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Fencing Guidelines and Specifications for Conservation Easements

I. SUMMARY

- Excessive or poorly laid out fences cause serious degradation of habitat quality.
- Most landowners’ needs can be met with minimal impacts to wildlife and habitat connectivity. This report offers many solutions to common landowners’ needs.
- Generally, each property will need a site-specific fencing plan, using the landowner’s needs and the property’s characteristics to decide on materials and placement.
- When fences that block wildlife movement are indeed necessary, careful choice of materials and placement can reduce habitat fragmentation and direct injury to wildlife.

II. BACKGROUND

“Our challenge now is to conserve the very nature of nature, which is the power to connect, to sustain, to heal and to invent; to keep filling the world with an infinite variety of wonders… That is how we can move beyond saving bits and pieces of nature, and plan for the preservation of wholeness.”

D.H. Chadwick

Fences are an increasing concern for conservation efforts in regions such as Sonoma County where the human population is growing in rural or formerly undeveloped areas. Fences that prevent wildlife from moving as they need to—not all fences do this—contribute to habitat fragmentation. Fragmentation is any event that creates a greater number of habitat patches that are smaller in size than the original contiguous tract(s) of habitat. The remaining fragments or patches of habitat are surrounded by a “matrix” of less than ideal conditions. Other human constructions besides certain fences can fragment habitat, such as roads, buildings, landscaping, and agricultural development.

Throughout this report, the word “wildlife” is used to mean all wild, locally native, terrestrial vertebrates. There are too many species to consider individually, but one can use a mental short-cut to address the needs of most wildlife that are affected by fences. The short-cut is to consider a few common species whose size and needs are similar to other species’, or which are important for ecosystem function. In practice, meeting the needs of deer, bobcats, badgers, rabbits, and small rodents will cover most of the animals in Sonoma County affected by fences.

Through the years fences have been built without realizing their effects on local wildlife. As fences continue to be erected, the remaining area of functionally connected wildlife habitat dwindles. A landscape with smaller isolated pockets of habitat has a lower capacity to support wildlife, because of the following effects:

- animals lose access to food and water
- animals lose access to mates, leading to genetic isolation of animal populations and inbreeding
- animal populations are more vulnerable to events like wildfire, disease, and drought
- local populations may eventually go extinct
Properly designed fences enable wildlife to use, or move through, an area with limited impediment, helping to keep areas of land biologically connected. The ideal fence from a wildlife standpoint is one that can be seen easily and can be leapt over or scurried under without injury. Each property or situation may require a different kind of fence, but any fence can be designed and placed with wildlife in mind. An initial evaluation of the property should take place to determine the need, location, and type of fence to be erected.

A plan should be created prior to the construction or replacement of any type of barrier intended to prevent escape or intrusion or to mark a boundary. Certain questions should be asked to prevent unnecessary damage to wildlife: Do I need a fence at all? How much area really needs to be fenced? How can I meet my needs with the least impact on habitat connectivity? How can I arrange what I want into the least amount of land?

On properties where natural resources, recreation, or scenic resources are part of the conservation purpose, the District may become involved in deciding what type of fencing is appropriate. In general, the District will approve appropriate fencing for the following purposes: to mark a property boundary, to reduce excessive trespass by people or vehicles, to contain household pets or livestock, to protect livestock or pets from predators, or to protect a garden plot, landscaping, crop, or other special area threatened with damage by livestock or deer.

The District may make site visits before a new fence is erected, or before an existing fence is replaced or receives maintenance. Plans for new or replacement fencing, including its materials specifications, locations, and routine maintenance, may be the subject of an agreement between the District and property owner. Before building any permanent fencing, landowners may be required to submit a plan map to the District showing the proposed location of the fence, information about materials and type of construction to be used, and a statement of the purpose and need for fencing.

To sustain viable wildlife populations long-term, habitat connectivity must extend beyond individual parcels. The District may include language in easements that prohibits the construction of fences that connect to adjoining fences or structures, whether on the site or on neighboring parcels, in such a way that wildlife movement is impeded.
III. PURPOSES FOR FENCES

The need to establish territory is a natural instinct in most animals. Most wildlife creates territorial boundary lines by placing fecal material in prominent sites along the perimeter of its territory. As humans developed the ability to build structures and domesticate wildlife, they erected barriers for some of the same purposes. Today, people build fences for just a handful of reasons:

<table>
<thead>
<tr>
<th>Purposes for Fences</th>
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</thead>
<tbody>
<tr>
<td>• To mark a property boundary</td>
</tr>
<tr>
<td>• To prevent vehicles from entering an area</td>
</tr>
<tr>
<td>• To contain livestock</td>
</tr>
<tr>
<td>• To keep certain wildlife (mainly deer and rabbits) away from crops, landscaping, and gardens</td>
</tr>
<tr>
<td>• To keep predators away from vulnerable livestock</td>
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<tr>
<td>• To keep people from entering an area</td>
</tr>
</tbody>
</table>

Only certain kinds of fences cause problems for wildlife. Any of the purposes above can be accomplished WITHOUT causing undue harm to wildlife, by using the guidelines in this report.
## IV. FENCING DECISION TREE

**Use the Appropriate Solution for Your Situation**

Use the capitalized letter beside each solution to learn about it in the Solutions section.

