

**NATURAL RESOURCES CONSERVATION SERVICE
NEW JERSEY
CONSERVATION PRACTICE STANDARD**

WINDBREAK/SHELTERBELT ESTABLISHMENT

(Ft.)

CODE 380

DEFINITION

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

PURPOSE

- 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.

CONDITIONS WHERE PRACTICE APPLIES

Apply this practice on any 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.

Refer to Forest Site Preparation, 490, for preparing site conditions for plant establishment.

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.

Species must be adapted to the soils, climate and site conditions. Select plant species that are native to New Jersey, 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. Refer to Table 3 for a selected list of tree and shrub species that can be used.

Types of Plant Materials - 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. If using containerized materials, do not transplant hardwood stock more than 1¾ inches trunk caliper, and pine stock more than 2½ inches trunk caliper. Smaller caliper plants are easier to transplant and usually have higher survival rates than larger caliper

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 download it from the <http://www.nrcs.usda.gov/technical/efotg>.

**NRCS, NJFOTG
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stock. Trunk caliper of nursery stock is measured at 6 inches above the soil surface if the plant's caliper is equal to or less than 4 inches, in accordance with American Nursery and Landscape Association standards.

Tables 1 and 2 can be used for planting dates and spacing in the appropriate plant hardiness zone (Figure 3).

Spacing between individual plants shall be based on the needed growing space for plant type and species (Table 2), the accommodation of maintenance equipment, and the desired characteristics of the stem(s), branches and canopy as required for a specific purpose.

The windbreak will be oriented as close to perpendicular to the troublesome wind as possible.

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

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

Moisture conservation or supplemental watering shall be provided for plant establishment and growth where natural precipitation is too low for the selected species.

Refer to Tree/Shrub Establishment (612) for further guidance on planting trees and shrubs.

Height, Density, and Orientation - For wind protection, the windbreak/shelterbelt shall be oriented as close to perpendicular to the prevailing damaging wind as possible. The area to be protected shall be located within a leeward (downwind) distance of 10H from the planting. Greatest wind speed reduction occurs in the area from two times (2H) to ten times (10H) the height of the windbreak/shelterbelt on the leeward side, depending on the height, density, and orientation of the barrier. (see Figures 1 and 2)

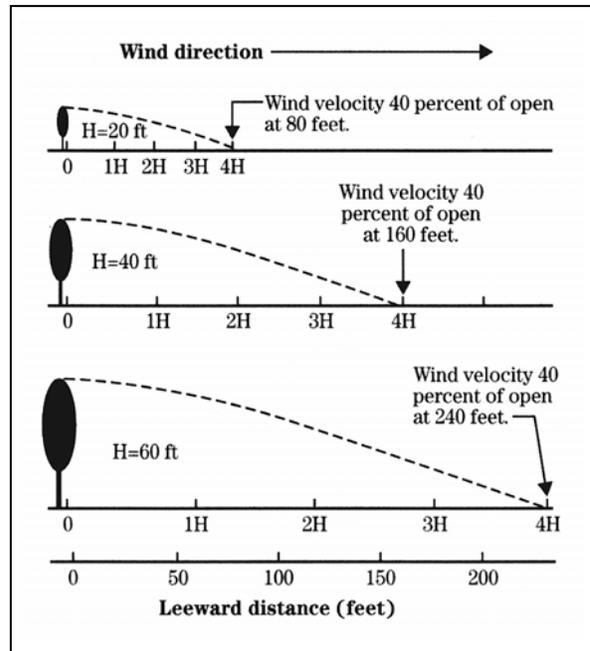


Figure 1. The leeward (downwind) distance of wind protection is proportional to the height of the barrier.

Use a minimum of one row of trees to provide protection from wind. If year-round protection is needed, use at least one row of evergreen trees. For higher levels of protection, use at least three rows of trees and shrubs, with at least one row being evergreen. Use Table 2 to determine appropriate spacing.

