NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

WINDBREAK/SHELTERBELT ESTABLISHMENT

(ft.)

CODE 380

DEFINITION

Windbreak or shelterbelts are single or multiple rows of trees or shrubs in linear configurations.

PURPOSE(S):

- Reduce soil erosion from wind.
- Protect plants from wind related damage.
- Manage snow deposition.
- Provide shelter for structures, animals, and people.
- Enhance wildlife habitat.
- Provide noise screens.
- Provide visual screens.
- Improve air quality by reducing and intercepting air borne particulate matter, chemicals and odors.
- Delineate property and field boundaries.
- Improve irrigation efficiency.
- Increase carbon storage in biomass and soils.
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

Apply this practice on any areas where linear plantings of woody plants are desired and are suited for controlling wind, noise, and visual resources. Use other tree/shrub practices when wind, noise and visual problems are not concerns.

This practice does not apply to plantings that are intended to function primarily as field borders, hedgerows, or riparian forest buffers, for which other standards are applicable. (Refer to the Virginia Practice Standards for *Field Border, (Code 386); Hedgerow Planting, (Code 422)*; and *Riparian Forest Buffer, (Code 391)*.)

CRITERIA

General Criteria Applicable to All Purposes

Vegetation may be established by using bare-root seedlings, containerized stock, or balled-and-burlapped stock. Only viable, high quality planting stock shall be used.

The location, layout and density of the planting will accomplish the purpose and function intended within a 20-year period.

Plant growth rates, shade tolerance, soil moisture requirements and tolerances, and other plant characteristics shall be considered when selecting species. Within a row, use only one species, or select a mix of species that have similar growth forms and growth rates.

Select plant species that are native to Virginia, or are introduced and are non-invasive (i.e., not likely to spread beyond the planted area and displace native species). Plantings consisting of two or more species, especially locally native plant species, shall be encouraged. For best results, use species and varieties with proven conservation traits. Plant species must be selected based on the planned purpose(s) and the soil, climate and site conditions.

Density is the solid portion of the barrier, i.e., the amount of leaves, branches and trunks in the windbreak. The density of a windbreak is determined by the choice of species (especially evergreen vs. deciduous), the number of rows used, and the spacing of the plants between and within rows. Windbreaks shall be planned to

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

meet density requirements when specified in this standard for specific purposes.

Spacing between and within rows shall be based on the needed growing space for plant type and species, the accommodation of maintenance equipment, and the desired characteristics of the stem(s), branches and canopy as required for a specific purpose.

Use staggered spacing in multiple row plantings. Plant taller-growing trees or shrubs in center rows, and medium or lower growing species in outer rows.

The maximum design height (H) for the windbreak or shelterbelt shall be the expected height of the tallest row of trees or shrubs at age 20 for the given site.

Orient the windbreak as close to perpendicular to the troublesome wind as possible.

The length of the windbreak will be sufficient to protect the site including considerations for the "end effect" and the change in the wind direction.

Avoid planting trees or shrubs where they will interfere with structures, and above or below ground utilities.

Follow recommendations for planting rates, methods, spacing, and dates obtained from the Virginia Plant Establishment Guide and/or Virginia Practice Standard *Tree and Shrub Establishment Standard (Code 612).*

Additional Criteria to Reduce Soil Erosion and Protect Plants from Wind

The interval between windbreaks shall be determined using current, approved, wind erosion technology. Interval widths shall not exceed that permitted by the soil loss tolerance (T), or other planned soil loss objective. Calculations shall account for the effects of other practices in the conservation management system.

For wind erosion control, temporary measures will be installed to supplement the windbreak unit it is fully functional.

Sites, fields, and plants are protected within an area 10 times the design height (H) on the leeward side and two times the design height (H) on the windward side of the windbreak.

Select species that are taller than the crop being protected.

Additional Criteria to Provide Noise Screens

Noise screens shall have a minimum density of 65 percent during the months when noise abatement is needed, and shall be as close to and as tall as the noise source as practicable. The length of the noise screen shall be twice as long as the distance from the noise source to the receiver.

At least two rows of medium and/or high density plants (at least one row of which is trees) are usually needed to meet the minimum 65 percent density requirement. If year-round protection is needed, use at least two rows of evergreens, of which one row must be trees. For higher levels of protection, use at least three rows of trees and shrubs, with at least one row being evergreen trees. Plant as close together as practical to form a tight barrier.

For high-speed traffic noise, the barrier shall not be less than 65 feet wide. For moderate speed traffic noise, the barrier width shall not be less than 20 feet wide. Species selected for traffic noise screens shall be tolerant of noxious emissions, sand and gravel depositions, and salt spray from traffic areas.