<table>
<thead>
<tr>
<th>Most Wildlife Friendly</th>
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<tbody>
<tr>
<td>• To mark a property boundary</td>
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<tr>
<td>boundary markers .............................................................. A</td>
</tr>
<tr>
<td>bollards .............................................................................. B</td>
</tr>
<tr>
<td>living fence ....................................................................... C</td>
</tr>
<tr>
<td>wildlife friendly fence ................................................... D</td>
</tr>
<tr>
<td>• To keep vehicles out</td>
</tr>
<tr>
<td>bollards .............................................................................. B</td>
</tr>
<tr>
<td>living fence ....................................................................... C</td>
</tr>
<tr>
<td>wildlife friendly fence ................................................... D</td>
</tr>
<tr>
<td>• To contain livestock that do not need protection from predators</td>
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<tr>
<td>wildlife friendly fence .................................................... D</td>
</tr>
<tr>
<td>temporary fence .................................................................. E</td>
</tr>
<tr>
<td>rental goats ....................................................................... F</td>
</tr>
<tr>
<td>• To keep herbivorous wildlife away from crops, landscaping, gardens</td>
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<tr>
<td>Areas under 1 acre</td>
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<tr>
<td>temporary fence .................................................................. E</td>
</tr>
<tr>
<td>chemical deterrents ......................................................... G</td>
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<tr>
<td>mesh or netting ............................................................... H</td>
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<tr>
<td>fishing line ......................................................................... I</td>
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<tr>
<td>Small or large area</td>
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<tr>
<td>staggered picket fence .................................................... J</td>
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<tr>
<td>angled, sloped, or double fence ......................................... K</td>
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<tr>
<td>electric tape or braid ........................................................ L</td>
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<tr>
<td>dogs with underground electric fence ................................ M</td>
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<tr>
<td>&quot;deer fence&quot; ...................................................................... N</td>
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<tr>
<td>• To keep predators away from vulnerable livestock</td>
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<td>guard animals ...................................................................... O</td>
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<td>anti-predator fence ............................................................ P</td>
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<tr>
<td>• To keep people from entering an area</td>
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<td>poison oak barrier ............................................................ Q</td>
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<td>anti-personnel fence .......................................................... R</td>
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These approaches impede wildlife beyond target species. See Box below.

| Least Wildlife Friendly |
V. DESIGN FOR FENCES THAT IMPEDE WILDLIFE

Where Wildlife-Blocking Fences are Necessary, Proper Design Greatly Reduces their Impacts to Wildlife

- Only fence the smallest area necessary to protect gardens, house pets, children, crops, or agricultural facilities from wildlife. No wildlife-excluding fence should be constructed that contains natural habitat.

- A wildlife-blocking fence should be located at least 50 feet from the riparian forest canopy or 150-200 feet from the stream bank top, whichever is greater.

- Any fencing design should exclude vehicles, livestock, heavy equipment, herbicide and pesticide use, and other damaging elements from sensitive natural areas such as wetlands, streams, riparian areas, and populations of rare plants or animals. A setback of 100 feet is a minimum for protecting these natural resources. Vehicle and equipment traffic should also be kept out from under the dripline of mature trees.

- Fences should be less than 40 inches high unless deer or humans must be excluded.

- Prevent animals from lethally entangling their legs in the top wires of a fence. Either leave at least 12 inches between the top two wires, or top the fence with a wooden rail, mesh, or chain link instead of wire.

- The fence should be at least 16 inches off the ground unless protection from predators or small animals is needed.

- All wire should be smooth, that is, not barbed. If this is not possible, the bottom and top wires should be smooth.

- Fencing should be visible to wildlife, to prevent animals from colliding with it. A new fence must be flagged to protect both the fencing and animals until wildlife becomes accustomed to it.

- Fences must be maintained, or they can become a danger to wildlife. Wires must be kept taut and poles must be upright and in good condition.

- Fences along roads should be set back 300 feet from public roads. This minimizes potentially lethal animal-vehicle collisions, and animal-fence collisions, by providing space for animals and drivers to see and avoid one another.

- Fences should not connect to other fences or structures onsite or on neighboring parcels in such a way as to prevent wildlife passage.

- Gates should be in the corners of a fence to allow trapped wildlife an exit from a fenced enclosure.

- The bottom wire of any electric fence should be grounded.

- Use the guidelines in the Solutions section to tailor the fence to your needs.
VI. WORKING WITH EXISTING FENCES AND PHASING

On some properties the District may choose to require immediate or gradual removal of certain elements from an existing fencing scheme, instead of building a new fence. This approach may work well in the following common situations:

- Many rural properties have multiple types of wire built up over decades of various uses, and often the existing configuration exceeds the landowners’ needs and also stymies wildlife movement. In these cases, certain layers of the existing configuration could be removed.
- The property may have been fenced to contain small stock such as sheep, but now it either contains large stock such as cattle or horses, or no livestock at all.
- Agricultural properties with exclusionary fencing may have needed deer protection in the past, but some of these properties are now surrounded by housing or other development that precludes the presence of numbers of deer, so the property is no longer subject to browsing pressure.
- Vineyard properties may have been fenced with small-mesh material to exclude small herbivores such as rabbits when the vines were young, but where vines are now mature enough to withstand them. In some cases, the combination of mature vines and fewer deer in the area means that deer fences are no longer necessary.

On some properties, it may be more economical to create holes for wildlife in existing fencing, rather than removing the whole fence. This approach can also be appropriate where the landowner wants the property to “look” fenced. Such holes should be at least 5 feet high and 2 feet wide, with no sharp edges. The bottom of the hole should be flush with the ground.

