“Windbreak Design”

United States Department of Agriculture

Natural Resources Conservation Service

Windbreak / Shelterbelt

Definition:

Plantings of single or multiple rows of trees or shrubs that are established for one or more environmental purposes.

Practice Purposes*

- Reduce soil erosion from wind
- Protect plants from wind related damage
- Alter microenvironment for enhancing plant growth
- Manage snow
- Provide shelter for structures, livestock, and recreational areas
- Enhance wildlife habitat by providing travel corridors
- Provide living noise screens
- Provide living visual screens
- Provide living barriers against airborne chemical drift
- Delineate property and field boundaries
- Improve irrigation efficiency
- Enhance aesthetics
- Increase carbon storage

*Source: NRCS National Standard 380

Design Elements

- **Orientation (location and layout)**
- **Species**
- **Height**
- **Density**
- **Width (number of rows)**
- **Length**
- **Management**
- **Operation and maintenance**
- **Limitations**

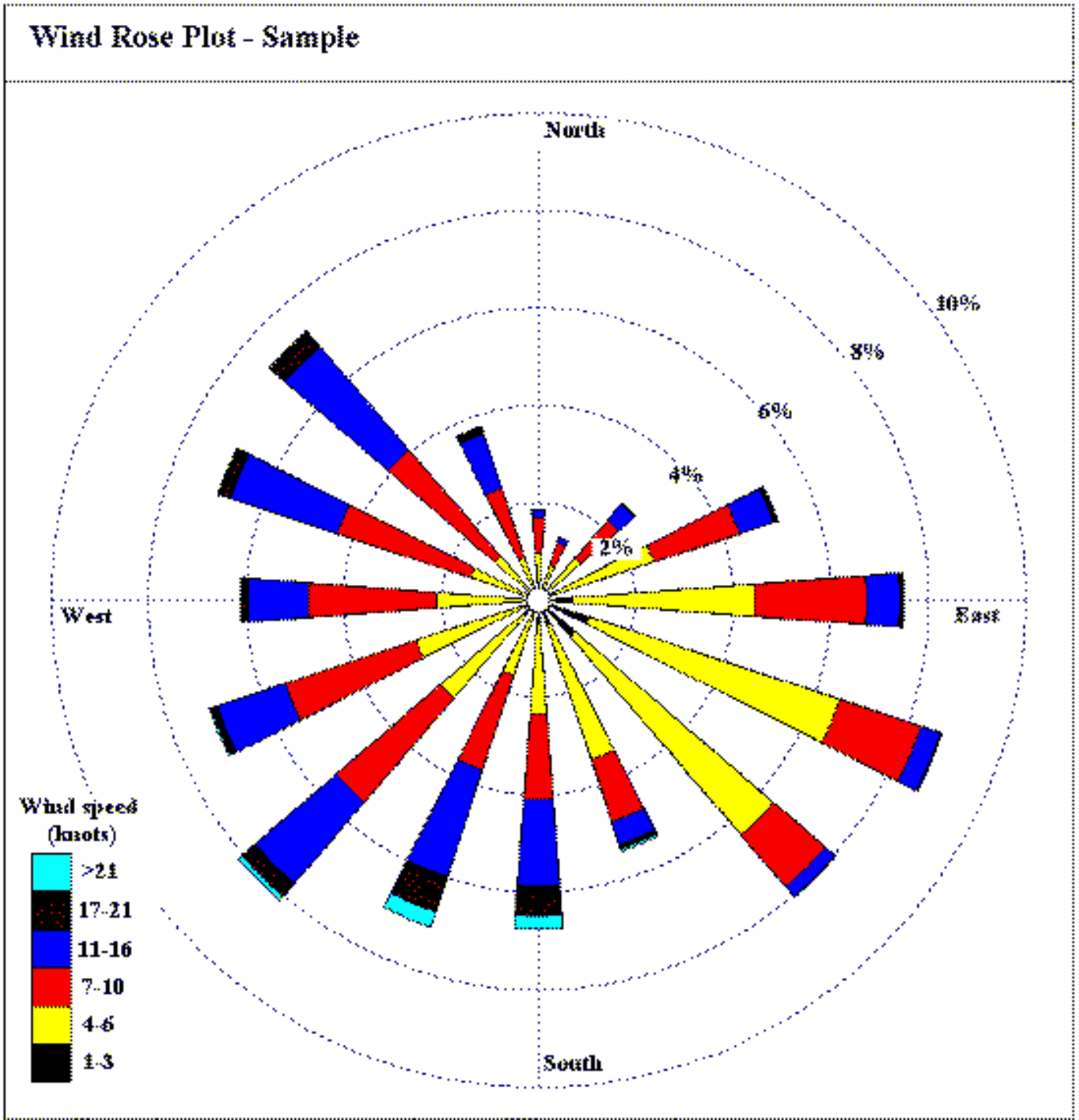
Criteria for elements vary by purpose

What are the defined purposes for windbreak or shelterbelt?

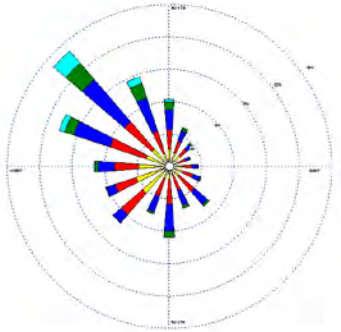
Determining Wind Direction

Wind Roses

Reading a Wind Rose



Sioux Falls, South Dakota - Wind Roses



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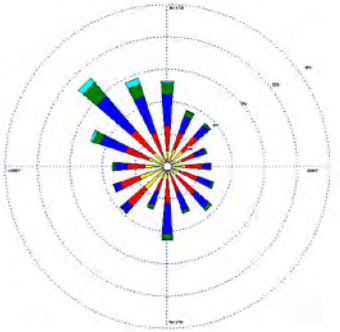

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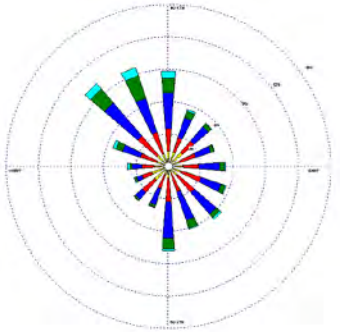

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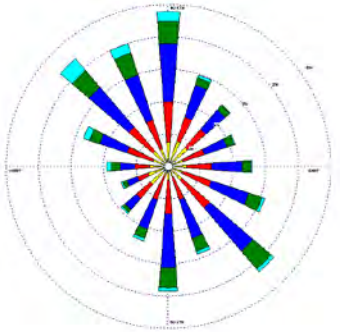

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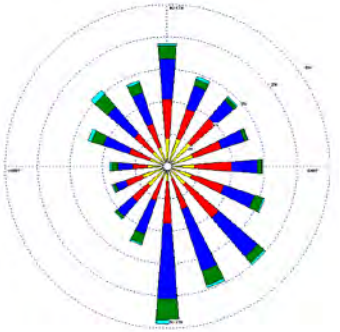

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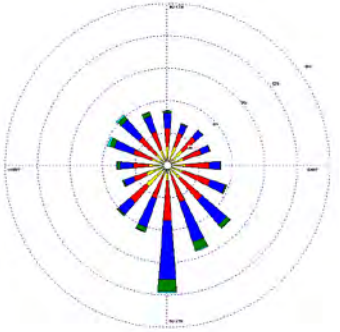

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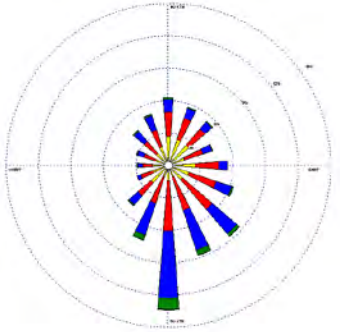

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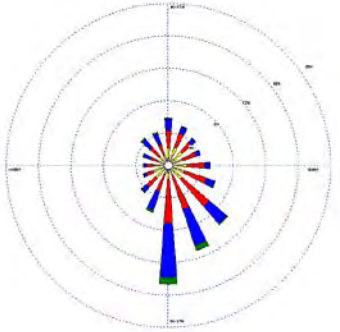

