecting special trees. Depending on the paint color chosen, this tactic can preserve the visual appearance of an area. The sand and paint mixture requires minimal material and labor, annual monitoring, and periodic repainting.

Protecting trees with sand and paint is still experimental and is not considered a best management practice because it does not work well on small diameter trees. Since it only takes a few bites for a beaver to get through a small tree, they are more likely to tolerate the unpleasant sand mixture. Only try this method on trees that are 6 inches in diameter or wider. This treatment has also caused young trees to die, which may be due to toxicity of the paint or reduced respiration (suffocating under the paint). This method is also not recommended for highly valuable trees, as beavers will chew through sand–paint mixtures in some cases. If losing a valuable tree to beaver foraging is unacceptable, use a wire cage instead of a sand and paint coating.

Site Planning

- This technique is not be suitable for trees covered in lichens. Check the condition of the tree trunk(s) prior to painting and do not use on trees with epiphytic growths from the base up to 4 feet high.
- Check environmental safety concerns for the paint you select. Many people have had success with latex paints. Some exterior latex paints contain heavy metals to protect color from fading, so for this reason, interior paint can be a safer choice for use near creeks but may not last as long as exterior paint. Only use non-toxic paint.
- Buy dry, bagged sand (30-mil, 70-mil, or masonry sand).

Installation

- Mix 2 cups (~ 32 ounces) of fine dry sand into every 1 quart of latex paint, matched to the color of the tree trunk.
- If making a large batch, add ingredients together in a 5-gallon bucket and stir until fully combined using a mixing arm attached to a drill. Continue to stir frequently while painting to keep the sand particles in suspension.

- Paint the mixture on the tree, thinly coating the bark entirely from the base to 4 feet above the ground as well as any exposed roots.
- Apply only to dry bark (don't paint if it's been raining recently) and don't let paint drip into the water.

Maintenance

- Frequent maintenance is critical when using this approach. Depending on the type of mixture used, tree species, and other environmental factors, sanded paint layers will flake off or wear thin. Re-application of the mixture will be required periodically based on the specifics of your site. Also, as the protected tree grows in diameter, areas of unprotected bark will emerge. Check on sand painted trees frequently and liberally re-apply the coating.

In Europe, a commercial product called WÖBRA was developed to protect trees from foraging elk. A proprietary mix of glue and sand, this product has been used with success to deter foraging beavers. However, it is quite expensive.

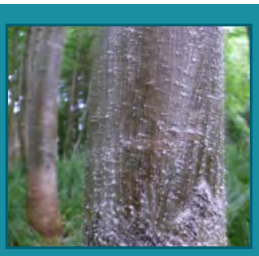


Photo: Gerhard Schwab

Crop protection

When to use crop protection

Crop protection using fencing is an immediate and cost-effective solution that can protect plants near waterways while allowing beavers to remain in their habitat. It can be used as a long-term installation to deter foraging beavers from crops, orchards, or vineyards planted next to waterways — or it can be installed as a short-term solution to protect annual crops or to protect restoration plantings for the first five years as they get established in riparian areas. Two primary fencing options include installing an electric fence or a non-electric mesh fence. Electric lines can also be retrofitted to an existing fence.

> **Shocking beavers isn't friendly, but it's kinder than killing them.**
>
> If you choose to install crop protection that uses electric fencing, please follow these BMPs to minimize the risk that beavers or other wildlife will become entangled or injured.

