NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

LIVESTOCK SHELTER STRUCTURE

(No.)

Code 576

I. DEFINITION

A permanent or portable structure with less than four walls and/or a roof to provide for improved utilization of pastureland and rangeland and to shelter livestock from negative environmental factors. This structure is not to be construed to be a building.

II. PURPOSE

- To provide protection for livestock from excessive wind, cold, or snow.
- Protect surface waters from nutrient and pathogen loading.
- Protect wooded areas from accelerated erosion and excessive nutrient deposition by providing alternative livestock shelter location.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice is applied to provide protection to sensitive areas by providing a source of shelter that is located away from: the existing shelter in wooded areas, on stream banks or depressions, **and rangeland**. **Livestock shelter structures used for this purpose** must be used in conjunction with exclusion of animals from the sensitive area. Use a livestock exclusion practice NRCS Conservation Practice (CPS) Fence (Code 382).

This practice is applicable where animal productivity and well-being are adversely affected by negative environmental conditions such as direct and unimpeded wind or snow.

This practice is not applicable on winter feeding areas identified as having a high Phosphorous Index in the Nutrient Management Plan.

A permanent structure is applicable when:

- **wind/snow protection is necessary for livestock in confined animal feeding operations.**

A portable structure is applicable when:

- **wind protection is necessary to support a managed grazing system. The managed grazing system may include annual crop residues, standing cover crop combinations, swathed warm season forages, or other stockpiled standing perennial or annual forage.**
- **wind protection is necessary for livestock that are winter feeding mechanically harvested feeds (bale grazing, bale feedings, bale processors, feed wagons, etc.) on cropland, hayland, or tame pastureland.**

IV. CRITERIA

A. GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

1. Location

Locate the structure to avoid adverse effects to cultural resources and endangered, threatened, and candidate species and their habitat. **Livestock shall be excluded from riparian areas and rangeland.**

Select upland locations that are away from riparian areas and concentrated flow areas to avoid impairment of water quality. **Select locations to avoid runoff water directly entering into sensitive surface and sub-surface water bodies including pothole wetlands.** Locate structures a minimum of 100 feet from any surface water bodies, 150 feet from an up-gradient well and 300 feet from a down-gradient well. Select location(s) that will not have surface water flow through the structure, **including during snow melt**.

Potential wintering sites could include any of the following, alone or in combination: annual crop residues, standing cover crop combinations, swathed warm season forages, bale grazing (usually on hayland or tame pastureland), bale feeding (rolling the bale out so a greater acreage is covered than would be provided by bale grazing, also usually on hayland or tame pastureland)

Locate shelters perpendicular to the prevailing winter winds, where possible. See Figure 1. The site must be accessible by vehicle or equipment.

Figure 1 – Typical Wind Shelter Structure

Locate the shelter on level, uninterrupted terrain, if possible. If the shelter must be located downwind of a hill, place the shelter as far downwind as possible. A shelter upwind of a hill shall be placed a minimum of 75 times the shelter height upwind of the base of the hill.

Ensure obstacles, such as fences, are not in the snowdrift zone (see Figure 2) to facilitate cattle movement.

2. Erosion and Pollution Protection
Where appropriate, stabilize all areas disturbed by construction with vegetation as soon as possible after construction. Refer to NRCS CPS Critical Area Planting (Code 342). For permanent structures, if vegetation is not appropriate for the site use NRCS CPS Heavy Use Area Protection (Code 561) to stabilize the area.

3. Materials
Construct the structure of durable materials that are commensurate with a minimum structure life of 10 years.

4. Waste Management
Design the structure to facilitate the distribution of manure.

A nutrient management plan (NRCS CPS Nutrient Management Code 590) shall be developed when livestock are winter feeding

mechanically harvested feeds on cropland, hayland, or tame pastureland. Shelter and feeding locations shall not be located in areas identified as having a high Phosphorous Index in the Nutrient Management Plan.

The current nutrient status of the winter feeding areas should be considered prior to the implementation of the Livestock Shelter Structure. If nutrient levels on the planned feeding areas are a concern, a current soil test should be utilized to determine if the feeding area is suitable.

5. **Shape and Size**
Shelters shall be a 90^0 "V" shaped, semi-circular shaped, or straight line structures. For optimum protection from wind and drifting snow, a "V" shaped or semicircular structure is recommended.

Shelters that are 90^0 "V" shaped or semi-circular shaped shall be equilateral, having all sides the same length. The shelter opening width (perpendicular to the wind direction) should be no wider than 15 times the shelter height.

"V" Shelters. Construct "V" shaped shelters with a solid face to divert drifting snow around ends of the barrier. Wind speed reduction of 60-80 percent is possible in the protected area extending 5H downwind of the barrier (Figure 2). The V, or closed end, should point in the direction of the winter and early spring prevailing winds. The shelters cause the snow to be diverted around the shelter and deposited in drifts extending five times the shelter width (D) downwind.

Compute the shelter zone area as shown in Figure 2. The shelter structure shall provide a shelter zone area based on the values in Table 1. **If multiple shelters are needed, planner discretion should be used to determine the number and location needed to treat the resource concern.**

Design the shelter dimensions following guidance provided in Tables 1 and 2.

