Windbreak/Shelterbelt Establishment (Ft.) 380

DEFINITION

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

PURPOSES

- Reduce soil erosion from wind.
- Protect plants from wind related damage.
- Alter the microenvironment for enhancing plant growth.
- 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 areas where linear plantings of woody plants are desired and suited for controlling wind, noise, and visual resources. Use other tree/shrub practices when wind noise and visual problems are not concerns.

CRITERIA

General Criteria Applicable To All Purposes

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

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

Select species that are adapted to site condition and suitable for the planned purpose(s). Refer to the Conservation Tree/Shrub suitability Groups (CTSG) tool in the MI-NRCS electronic Field Office Technical Guide (eFOTG), Section II.

Do not use plants on the Federal or state noxious weeds list. Refer to the Invasive Plant Species List in eFOTG, Section II.

Use only viable, high quality and adapted planting stock. Refer to the Windbreak/Shelterbelt Establishment (380) Job Sheet for minimum planting stock size requirements.

If existing vegetative cover is anticipated prior to establishment of trees or shrubs, prepare the site using the Tree/Shrub Site Preparation (490) conservation practice standard.

Maintain a 36” diameter weed-free area around planted seedlings or cuttings until average tree/shrub height is taller than the surrounding weeds. Use the Mulching (484) conservation practice standard for organic or inorganic mulch, including fabric weed barriers. Use the Herbaceous Weed Control (315) conservation practice standard for chemical or mechanical (tillage) weed control.

If tillage is used for weed control, care must be taken not to damage plant stems. Keep tillage depths shallow to avoid root damage.

Note: Mowing or cutting of weeds or grass is not an acceptable means of weed control around woody

plantings, but may be used to improve access to plantings.

Evaluate each site to determine if mulching, supplemental water or other cultural treatments will be needed to assure adequate survival and growth. Refer to the Mulching (484), Cover Crop (340) or other applicable conservation practice standards, as needed.

Avoid planting trees or shrubs where they will interfere with structures or any above or below ground utilities. Establish woody plants without compromising the integrity of property lines, fences, utilities, roads, legal drains, easements or public rights-of-way.

Locate windbreaks such that snow deposition will not pose a health or safety problem, management constraints, or obstruct human, livestock or vehicular traffic.

Plan the minimum setback distance from the outside tree or shrub row to adjacent property line or contrasting land use areas to be equal to the 20-year height of the tree or shrub, unless the 20-year height is > than 20', or the adjacent land is in agricultural production, in which case use a minimum setback of 20 feet. Refer to the CTSG Tool to determine 20-year height.

Where subsurface drains (tile lines) cross through a tree/shrub planting, and where these drains are to remain functional, install a sealed conduit through the planting and extending a minimum of 100 feet beyond large trees and 75 feet beyond small to medium sized trees and shrubs.

Planting Dates

Select planting dates, and handling and planting techniques to help ensure that planted materials have an acceptable rate of survival.

Plant bare-root stock, seedling plugs, live cuttings, containerized stock or balled and burlapped stock during the dormant season in the Spring after the ground thaws until June 1 as soil moisture and local weather conditions permit or in the Fall, after October 1 until the ground freezes when soil moisture is adequate.

Do not plant seedlings (bare-root or plugs) in the Fall on soils subject to frost-heave action (clays, clay loam, silty clay loams, silts, silt loams, and loams).

Density and Spacing Requirements

Base spacing between individual plants 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.

Windbreak design density will vary based on the planned function of the barrier (see Additional Criteria sections below). Plant densities for trees and shrubs will depend on their potential height at 20 years of age. Base height estimates on: 1) performance of the individual species (or comparable species) in nearby areas on similar sites, or 2) predetermined and documented heights using the CTSG Tool.

Spacing Between Rows

Spacing between adjacent rows can vary or be uniform. However, ensure the minimum distances listed in table 1 are met.