Additional Criteria to Improve Air Quality by Reducing Airborne Odors, Particulate Matters, and Chemicals and Odors

Windbreaks that are intended to intercept particulates and/or chemical drift shall consist of species that are tolerant of wind-borne particulates and herbicides from adjacent areas. Selection of species, and length and location of plantings shall be determined based on the type of airborne materials to be reduced.

Select and maintain tree and shrub species with foliar and structural characteristics to optimize interception and absorption of airborne chemicals or odors.

Plantings shall have a minimum density of 65 percent during the months when protection is needed. At least two rows of medium and/or high density plants (at least one row of which is trees) are usually needed to meet the minimum 65 percent density requirement. If year-round protection is needed, use at least two rows of evergreens, of which one row must be trees. For higher levels of protection, use at least three

rows of trees and shrubs, with at least one row being evergreen trees.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

Carbon sequestration (storage) is the process through which carbon dioxide (CO_2) from the atmosphere is absorbed by plants and converted during photosynthesis into plant material. Carbon is stored in biomass (tree trunks, branches, foliage and roots) and in soils (as leaf litter and other plant debris). Carbon sequestration rates vary by plant species and age, soil type, and climatic conditions.

Select appropriate species and stocking rates for site conditions, and maximize the width and length of the windbreak to fit the site. Use fast-growing species if rapid rates of carbon sequestration are desired. Prediction of carbon sequestration rates shall be made using current, approved carbon sequestration modeling technology.

Additional Criteria for Improving Irrigation Efficiency

For sprinkler irrigation systems, the windbreak shall be taller than the spray height.

The windbreak shall ~~out~~ not interfere with the operation of the irrigation system.

Additional Criteria to Manage Snow Deposition

The windbreak shall be oriented as close to perpendicular to the snow-bearing wind as possible.

For even snow distribution across a field, the windbreak density (during expected snow-producing months) shall not be less than 25 or greater than 50 percent. The interval between barriers will not exceed 20H.

For managing snow deposition, the minimum barrier density shall be at least 50 percent during expected snow-producing months. At least two rows of medium and/or high density plants (trees and/or shrubs) are usually needed to reduce wind velocities sufficiently for snow to accumulate. Windbreaks will be located so that snow deposition will not pose a health or safety problem or obstruct human, livestock, or vehicular traffic.

Where water erosion and/or runoff from melting snow is a hazard, it shall be controlled by supporting practices.

Additional Criteria for Enhancing Wildlife Habitat

Where wildlife habitat is identified as the primary purpose, select trees and/or shrubs that will also provide food, nesting cover, and/or protective cover for the individual wildlife species or groups of desired species including pollinators. Plantings shall consist of four or more species to provide greater vegetative diversity. Use locally native plant species when feasible.

Windbreaks that will serve as travel corridors shall be at least 50 feet wide and shall be used to connect two or more habitat areas (which are each at least 500 feet wide).

Height, length, location, and number of rows shall be determined based on the primary purpose of the practice. For additional information concerning the wildlife value of various native tree and shrub species, refer to the Virginia Practice Standard for *Conservation Cover (Code 327).*

Additional Criteria to Provide Shelter for Structures, Animals and People

For wind protection, the windbreak shall be oriented as close to perpendicular to the prevailing damaging wind as possible, and have a minimum density of 65 percent during the months when protection is needed.

The area to be protected shall be located within a leeward (downwind) distance of 2–5H from the planting (see Figures 1 and 2), but at least 100 feet downwind in snow country to allow adequate space for snowdrifts to accumulate.

