TECHNICAL NOTE

WOODLAND TECHNICAL NOTE NO. 41 **OCTOBER 1, 2007**

WINDBREAK/SHELTERBELT RENOVATION

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PLANNING CONSIDERATIONS

Windbreak renovation recommendations should be site specific to match landowner objectives, site potential, and the composition and condition of the existing windbreak. Renovation may involve one, or a combination of actions to restore or create the proper spacing, density, structure, and species composition in a windbreak/shelterbelt so that it can function properly.

Windbreak/shelterbelt renovation should not be initiated without an adequate inventory and evaluation of the existing windbreak/shelterbelt to determine probable causes of why it is not functioning as intended. Items to document and evaluate when inventorying a windbreak include:

1. Species composition, age, vigor, density, and height
2. Length, configuration, and plant to plant spacing
3. Competition
4. Insect, disease, and possible herbicide damage
5. Soils on the site
6. Animal and/or weather damage
7. Extent of natural reproduction

For help in evaluating the condition of a windbreak, a key to windbreak renovation needs is available in the University of Nebraska Cooperative Extension publication EC 98-1777-X "Windbreak Renovation." The key is based on observed symptoms and identifies renovation methods to consider.

Depending upon the renovation method chosen, some or all of the following practice standards or technical documents will be required when developing a windbreak/shelterbelt renovation plan.

- County specific soil suitability for windbreak species found in "Conservation Tree/Shrub Groups," Section II, South Dakota Technical Guide (SDTG).
- Woodland Technical Note No. 38 "Tree & Shrub Handling, Planting, and Care."
- "Estimated 20 Year Tree Heights by Conservation Tree/Shrub Groups."
- Tree/Shrub Pruning (660) standard.
- Windbreak/Shelterbelt Establishment (380) standard.

Caution: Several of the windbreak renovation methods involve substantial soil disturbances to depths below typical agricultural tillage. This depth of disturbance may require notification of various utility companies via the SD One Call System at 811.

Renovation plans should result in plantings, which achieve the design density necessary to accomplish the intended purpose and function of the windbreak/shelterbelt.

WINDBREAK RENOVATION DESCRIPTIONS AND TECHNIQUES

The following restoration methods can be used individually or in combination to restore or enhance the useful lifespan of windbreaks or shelterbelts.

RELEASE OF SOD BOUND TREES AND SHRUBS

Sod Release and Management is the control and management of herbaceous weeds, particularly sod forming grasses, in order to reduce the stress on windbreak plants and/or prepare the site for other renovation methods.

When competing herbaceous vegetation is affecting the health of the planting, the sod should be mechanically or chemically controlled to improve the growth and vigor of the trees and shrubs. This renovation technique would be applicable to sod bound plantings where at least 70 percent of the original windbreak is still alive.

If mechanical release is conducted, till no deeper than three inches between the rows and no closer than two feet from the base of the plants to minimize root damage. The optimum time is midsummer or early fall. Numerous applications will be needed each year. Keep in mind that each application runs the risk of mechanically damaging the existing trees and shrubs.

When chemical release is considered, consult the county extension agent or the SD Department of Agriculture, Division of Resource Conservation and Forestry for specific information regarding the kind of herbicide to use and its proper application.

All herbicides will be applied according to label regulations with particular care to minimizing damage to trees and shrubs. Several applications may be needed for adequate control. Operations may have to be repeated yearly. Many of the effective herbicides work on contact or via translocation. Avoid contact of these products on young bark or green leaves of trees or shrubs. Be alert to potential long-term herbicide buildup.

Read and follow all label instructions on the safe use and handling of the material. Dispose of unused material or empty containers according to local, state, or federal laws and regulations.

REINFORCEMENT PLANTINGS

Additional rows of trees or shrubs can be added adjacent to or within an existing windbreak/shelterbelt to improve density.

Renovation plans, which involve the replacement or planting of new trees and shrubs, will:

1. Use species adapted to the soil properties and the planting site;
2. Consider shade tolerance when selecting species for replanting within or adjacent to an existing windbreak or shelterbelt;
3. Avoid plants that may be alternate hosts to undesirable pests;
4. Use acceptable planting stock;
5. Use appropriate planting methods, and
6. Have planting sites properly prepared.

Guidelines for the above items are covered in SD Woodland Technical Note No. 38.