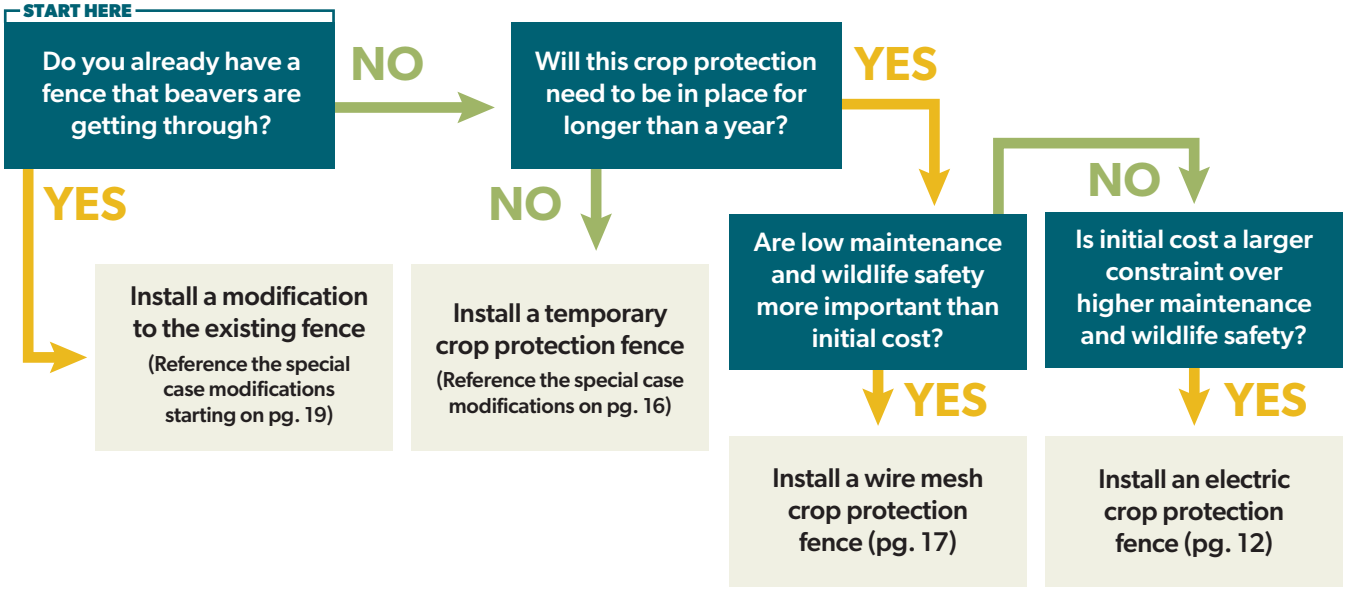


Figure 5: How to choose the correct type of crop protection fence.

How it works

Although beavers live most of their lives in waterways, they often need to travel upland in search of food and building materials. Landowners with important crops adjacent to waterways often turn to fencing to deter foraging beavers. However, beavers are more agile than they appear and can easily squeeze or dig under most fences. In addition, although beavers are not good climbers and prefer to go under or around, they will occasionally attempt to climb over or push obstacles out of their way. Regardless of their methods, these little engineers are intelligent problem solvers and special fencing considerations are required to keep them out. Fencing needs to either quickly deter beavers by using electricity or be robust enough to prevent them from digging under.

Essential considerations

- **The right design**
  You may have an orchard that needs protection for many years, or you may already have a fence and you just need help making it beaver proof. Perhaps you only need to exclude beavers for a couple of months. Use Figure 5 to determine what type of fence fits your needs.

- **Adequate coverage**
  Beavers will approach the planting from the nearby waterway habitat. While they may have an established path or slide, they will quickly find a new angle of approach if their habitual route is blocked. Build a fence long enough to anticipate any of the approaches that beaver may take from their habitat (Figure 6). Protect the length of cropland adjacent to the waterway habitat, plus an additional 30 yards of fence on either side to keep beavers from going around.

- **Protection near the ground**
  Beavers aren't very tall and can squeeze very low to the ground to duck under a fence. They are also great diggers. Electric fence posts need to be closely spaced on uneven terrain to prevent beavers from slipping under. Non-electric fences need to extend across or below the ground surface to deter digging.

- **Plan for maintenance**
  A regular maintenance schedule is critical to the long-term success of crop protection. Electric fences require more maintenance than non-electric mesh fences to prevent vegetation from touching the wires. All fence types should be routinely monitored for damage