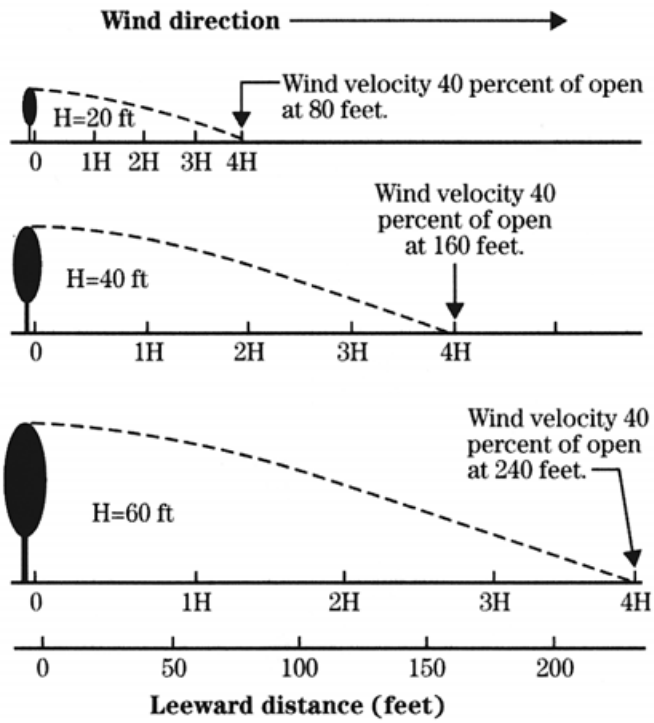
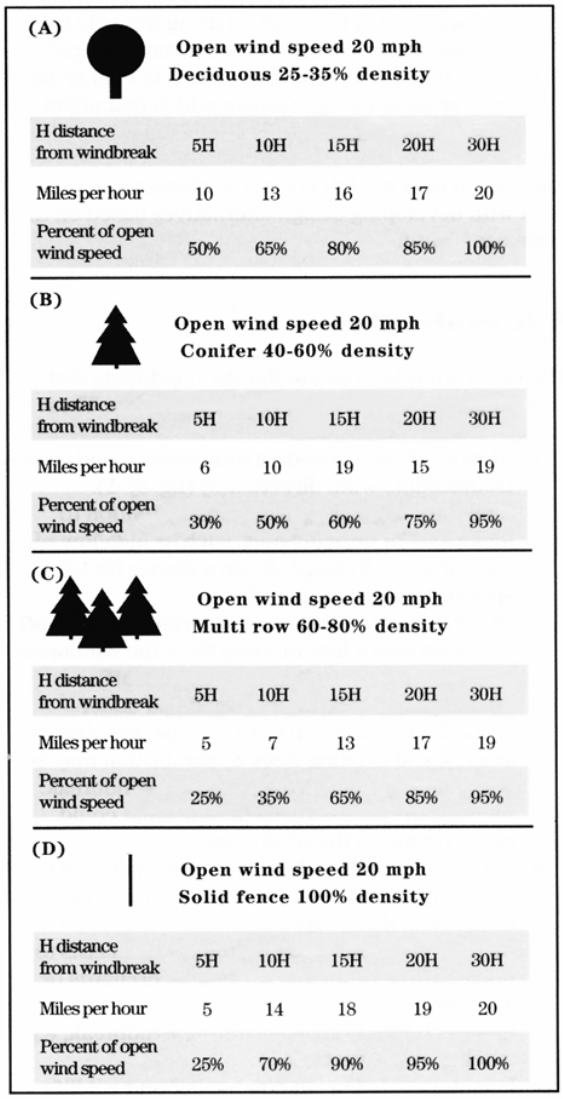


Figure 1. The leeward (downwind) distance of wind protection is proportional to the height of the barrier.

At least two rows of medium and/or high density plants (at least one row of which is trees) are usually needed to meet the minimum 65 percent density requirement. If year-round protection is needed, use at least two rows of evergreens, of which one row must be trees. For higher levels of protection, use at least three rows of trees and shrubs, with at least one row being evergreen trees.

To allow for changes in wind direction, it may be necessary to design the windbreak to provide protection from multiple directions by using an L, U, or E shape. When orienting the windbreak, avoid placement that may cause future management problems.



(A) Open wind speed 20 mph
Deciduous 25-35% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	10	13	16	17	20
Percent of open wind speed	50%	65%	80%	85%	100%

(B) Open wind speed 20 mph
Conifer 40-60% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	6	10	19	15	19
Percent of open wind speed	30%	50%	60%	75%	95%

(C) Open wind speed 20 mph
Multi row 60-80% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	5	7	13	17	19
Percent of open wind speed	25%	35%	65%	85%	95%

(D) Open wind speed 20 mph
Solid fence 100% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	5	14	18	19	20
Percent of open wind speed	25%	70%	90%	95%	100%

Figure 2: The density of the barrier (type of planting, spacing, and number of rows) affects wind speed reduction leeward (downwind) of the windbreak.

The length of the windbreak determines the amount of total area receiving protection. For best protection, the uninterrupted length of a planting should exceed the height by at least 10:1. For example, if planned height of the planting is 30 feet, the windbreak needs to be at least 300 feet long to minimize the impact of air turbulence around the end of the planting. The windbreak should also extend at least 100 feet past the site being protected to account for air turbulence around the end of the planting.

Additional Criteria for Visual Screens

Locate visual screens as close to the observer as possible with a density, height and width to sufficiently block the view between the area of concern and the sensitive area.

Additional Criteria to Reduce Energy Use

Orient the windbreak as close to perpendicular to the troublesome wind as possible

Use proper plant density to meet energy reduction needs.

Use plants with a potential height growth that will be taller than the structure or facility being protected.

CONSIDERATIONS

Consider the time of year when wind protection is needed, and the direction of the prevailing wind.