Residual plants will be protected during the renovation. Avoid mechanical wounding of the trees and shrubs to be retained in the windbreak/shelterbelt.

Supplemental or Enlargement Plantings

Cultivated sites

Supplemental row plantings should not be closer than 30 feet to existing rows of large spreading trees such as cottonwood, Siberian elm, or silver maple.

All other supplemental row plantings should not be planted closer than 20 feet to an existing row unless the renovation plan includes the eventual removal of the adjacent row prior to it suppressing the newly planted row.

The row nearest to the existing windbreak should be planted to Austrian pine, eastern redcedar, ponderosa pine, Rocky Mountain juniper, scotch pine, or a shade tolerant shrub.

Scalp planting sites

Scalp plantings should be limited to sites where proper site preparation is not possible.

Treat scalp plantings made in existing isolation strips or areas immediately adjacent to existing plantings as an underplanting.

Underplanting or Interplanting

Underplanting is the addition of trees or shrubs under the canopy of an existing windbreak. Plant approximately midway between the rows of an existing windbreak or shelterbelt where the majority of trees or shrubs in two or more adjacent rows are missing, dead, or in poor condition.

The replacement species selected must have the ability to handle the competition from existing trees and shrubs for light and moisture and still respond to eventual release.

Species adapted for underplanting or interplanting are: Eastern redcedar, Rocky Mountain juniper, and shade tolerant shrubs.

For seedlings planted by mechanical methods or by hand, the width of the scalped area should be a minimum of 16 inches.

Do not make scalp plantings where adequate natural regeneration is present.

Scalp plantings will not be made in heavy sod unless the grass has been controlled either chemically or mechanically.

This renovation method is the most difficult to successfully achieve. Other methods of renovation such as sod control, row replacement, and enlargement planting should be encouraged before underplanting, or used in conjunction with underplanting for the best renovation results.

ROW REMOVAL AND REPLACEMENT

Entire or partial rows of trees or shrubs will be clearly marked and identified for removal to allow rows of new trees or shrubs to be planted.

At a minimum, this renovation method removes the top growth of dead and dying trees. Traditionally, it has often included the removal of stumps and roots and the leveling of the renovation site. Tops may be removed by an assortment of tools and machines such as chainsaws, hydraulic shears, hydraulic saws, PTO-driven saws, dozers, endloaders, or etc. Root and stump removal and site leveling are often done with construction equipment or larger agricultural equipment.

Generally, in multiple row removals of interior rows, one less row will be planted than was removed. This requirement is necessary to provide enough growing space for the replacement plantings. This requirement is not necessary in windbreaks where existing between row spacing exceeds 25 feet.

If new trees or shrubs are to be established in the area of the old windbreak, resprouts should be controlled and the site will be fallowed at least one growing season before attempting to plant the new windbreak.

Perennial sod-forming grasses should be controlled for at least one growing season prior to planting the new trees or shrubs.

All tree and shrub debris from the cleared area, which could interfere with new planting and maintenance operations should be removed from the site and disposed of prior to planting.

Removal of woody material may be accomplished by any means, which does not damage the trees and shrubs to be retained or cause adverse offsite impacts.

Tops of American elm and Siberian elm should be disposed of by burning, burying, chipping or debarking to reduce the risk of spreading Dutch elm disease.

Other species of woody material may be burned, buried, hauled away or left in piles as long as applicable local and state laws are followed. Consider burning or burying other species if infected with diseases that may be spread to nearby trees.

Disposal of woody material (including burning) shall be done in compliance with all local applicable laws and state regulations, including the state's Best Management Practices (BMP's).

In multi-row windbreaks where a stand of larger trees will remain after the row removal, consider leaving hollow trees as den sites and a few of the larger dead trees as raptor roost sites.

If stumps and roots are removed, the site should be leveled to allow for planting and maintenance with normally available equipment.

Planting may be by any method that results in a healthy, vigorously growing tree or shrub.

Use extreme caution when replanting sites that have been leveled after stump and root removal. Buried woody debris can be hooked by moving machinery and thrust at people on the tree planter. Ensure protective shields are in place or take other precautions to minimize risks to operators.

If only the tops are removed, the stumps should be left short enough to not impede subsequent management operations.

Treat live stumps with an approved herbicide immediately after cutting to prohibit resprouting. (If resprouting is desired, follow guidance under Coppicing.)