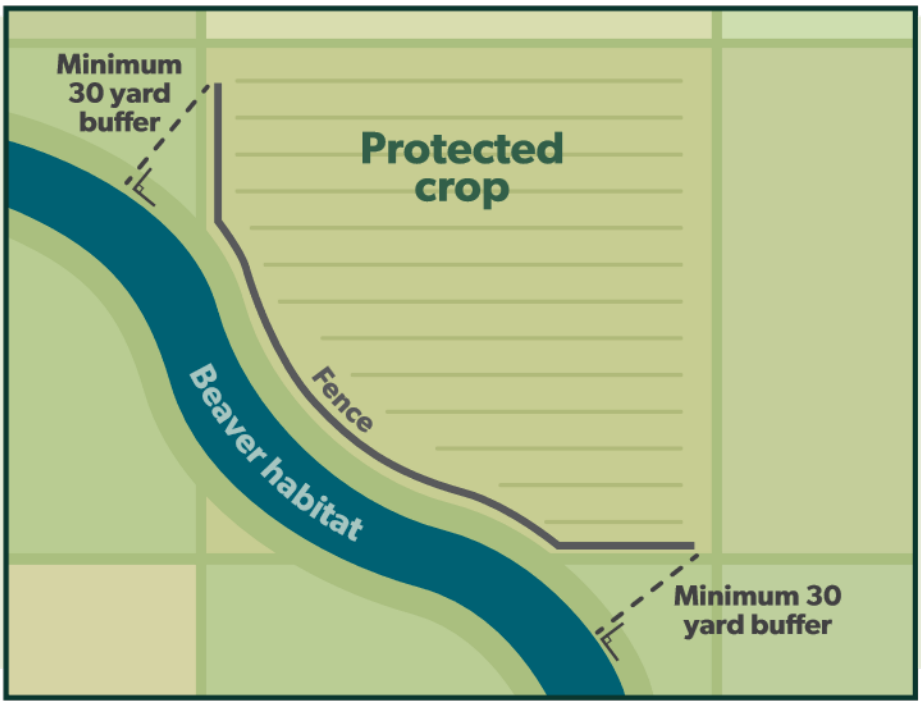


Figure 6: An overview of a crop adjacent to a waterway with beaver habitat that has been protected by fencing. When sizing crop protection fencing it is important to extend the fence a minimum of 30 yards past the connection between beaver habitat and croplands to prevent beaver from walking around the fence to access the crop. Make sure the measurement is taken perpendicular from the nearest water point and not along property lines.

Best management practices

Crop protection with fencing can successfully facilitate human-beaver coexistence for many years provided these projects are planned, installed, and maintained correctly. Adhering to the following best management Practices will provide the highest chance of long-term success.

Installation plan for a standard electric crop protection fence

Electric fences can be installed temporarily using fiberglass New Zealand style posts with sliding plastic insulators, step-in posts with built-in insulators,

or permanently using a system of T-posts with plastic insulators. Both temporary and permanent electric fences require a simple grounding system and a power source. The fence can be powered with an energizer that uses either a solar panel and battery or plugs into AC power. The fence should contain a minimum of two charged "hot" wires, one 4 inches (~ 10 cm) above the ground and another 6 inches (~ 15 cm) above the first wire (Figure 7). When a beaver touches one or both wires, an intermittent electric current in the fence travels through the beaver, into the ground, and back to the grounding rods at the fence emitter. Put another way, the beaver becomes a bridge for electrical current as it tries to get back to the ground terminal on the energizer. Anyone who completes this electrical circuit by connecting the fence to the ground will get shocked. Electric fences work particularly well on beavers, as they are often moist when they contact the wires. Materials required to build electric fences for crop protection can be purchased at local farm and ranch supply stores, and only simple hand-tools are required for installation.