Table 1. Spacing Between Rows

Plant Type/Size*	Spacing Between Rows**
Between rows of shrubs and/or small trees (10-25' height)	12' – 20'
Between a row of shrubs and/or small trees (10-25') and a row of tall trees (<25')	16' – 20'
Between rows of large trees (>25')	20'

* Tree height refers to mature height. See CTSG tool for more information.

**Exceptions to the spacing requirements include the use of vegetation as a snow trap (wider spacing allowed) and where the landowner plans to remove every other row before crowding starts (closer spacing allowed).

If plantings are to be cultivated, mowed, or require other equipment access, plan the row spacing wide enough for maintenance equipment to operate freely

between rows. Usually this requires about 4 feet more than the width of cultivation equipment.

Spacing Within Rows
Ensure the within-row spacing requirements listed in table 2 are met.

Table 2: Spacing Within Rows

Plant Type/Size	Spacing Between Plants**
Shrubs less than 10' in height*	4' – 8'
Shrubs and small trees from 10' to 25' in height*	5' – 10'
Trees greater than 25' in height*	8' – 18'

* Tree height refers to mature height. See CTSG tool for more information.

**Where plantings exceed the minimum design criteria, through the use of additional rows, plant-to-plant spacing up to 20 feet may be planned for appropriate species.

Stagger trees in adjacent rows to increase density, and shorten time before windbreak become functional.

Windbreak Density
Total windbreak density is a function of the season (leaf-on versus leaf-off), the number of rows, the species planted and the spacing used. Table 3 provides guidance on designing windbreak density.

Table 3: Suggested Designs to Achieve Desired Density

Density & Season	Suggested Layout/Design*
30-40%, leaf-off	1 row of deciduous trees, 14-18' spacing
30-40%, leaf-off	1 row of shrubs, 4' spacing
40-60%, leaf-off	3 rows: 2 rows of deciduous trees + 1 row of shrubs
40-60%, leaf-off	2 rows of shrubs
40-60%,leaf-on	1 row of deciduous trees, 12' spacing
40-60%, year-round	1 row of dense conifer (e.g., spruce, cedar), 10' spacing
40-60%, year-round	2 rows of sparse conifers (e.g., pine)
40-60%, year-round	3 rows: 1 row of shrubs + 1 row of sparse conifers (e.g., pines) + 1 row of deciduous tree (may be >60% during growing season)
40-60%, year-round	4 rows: 2 rows of shrubs + 2 rows of deciduous trees (may be >60% during growing season)
60%+, year-round	3 rows of conifers
60%+, year-round	3 rows: 2 rows of conifers + 1 row of shrubs
60%+, year-round	4 rows: 2 rows of conifers + 2 rows of deciduous trees.
60%+, year-round	4 rows: 1 row of conifers + 2 rows of deciduous trees + 1 row of shrubs

*Note: "conifer" in this table refers to evergreen conifers only.

Additional Criteria to Reduce Wind Erosion and Protect Growing Plants
Determine the interval between windbreaks using current, approved, wind erosion technology, e.g., NRCS Wind Erosion Prediction System (WEPS). Account for the effects of other practices in the conservation management system when determining windbreak interval.

For wind erosion control, install temporary measures to supplement the windbreak until it is fully functional.

Note: 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 crops being protected.

Ensure that the length of the windbreak is sufficient to protect the site including consideration for the "end effect" and changes in wind direction.

For reduced soil erosion from wind, design the windbreak density to be 40% to 60%. Refer to Table 3 for windbreak designs to achieve this density.

Additional Criteria to Manage Snow Deposition (Living Snow Fence)

Orient the windbreak as close to perpendicular to the snow-bearing wind as possible.

For snow distribution across a field, design the windbreak density (during expected snow-producing months) to be between 30% and 40%. Refer to Table 3 for windbreak designs to achieve this density.

Design the interval between barriers to not exceed 20H.

For snow accumulation, design the minimum barrier density, during expected snow-producing months, to be > 60%. Refer to Table 3 for windbreak designs to achieve this density.