Instead of making immediate wholesale changes to existing fences, it may be preferable to phase in wildlife-friendly approaches to marking boundaries, excluding wildlife, or containing livestock over time. These gradual or postponed changes may be spelled out in the Conservation Easement. The following situations are examples:

- Some solutions, such as living fences, or using guard animals instead of predator-proof fences, take time to implement.
- Some solutions may be appropriate for phased implementation because they are costly.
- The current owner may wish to continue a land use that requires fences, but may want to restrict future owners from using wildlife-blocking fences.

Fencing materials have a finite lifetime. When materials need replacement and maintenance, this is a logical time to reconsider the layout and design of existing fences in light of the property owner’s needs. In many cases, a more wildlife friendly fencing design can be found that will meet the owner’s needs.

VII. FUNDING FOR WILDLIFE FRIENDLY SOLUTIONS

Some kinds of fencing can be prohibitively expensive on large properties. In extreme cases, many thousands of feet of high fence at $8 per foot may be needed to properly fence a large vineyard. Long stretches of less expensive fencing are also required, for example, to remove cattle from stream areas. It is in the interest of several public agencies, besides the District’s, to improve the habitat values on private properties.
The California Department of Fish and Game (DFG) is the logical source of state support for wildlife-friendly fencing, but they do not currently focus on this area. The Yountville office of DFG is producing a brochure to educate the public about wildlife friendly fencing. DFG's Wildlife Conservation Board is a candidate source of funds for a county-wide or regional program to support fencing improvements for habitat enhancement.

Thousands of dollars are spent annually in Sonoma County by the US Department of Agriculture through a variety of programs to improve agricultural practices. They include the Environmental Quality Improvement Program (EQIP) and the Wildlife Habitat Improvement Program (WHIP). The District, the County, and other organizations may be able to work with local USDA decision-makers to prioritize re-fencing projects on agricultural lands.

Resources are especially lacking to address wildlife and fencing issues on non-agricultural lands. In Sonoma County, rural residential properties are increasingly in need of fencing improvements or fence removal. A program that matched costs with landowners would encourage better practices.

VIII. ENFORCING FENCING EASEMENT LANGUAGE

The District may monitor the construction and the effects of new or replacement fencing for the first 3 months after installation. After the initial monitoring time, the District will inspect the fence as part of its routine easement monitoring. If the fence does not conform to agreed-upon specifications, location, or maintenance, the District may require the property owner to rebuild, relocate, or perform maintenance on the fence within a 2 month time frame. If the required work is not performed, and the property owner does not provide a reasonable justification, the District may require removal of the fence.

IX. SOLUTIONS

A. Boundary markers or signs

Many landowners wish to mark their property boundary. In such cases it is essential to do so without damaging the natural beauty and wildlife value of the property, which may be the very reason the landowner chose to live there.

In California, the legal requirement for posting a property boundary is to place boundary markers or trespass notifications at intervals of 3 per mile to delineate the property boundary. People who cross a boundary posted in this manner are liable for prosecution for trespassing. No fence is needed to post a boundary.

B. Bollards, with or without barrier cables

1. Bollards or barrier posts: Bollards and barrier posts are short durable posts, often up to 8 inches in diameter, that are spaced along a boundary. They are an effective, attractive way to control off road vehicle traffic.
2. Barrier chain fence: A barrier chain connecting bollards is an aesthetic solution typically used for dissuading vehicle and pedestrian use.

C. Living fence or hedgerow

Living fences, or hedgerows, are narrow belts of vegetation, usually consisting of a variety of shrubs with a scattering of trees. They can be used to delineate property boundaries, and also have a number of other beneficial effects. Hedgerows connect natural areas where the land in between has been cultivated or urbanized. They can be planned in combination with other practices to enhance landscape aesthetics, reduce soil erosion, improve sediment trapping, improve water quality and provide wildlife habitat. Hedgerows can be established using woody plants that produce erect stems attaining an average height of at least 3 feet. Minimum hedgerow width should be 15 feet at maturity to provide substantial wildlife habitat. This may require more than one row of plants. Plants must be suited to local soils, climate and conservation purpose. To optimize their value to birds and other beneficial wildlife, hedgerows should be structurally diverse and consist of a variety of locally native plants. Avoid poisonous plants such as oleander. Avoid invasive species that spread aggressively, such as Arundo and bamboo. Avoid water-hungry species except where they would naturally occur, such as redwoods in foggy areas and willows in wet areas.

Hedgerows must be protected from livestock grazing and trampling, and deer browsing, to the extent necessary to ensure that they will perform their intended purpose. Competing vegetation must be controlled until the hedgerow becomes established. Control should continue beyond the establishment period, if necessary. Irrigation is necessary, although if locally appropriately native species are used, it can be discontinued after 2 to 3 years. Trees and shrubs will grow faster with more years of irrigation.