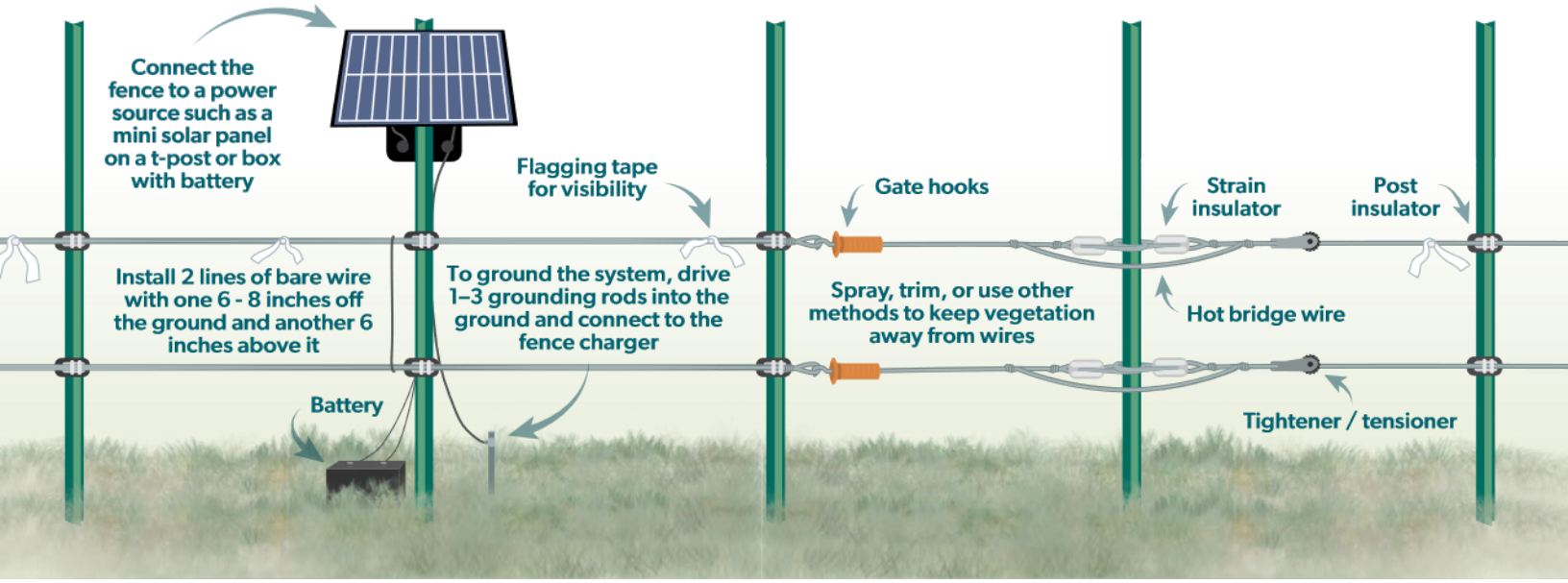


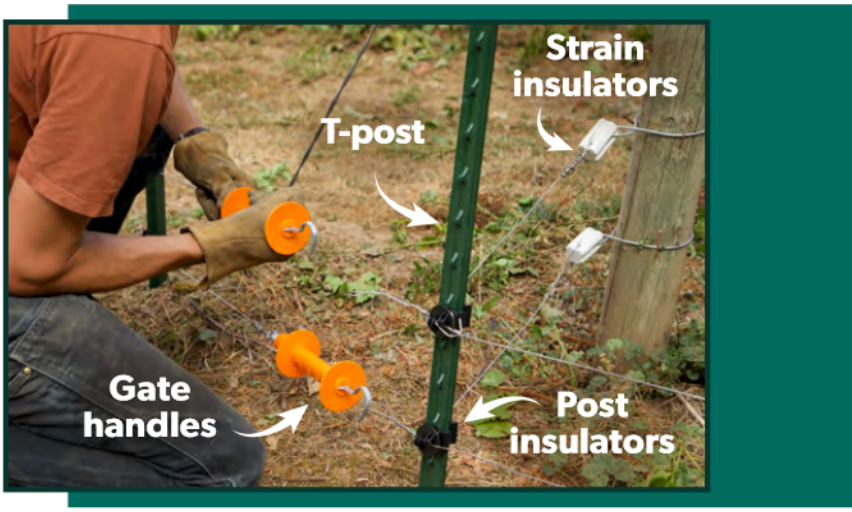
Figure 7. Components of a standard electric crop protection fence. Although the battery is shown exposed here, it should be covered to protect it from rain.

Site planning

1. **Map out your fence**
   Mark any areas where you will need gates and where you will place the electric fence charger (energizer). Determine the source of electricity to the fence. If you will be connecting your energizer to AC power, plan how and where lines will connect to the fence. Otherwise, select a location to install a solar and battery energizer. Consider whether solar panels and batteries might have a high risk for theft in your area and plan accordingly.

2. **Acquire materials**
   - **Energizer**
     The energizer (also called an electric charger) generates the electrical pulse that travels through the wire. Some energizers come with a wildlife setting that prioritizes charge during the night hours.

Purchase a charger with this setting if possible.



- **Fence wire**
  Select either aluminum wire (the most conductive and durable option) or electrical "poly wire" rope (a highly visible option woven with synthetic threads and fine wires). For bare wire, select a minimum thickness of 12.5 gauge (remember when shopping for wire that wire gets thinner as the gauge numbers increase). This type of fencing is typically sold in 250-foot rolls. You will need enough to reach your total fence distance times two wires, plus an extra 20+ feet for making connections at the charger, tensioners, gates, etc.

- **T-posts**
  These can be spaced every 16 feet (~ 5 meters) along the stretch of bank that needs protecting if the terrain is relatively flat. For uneven ground, pound in another post between each of your regularly spaced posts (at 8 feet or ~ 2.5 meters). Buy heavy-duty steel T-posts in the shortest size (generally 4 feet tall).

- **Post insulators**
  These plastic components attach the electric wire to the T-posts while preventing the current from grounding on the steel post. There are various types of insulators available. Choose a design that is intended for smooth wire and T-posts. You will need two per post (excluding posts that will use strain insulators).

A corner T-post with strain insulators, tighteners, and gate handles. A hot wire bridges the corner to carry the electricity past the post and insulators.

- **Strain insulators**
  These components are made from either plastic or ceramic and they are used to transition from the hot electric wire to a grounded wire attached to a post (Figure 6). This allows you to build a stable connection to the T-post from which you can put tension on the electric fence wire. You will need two per post for each end of the fence, each side of a gate, and at any corner post.

- **Tighteners**
  These devices are installed, one per each run of fencing, to ensure the wire stays tight. There are a few designs, the simplest being a wheel-shaped piece of aluminum that fits onto the wire once it has been installed. You will need two (one per wire) for each length of fence between strain insulators. A tight electric line helps prevent animals from becoming entangled or injured.