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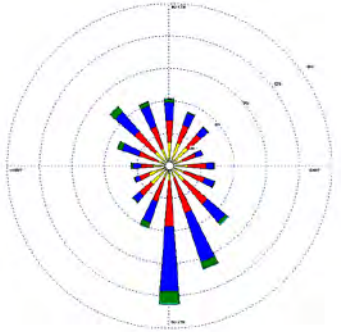

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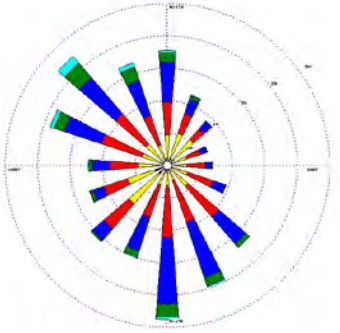

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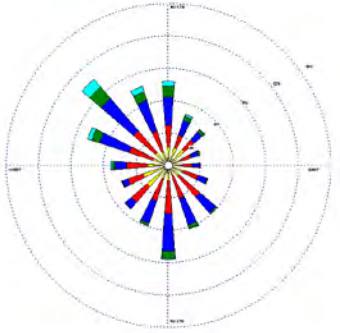
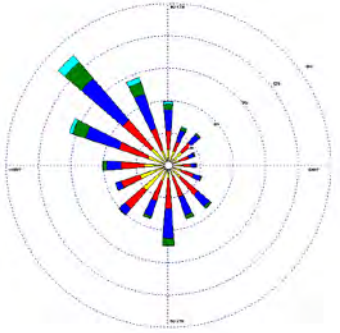


November



December

Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

Element: Orientation (location / layout)

Location!

Location!!

Location!!!

Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

Element: Orientation (location / layout)

Perpendicular to damaging winds during the critical periods;

Identification of damaging winds is a critical first step. Data from local weather stations, climate data bases and landowner observations are all information sources. Account for changes in wind direction during different critical periods. For example:

- **Wind erosive winds - West**
- **Crop drying winds - South**

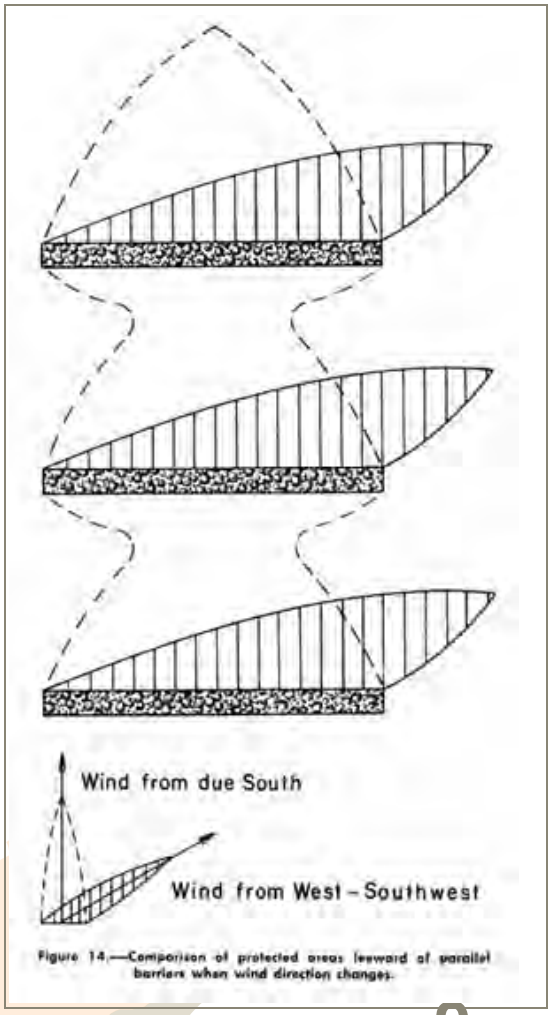


Figure 14.—Comparison of protected areas leeward of parallel barriers when wind direction changes.

Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

Element: Orientation (location / layout)

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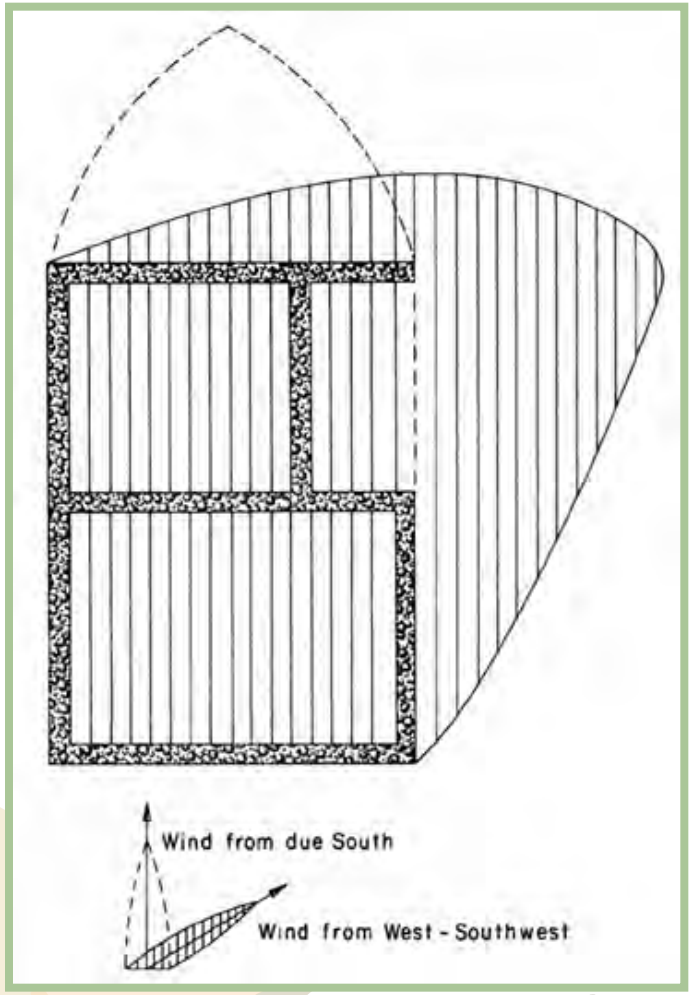
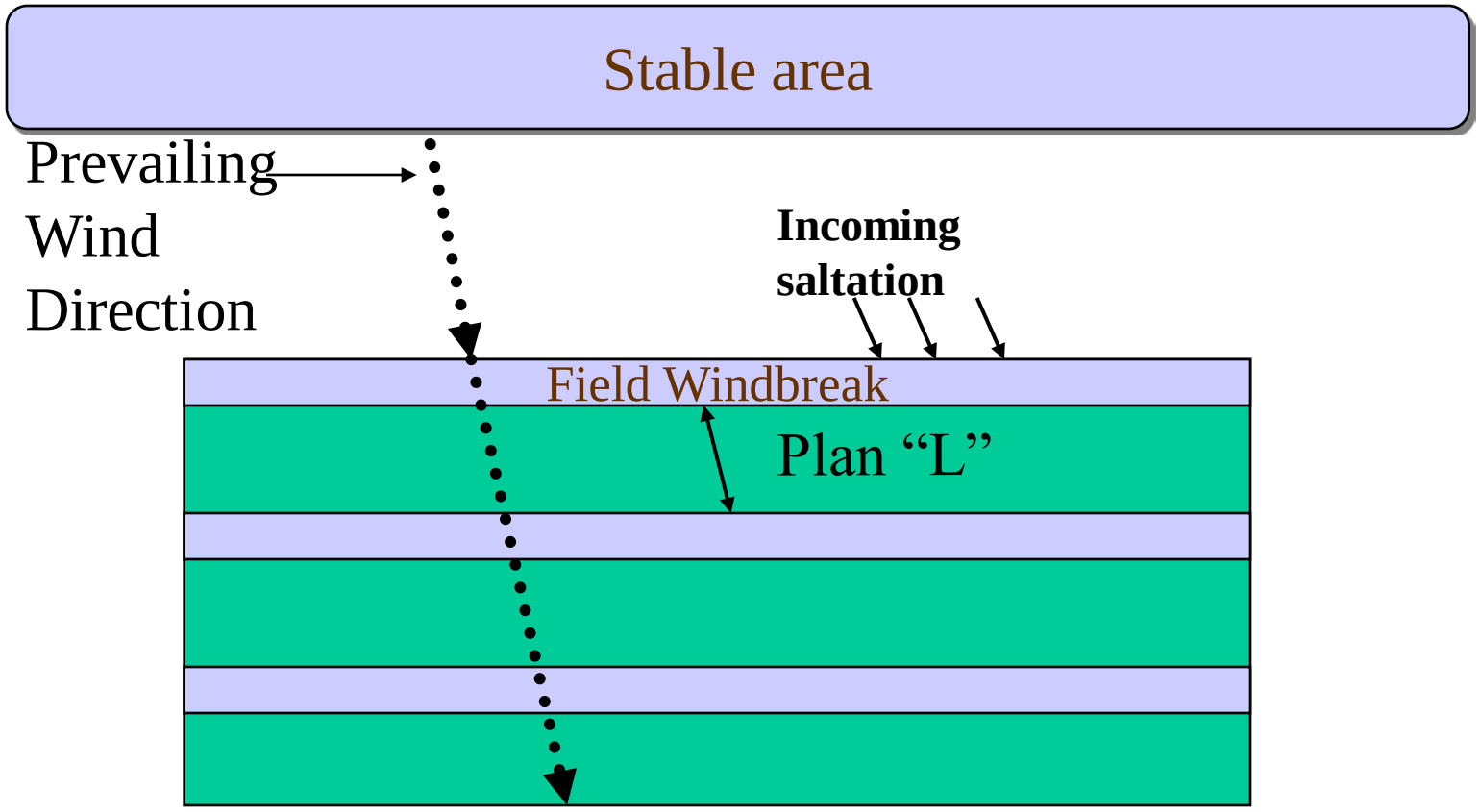