D. Fence permeable to all wildlife

Truly wildlife-friendly fences enable virtually all wild animals to move through an area without harm and with minimal impediment. To achieve this permeability, the fence must have the following characteristics:

- Fences should be less than 40 inches high. For some horses, the height may need to be raised up to 6 feet to prevent the horses from leaning on or jumping over the fence.
- Top the fence with a wooden rail, wire mesh, or chain link instead of wire. This prevents animals from lethally entangling their legs in the top wires of a fence, and prevents birds from colliding with the wire, which is difficult for them to see. If this is not possible, leave at least 12 inches between the top two wires.
- The fence should be at least 16 inches off the ground. For small stock such as sheep or goats where predation is not a concern, lower the lowest wire to 10 inches from the ground.
- All wire should be smooth, that is, not barbed. If this is not possible, the bottom and top wires should be smooth.
- Use 3 horizontal rails or strands of wire instead of 4.
- Fencing should be visible to wildlife, to prevent animals from colliding with it. A new fence must be flagged to protect both the fencing and animals until wildlife become accustomed to it.
- Fences must be maintained, or they can become a danger to wildlife. Wires must be kept taut and poles must be upright and in good condition.
Many combinations of materials can follow these rules, accomplish the desired purpose, and be aesthetically pleasing.

1. A fence with wooden or metal posts and a wooden top rail, with rails or smooth wire strands below the top rail.
2. Traditional split-rail fence.
3. Traditional wire fencing for larger livestock such as cattle and horses.
4. Recycled plastic rail fence: Recycled plastic fencing is more environmentally friendly than PVC/vinyl fencing, as it uses recycled milk jugs and other items containing high density polyethylene that have been cleaned, ground up and reformed after heating.7
5. White electric tape or braid is highly visible to wildlife and livestock. It can be used for all types of livestock, including horses, as a psychological barrier for temporary or permanent fencing. It is safer for livestock than hard fencing.8 9

Any fencing design should keep vehicles, livestock, heavy equipment, herbicide and pesticide use, and other damaging elements away from sensitive natural areas such as wetlands, streams, streamside or riparian areas, and populations of rare plants or animals. A setback of 100 feet is a minimum for protecting these natural resources. Vehicle and equipment traffic should also be kept out from under the dripline of mature trees.

**E. Temporary or let-down fence**

Fences or other barriers can be erected for short periods of time to protect plants or contain livestock. Consider using temporary fencing in the following situations:
- during times of year when wildlife is most likely to visit a garden
- until decorative or agricultural plants are large enough to withstand browsing
- to contain livestock short-term, to graze, remove vegetation, or reduce flammable vegetation

1. Let-down fence. Let-down fences are designed to lay down on the ground when not in use. Where livestock graze seasonally for fire reduction purposes, the fence can be raised. They are simple to drop and raise again, and are very cost-effective because a gate is not required to move livestock between pastures.10
2. Temporary netting or mesh fence. Place netting or mesh around plants that may attract deer. Erect the netting closely around the plants and only when the plants are growing. Deer netting can be used in combination with sturdy wooden stakes to create a fence around large plantings, or deer mesh can be wrapped around individual plants. In addition, deer dislike walking on this type of material, and netting or mesh may be secured to the ground to deter deer from entering garden beds.11
3. Portable fence. Sections of chain link/woven wire fence or electric fence are available for rent. Portable fences assist with rotational grazing, protecting small gardens or crops, or creating temporary enclosures for mother and young.12 13 14

Any fencing design should exclude vehicles, livestock, heavy equipment, herbicide and pesticide use, and other damaging elements from sensitive natural areas such as wetlands, streams, streamside or riparian areas, and populations of rare plants or animals. A setback of 100 feet is a minimum for protecting these natural resources.
F. Rental goats

Fire reduction is a great concern for some landowners. Grazing an area with horses or cattle may reduce the hazard, but the impact to the land may be severe over time. The land must be fenced to contain the livestock and damaging erosion may take place. An alternative is to utilize rented goats. Three hundred goats can clear an acre a day with the use of a herder and dog(s) along with a portable fence enclosure moving the herd through the property.

Goats should be excluded from sensitive natural areas such as wetlands, streams, streamside or riparian areas, and populations of rare plants or animals. A setback of 100 feet is a minimum for protecting these natural resources.

G. Chemical deer deterrents

Deer will almost always stay away from plants that offend two or more senses. Thus, if a plant not only tastes bad, but also smells bad, deer will stay away from it and the general area it is planted in. Some of the most effective natural deer deterrents are liquids that can be sprayed onto vulnerable plants: hot pepper wax, garlic oil, predator urine, fragrant soaps and home brews. Hot pepper wax works on the sense of taste, and the others offend the sense of smell. Deer do not stay in an area where there is the smell of urine from natural predators, such as the mountain lion or coyote. Combining hot pepper wax, predator urine and garlic or a fragrant soap serve as a highly effective mix. These types of deterrents give best results for small gardens. Depending on the deterrent, the ingredients must be reapplied every two to four weeks.

You can also plant poisonous plants that deer will not eat. Frequently plants give animals warnings that they are poisonous by an unusual color, or a strong smell or taste. For example, the deep purple-black color of the fruit of nightshade (Solanum spp.) serves as a warning to animals.

Wireless deer fence: This product should be used in areas of one-half acre or less. Posts are positioned around plants that deer like to feed on and on deer paths into the yard or garden. A sweet smelling deer attractant is added to the post. When deer touch the post where the attractant is located, an electric shock is transmitted, frightening the deer from the area. Thus, by learned behavior, deer are trained to stay away. The shock is supplied by two AA batteries (up to 360 volts) but because the discharge time is short, the amperage is equivalent to a static electric shock.

If deer encounter a plant that is new to them, and it is offensive, they will often not come back to it. For this reason it is important to make new plantings as undesirable as possible by using deer deterrents for the first few weeks the plant is in the garden, especially if the plant is not native to the area.