- **Gate handles**
  These insulated handles allow you to open and shut a section of electric fence without turning off the fence. You will need two (one per wire) for every planned gate opening.

- **Grounding rods**
  Grounding rods are typically round, steel rods that are either galvanized or coated in a layer of copper. For long-term fences these rods are 8 feet long and meant to be driven into the soil at least 6 feet deep. You will need at least one (or two if the soil is very dry).

3. **Prepare the site**
   Mow and clear a strip down to the ground surface along the path where you will build the fence. Consider removing a furrow of soil that is 16 inches wide by 4 inches deep (~ 40 by 10 centimeters) by hand or with a plow and filling this furrow with wood chips. Alternatively install a 16-inch-wide strip of synthetic weed barrier cloth. Both of these techniques help keep grass from growing up into the electric line.

Installation

1. **Install the T-posts along the prepared strip of land.** Remember to adjust the distance between the posts depending on the topography of the land. Install them further apart over flat sections and closer together over uneven terrain.

2. **Attach the insulators to the posts.** Ensure that the post and strain insulators are attached to the right posts. Post insulators keep electricity flowing past and the wire is free to move, whereas strain insulators stop the flow of electricity (and might need to be bridged) and are points where the wire ends are fixed in place.

3. **Install grounding rods.** It is a good idea to install two or more grounding posts a minimum of 4 feet long (6 feet in the soil is ideal) and 10 feet apart from each other Wire them together in series, using specialized ground clamps to attach the wire.

Dry soil adaptation:

If soils are routinely extremely dry, consider installing a "ground" wire from the charger along the length of the fence, positioned below the first hot wire. This will deliver a shock when contact is made between the ground and hot wires, rather than by completing a circuit through the ground.

4. **Install the energizer.** The energizer will need to be connected to both the power source and to the grounding rods. Leave the energizer OFF for the entirety of the installation process.

5. **Install the wire on the fence.** Start the installation at the post furthest from the energizer. Once the wire is attached, use the tighteners to create tension on the wires. Be sure to add bright flagging tape or use another method of ensuring that wires close to the ground are visible to people and do not pose a tripping hazard.

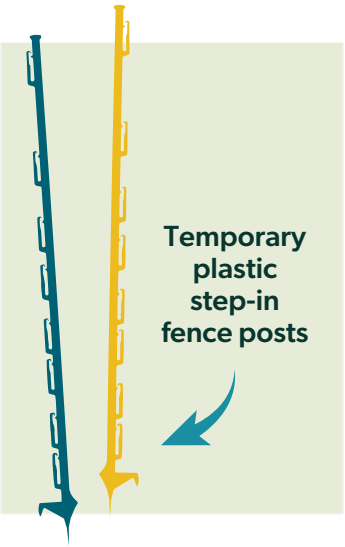
6. **Turn on the energizer** and use a voltmeter to test if the fence is working.

Maintenance

Regularly trim or use other methods to keep vegetation away from the wires. Vegetation will grow and touch the wires of the electric fence, causing a short and reducing the effectiveness of the fence. In addition, it is very important to keep grass trimmed during hot and dry summers since electricity can easily start grass fires. Under severe fire hazard conditions, it is recommended to turn the fence off. In many situations, once beavers are actively avoiding the fence they will not notice it being temporarily shut off. Keep the electrical lines tight and well flagged and watch for any unintended impacts or injuries to beavers or other wildlife (i.e. animals becoming tangled in the lines or injured by a strong current).

A voltage between 2 and 3 KV is enough to deter beavers.

Special case modifications



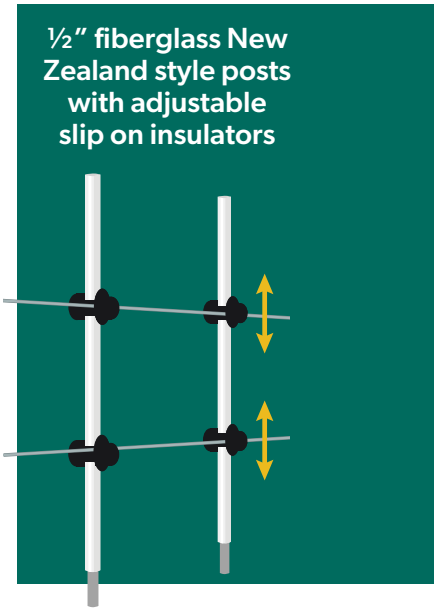
Modification 1: Temporary electric fences

Ready-made plastic posts

There are many different designs for temporary electric fencing posts. Typically, these are made from either steel, fiberglass, or plastic, with built-in post insulators and a foot-step near the base to use for pushing them into the ground. You will need a design that features an insulator at about 4 inches above the ground level (typically the level of the foot-step) and another 6 inches above that.