All plantings should complement natural features. Consider enhancing aesthetics by using evergreens, flowering species, or brilliant fall foliage. Wildlife and pollinator needs should be considered when selecting tree and shrub species. Species diversity, including use of natural species, should be considered to avoid loss of function due to species-specific pests.

Assess site conditions including surrounding land uses, soils, residual herbicides (to the extent known), available moisture during the growing season, and existing vegetation on the site and in adjacent areas, including any noxious weeds that may be present. Selection of plants should favor species or varieties tolerant to herbicides used in the area.

Avoid selecting plant species or planting near existing species that may be alternate hosts to undesirable pests, or that may be considered invasive or undesirable. Species diversity, including use of native species, should be encouraged in order to minimize problems due to species-specific pests.

When selecting and purchasing plants, consider the length of time needed to achieve the desired purpose. Slow-growing species will take longer to reach the design height than fast-growing species. Seedlings will take longer than containerized or balled-and-burlapped stock.

Consider wildlife and pollinator needs when selecting tree and shrub species. When planting around poultry houses, species that are highly attractive to birds are undesirable. In other locations, consider using plants that have multiple wildlife values such as those suited for nesting habitat, fruit, seeds, browse, and protective cover.

Around buildings and other structures, consider soil quality especially in terms of compaction and potential contamination with construction debris, gravel, and other fill material. Compaction and inorganic fill materials can severely hinder plant rooting and survival. Consider the need for deep tillage and the addition of soil amendments to improve soil quality.

Consider the need for supplemental watering or irrigation when establishing plantings, especially if containerized stock or balled-and-burlapped plants will be used. During summer months when air temperatures, evaporation rates, and evapotranspiration rates are high, plants generally need at least 1 inch of water per week from rainfall or irrigation sources. Sufficient moisture during the first five years is important for plant survival and overall plant health.

Consider the need for weed control within and between rows. Weed control is extremely important to the establishment and longevity of windbreaks. Consider using plastic landscape fabric, polyethylene sheeting (6 mil), and/or mulch as a weed barrier. Pre- and post-emergent herbicides or periodic mowing may also be needed where weed pressure is high. For windbreaks that will be maintained with mowing, consider that plant spacing will need to accommodate mowing equipment.

Consider access routes and the need to maintain space for future expansion when designing windbreaks near buildings. Take note of other constraints such as economic feasibility, regulatory or program requirements, the need for permits or approvals, and visual aspects.

Consider that establishing visual screens for animal production and waste facilities may result in fewer odor complaints by neighbors. Windbreaks for controlling odor and dust particles will be more effective as the amount and density of foliage increases. Multiple row plantings are preferable because they provide greater interception than single row plantings. Windbreaks planted near animal facilities may also provide water quality benefits by intercepting nutrients in surface and subsurface water.

Consider that a curving planting may provide a more pleasing appearance than one with straight rows or squared corners.

Consider the direction of prevailing winds in summer and winter when designing windbreaks near buildings and livestock areas. Windbreaks that are intended to provide protection from winter winds should be planted more densely, while those that are intended for shade should be planted more loosely to allow air circulation during summer months. Consider conservation of archeological, historic, structural and traditional cultural properties, when applicable.

In cropping systems, select windbreak and shelterbelt species that minimize adverse affects

to crop growth (e.g. shade, allelopathy, competing root systems or root sprouts).

PLANS AND SPECIFICATIONS

Plans and specifications for establishment of the windbreak shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail concerning site preparation and establishment to ensure successful installation of the practice.

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Field location, extent of the windbreak or shelterbelt in length and width, conservation plan map or sketch showing the location and layout of the practice, and assistance notes. Assistance notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom;

2. Species selected for establishment, number of rows, spacing, total quantities needed, and planting dates.

3. Completed copy of the appropriate Job Sheet(s) or other specifications, and management plans.

OPERATION AND MAINTENANCE

The completed Job Sheet can serve as the operation and management plan as well as supporting documentation and shall be provided to the client. If necessary, additional management requirements can be developed on a site specific basis to assure performance of the practice as intended.

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life:

1. Inspect trees and shrubs periodically and protect from adverse impacts including insects, diseases, fire, or damage from livestock and wildlife;
2. Control competitive grasses and weeds around plants by mowing, mulching, and/or chemical control until plants are well-established. Control all noxious weeds as required by state law;
3. Provide supplemental water as needed;
4. Replace dead trees and shrubs until the barrier is functional;
5. Thin or prune the barrier as needed to maintain its function;
6. For windbreaks that are planted to reduce particulates, build-up of particulates on leaves may threaten to smother and kill the plants. When feasible, periodically remove the accumulated particulate matter from the leaves by hosing the plants with water. Excessive accumulation of particulates may require installation of additional barriers such as fencing or netting to protect the plants.

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