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

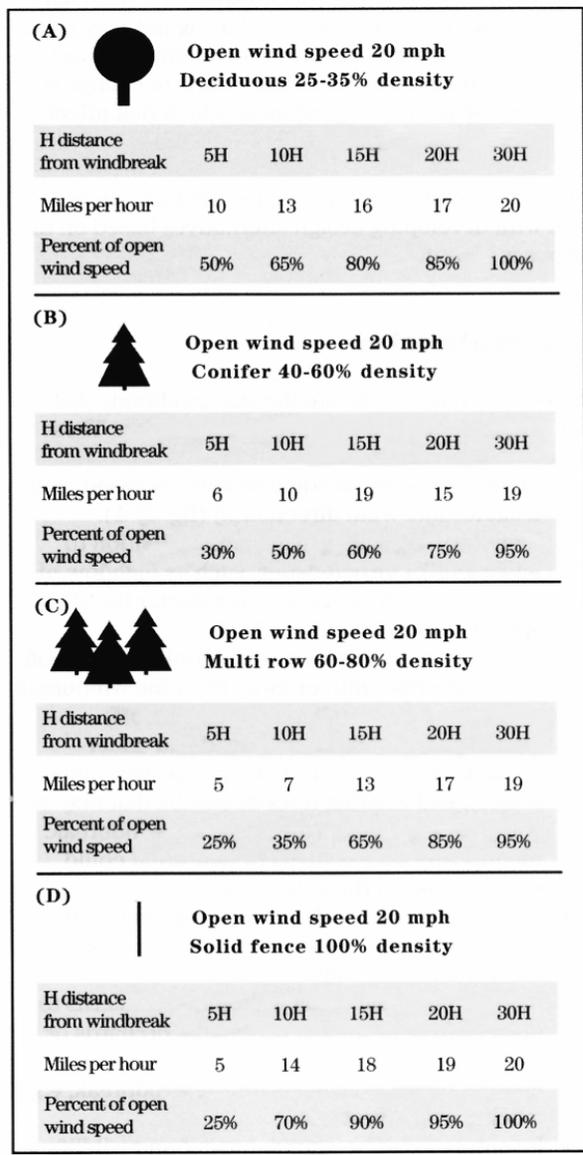


Figure 2. The density of the barrier (type of planting, spacing, and number of rows) affects wind speed reduction leeward (downwind) of the windbreak.

Length - The length of the windbreak/shelterbelt 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/shelterbelt needs to be at least 300 feet long to minimize the impact of air turbulence around the end of the planting. The windbreak/shelterbelt 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 to Reduce Wind Erosion and Protect Growing Plants

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 until 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 crops being protected.

Additional Criteria to Manage Snow Deposition

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

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

For snow accumulation, the minimum barrier density, during expected snow-producing months, will be 50 percent.

The length of the windbreak will extend beyond the area being protected to allow for end drifts.

Windbreaks will be located so that snow deposition will not pose a health or safety problem, management constraints, 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 to Provide Shelter for Structures, Livestock and People

For wind protection, the minimum barrier density will be 65 percent during the months of most troublesome wind.

The area to be protected will fall within a leeward distance of 10H.

Drainage of snowmelt from the windbreak shall not flow across the livestock area.

Drainage of livestock waste from the livestock area shall not flow into the windbreak.

Additional Criteria for Noise Screens

Noise screens shall be at least 65 percent dense during the time of the year when noise is a problem, as tall as, and as close to 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.

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 will be tolerant to noxious emissions, sand, gravel depositions or salt spray from traffic areas.

Additional Criteria for Visual Screens

Visual screens shall be located 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 Improve air quality by reducing and intercepting air borne particulate matter, chemicals and odors.

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

Windbreak density on the windward side of the problem source, (i.e. particulate, chemical or odor) shall be greater than 50% to reduce the airflow into the source area.

Windbreak density on the leeward side of the problem source, and windward of the area to be protected, shall be greater than 65%.

Select and maintain tree and shrub species with foliar and structural characteristics to

optimize interception, adsorption and absorption of airborne chemicals or odors.

Particulates from Poultry Houses - The following criteria apply to controlling particulates vented from poultry house tunnel fans:

At least one row of evergreen trees and/or shrubs shall be planted a minimum distance of 25 feet from the fans. If this distance is not available, other barriers such as fencing, netting, tall grasses, or earthen berms may be needed to control particulates. Plants may need to be planted farther than 25 feet away from the fans if access to the poultry house is needed in this area. Distances in excess of 50 feet may not provide sufficient particulate trapping.

Species suitable for use with tunnel fans are:

- **Trees** - Eastern Red Cedar, Leyland Cypress, American Holly, and White Pine;
- **Shrubs** - Northern Bayberry and Southern Waxmyrtle.

See Table 3 for additional information concerning these 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.