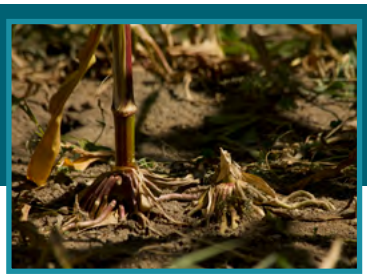
Adjustable fiberglass posts

New Zealand style electrical posts are typically a bare rod of fiberglass that are pushed or hammered into the ground. They can be used with a variety of plastic or metal insulators that slide onto the pole and can be positioned wherever they are required.



Instructions: Temporary electric fences can be installed using many of the same steps as a standard electric crop protections fence, with just a few modifications:

- Use electrical "poly wire" rope (instead of bare wire) as it is easier to work with when using repeatedly.
- Use a grounding rod that is easier to remove from the soil. Temporary rods are 2–4 feet long with a T handle at the top that makes it easier to pull out of the ground.



Installation plan for a wire mesh crop protection fence

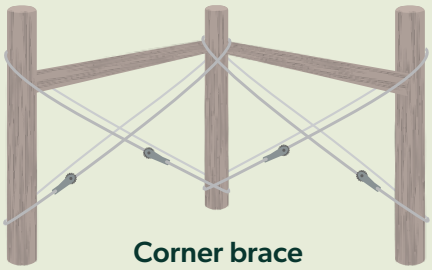
Site planning

1. **Map out your fence**
   Use a string line with stakes to layout your fence line and minimize corners where possible, as this will limit the wooden post braces needed and make stretching the wire mesh easier. Mark any areas where you will need gates.

2. **Acquire materials**
   - **Fence wire**
     Select a "field fence" livestock wire with a maximum mesh size of 4 by 4 inches and a minimum thickness of 12.5 gauge (remember when shopping for wire that wire gets thinner as the gauge numbers increase). For beavers, buy fencing that is 4–5 feet tall for the above ground portion and 3-foot-tall fencing for the buried fence. Alternatively, a single 6-foot-tall mesh can be used if the above and below ground fence sections are being installed at the same time.

   - **T-posts with clips**
     Buy heavy-duty steel T-posts and be sure to ask for the wire clips that typically come with them. Buy posts that are 6 feet tall.

   - **Wooden posts**
     You will need to construct an H-brace (three wooden posts) every time your fence changes grade and on either side of a gate opening (avoid gates where possible), and a corner brace (five wooden posts) every time it changes direction. Buy 6-foot-tall heavy duty wooden fence posts.


Corner brace

   - **Fence staples and bracing wire**
     You will need a surprising amount of 9-gauge smooth fencing wire (approximately 60 feet per H-brace and 120 per corner brace. This wire provides angled cross bracing on your wooden posts. Remember to buy heavy duty fence staples.

   - **Tighteners**
     You will need two per H-brace and four per corner brace. There are many styles of tighteners to choose from. The Hayes-style cog tighteners are easy to use.

Installation

If you have never done a fencing project, we suggest you find a friend or professional to help. There are a myriad of excellent fencing guides online. The following guidance assumes a knowledge of basic fencing and focuses on the unique requirements for fencing out beavers:

1. **Trench in a mesh skirt.** With a trenching machine, open a ~ 2 foot deep slot in the soil, along your planned fence (the side that the beavers will be coming from). Place the fencing in the drench and backfill with soil. Leave at least 1 foot of fencing exposed above ground. If wire fencing of a sufficient height can be obtained, the mesh skirt and above ground fence can be installed as a single mesh piece at this step.

2. **Install above ground fence.** Build your wooden braces and install your T-posts at regular intervals 8 feet apart. Attach the mesh to the outside (beaver side) of the posts.

3. **Connect your fences.** Secure the two overlapping sections of fencing with a line of hog rings so that a beaver cannot push them apart. Be sure that your below ground fence skirt is in front of your above ground fence (skip this step if using a single mesh piece).

4. **Install gates.** Dig out a furrow of soil that is 16 inches wide by 4 inches deep (~ 40 by 10 centimeters) under your gate. Lay a piece of mesh skirt from your below ground fencing in this depression, add rebar and and pour a concrete pad throughout the depression. This pad will keep beavers from gaining access under the gate.