Windbreak Orientation

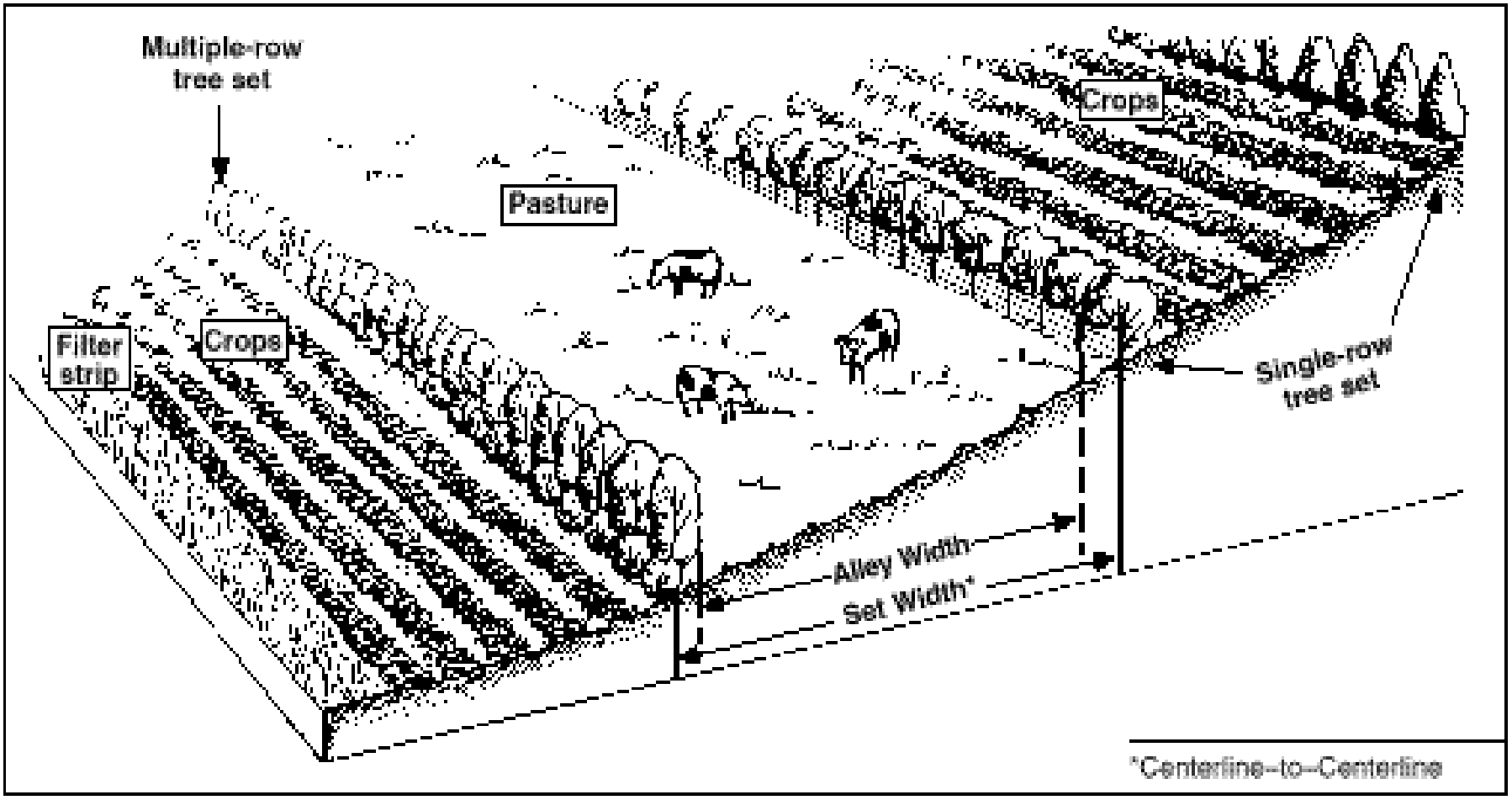
- Orient windbreaks perpendicular to troublesome winds
- Plan multiple windbreaks for whole field protection

Windbreak Design - Field



Protecting the Entire Field

Alley Cropping - Design



Alley width depends on purpose, tree canopy, crop sensitivity, crop rotation, crop or forage grown.

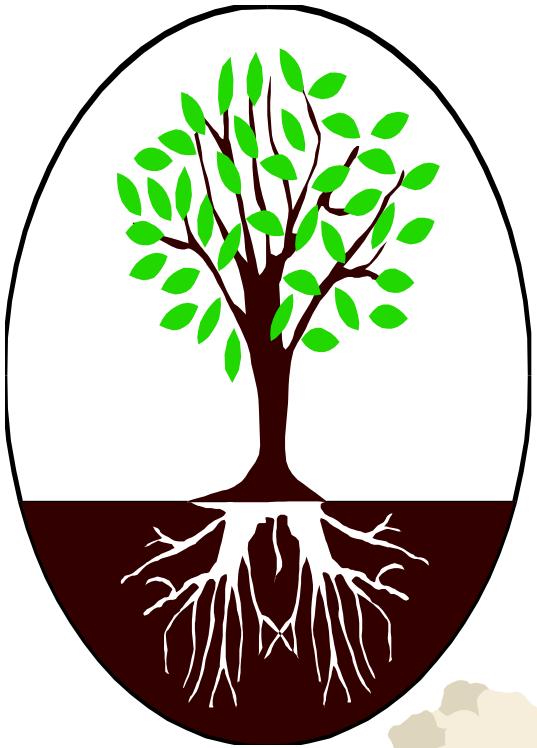
Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

Element: Species

Optimal branching/foliage density during growing season; Match height to achieve desired protected area; 40-60% density;

Species selection must be based on the soil and climate conditions of the site. Choose species foliage and branching characteristics that will achieve the desired protection during the critical periods.