Planting on these sites may be by any method that results in a healthy, vigorously growing tree or shrub. Due to the presence of stumps and roots, planting methods may be limited or must be modified. Often, traditional tree planters will function well within a few feet of the stump row, especially when equipped with a coulter. When planting within the old stump rows, hydraulic augers work well to dig the hole, which allows for easy and proper hand planting. See Figure 1. Though the risk of hooking roots that are buried in the soil may be less than on a leveled site, exercise caution and ensure protective shields are in place.

Maintenance operations may have to be modified on sites where new trees have been planted within the old tree row or immediately adjacent to the old tree row. Machine applied fabric and in-row tillage are often not possible due to the remaining roots and stumps. Hand placed and pinned fabric, mulching, herbicides, and careful tillage are alternative weed control methods that are appropriate depending upon the site.

Continued control of resprouting may be needed for one to two years after the initial treatment. Effectiveness of initial treatment is dependent upon species, chemical, time of year, and growth stage of plant.

Figure 1a: Replacement trees hand-planted between dead stumps

Figure 1b: Replacement trees machine-planted close to dead stumps

THINNING, PRUNING, AND COPPICING

Thinning

Thinning is the removal or killing of selected trees or shrubs within a row, or an entire row.

Individual trees or shrubs should be identified and marked for thinning to reduce plant competition, alter the density of the planting, or improve the growth of the remaining trees. Exercise caution when selecting trees to be thinned so that the function of the windbreak is not radically impaired.

Identify entire or partial rows of trees or shrubs for removal that will release adjacent rows of conifers or a more desirable deciduous species. Removal can be accomplished with chainsaws, tree spades, handsaws, brush cutters, tree shears, hydraulic saws or some other tool or machine. Rarely will the roots be removed, except in situations where tree spades are used to remove live trees for transplanting.

Tree tops and shrubs should be removed in such a manner that residual stumps and the debris from the thinning operation do not impede subsequent management operations. Tops may be removed from the site, stacked or cut "low and short" and left where they fall. Manage the debris from the thinning in a way that is compatible with landowner objectives.

Debris from Siberian elm or American elm must be chipped, burned, or buried to reduce risk of spreading Dutch elm disease. Elm wood disposal should occur immediately, if removal is during the growing season; or before the next growing season, if removed during the fall or winter.

Depending upon the species thinned, stump resprouting may have to be addressed. Repeat thinning operations or treatment with herbicides may be appropriate. There may be a risk of selected herbicides being translocated from the treated stump to the adjacent tree or shrub via root grafts. Not all species readily develop root grafts. Root grafting does not occur between plants of different species.

Single row windbreaks

Thinning consists of removing every other plant within the row to reduce density to the desired level. This type of thinning is most often utilized to reduce windbreak density and alter snow distribution patterns. Stump resprouts are usually not desirable and should be controlled.

Multi-row windbreaks

Thinning should favor those plants which have the most vigor, those long-lived species (including natural regeneration) which respond to release, or those species which will best perform the desired function of the barrier.

Thinning consists of removing selected trees or shrubs in a manner that leaves more growing space for each of the remaining trees or shrubs. Thinning may remove every other or every third plant within the selected row. It may also be done in such a matter that plant removals from several rows will result in the desired plant-to-plant spacing. Thinning is a key function in managing natural regeneration. A residual plant-to-plant spacing of 4-6 feet is appropriate for shrubs and 12-18 feet is appropriate for large trees.

Pruning

Pruning of trees will be used to remove diseased branches or alter the density of the planting.

Pruning is the removal of selected branches from trees. For most tree species, new tree limbs will not grow from the area pruned, unless pruning was performed incorrectly or the trees were under severe stress. Guidance on pruning techniques can be found in SD Woodland Technical Note No. 40. Pruning to alter windbreak densities will often need to be repeated at a later date to maintain the desired benefits.

- Pruning to reduce windbreak density can be done in two ways.

  The first method involves removing all limbs from all trees to a certain height, usually three to five feet above the ground. This type of pruning is usually done on field windbreaks to address snow distribution. After a field windbreak has been pruned in this manner, the downwind snowdrift will usually be wider, shallower, and farther away from the tree row. A negative aspect to this method is that the protection to the crop during the growing season will be reduced, especially near the tree row.