In severe drought conditions, or when deer have very limited access to food, they will eat almost any type of vegetation, sprayed or not.

H. Mesh or netting

If only a few selected plants need to be protected, deer netting or mesh may be wrapped or staked around each plant. You may only need to protect the plants in certain seasons, such as winter or late summer.
To wrap the deer mesh directly on the plant, go all the way around each plant at least two times. The mesh should drape on the ground about 6 inches and either totally cover shorter plants, or go up about 6 feet for taller plants. Secure the mesh by stapling the netting to itself. Rope may be wrapped around the mesh to secure it more thoroughly. Heavy rocks may be placed on mesh draped on the ground.

Another approach is to build a fence surrounding all sides of each plant. Insert sturdy wooden stakes greater than 6 feet tall into the ground about 18 inches from the plant. Staple the netting to the wooden stakes. The netting should be at least 6 feet high and drape on the ground by several inches. Anchor the netting on the ground with rocks to prevent deer from burrowing under the barrier.19

**I. Fishing line**

Small gardens or vineyards can use monofilament fishing line around and above the plants. Deer approach food with their noses and are startled when their nose comes in contact with something they can not see. Their confusion causes them to leave the area alone.20

**J. Staggered picket fence**

This solution is appropriate for deer only. Deer have poor depth perception. A fence with irregular heights is an optical illusion for deer because they are unable to determine the overall height of the fence. Deer will typically not jump over a fence where height can not be determined. It does not need to be more than five feet high. A staggered picket fence can keep deer out of an area such as a flower bed.21

**K. Angled, sloped, or double fence**

Deer are able to jump high and jump wide, but cannot do both at the same time. Deer resist jumping over a structure if they are unable to see the landing site, or when their poor depth perception makes the jump distance ambiguous. Three solutions capitalize on this weakness:

- Two parallel 5 foot tall fences separated by 4 to 5 feet apart.
- A 5 foot high fence with an “out-rigger” at the top that aims in the direction that deer approach the fence.
- A fence that slopes at a 30 degree angle, with the top pointing away from the garden.22

These fences should be built so they are passable to all other wildlife, using the guidelines in **D. Wildlife Friendly Fences**.

**L. Electric braid or tape**

Electric braid or tape fences also can be used to exclude deer from crops.23 24 Deer investigate an area with their nose. When a deer’s nose touches the electric braid fence, an electric shock occurs, discouraging them from entering the area. A study conducted by the US Department of Agriculture found that a 4 foot electric braid fence was 99% effective at keeping deer away from feeding troughs filled with whole-kernel corn. The US Air Force and Navy have installed electric braid fences around runways in Little Rock, Arkansas and Oceana, Virginia to protect against deer-strikes.11 Vineyard owners in Sonoma Valley report that electric fences are only effective in keeping deer out vineyards for approximately one year. After that, deer and other animals learn
how to get around the shock or become desensitized to the shock when the reward on the other side is so great.25

**M. Dogs with electric underground fence**

Several companies produce these devices, which can handle up to 45 acres. Multiple dogs are needed for large areas. Working dogs are used to keep deer away from gardens, small vineyards and other plants. The dogs must spend the night outside. This method is best suited for medium sized dogs such as Labrador retrievers or German short haired pointers that can sleep outdoors at night without harm. The dogs are equipped with special collars that give them a shock if they cross a buried wire barrier. The wire is buried 1 to 3 inches below the soil surface and is placed around the area of concern. Once the dogs are trained, they roam freely in the area needing protection to scare off deer that might enter. It is possible that vineyard and orchard owners may be able to write off the expense26.

**N. “Deer fence”**

Deer proof fences should be used as a last resort and primarily for crops. High-tensile fences are effective in reducing crop damage in areas that have moderate to high wildlife pressure, although no fence is 100% effective.27 Some vineyardists report that deer fences only keep out deer, and that other wildlife—including rabbits, foxes, coyotes—are still able to get into the vineyard.28 Wildlife biologists generally disagree. Some animals do get through, but not many, certainly not enough to consider the typical “deer fence” friendly to other wildlife species.

Determine exactly what needs to be protected from deer and what does not. Allow the largest possible natural habitat to remain accessible to wildlife. Locating gardens, vines, and fruit trees close together so that one fence can protect everything is a helpful strategy. If a corridor is to be left between blocks of fenced land, leave at least 20 feet so that animals can pass between the blocks. Consider using temporary fencing if deer pressure is seasonal. It is essential to avoid including areas of natural habitat inside these fences. Follow the design guidelines on page 7. An added incentive for keeping grape-vines well away from riparian areas is the reduced risk of sharpshooter predation.

To exclude deer, fences should be at least 7.5 to 8 feet high in total. Various kinds of wire mesh are available with various costs, heights, ease of use, and durability. Some common types are “non-climbing,” graduated mesh, woven wire, chain link, and welded wire. The largest mesh size possible should be used, so that small animals are not excluded by the fence. Graduated mesh is not appropriate in most situations. Most wire types are not tall enough to use alone, so they are typically topped with wire strands. These wires must be smooth (not barbed) and maintained at full tension. A single wire is preferable; if there are more, they should be at least 12 inches apart to prevent deer from entangling their legs. These wires must be visible to deer, especially when new. Painting the wire white or tying flagging or ribbon onto it at intervals is effective.