Plant Materials - Trees



Desirable Characteristics:

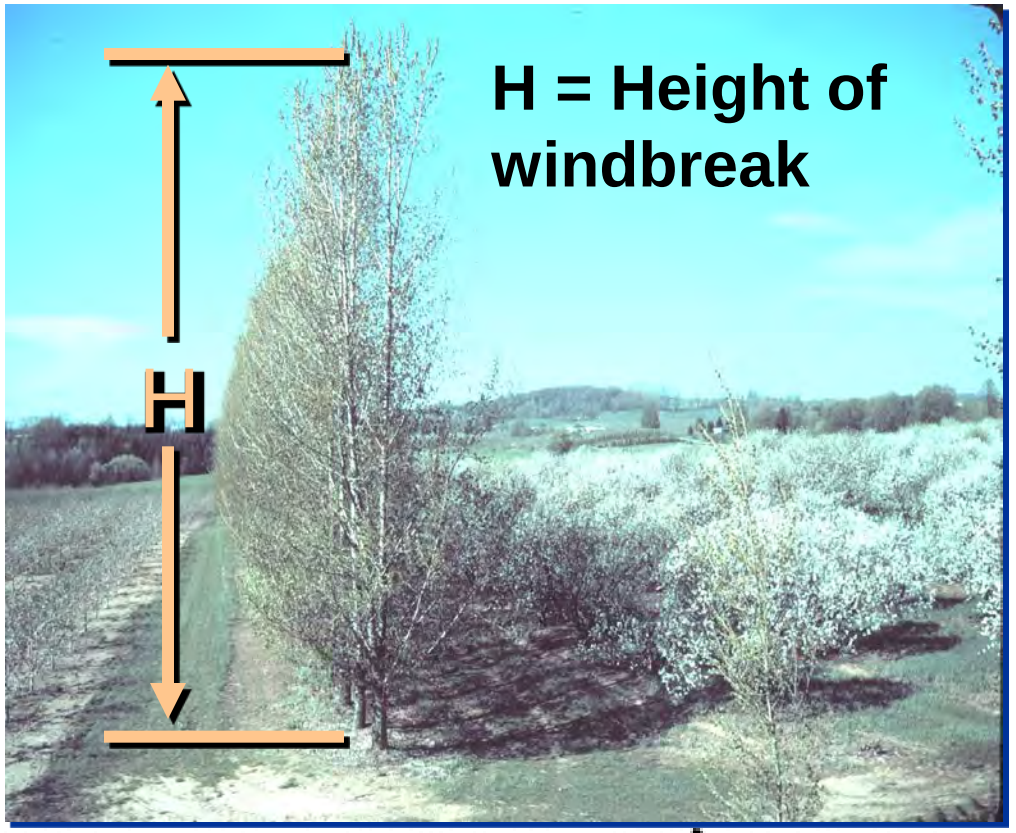
- Produce high-value product(s)
- Yields annual or periodic commercial product
- Relatively fast growing
- Appropriate shade for companion crop
- Adapted to site and soils
- Minimal roots at soil surface
- Provides additional wildlife habitat to the site

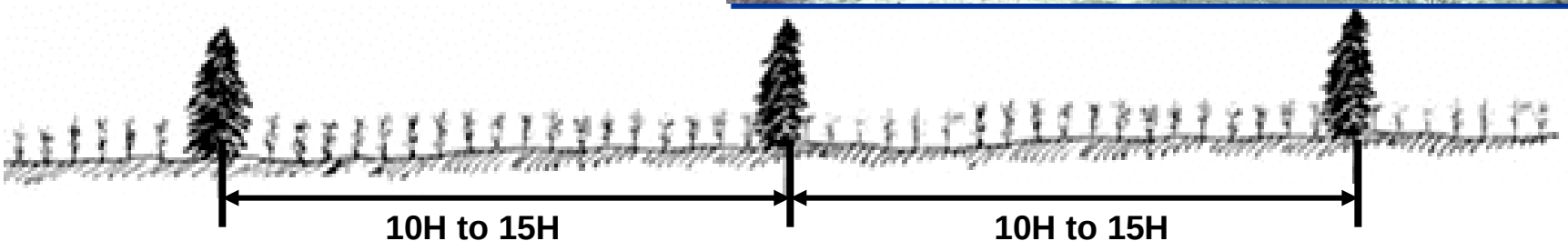
Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

Element: Height

Match height to achieve desired protected area

The height determines the distance of the sheltered zone. For example, select the tallest trees suited to the site for large fields and fewest windbreaks.





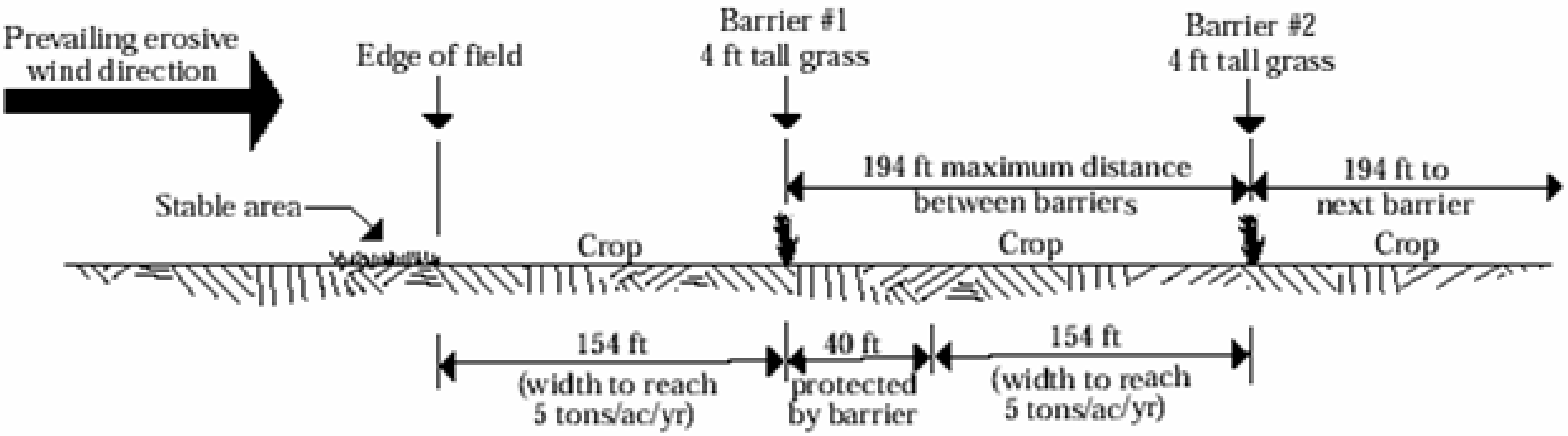
Windbreak Spacing - Erosion

Element: Barrier direction and spacing

Spacing

Do not exceed ten times the expected height of the barrier.

Also, consider the width of farm machinery,



next

Windbreak Spacing - Erosion

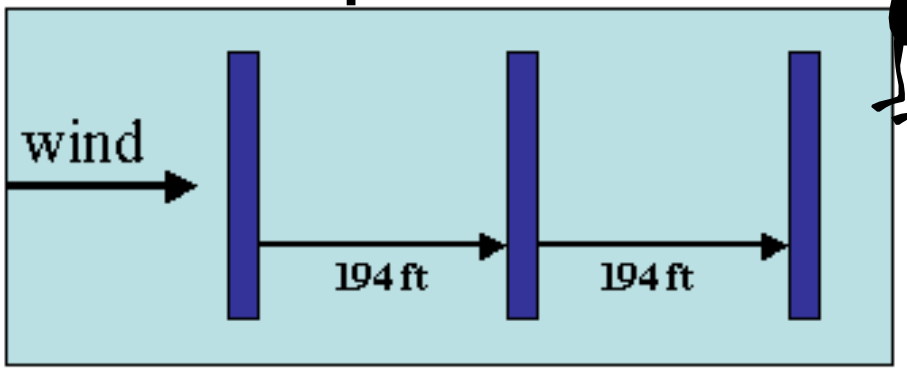
Element: Barrier direction and spacing

Direction

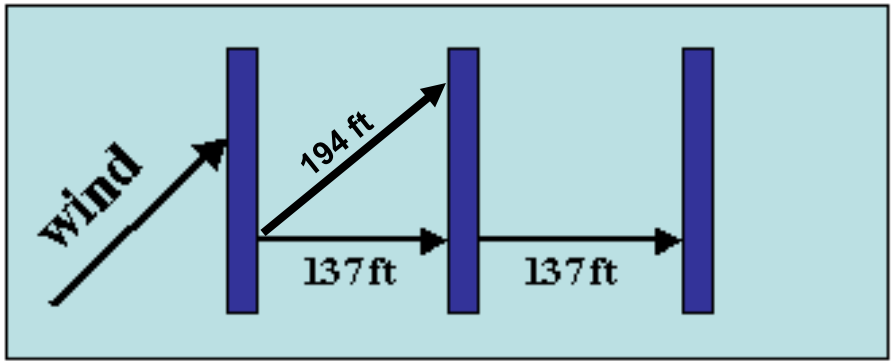
Orientation perpendicular to the prevailing wind erosion direction is best.

The more the barriers deviate from perpendicular to the prevailing wind erosion direction, the closer they must be spaced.