  The second method involves removing selected limbs throughout the canopy to reduce overall density of the windbreak to a desired level. This method will look more natural and would be very appropriate where windbreaks are protecting specialty crops that need the proper mix of

airflow and protection. It is considerably more labor intensive and would have to be performed more often than the first method.

Best time for either type of pruning is when trees are dormant. (October to February)

Early spring after snow melt is a good time to inspect windbreaks looking for damaged limbs, double leaders and other deformities caused by weather or animals. Using the proper pruning techniques, prune off the damaged branches in a way that encourages rapid callus formation and proper growth forms. Pruning to a single leader at the correct time (when limbs are less than one inch in diameter) will result in taller trees that are more wind hardy and will result in fewer limbs falling into adjacent fields. Windbreaks should be examined every year or after major storm events to determine pruning needs.

Coppicing

Coppicing is the removal of the top growth on deciduous trees and shrubs and allowing the stumps to resprout. This technique is applicable to most deciduous shrubs and many of the deciduous trees.

Identified rows of shrubs or trees in decline can be cut to the ground to allow sprouting (coppice) and improve ground level density and vigor.

For older shrub rows, broken down by years of snow and ice or other factors, coppicing is an effective way to remove the old, "leggy" material that has lost its windbreak effectiveness. The best time to perform this operation is when the plants are dormant, in late fall to early spring before initiation of bud swell. The most commonly used tools are chain saws and power pole pruners. For species with larger diameter trunks and few fine stems, some of the hydraulic shears on skid loaders may be appropriate. No matter which tool is used, care must be taken to prevent injury to stem, root collars and roots. Cuts should be clean with no ragged ends. Bark of the residual stumps should not be damaged or stripped. Cut off shrubs four to six inches above the ground. For most shrubs with healthy root systems, regrowth the first year will reach 30-50 percent of the precut height.

Figure 3 illustrates three different phases of a coppiced shrub renovation.

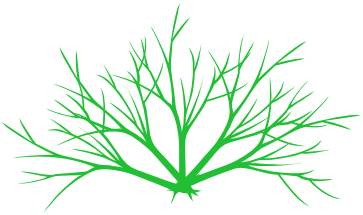

Figure 3a: Leggy, over mature shrub prior to coppice renovation.

Figure 3b: Top growth removed. 4-6 inch stump remains.

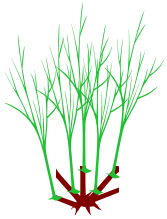

Figure 3c: First year coppice regrowth.

Successful coppicing of older shrubs is dependent upon the shrubs having a reasonably healthy root system. Shrub rows with many gaps, evidence of diseases, and exhibiting minimal annual growth for the past several years may not be suitable candidates for coppice renovation. In these situations coppicing, if used, will need to be supplemented with new plantings.

When using pole pruners or chainsaws, be sure to understand the safe operation requirements of these tools. Wear proper safety equipment. When uncertain of personal skills and abilities, rely on trained professionals to perform the task.

Certain deciduous trees exhibit strong tendencies towards coppicing after the main stem has been removed. To determine which species have the greatest chance of being successfully renovated via coppicing, see Woodland Technical Note No. 37, "Tree and Shrub Characteristics." Deciduous trees should be cut off to a height of four to six inches to encourage a strongly attached sprout arising from the root collar rather than as an advantageous sprout arising from higher locations on the stump.

As with shrub coppicing, the best time to complete the work is when the trees are dormant. Care must be taken to prevent injury to the tree stem, root collars and roots. Cuts should be clean with no ragged ends. Bark of the residual stumps should not be damaged or stripped.

Removing the top growth from trees is usually accomplished with chainsaws or specialized tools mounted on skid loaders or tractors. When using chain saws to fell larger trees, ensure that proper techniques and safety equipment are used. If in doubt, hire someone with the necessary skill, experience, and equipment.

One main difference between coppice regeneration on shrubs versus coppice regeneration on trees is the required maintenance during the first few years after regrowth. In most cases, regenerated trees will require pruning multiple stems to leave only one or two stems per stump prior to the second to fourth growing season.