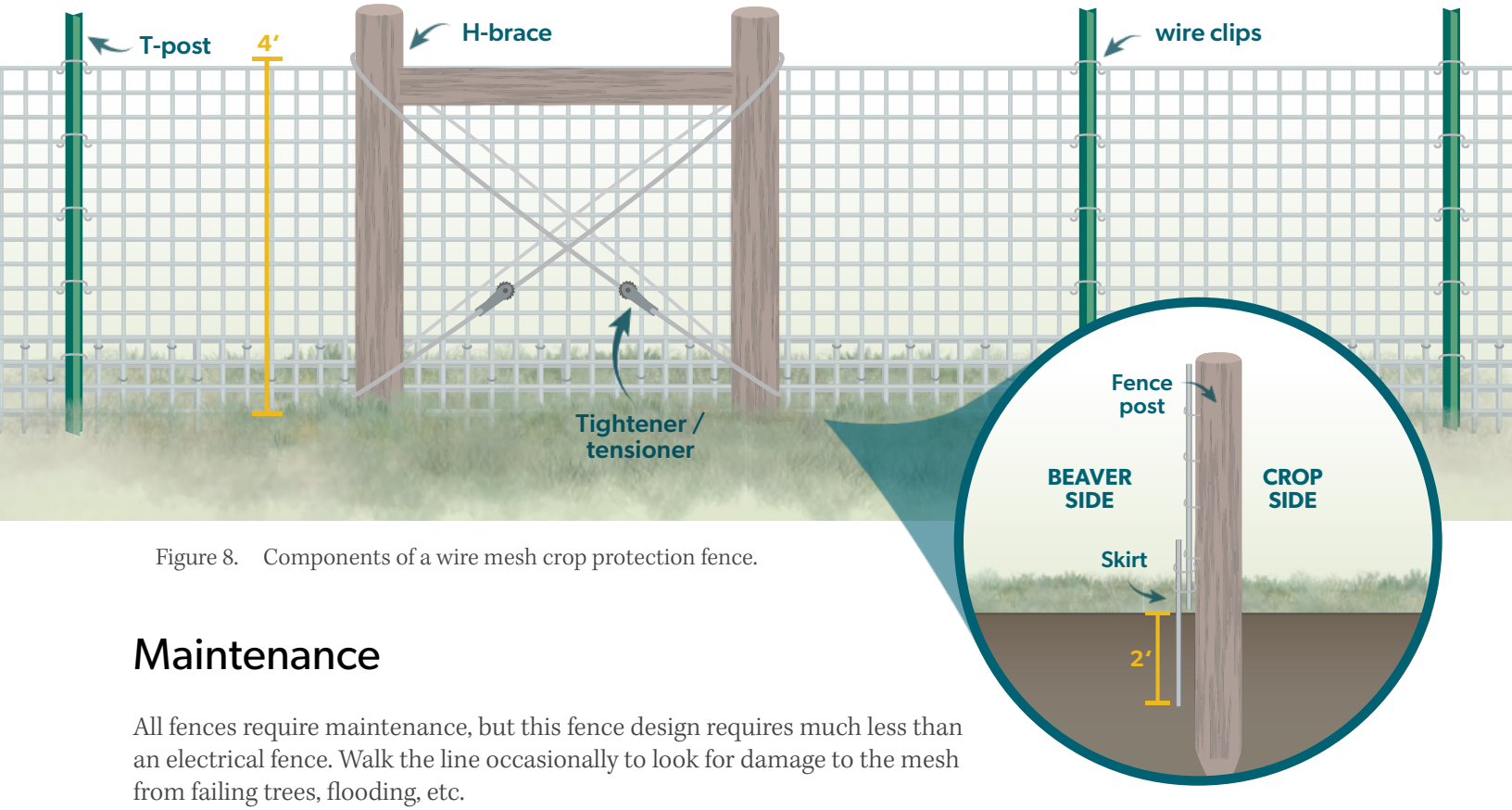
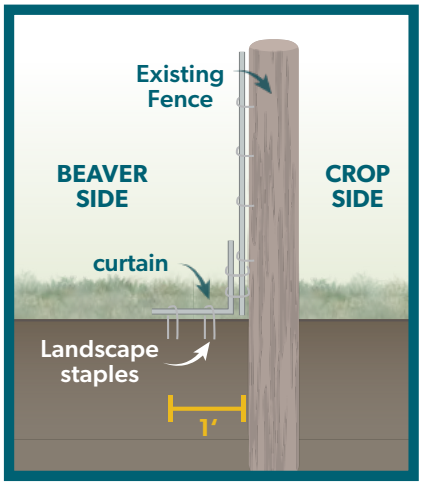


Figure 8. Components of a wire mesh crop protection fence.

Maintenance

All fences require maintenance, but this fence design requires much less than an electrical fence. Walk the line occasionally to look for damage to the mesh from failing trees, flooding, etc.