Plant 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 Enhancing Wildlife Habitat.

Plant species selection shall benefit targeted wildlife species.

Design dimensions of the planting shall be adequate for targeted wildlife species.

Additional Criteria for Improving Irrigation Efficiency

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

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

CONSIDERATIONS

Consider enhancing aesthetics by using evergreen species or species with features such as showy flowers, brilliant fall foliage, or persistent colorful fruits.

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

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

Plants that may be alternate hosts to undesirable pests should be avoided.

All plantings should complement natural features.

Tree or shrub rows should be oriented 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.

Wildlife needs should be considered when selecting tree or shrub species. Species diversity, including use of native species, should be considered.

Species diversity, including use of native species, should be considered to avoid loss of function due to species-specific pests.

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.

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

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

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

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).

Replacement of dead trees or shrubs will be continued until the windbreak/shelterbelt is functional.

Supplemental water will be provided as needed.

Thin or prune the windbreak/shelterbelt to maintain its function.

Inspect trees and shrubs periodically and protect from adverse impacts including insects, diseases or competing vegetation. The trees or shrubs will also be protected from fire and damage from livestock and wildlife.

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

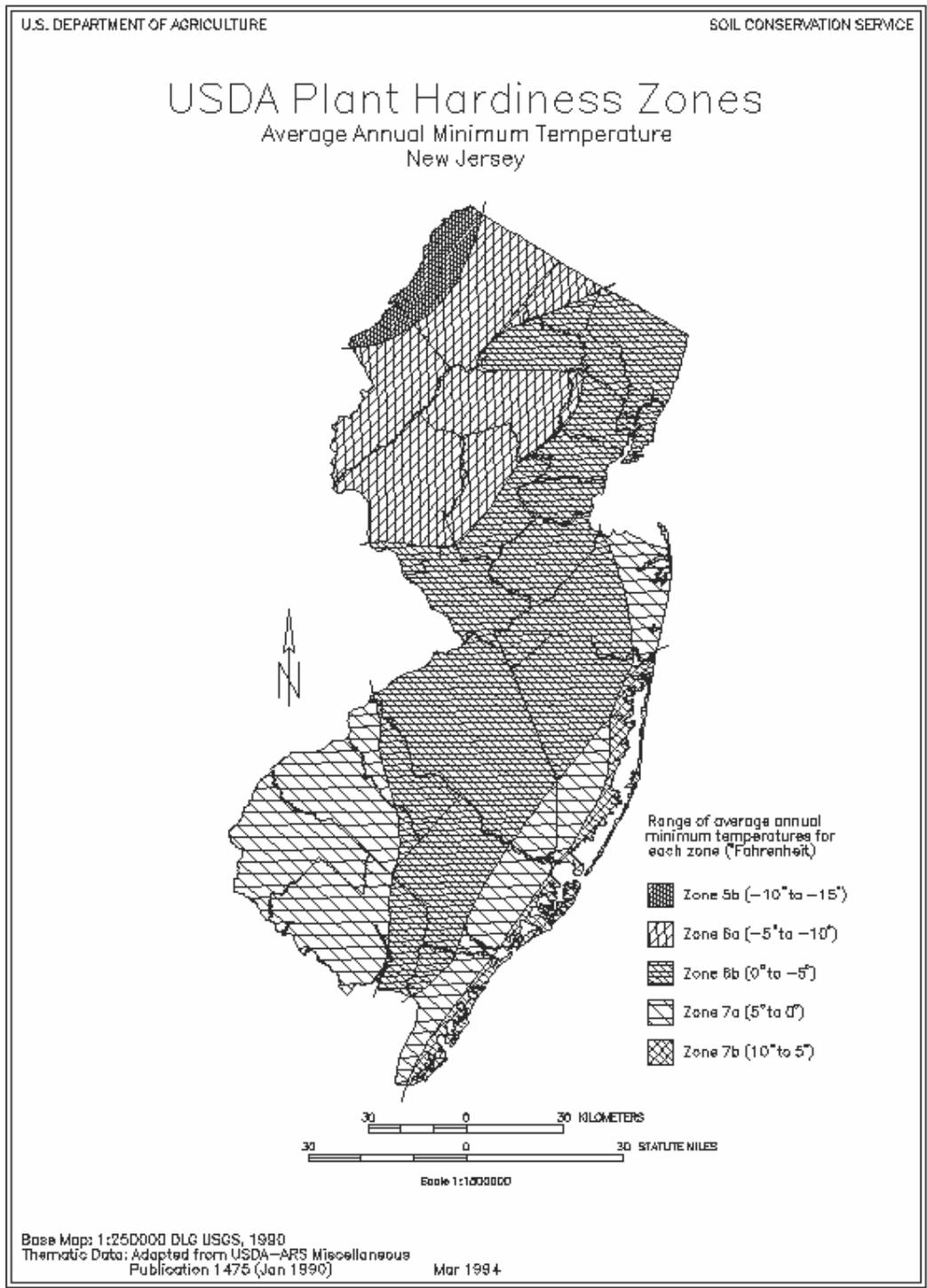


Figure 3

TABLE 1: Recommended Planting Dates in New Jersey ^{1/}			
Type of Plant Material	Plant Hardiness Zones		
	5b and 6a	6b	7a and 7b
Bare-Root Plants ^{2/}	Mar 15 to May 15* Nov. 1 to Dec. 15 ☼	Mar 1 to May 1* Nov. 1 to Dec. 15 ☼	Feb 15 to April 30* Nov. 1 to Dec. 15 ☼
Containerized Stock; Balled-and-Burlapped Stock	Mar 15 to May 31* Oct 15 to Dec 1☼	Mar 1 to May 15* Oct 15 to Dec 15 ☼	Feb 15 to May 5* Nov 1 to Dec 15 ☼

TABLE 1 NOTES:

1. The planting dates listed are averages for each zone. These dates may require adjustment to reflect local conditions, especially near the boundaries of the zones.