Gates must be placed in fence corners, not along straight sections. According to several vineyard owners and managers, corner gates work well for herding deer from the vineyard.29 Cattle guards with round bars can also reportedly work well to keep deer out if a gate is undesirable.30
O. Guard animals

The most vulnerable livestock in Sonoma County are sheep, goats and new born animals, though adult cattle are also susceptible to rare mountain lion predation. The main predators of these animals are the coyote and feral or wandering neighborhood dogs, though mountain lions, bobcats, bears, eagles and boar have also killed livestock in some western states. It is critical not to jump to conclusions when a livestock animal is found dead or has disappeared. The animal may have died from disease or ingesting poisonous plants or materials and the predator may only have scavenged the body. It is important to understand the various techniques used by different predators to bring down their prey and their practices of eating prey.31 32

Felids (mountain lions and bobcats) like to stalk their prey and attack from cover, indicated from the broken neck of the prey with bite wounds on the head, shoulders and/or neck. They may also kill by biting the throat of young or small animals. Mountain lions’ main diet consists of deer with small animals making up the rest. Bobcats as a general rule do not prey on adult sheep, goats, or calves. Canids (dogs, coyotes, and foxes) usually attack the throat of the prey just behind the jaw and below the ear or in the case of dogs cause general mutilation all over the body.

1. Llamas

Guard llamas are very successful in preventing predation in sheep and goat flocks.33 34 A survey of 145 sheep producers using llamas indicates that over 50% were 100% effective and another 40 to 45% were highly effective in reducing losses of sheep to predators. Llamas do not have to be trained or raised with the sheep or goats. They have strong herd instincts. When a llama is removed from its own herd and placed with a sheep or goat flock, the llama adopts the flock as its new herd. Being the largest of that new herd, the llama becomes dominant and protective. A single llama is more effective than two or more llamas and can successfully guard flocks of 200 to 1000 animals in all types of terrain and pasture sizes. A gelded llama may be better than an intact male since the intact male, though an effective guard, may try to breed with the ewes. Llamas live a long time, have low maintenance needs, require no training, eat the same food as sheep and goats, and generally have good health.
2. Donkeys

Donkeys have strong herding instincts and a natural dislike and aggression toward dogs and coyotes. Under proper conditions guard donkeys can provide a high degree of around-the-clock protection for sheep and goat flocks. One gelding or jenny (with or without foal) should be used. Donkeys live a long time, have low maintenance needs, require no training, eat the same food as sheep, and are not prone to wandering provided the fences are well maintained.

The ideal situation is placing a jenny and her foal with the flock until the foal is weaned. Once weaned, the jenny should be removed from the flock assuring a bond between the foal and flock allowing the young donkey to become the protector. If the foal is a male, he should be gelded. Donkeys are best suited for flocks of less than 100, but may be able to guard up to 200 animals if the terrain is flat and barren and they are grazing in one pasture. Guard donkeys should be at least 2 years old and at least 44 inches high at the shoulders.

Instances have been reported of donkeys being over-protective especially during lambing season where the donkey may perceive the lambs as intruders and injure or kill the lambs. Thus, during the lambing season, the donkey should be housed or penned separately from the ewes.

3. Dogs

Certain breeds and strains of dogs, such as Great Pyrenees, Kuvaszok, different Turkish guarding breeds (Anatolian shepherd, Akbash, Karabash), and others, are trained to stay in a fenced area rather than roam. The best breed and strain depends on the individual farm or ranch and the amount of human interaction with the dog. The dogs are raised with the sheep and goats and instinctively become protective of the herd or flock. Training and bonding or adjustment time can take as long as one year. Success depends on the individual dog, predator density, and the amount of cover available for predators.

P. Anti-predator fencing

Please read the introductory text in O. Guard animals.

In rural areas, pets should be restricted to yards and/or brought in at night. In rare situations, children should also be supervised or contained inside protective fencing.

To protect livestock from felids, bring stock in at night, and use electric fencing around the holding area. To protect small animals or pets in kennels, top the enclosure with wire, with electrified wires around the edges. Do not site pet or livestock holding areas under trees or overhangs.

To exclude canids, fences need not be higher than 5 feet, but they need a buried skirt of fencing to prevent animals from digging under the fence.

To keep foxes or raccoons from poultry or birds in aviaries, mesh fencing should be installed on all sides and the top of containment areas, and have a buried skirt. Cones of aluminum or wrapping tree trunks with aluminum sheeting can keep foxes from climbing trees and gaining access.
Bears are not a common problem in Sonoma County, but human-bear conflicts may increase as more people live and farm in remote areas. A-frame electric fences have proven effective in protecting local vineyards.

Electric fences have been used for years for livestock protection with success, but a completely electric fence is very costly to construct and maintain. In order for the electric fence to work effectively, the land must be leveled so no dips or rocks allow an area where canids can dig under. The area should be reseeded with grass to prevent erosion and weed growth. Considering the requirements for an effective electric fence for predator control, it is often more practical to combine wire mesh with electrified fencing. Maintenance is important to make sure the wires are taut, to clear excessive vegetation growth and fallen tree limbs, and to replace wire from time to time to have adequate shocking power.

**Q. Poison oak barrier**

This approach, although admittedly unusual, should be considered when blocking a small area would solve the problem. Poison oak is a native, disturbance-adapted plant that provides abundant food and cover to wildlife. It grows readily. Obviously it should not be used where human traffic is desirable.