For windbreaks with trees, design the windbreak such that the windward row is at least 75 feet from the area to be protected and extends 85 feet in either direction perpendicular from the area to be protected.

For windbreaks composed of shrubs only, design the windbreak such that windward row is at least 35 feet distant to the area to be protected and extends 50 feet in either direction perpendicular to the area being protected.

Locate living snow fences established for snow protection along roads such that visibility and snow deposition will not adversely impact the road or intersection. Observe local regulations concerning planting of trees and shrubs for snow protection along roads.

Use supporting practices to control water erosion and/or runoff from melting snow hazard, if needed.

Additional Criteria to Provide Shelter for Structures, Animals and People and/or Reduce Energy Use

Design the planting to be oriented as close to perpendicular to the troublesome wind as possible.

Place plantings at least 75 feet from structures or feedbunks to avoid snow accumulation and reduce turbulence. Extend the ends of the windbreak at least 85 feet beyond the structure or livestock area to prevent the drift, which forms at the end of the windbreak, from interfering with farm operations.

For wind protection, design the windbreak density to be at least 60 % during the months of most troublesome wind. Refer to Table 3 for windbreak designs to achieve this density.

Ensure that the area to be protected falls within a leeward distance of 10H.

Ensure that drainage of snowmelt from the windbreak does not flow across livestock areas.

Ensure that drainage of livestock waste from the livestock area does not flow into the windbreak.

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

Additional Criteria to Enhance Wildlife Habitat

Select plant species to benefit desired wildlife species including pollinators.

Design the windbreak with dimensions that will be adequate for desired wildlife species.

Additional Criteria for Noise Screens

Design noise screens to be at least 60 % dense during the time of the year when noise is a problem and as tall as, and as close to, the noise source as practicable. Refer to Table 3 for windbreak designs to achieve this density.

Plan the length of the noise screen to be twice as long as the distance from the noise source to the receiver. For high-speed traffic noise, design the barrier to be at least 65 feet wide. For moderate speed traffic noise, design the barrier to be at least 20 feet wide.

Select species that will be tolerant to noxious emissions, sand, gravel depositions or salt spray from traffic areas, if applicable.

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 Improve Air Quality by Reducing and Intercepting Airborne Particulate Matter, Chemicals and Odors

Plan a windbreak interval to be less than or equal to 10h depending on site conditions and related supporting conservation practices.

Design windbreak on the windward side of the problem source, (i.e. particulate, chemical or odor) to have at least 40% density to reduce the airflow into the source area.

Design windbreak on the leeward side of the problem source (windward of the area to be protected), to have at least 60% density. Refer to Table 3 for windbreak designs to achieve these densities.

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

To achieve maximum odor dilution, use at least one row of the tallest adapted tree species available and at least one row of an evergreen species.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

Maximize width and length of the windbreak to fit the site.

For optimal carbon sequestration, select plants that have higher rates of sequestration in biomass and soils.

Plan and manage the appropriate plant spacing for the site that will maximize above and below ground biomass production.

Minimize soil disturbance during establishment and maintenance of the windbreak/shelterbelt.

Additional Criteria for Improving Irrigation Efficiency

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

Ensure that the windbreak will not interfere with the operation of the irrigation system.

CONSIDERATIONS

Selection of plants for use in windbreaks should favor species or varieties tolerant to herbicides used in the area.

Avoid plants that may be alternate hosts to undesirable pests.

Wildlife and pollinator needs should be considered when selecting tree or shrub species, and planning the windbreak layout. Species diversity, including use of native species, should be considered to avoid loss of function due to species-specific pests.

Alternating species, either trees or shrubs, within the same row is only recommended if the species used have similar growth habits and their projected height (H) at 20 years of age is within 10%.

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).

Consider the invasive potential when selecting plant species.