2. When planted during the growing season, most of these materials must be purchased and kept in a dormant condition until planting.
 - * These periods may be extended if irrigation is available.
 - ☼ Frequent freezing and thawing of wet soils may result in frost-heaving of materials planted in late fall, if plants have not sufficiently rooted in place. Large containerized and balled-and-burlapped stock may be planted into the winter months as long as the ground is not frozen and soil moisture is adequate.

TABLE 2: Recommended Spacing Within and Between Rows ^{1/}					
Plant Type	Spacing (feet) Within Rows for:				Spacing (feet) Between Rows for:
	Protection from Wind and Wind-borne Odors, Particulates, Chemicals, Snow		Noise Screens and Visual Screens		All Purposes
	<i>Single Row</i>	<i>Multiple Rows</i>	<i>Single Row</i>	<i>Multiple Rows</i>	
Shrubs	3 - 5	3 - 6	2 - 4	2 - 5	10 - 20
Deciduous Trees	8 - 12	10 - 18	5 - 8	8 - 10	10 - 20
Evergreen Trees (columnar form)	5 - 8	6 - 10	3 - 5	4 - 8	10 - 20
Evergreen Trees (conical & broad forms)	8 - 12	8 - 16	4 - 6	6 - 10	10 - 20

TABLE 2 NOTE:

1. Use spacings at or near the lower end of the range to create a dense barrier in a shorter period of time.

TABLE 3: Selected List of Trees and Shrubs for Windbreak/Shelterbelt Plantings							
Plant Names	Plant Hardiness Zones ^{1/}	Geographic Distribution in New Jersey ^{1/}	New Jersey Native Species	Soil Drainage Class ^{2/}	Average Height at 20 Years	Growth Rate	Remarks
DECIDUOUS TREES							
ASH, GREEN <i>Fraxinus pennsylvanica</i>	All	All but outer Coastal Plain	Yes	SP -P	35 ft.	Moderate	Naturally occurring on streambanks and floodplains.
ASH, WHITE <i>Fraxinus Americana</i>	All	All but outer Coastal Plain	Yes	W - SP	35 ft.	Moderate	Attractive fall color (yellow to maroon).
BASSWOOD <i>Tilia Americana</i>	5b, 6a, 6b	Mostly North Jersey	Yes	W - SP	40 ft.	Fast	Prefers wet sites. Bees and insects love it.
BIRCH, RIVER <i>Betula nigra</i>	All	Statewide	Yes	W - P	30 ft.	Fast	Naturally occurring on streambanks and floodplains. Unique peeling reddish bark. Attractive for landscaping.
BLACKGUM <i>Nyssa sylvatica</i>	All	Statewide.	Yes	W - P	30 ft.	Moderate	Foliage turns bright red in early fall.
EASTERN COTTONWOOD <i>Populus deltoides</i>	All	Along the Delaware River and the coast	Yes	W – SP	60 ft.	Very fast	Fast growth.
HACKEBERRY <i>Celtis occidentalis</i>	All	Statewide, except for the Pine Barrens	Yes	W – SP	20 ft.	Slow to moderate	Hardy, yellow fall color
HYBRID POPLAR <i>Populus spp.</i>	All	Some species not native to New Jersey	Yes/No	W – SP	60 ft.	Very Fast	Fast Growth. Use for biomass production.
MAPLE, RED <i>Acer rubrum</i>	All	Statewide.	Yes	W - P	35 ft.	Fast	Red fall color and blooms.