**R. Anti-personnel fence**

A fence that completely excludes people will also exclude virtually all terrestrial wildlife, so it should only be used where no other approach to excluding people is feasible. The first line of defense is to call the local sheriff promptly, every time trespass occurs. Usually this routine will quickly teach trespassers to avoid the site. This approach generally works well except in remote sites that make it infeasible or time-consuming for law enforcement personnel to travel to the site. In some situations, focused night lighting or a barrier at a bottleneck in the approach to the site may suffice to keep people out. If a fence is necessary, remember that as with fences to exclude wildlife, no fence will be 100% effective forever.

1. To keep people out of small areas, use chain link or small mesh sturdy wire fencing 7 to 8 feet high that reaches to the ground or is buried below-ground. Fenced areas should be as small as possible, and should never include areas of natural vegetation. Follow the design guidelines on page 7.

2. To prevent trespass into large areas, a fence or fences can be constructed on some sites in such a way that it appears impenetrable but still does not pose an undue burden on wildlife. Appropriate sites will have steep slopes, dense vegetation, or both. Construct a chain link or small mesh sturdy wire fence 7 to 8 foot high, across the access route in an area that is steep and/or has thick tree and shrub cover. The fence can go a maximum of 600 feet in either direction of the trail, and should be angled into thick cover, poison oak, and steep slopes. This will give the impression to trespassers, hikers, mountain bikers, or horse riders that the fence goes on longer than they are willing to detour from the trail. The sole “wildlife-friendly” aspect of such fences is their short length. Place the fence(s) wherever the shortest possible fence will be effective, not necessarily on the property line. The fenceline does not have to be straight. Wildlife will follow a fence line until the opportunity arises to get over or around the fence.
X. SPECIFICATIONS AND COSTS

Specifications and prices are intended to provide preliminary information, and do not include labor unless specified. Prices for materials were accurate in 2003. Actual costs will depend on the final height of any structures, the exact product or company chosen, labor costs, and prices at the time of purchase. The inclusion of any product or company does not imply endorsement.

A. Boundary markers or signs

Signs or boundary markers: $20 per sign.

B. Bollards, with or without barrier cables

Bollards: Bollards are spaced 4 to 5 feet apart and 4 feet high to be visible to automobiles. Different styles are produced depending on company. 4 by 7 inch galvanized steel bollards, filled with concrete for durability, may cost $1,500 to $1,600 for a 40 foot length (10 bollards), including labor. If desired, a chain can be used to link the bollards.

Barrier chain gate: Bollards are spaced every 10 feet and are 4 feet high to be visible to automobiles. The outer two bollards are permanent and set in concrete, while the two inner bollards are removable and are set in sleeves 6 inches below grade. A chain is attached to each bollard by means of a 4 by 1 inch “U” bolt. For a 40 foot long stretch, costs can range from $1,200 to $1,400 fully installed.

C. Living fence or hedgerow

For general instructions on how to install hedgerows, see http://www.yolorcd.ca.gov/hedgerows/design/hedgerow.html. Consult nurseries that specialize in locally native plants to identify plant material appropriate for the site. Two of these are North Coast Native Nursery (North Coast Native Nursery, P.O. Box 660, Petaluma, CA 94953, phone 707.769.1213, www.northcoastnativenursery.com) and Larner Seeds (PO Box 407, Bolinas, California 94924, 415-868-9407, www.larnerseeds.com). In Sonoma County, widely appropriate species include coast live oak, California bay, coyotebrush, and California red fescue, but there are many available species for every microclimate in the county. Plants should be spaced so the overall effect will be dense but not over-crowded when the plants reach maturity. Native tree saplings cost $10 to $80 each depending on size. Shrubs cost $5 to $20 depending on size. Perennial native grasses, an important part of a living fence or hedgerow, cost $2 to $6.

D. Fence permeable to all wildlife

1. Posts and a wooden top rail
   Wooden rails: 4” by 12’ pressure treated; $10.50 each.
   Smooth wire: 1320 feet of 12.5 gauge smooth wire; $41.95.
   Wooden posts: 5” by 8’ pressure treated; $9.40 each. Posts should be at least 12 feet apart.
2. Recycled plastic rail fence. Most manufacturers offer a limited lifetime guarantee. Double rail fence: (2) 6 foot post, (2) 8 foot rails, (2) post caps and (4) rail pins; $50 per section.
   Triple rail fence: (2) 7 foot post, (3) 8 foot rails, (2) post caps and (6) rail pins; $64 per section.
3. Electric Tape: A 4-strand fence 1000 feet long may cost $1700 to $2000. See pictures in L. Electric braid or tape.
4. Electric Braid fence: A 4-strand fence 1000 feet long may cost $1800 to $2300. See pictures in L. Electric braid or tape.

E. Temporary or let-down fence

Netting: 4 by 4 inch squares, 10 feet high: $1.20 per linear foot. ¾ by 1 inch squares, 7 by 100 feet: $55.50.
Mesh: 3 ¾ by 3 ¼ inch diamond mesh, 10 feet high: $0.55 per linear foot. 0.4 by 0.5 inch, 7 by 100 feet: $16.
Poles: $2 to $4 each.
Portable fence: Depending on size and type of electric portable fence, cost range from $100 to $2500.
Let-down fence: Use three strands of smooth wire, with a top strand height no greater than 38 inches. The distance between the top and 2nd wire should be at least 12 inches. The lowest wire should be at least 16 inches above ground level so fawns can crawl under. Posts: 5“ by 8’ pressure treated; $9.40 each. 3” by 8’ pressured treated dowels; $4.50. Smooth wire: 1320 feet of 12.5 gauge smooth wire; $42.