Special case modifications



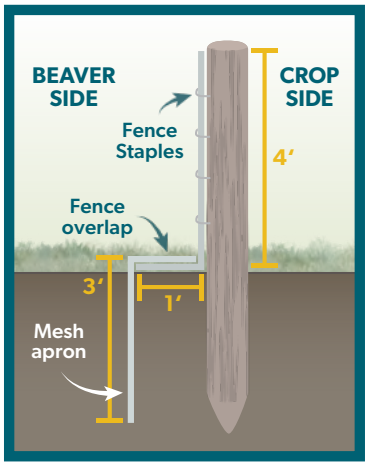
Modification 1: Beaver-proof curtain

A beaver-proof curtain can be added to an existing fence. It consists of a piece of mesh fencing attached to the base of the existing fence and bent so that it extends onto the ground surface. The curtain is fixed to the ground with landscape staples.

Instructions: Roll out a strip of wire mesh fencing, 2 feet wide, attach one side to the bottom of existing fence with hog rings or twisted wire (if the existing fence is wire mesh), or extend mesh up the fence at least 3 feet if the existing fence is a design that beavers can get through.

Modification 2: Beaver-proof apron

A beaver-proof apron is similar to a curtain but extends into the ground rather than across it. The piece of mesh is buried in the soil adjacent to an existing fence, then folded along the ground across the gap and attached to the bottom of the fence.



Instructions: Dig a trench at least 2 feet (~ 0.6 meters) deep, one foot to the outside of your existing fence (or as close as you can operate the trencher). Place the fencing in the trench and backfill with soil. This will leave 1 foot of fencing exposed; fold this down to the ground toward your aboveground fence line. It should just reach. Attach the top of the buried piece to the bottom of existing fence with hog rings or twisted wire (if the existing fence is wire mesh), or extend mesh up the fence at least 3 feet if the existing fence is a design that beavers can get through.

Modification 3: Beaver-repellent electric line

On existing fences, a single electric line can be installed approximately 4 inches from the bottom to deter beavers from digging under it.

Instructions: Install one insulator per post to keep the lower wire held 4 inches off the ground. Ensure that the post and strain insulators are used correctly and that they keep the wire from touching the existing fence.

Experimental approaches

Beaver buffer

Beavers feel safest in the water and prefer to stick close when foraging. Providing a buffer along waterways with adequate vegetation for beavers to eat can help prevent them from travelling further into croplands in search of food. Almost all beaver-human conflicts occur within 100 yards of a waterway. The larger the buffer of vegetation available, the less likely they will search further upland for food. Planting willows in riparian areas is often recommended since they are easy to plant, grow quickly, and are a favorite of beavers. Plant willow stakes at a high density (1 foot apart or closer) and concentrate them where the soil will remain moist year-round. See the Project Beaver infosheet "Planting to attract beavers" for more information.

Short-term electricity

Beavers are intelligent and quickly learn to avoid electric fences. Some experiments have tested electrifying crop protection fences for only a short time, long enough to "train" the beavers. After about a month, beavers tend to avoid foraging in area where the electric fence was installed and the energizer can be removed. This method only works if the same beavers remain in the area and is dependent on the availability of other food sources. It works best if there are plenty of other options for the beavers to choose from. This method has mixed results but has been reported to work for up to 6 months after the energizer has been removed. One concern with this method is that beavers (and other wildlife) may be more likely to become entangled in electric lines if they are not on.

> *In dedication to Gerhard Schwab, who pioneered the use of simple electric fences for keeping beavers out of croplands in Germany; a technique that is now used across the Northern Hemisphere. Prost!*

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Some learning is directly handed across from one human to another, and I have a clear memory of some of the people who have taught me techniques that appear in this document. I was introduced to tree protection cages by Leonard Houston, Lois Houston, and Michael Callahan. Gerhard Schwab taught me about electric fencing, plus that neat trick for wiring up a tree cage when you're mowing. I learned about wire enclosure fencing and the issues with electric fencing from Roisin Campbell-Palmer and Derek Gow, while Alexa Whipple was the first to explain stabilizing flanges. Sherry Guzzi taught so many of us about using sand and paint deterrent. To those, and to all the others I have forgotten or never knew — having benefited too far down the line to track back their innovative contributions — my sincerest thank you!

Beavers will continue to eat plants that humans care about and those people will continue to innovate creative solutions. Project Beaver will update this document as innovations continue to find their way into use and are adopted by practitioners as best management practices. Remember, the next best innovation will never be found in a BMPs document.

Access other Project Beaver resources including our infosheets at projectbeaver.org


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