Older-age and medium to larger size planting stock, including bare rooted, transplants, balled and burlap and container grown stock are recommended in single row and minimum design windbreaks. Tree/shrub mortality is more critical in these designs; larger and older planting stock may provide an advantage in survival rates.

Closer spacings will provide protection in the shortest period of time. However, plantings with narrow spacing should be designed with a thinning recommended to achieve the ultimate spacing.

Multiple-row plantings should contain a variety of species to lessen the chance of loss due to species-specific insects or disease.

In multiple-row plantings, the species with the shortest 20-year height and slower-growing species should be planted in outer rows so they are not overtopped by fast-growing and taller species.

Orient tree or shrub rows on or near the contour where water erosion is a concern. Where water erosion and/or runoff from melting snow is a hazard, it should be controlled by supporting practices.

When designing and locating a windbreak or shelterbelt, consider the impact upon the landowner's or public's view of the landscape.

A shelterbelt can be used as a travel corridor to connect existing patches of wildlife habitat.

Spacing between windbreaks and rows of windbreaks may be adjusted, within limits of the criteria above, to accommodate widths of equipment.

To provide shelter for structures, animals or people, if sufficient space is available, consider planting a dense single or double row of shrubs or vegetative barriers such as wheatgrass or big bluestem may be planted 40 to 100 feet windward of the windbreak to trap snow and enhance wildlife habitat.

Windbreaks for odor and chemical control increase in effectiveness as the amount of foliage available for intercept increases. Multiple-row, wide plantings offer greater interception potential than do smaller plantings.

When using trees and shrubs for greenhouse gas reductions, prediction of carbon sequestration rates should be made using current, approved carbon sequestration modeling technology.

Additional Considerations for Odor Control
In order to ensure maximum year around odor dilution, the odor source should be surrounded on all 4 sides by windbreaks to account for varying wind directions, with each side placed 75 to 100 feet from the odor source.

Paired windbreaks can be an alternative where a 4-sided windbreak is impractical or undesirable.

Paired windbreaks, located 75-100 feet upwind and downwind (based on the prevailing wind direction) from the odor source, will create good conditions for mixing and dilution.

Additional Considerations for Enhancing Wildlife Habitat
Shrub windbreaks containing multiple rows may be enhanced for wildlife by staggering rows and spacing plants up to 8 feet within rows to enhance fruit production.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site using the NRCS MI Windbreak and Shelterbelt Establishment (380) Job Sheet or other approved specification sheets, job sheets, and/or narrative statements in the conservation plan or other acceptable documentation.

Specifications will include, but are not limited to, the following:

- Purpose of the Windbreak/Shelterbelt
- Planting dates
- Location of practice
- Planting layout, including spacing between and within rows
- Tree/shrub species to be planted, by row
- Planting method
- Site preparation requirements
- Post-planting weed control requirements
- Operation and maintenance requirements

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

Replace dead trees or shrubs if survival drops below 90% of the minimum allowed design stocking/density for the intended purpose and continue replacement as needed until the windbreak/shelterbelt is functional.

Inspect the windbreak at least semi-annually and protect and restore as needed from adverse impacts such as excessive traffic, pest infestations, pesticide use on adjacent lands, livestock use and fire. Repellents, poisons, tubing, netting and cages of various kinds may be needed to control rodents and animal damage. Refer to the Firebreak (398), Access Control (472), and other applicable conservation practice standards as needed.

Provide supplemental water as needed. Refer to Windbreak/Shelterbelt Establishment (380) Job Sheet.

Thin or prune the windbreak/shelterbelt to maintain its function. Refer to the Windbreak/Shelterbelt Renovation (650) and the Tree/Shrub Pruning (660) conservation practice standard for more information.

Periodic applications of nutrients may be needed to maintain plant vigor.

Control wind or concentrated flow erosion in the area up-wind or up-gradient of the windbreak to maintain its function using appropriate conservation practices, as needed. Following severe storms, check for evidence of sediment deposits, erosion or concentrated flow channels. Prompt corrective action needs to be taken to stop erosion.

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