Perpendicular



Deviation



Building a Buffer System

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Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

Element: Density

Optimal branching/foliage density during growing season; 40-60% density;

Choose species foliage and branching characteristics that will achieve the desired density during the critical protection periods. Spacing of the plants will determine the eventual density of the windbreak. The number of rows will also influence the level of density.

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
% of open wind speed	50%	65%	80%	85%	100%

Open Wind Speed 20 mph
Conifer 40-60% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	6	10	12	15	19
% of open wind speed	30%	50%	60%	75%	95%

Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

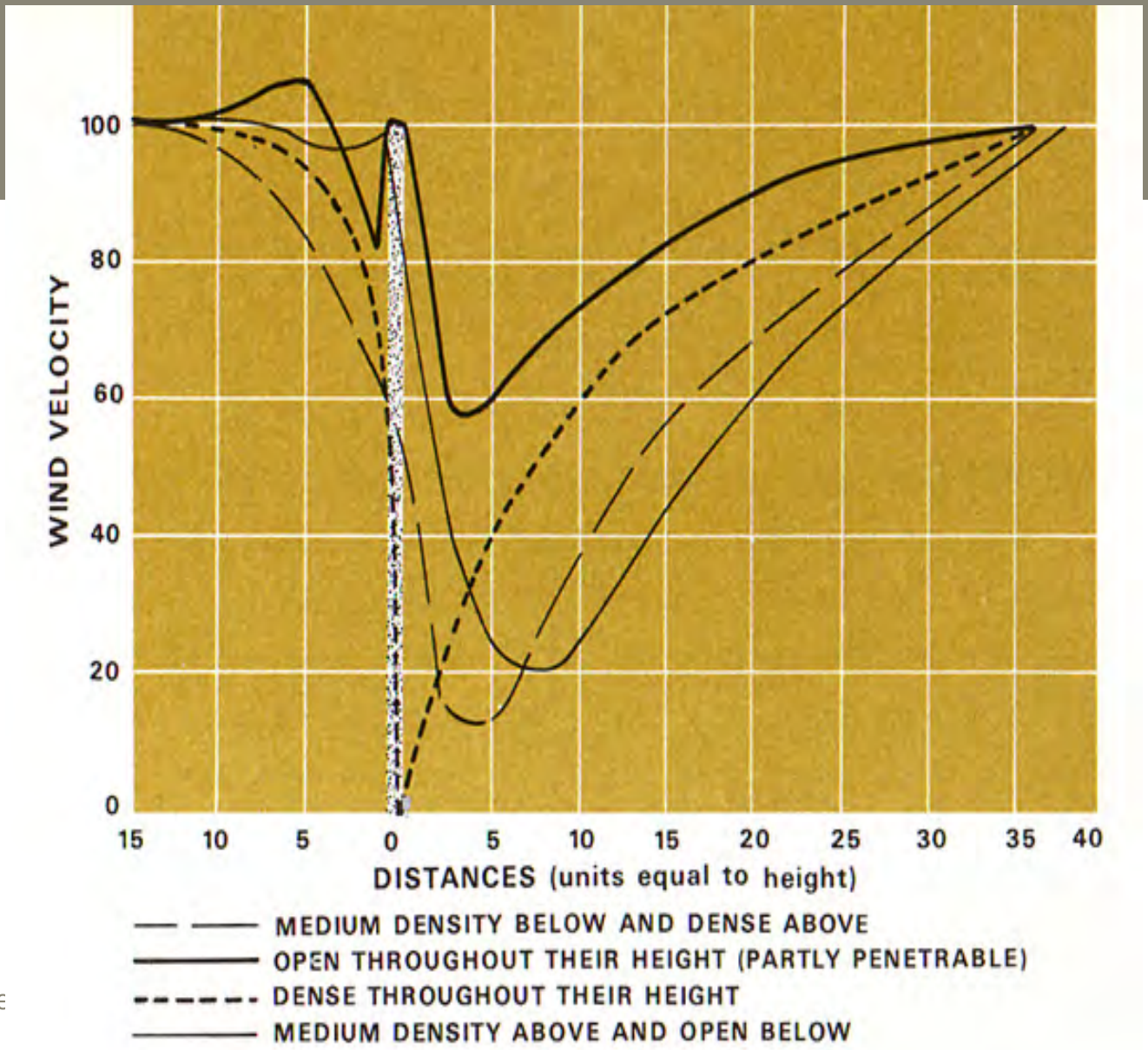
Element: Density

Optimal branching/foliage density during growing season; 40-60% density;

Choose species foliage and branching characteristics that will achieve the desired density during the critical protection periods. The width of the planting and the spacing of the individual plants will determine the eventual density of the windbreak.

Element: Density

Optimal branching/foliage density during growing season; 40-60% density;

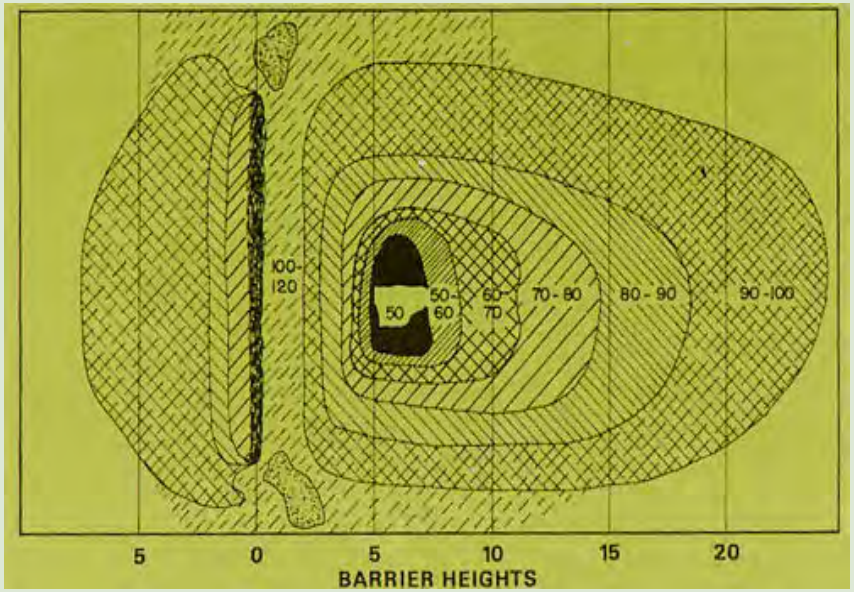


Purpose: Protect soils and plants, enhance the microenvironment & improve irrigation efficiency

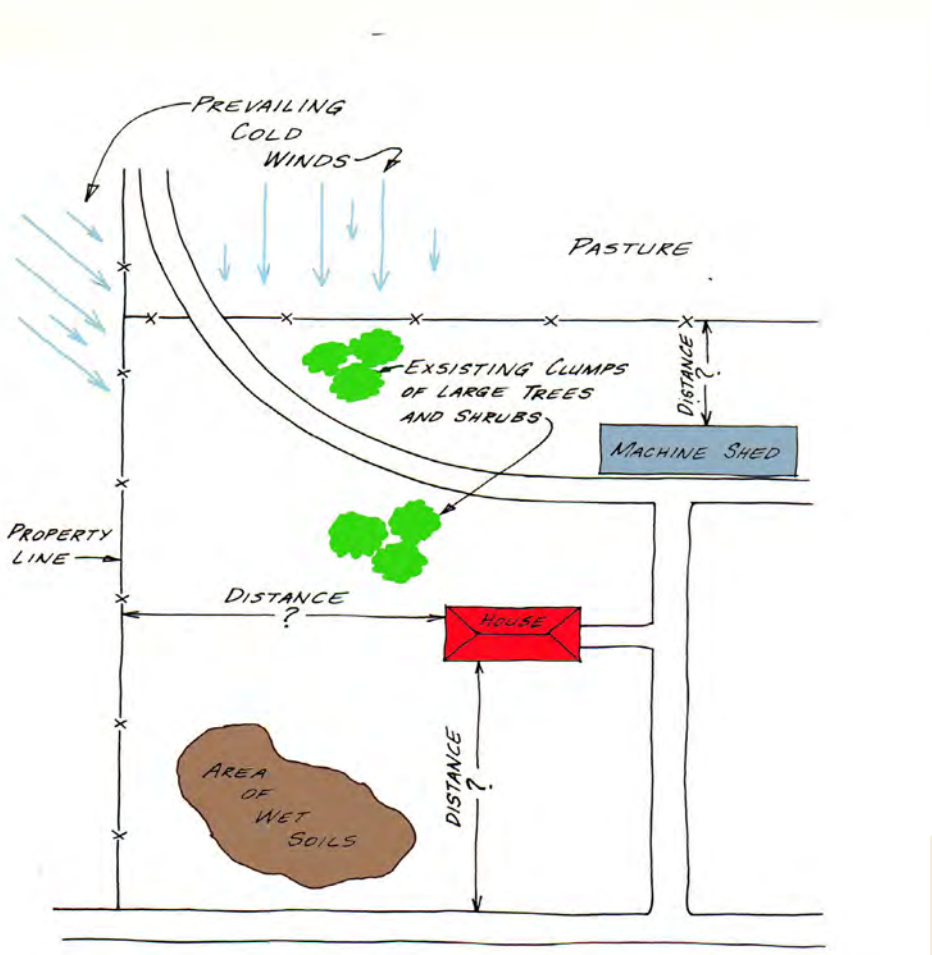
Element: Width and Length

One to three rows wide; Length at least 10 times the windbreak height;