**F. Rental goats**

An initial site visit determines the number of goats required, depending on acreage, slope, and density of vegetation. Between April and October, an average fee may be $750 per acre plus a transportation fee of $700 to $1300. Off season costs are $350 to $500 per acre plus transportation. Prices are lower for properties over 100 acres.

**G. Chemical deer deterrents**

- Hot pepper wax:  $11 per pint; $20 per quart; $75 per gallon.
- Garlic oil:  $7 per pint; $10 per quart; $85 per gallon.
- Garlic oil dispensers:  bag of 50 $29; bag of 250 $110.
- Coyote urine:  $11.00 per pint; $35.00 per quart; $100.00 per gallon.
- Coyote urine dispensers:  $2.00 for a 30 day dispenser.
- Plantskydd®: Emits an odor that prey animals associate with predator activity. $50 for 1.3 gallons treats 100 plants. $39 for 2.2 pounds of dry Plantskydd treats 400 - 600 plants. $330 for 22 pounds of dry Plantskydd treats 4000 - 6000 plants.
Wireless deer fence$^{50}$:
Kit ($60) comes with 3 posts and scent pellets. Additional scent pellets $6.95 each.

**H. Mesh and netting$^{51}$**

Mesh: 3¼ by 3¼ inch diamond mesh, 10 feet high: $0.55 per linear foot. 0.4 by 0.5 inch, 7 by 100 feet: $16.
Netting: 4 by 4 inch squares, 10 feet high: $1.20 per linear foot. ¾ by 1 inch squares, 7 by 100 feet: $55.50.
Poles: $2 to $4 each.

**I. Fishing line**

Monofilament fishing line: Available at sporting goods stores, $6 per 300 yards.

**J. Staggered picket fence**

These fences can be made out of wood or a vinyl product and need be no higher than 5 feet at the tallest point. The wood staggered fence can be made with a wide degree of varying heights, while the vinyl product comes in only two heights; 5 feet and 4 feet 2 inches, alternating in sequence. The cost for both products is approximately $45 per foot.$^{52}$

**K. Angled, sloped, or double fence**

1. Double row fence:
   Wooden rails: 4” by 12’ pressure treated; $11 each
   Smooth wire: 1320 feet of 12.5 gauge smooth wire; $42
Wooden posts: 5” by 8’ pressure treated; $10 each

2. Angled fence:
   Wooden rails: 4” by 12’ pressure treated; $11 each
   Smooth wire: 1320 feet of 12.5 gauge smooth wire; $42
   Wooden posts: 5” by 8’ pressure treated; $10 each

   ![Angled Fence](image)

   **L. Electric tape or braid**

   Electric Tape: A 4-strand fence 1000 feet long may cost $1700 to $2000.54
   Electric Braid fence: A 4-strand fence 1000 feet long may cost $1800 to $2300.55
**M. Dogs with underground electric fence**

Depending on the company and area to be covered, costs range from $300 to $2,000.\(^{58}\)

**N. “Deer fence”**

High-tensile wire fences: It is critical to properly install these fences. During installation, the fence is tightened to hundreds of pounds of tension. This requires properly installed ends, corners and brace post assemblies. If installation is substandard, the corner posts and ends may pull out. Posts need to be 5 to 6 inches in diameter and installed 36 to 40 inches below grade. Prices for materials range from $5 to $8 per foot depending on terrain, number of corners, type and height of wire, and number and style of gates.\(^{59}\)
O. Guard animals

1. Llamas\textsuperscript{60}
   Gelding males cost $300 to $800, intact males $200 to $700
   Annual expense for feed (not including pasture); $120
   Annual expense for veterinary costs; $30

2. Donkeys\textsuperscript{61}
   Purchase cost can average $500. Annual costs of feed (not including pasture) and veterinary
   services, $150 to $200.

3. Dogs\textsuperscript{62}
   Cost of purchase depends on breed of dog ranging from free to $1000. Daily food approximately
   $2 per day. Veterinary costs average $250 annually, but vary widely.

P. Anti-predator fence

See previous sections on L. Electric tape or braid and N. “Deer fence”.

Q. Poison oak barrier

Berries can be collected in early summer and propagated using standard nursery techniques.
Cover hands, legs, and arms, and use extreme caution when handling any part of the plant or
berries. Tools and clothes can be a vector for the oil over several days. Wash skin that touches
the plant or its oil with cool water and soap within a few minutes of exposure. Or, employ some
of the many individuals who are not sensitive. Young plants will need light irrigation during the
first 1 to 3 summers.

R. Anti-personnel fence

Short fences to block people from large rural areas should not run across any wildlife trails, deer
bedding areas, ridges or knolls, or drainages. The fence can run near trees and brush, since
this minimizes visibility, but installers should not cut trees, brush, or limbs. Piles of dead brush
along the fence in strategic locations can minimize a viewer’s ability to see where the fence
ends and discourage investigation. Maintain leaf litter along fences so deer and human tracks
are not visible.

Chain link fence fabric: $65 per 6 by 50 feet.
Terminal posts: $9.39 each.
Top rail 10'6": $6 each.
Line posts: $6 each.
Butterfly latch $5.49 each.
Tension bar: $2 each.
Post cap, brace band, and rail end: $1 each.
XI. REFERENCES

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