Select the stem(s) with the best form for the particular species, to meet landowner objective and the best attachment to the old stump. Remove remaining sprouts using proper pruning methods. Properly attached sprouts are usually those closest to the ground or arising from the root collar or immediately adjacent roots. Avoid keeping sprouts that are attached high on the stump as they tend to break easily with wind or snow. Waiting a year or two before pruning will make it easier to determine which sprouts are the best to leave.

One caution, when removing surplus sprouts, refrain from removing more than 50 percent of the total leaf area during any one season. Removing too much leaf area could cause undo stress to the plant.

See Figure 4 for illustrations of coppicing deciduous trees.

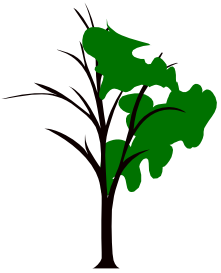

Figure 4a: Tree in a state of decline needing renovation.

Figure 4b: Top removed, leaving 4-6" stump on healthy roots.

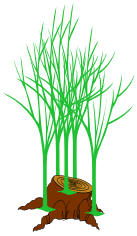

Figure 4c: Stump with multiple sprouts 1st or 2nd year after main tree removal.

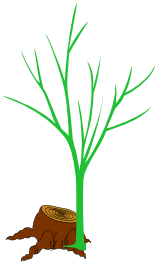

Figure 4d: Best sprout selected. Other sprouts pruned in year 3 or 4 after main tree removal.

MANAGE NATURAL REGENERATION

Natural regeneration is managing the naturally occurring seedlings that develop within the understory of some windbreaks to improve windbreak function. Species such as ash and basswood, are tall tree species that will often regenerate naturally within windbreaks. A wide assortment of shrubs such as honeysuckle, chokecherry, buffaloberry, etc., are often found as naturally regenerated seedlings within existing windbreaks. Eastern redcedar is also found in the understory of some windbreaks.

Presence of naturally regenerated trees and shrubs is largely dependent upon the site. Natural regeneration rarely occurs in single row windbreaks. Dense full shade, thick sods of grass, or long-term aggressive tillage will often limit the extent of natural regeneration. In SD, there is a marked decline in natural regeneration potential or success as one travels from east to west across the state. This is directly related to the amount of annual precipitation.

Managing natural regeneration usually means thinning competing woody vegetation regrowth in the understory to the desired spacing and controlling herbaceous weeds. Occasionally it involves

removing some of the overstory in order to open the canopy and allow more sunlight to reach the younger plants.

Herbaceous vegetation should be controlled whenever it begins to adversely affect tree and shrub growth and vigor. Thinning of woody plants can begin once they attain a three to four foot height. Plant to plant spacing after thinning operations are dependent upon the purpose of the windbreak.

Generally a residual plant to plant spacing of 12-18 feet for large trees, 8-14 feet for medium height trees and 4-6 feet for shrub species is appropriate. These suggested spacings are a bit wider than those for a new windbreak planting, but since thinning operations are so labor intensive, the wider spacing will allow the effects of the thinning to last longer.

Management of natural regeneration can result in a windbreak that appears to have rows, or it can

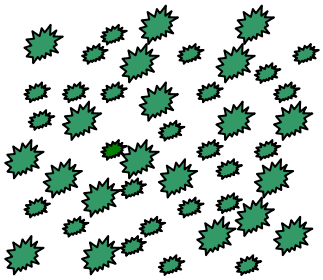

Figure 5a: Naturally regenerated stand prior to thinning.

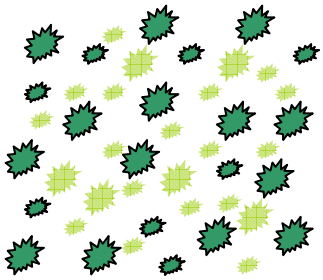

Figure 5b: Naturally regenerated stand, thinned to look natural.

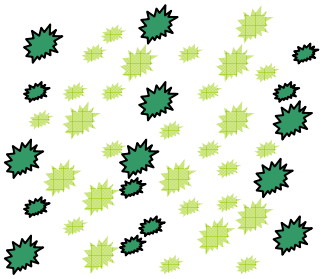

Figure 5c: Naturally regenerated stand, thinned to rows.

be managed to look totally natural (no noticeable rows.) See Figure 5.