To reduce the amount of land occupied by windbreaks, use the narrowest windbreaks that will achieve and maintain the target density. For full protection, the windbreak needs to extend the full length of the field needing protection.

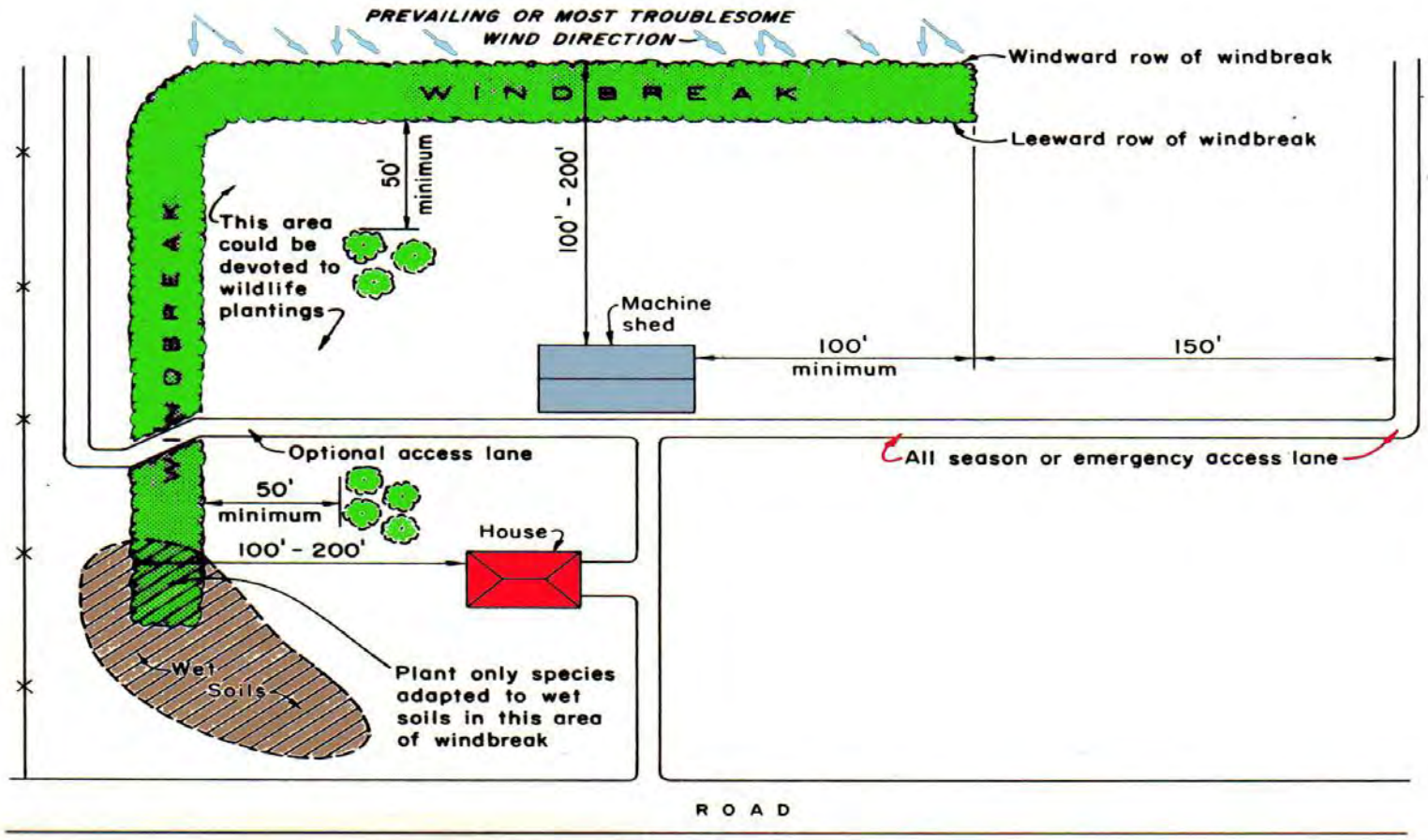


Windbreak Design Example



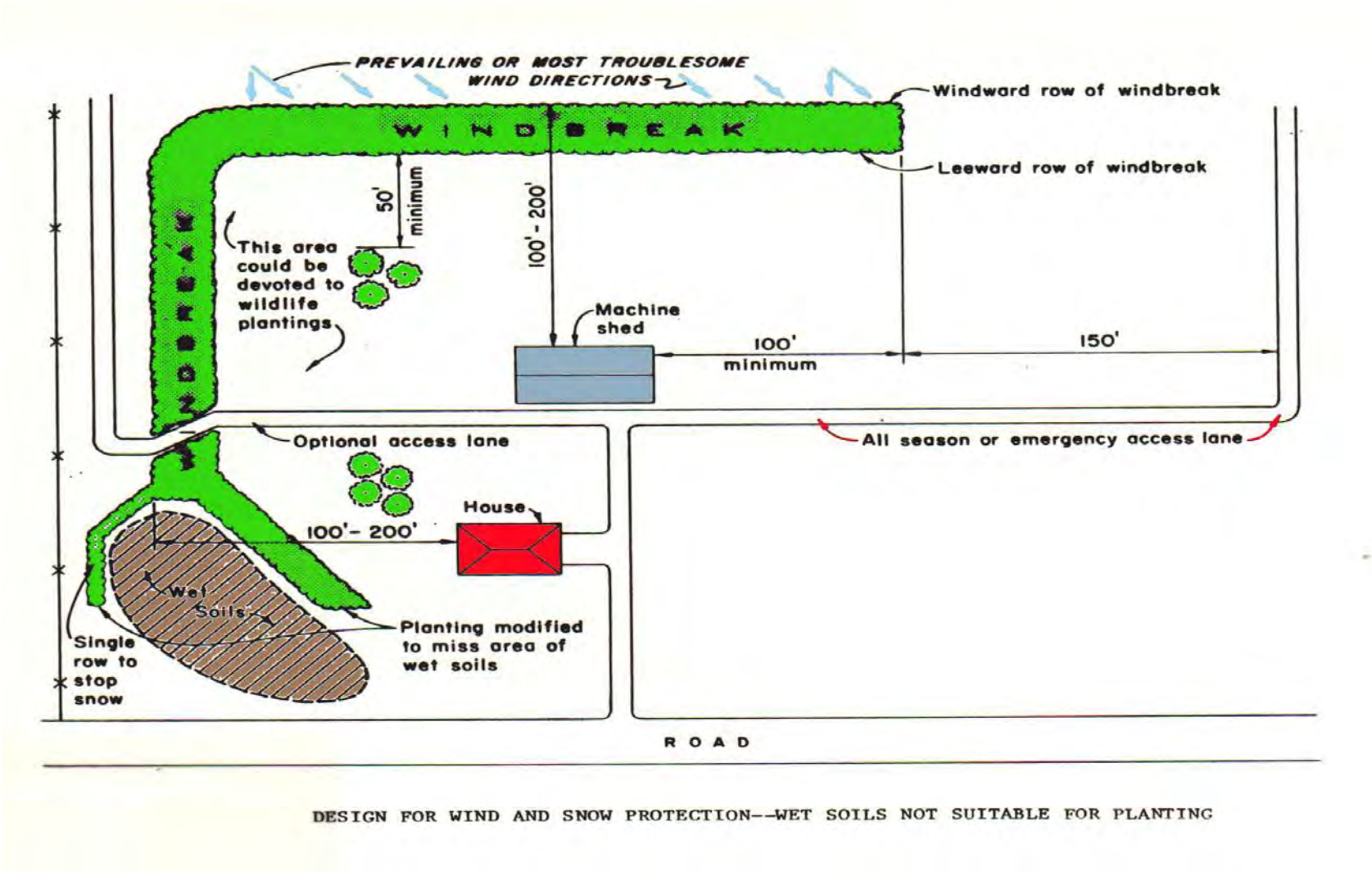
- **How would you place a windbreak for**
  - **Winter wind and snow protection?**
  - **Winter wind protection only?**
- **What are the width, length, and density considerations?**
- **How can the basic windbreak to enhanced for wildlife?**