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DECIDUOUS TREES (continued)							
OAK, PIN ^{3/} <i>Quercus palustris</i>	All	Statewide, except for Pine Barrens	Yes	MW - P	35 ft.	Fast	Bronze or red fall foliage. Widely planted as an ornamental. Produces small acorns.
OAK, NORTHERN RED ³ <i>Quercus rubra</i>	All	Mostly Piedmont & North Jersey. Uncommon on Coastal Plain.	Yes	W - SP	40 ft.	Fast	Excellent red fall color. Tolerates urban conditions; perhaps the fastest-growing oak for landscapes.
OAK, SAWTOOTH ³ <i>Quercus acutissima</i>	All	Introduced; not native to U.S.	No	W - SP	60 ft.	Fast	Native to eastern Asia. Good shade tree. Tolerates adverse conditions.
OAK, SCARLET <i>Quercus coccinea</i>	All	Statewide	Yes	W - SP	45 ft.	Fast	Excellent red fall color. Tolerates poor, dry soil.
OAK, SWAMP WHITE <i>Quercus bicolor</i>	All	Mostly Coastal Plain; infrequent elsewhere.	Yes	SP - P	30 ft.	Fast	Good choice for wet sites. Requires acid soils.
OAK, WHITE <i>Quercus alba</i>	All	Statewide.	Yes	W - SP	35 ft.	Slow	Variable fall color, stately tree.
OAK, WILLOW <i>Quercus phellos</i>	6b, 7a, 7b	Mostly Coastal Plain; infrequent elsewhere.	Yes	MW - P	30 ft.	Fast	Frequently used as an ornamental planting. Produces small acorns. Red fall color.

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DECIDUOUS TREES (continued)							
POPLAR, TULIP <i>Liriodendron tulipifera</i>	All	Statewide.	Yes	W - SP	50 ft.	Fast	Flowers produce abundant nectar, much used by bees. Dropped flowers and fruits can be messy. Tends to be weak-wooded, not recommended near buildings. Disease resistant.
SWEETGUM <i>Liquidambar styraciflua</i>	6b, 7a, 7b	Mostly Coastal Plain; infrequent elsewhere.	Yes	MW - P	40 ft.	Fast	Excellent yellow-red fall color. Widely planted as an ornamental. Fallen seed heads are a nuisance on lawns. Fruitless types are available. Disease resistant.
EVERGREEN TREES							
ARBORVITAE <i>Thuja occidentalis</i>	All	Native to North Jersey	Yes	W - P	25 ft.	Slow	Frequently planted statewide as an ornamental. Prefers moist, well-drained soil, but tolerates a wide range of conditions. Prone to bagworms. Can be planted near poultry house tunnel fans. . May be used for one row windbreaks.
CEDAR, EASTERN RED <i>Juniperus virginiana</i>	All	Throughout state	Yes	W - SP	20 ft.	Slow	Should not be planted near apple orchards; alternate host of cedar-apple rust. Can be planted near poultry house tunnel fans. May be used for one row windbreaks.