Generally, the easiest way to perform a thinning operation in a naturally regenerated windbreak, is to walk through the windbreak and mark (with paint or flagging) the plants to be left. Select those plants with the best form for the species that are located approximately where needed to give the desired plant to plant spacing. Try to leave a diversity of species when marking for thinning. Remove the remaining plants and saplings.

Removal of unwanted saplings can be done with loppers, axes, chainsaws or powered brush trimmers, etc. In most cases, the freshly killed stumps of deciduous species will resprout. To prevent resprouting, apply the appropriate herbicide at the correct time. Some herbicides may translocate through root graphs to nearby plants of the same species. Be sure to follow all label directions and precautions. Without chemical stump treatment, thinning operations may have to be performed two to three times on the same plant until the residual saplings have attained sufficient height to outgrow the competition.

Where appropriate, consider leaving a few of the larger snags for den trees and roost sites. If compatible with landowner objectives and local ordinances, pruned material could be stacked and left in brush piles for additional wildlife habitat.

ROOT PRUNING

Root pruning is a renovation method that severs competing tree roots within the top 18-30 inches of the soil surface by pulling a vertical blade or plow through the soil. Reducing the spread of tree roots reduces the competition to nearby crops or to newly planted trees in a supplemental planting.

Root pruning should only be done to one side of a tree each year in order to limit the stress to the existing trees.

Repeat root pruning as necessary to reduce crop stress at intervals of 5 to 10 years.

When performed to reduce crop stress, root prune trees and shrubs no closer than their canopy drip line boundary. See Figure 6.

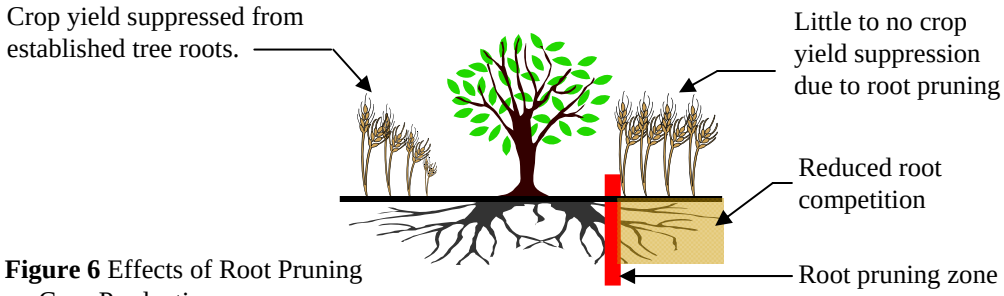

Figure 6 Effects of Root Pruning on Crop Production

For some species of trees, it is best if the root prune line falls within the crop field so that normal cropland tillage or herbicide applications can control the potential resprouts from the root pruning.

If underplanting or planting new tree rows adjacent to an existing windbreak, root pruning may be necessary to reduce stress to the newly planted trees. It can increase establishment success but may be stressful to the remaining windbreak trees. Root pruning will only provide benefits for two to three years.

The root prune line should be outside the crown drip line of the established trees to reduce the number and size of tree roots cut and to reduce damage to the tree foliage from the root pruning machinery. Root pruning should be completed only on one side of the established tree row. If possible, perform the root pruning operation to provide a minimum competition-free zone of at least eight feet wide prior to planting the new trees. This treatment will only provide benefits if adequate weed control is also performed in the area of the new trees. See Figure 7.

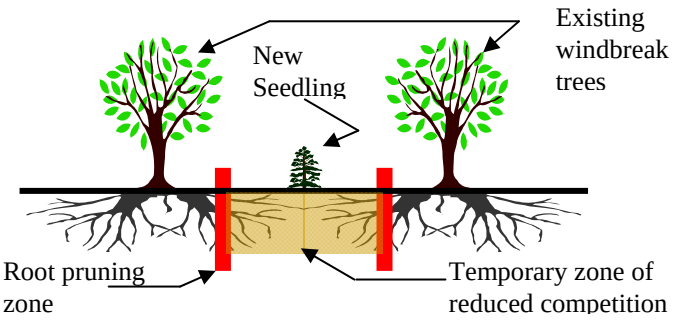

Figure 7 Root pruning to reduce stress on new trees

Locate all buried utilities prior to root pruning.

Control competitive vegetation as long as it inhibits the renewed growth and vigor of the windbreak or shelterbelt.

Livestock should be controlled or excluded as necessary to achieve and maintain the intended purpose.