Windbreak Design Example



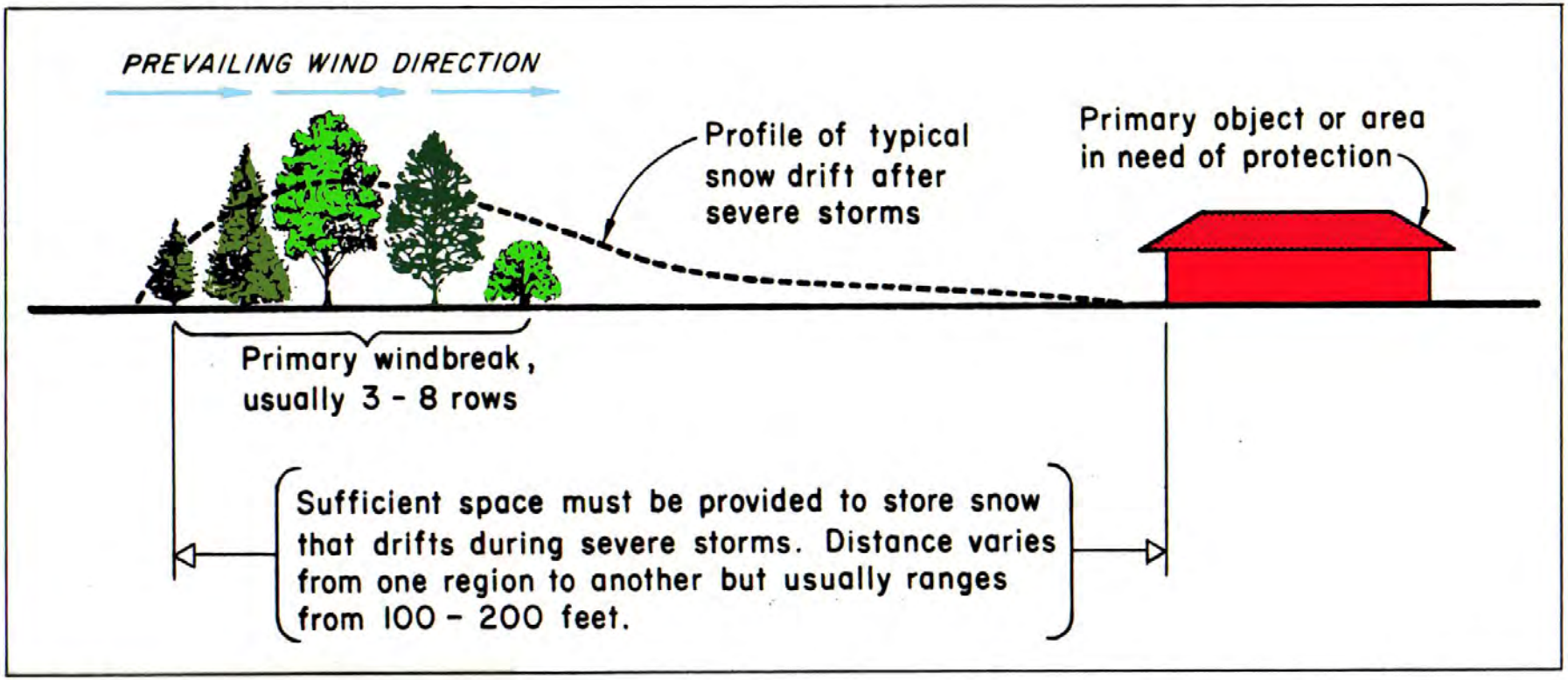
DESIGN FOR WIND AND SNOW PROTECTION--WET SOILS SUITABLE FOR PLANTING

Windbreak Design Example



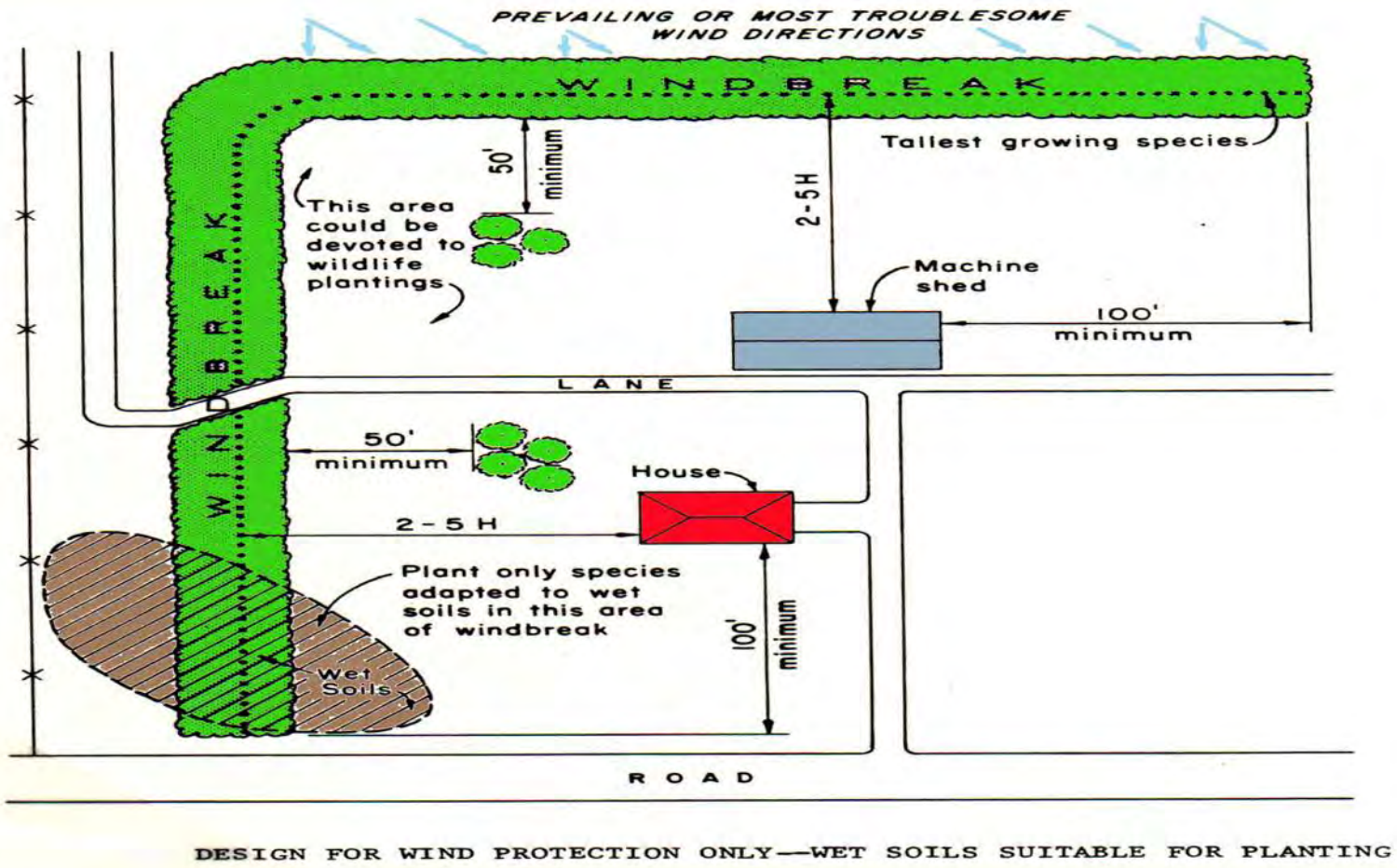
DESIGN FOR WIND AND SNOW PROTECTION--WET SOILS NOT SUITABLE FOR PLANTING

Windbreak Design Example



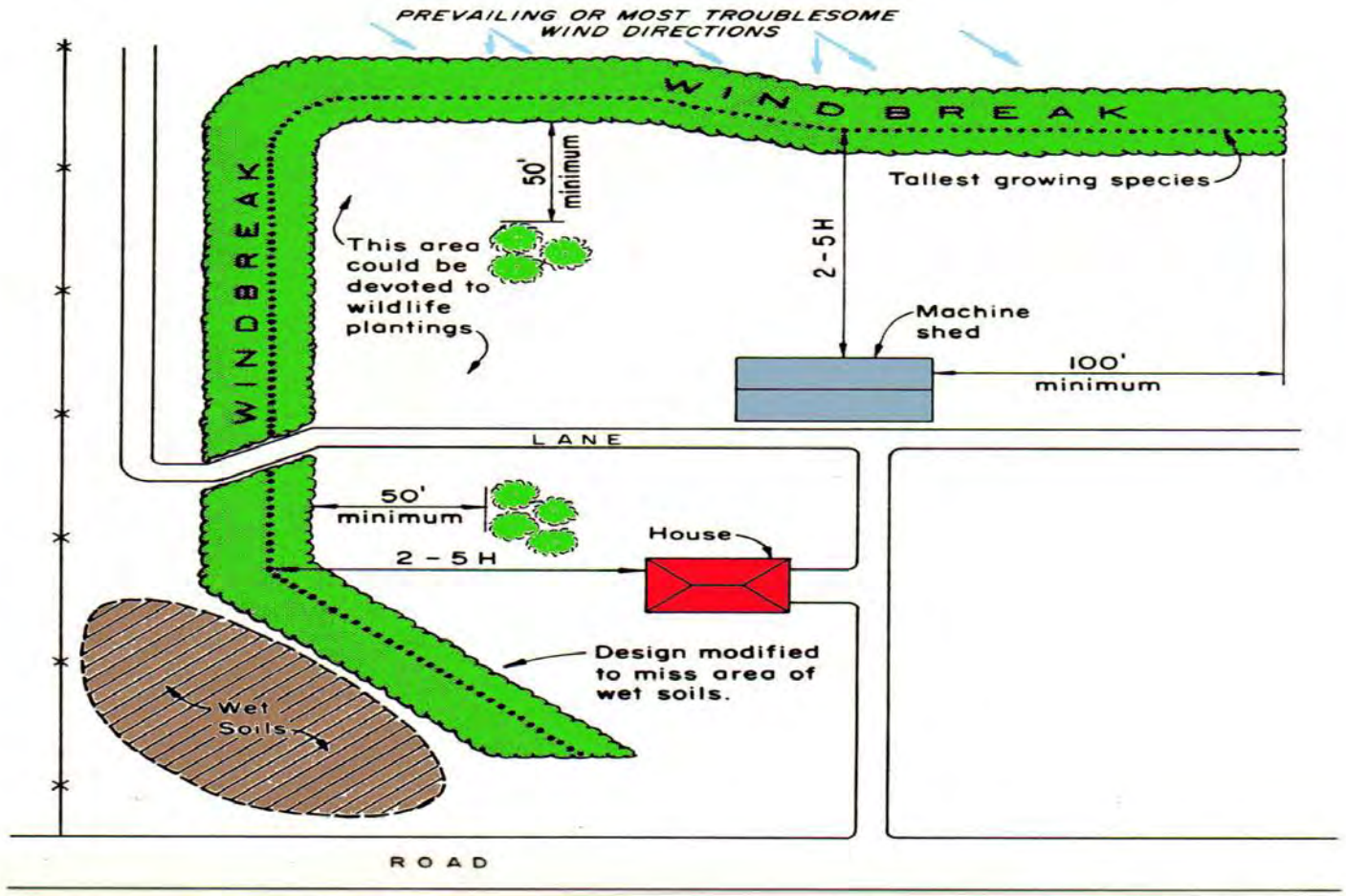
CROSS SECTION OF WINDBREAK FOR FARM - RANCH HEADQUARTERS OR LARGE RESIDENTIAL LOTS -- Wind and Snow Protection