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EVERGREEN TREES (continued)							
CYPRESS, LEYLAND <i>X Cupressocyparis leylandii</i>	6a, 6b, 7a, 7b	Introduced; not native to U.S.	No	W - SP	40 ft.	Fast	This is a hybrid of <i>Cupressus macrocarpa</i> and <i>Chamaecyparis nootkatensis</i> . Adaptable to adverse sites; growth is best on good sites. Prone to bagworms, canker, and windthrow. Use in multiple-row plantings to minimize windthrow. Can be planted near poultry house tunnel fans. . May be used for one row windbreaks.
HOLLY, AMERICAN <i>Ilex opaca</i>	6a, 6b, 7a, 7b	Mostly Coastal Plain.	Yes	W - P	20 ft.	Slow	Need male and female plants for fruit production. Shade tolerant. Can be planted near poultry house tunnel fans, but is very slow-growing. May be suitable for use in Row 1 to reduce wind velocity from fans, but should be backed by a fine-leaved evergreen to trap particulates.
PINE, JAPANESE BLACK <i>Pinus thumbergii</i>	All	Introduced; not native to U.S.	No	E - MW	35 ft.	Fast	Salt tolerant. Often planted in seashore communities.
PINE, LOBLOLLY <i>Pinus taeda</i>	6b, 7a, 7b	Native to Cape May, Cumberland, and Salem counties only.	Yes	MW - P	45 ft.	Fast	Self-prunes lower limbs, so best suited in a multiple-row planting.
PINE, PITCH <i>Pinus rigida</i>	All	Throughout the state, but more often found in Pine Barrens	Yes	E - P	30 ft.	Fast	Tolerant of dry, rocky, sandy soils. Mature trees are resistant to fire. Will reproduce from stump sprouts. A pitch/loblolly pine cross available.

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EVERGREEN TREES (continued)							
PINE, WHITE <i>Pinus strobus</i>	All	Throughout the state, but may not be native to Pine Barrens	Yes	W - MW	40 ft.	Fast	Frequently planted statewide as an ornamental. Does not tolerate much pollution. Can be planted near poultry house tunnel fans.
SPRUCE, NORWAY <i>Picea abies</i>	All	Introduced; not native to U.S.	No	W - MW	35 ft.	Fast	Fast growth rate when young, slows down with age. Prefers moderately moist, well-drained soil. Does not tolerate hot, dry, or polluted conditions.
SPRUCE, WHITE <i>Picea glauca</i>	5b, 6a, 6b	Introduced; native to Northern U.S.	No	W - MW	30 ft.	Moderate	Good ornamental and shade tree. Tolerates heat, drought, and wind better than most spruces.
SHRUBS							
ARROWWOOD <i>Viburnum dentatum</i>	All	Statewide.	Yes	W - P	10 ft.	Fast	Suckers freely. White flowers, bluish-black berries.
BAYBERRY, NORTHERN <i>Morella pensylvanica</i> (formerly <i>Myrica pensylvanica</i>)	6b, 7a, 7b	Statewide	Yes	W - SP	10 ft.	Moderate	Need male and female plants for fruit production. Salt tolerant (0-20 ppt.) Suckers to form colonies. Can be planted near poultry house tunnel fans.
BEACHPLUM <i>Prunus maritima</i>	6b, 7a, 7b	Along the coast	Yes	E - SP	12 ft.	Moderate	Does well along the coast
DOGWOOD, REDOSIER <i>Cornus sericea</i>	All	Mostly North Jersey.	Yes	MW - P	8 ft.	Fast	Attractive red stem color. White flowers and fruit.

SHRUBS (Continued)							
DOGWOOD, SILKY <i>Cornus amomum</i>	All	Statewide, though rarely in the pine barrens	Yes	MW - P	10 ft.	Fast	Produces fruit at 3-5 years of age. White flowers with blue berries. Prefers some shade.
LESPEDEZA, SHRUB <i>Lespedeza bicolor</i>	6b, 7a, 7b	Introduced; not native to U.S.	No	E - SP	8 ft.	Fast	Perennial semi-woody legume. Cut back periodically to maintain dense, shrubby growth. May become weedy in some habitats and may displace desirable vegetation if not properly managed. Does not tolerate shade or wet soils.
WAXMYRTLE, SOUTHERN <i>Myrica cerifera</i>	7a, 7b	Coastal Plain.	Yes	W - SP	10 ft.	Moderate	Need male and female plants for fruit production. Salt tolerant (0-10 ppt). Can be planted near poultry house tunnel fans.

TABLE 3 NOTES:

1. The **Plant Hardiness Zones** designate where a species can be successfully planted in New Jersey, while the **Geographic Distribution** describes where the species usually occurs under natural conditions.
2. **Soil Drainage Class** (refer to the county soil survey for further information):
E - Excessively Drained; W - Well Drained; MW - Moderately Well Drained; SP - Somewhat Poorly Drained; P - Poorly Drained.
3. **Oaks** are susceptible to Gypsy Moths and Bacterial Leaf Scorch.