Windbreak Design Example



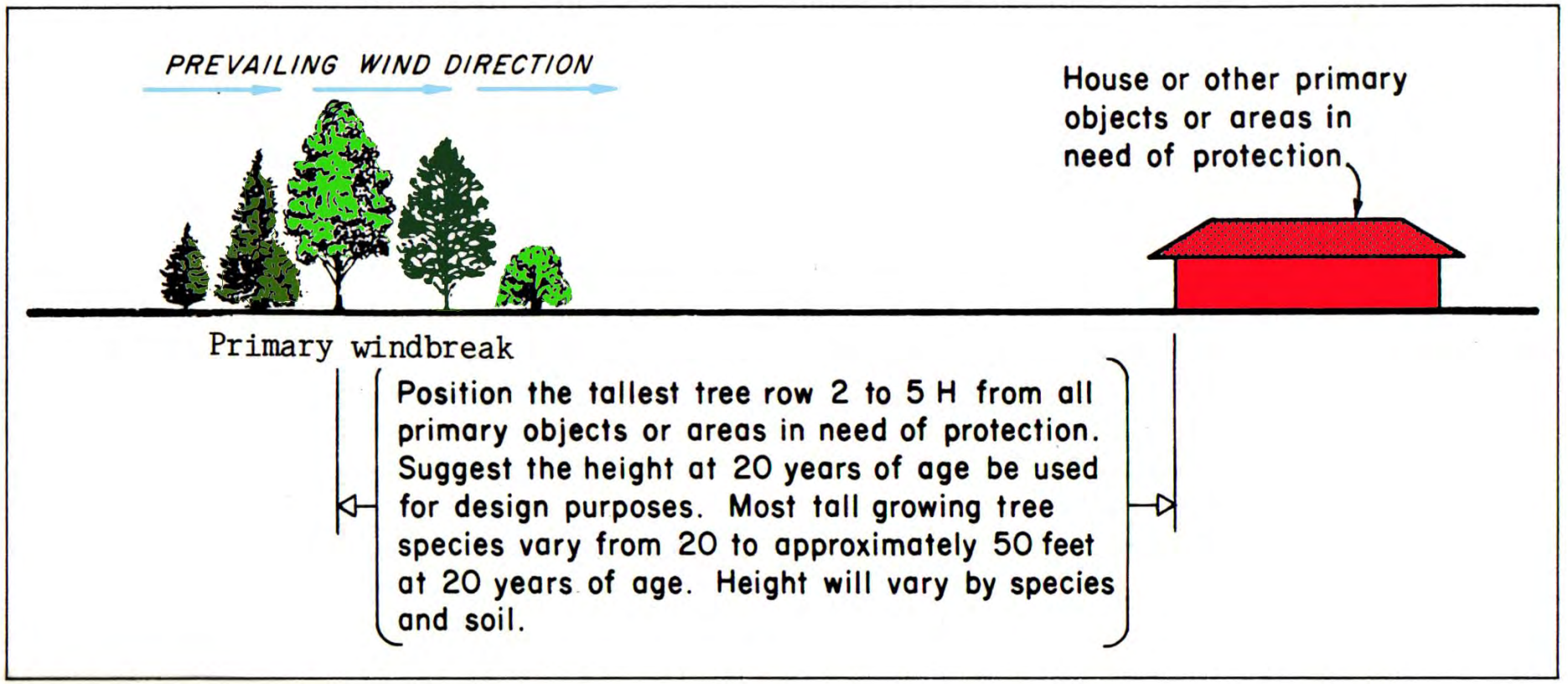
DESIGN FOR WIND PROTECTION ONLY—WET SOILS SUITABLE FOR PLANTING

Windbreak Design Example



Design for wind protection only--wet soils unsuitable for planting.

Windbreak Design Example



CROSS SECTION OF WINDBREAK FOR FARM - RANCH HEADQUARTERS OR LARGE RESIDENTIAL LOTS -- Wind Protection Only

Windbreak Design Example

Wildlife Enhancement