Figure 2 -- Snowdrift Protection from "V" Shaped Structures

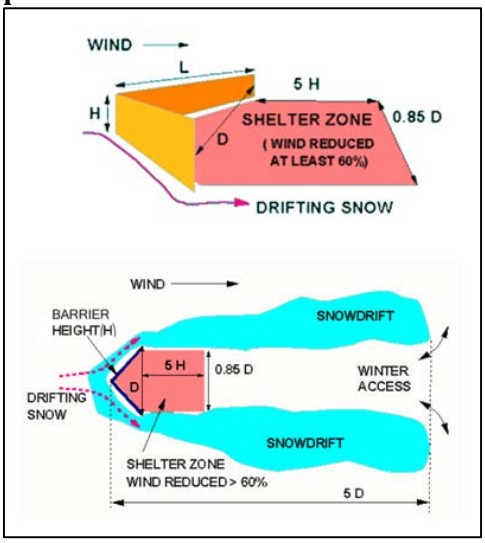

Table 1 – Minimum Wind Shelter Requirements

Animal Type	Minimum Shelter Zone Requirement Area (ft^2/head)
Dairy, beef, or horse	35-50
Swine, sheep, or goat	10-15
Poultry	3 – 7

Table 2 - Protected Area at Maximum Wing Length (See Figure 2)

Barrier height (H), ft.	Wing (L), ft.	Wing (D), ft.	Protected area, ft.^{2}
6	60	84.8	3,964
8	80	113.1	7,047
10	105	148.5	11,823
12	125	176.8	16,828

Semi-circular Shelters. Semi-circular shaped shelters can be built with approximately the same quantity of materials as the "V" design. The ratio of protected area to shelter length is about 27 percent higher than in the "V" shape. Base the dimensions for the semi-circular shaped barrier on a radius equal to one-half D for the "V" shaped barriers as shown in Table 2. Semi-circular shelters are generally the most economical (material cost per square foot); however, the type of material used for board or panels can be a limiting factor due to the shape. The semi-circular shape also tends to be self-bracing.

Straight line shelters. Straight line windbreaks are not as effective as the "V" shaped design since less protection is provided if wind direction varies from anything perpendicular to the fence. They will however provide effective wind protection for up to 15 to 20 times the height of the structure for solid and porous walls. Snow is forced over the fence and deposited downwind of the structure rather than diverted around it.

Porosity

Porous structures should have approximately 80% solid and 20% open area. Porous barriers should be mounted approximately 6-12 inches above the ground to reduce eddy currents (whirlwinds) and allow wind to move snow downwind of the protected area.

6. **Structural Criteria**

A site specific design incorporating a structural analysis based on the wind load requirements contained in this standard, must be provided by a North Dakota Registered Professional Engineer for the structure. North Dakota Standard Drawings 25, 26, or 27 have been developed to provide preapproved design alternatives for permanent and portable shelters.

Boards or panels shall be attached to the windward side of the shelter.

Structural components of both permanent and portable shelters shall be designed for a minimum FOS=1.2 for an 80 mph, 3-second gust.

Portable shelters shall be stable against overturning for a 50 mile per hour (mph), 3-second gust, with a minimum Factor of Safety (FOS) =1.0.

Permanent shelter post embedment designs will meet a minimum FOS=1.2 for an 80 mph, 3-second gust.

Post spacing and depth will require site specific designs based on sustained wind speed and direction **North Dakota Standard Drawing 26 or 27 may be used in lieu of a site specific design.**

Lumber installed within eight inches of the ground must be pressure treated in accordance with ASTM D1760 Standard Specification for Pressure Treatment of Timber products. For facilities that are organic producers or that sell

compost to organic producers, ensure that the treated lumber used in the shelter meets the requirements for organic production. It may be best to have the producer consult with the organic certifier as to the use and acceptability of treated lumber.

B. ADDITIONAL CRITERIA SPECIFIC FOR PORTABLE STRUCTURES

Portable structures shall only be used on cropland, hayland, or pastureland.

Equip the portable structure with a means to facilitate transport **(e.g. lifting bar)**. Provide lateral support to vertical and horizontal structural members to prevent twisting and/or buckling.

A management plan shall be developed prescribing how often to move the structure and where the structure shall be located.

- **At a minimum the structure must be moved once during the seasonal feeding period within the field.**
- **The structures must be moved beyond areas where cattle have been fed mechanically harvested feeds or beyond where cattle have been provided shelter during the grazing season.**
- **The structure must be moved to an area that has no excessive hoof action and high levels of manure once the criteria for the nutrient management plan has been met at the current location.**
- **When livestock are winter feeding mechanically harvested feeds on cropland, hayland, or tame pastureland, the management plan shall be based on the Nutrient Management Plan.**

The panel covering shall be porous or solid in accordance with the requirements for straight line, semi-circular, or 90^0 V-shapes.

V. CONSIDERATIONS

Permanent structures should be centrally located in the grazing/feeding system to promote equidistant travel to all areas.

The livestock shelter structure may require pollution and erosion prevention measures in the design.

Consider the economics, the overall waste management system plan, and safety and health factors.

When applicable, consider the use of NRCS CPS Animal Trails and Walkways (Code 575) when frequent travel to headquarters, grazing areas or watering facilities is required.

Consider soil types and seasonal water table zones when planning the location of the livestock shelter structure.

Consider placement of windbreaks so livestock have a southern exposure.

Provide rub-rails or other features as needed to protect the structure from animal damage.

VI. PLANS AND SPECIFICATIONS

Prepare plans and specifications for a livestock shelter structure according to this standard.

Describe the requirements for applying the practice to achieve its intended purposes.

Include construction plans, drawings, job sheets or other similar documents. Specify in these documents the requirements for installing the practice.

As a minimum, include:

- The type, location(s), and orientation of the shelter structure.
- **In lieu of North Dakota standard drawings:** calculations, as needed to set minimum thicknesses, strengths, etc., for the structures based on a standard design wind speed **as listed under Section IV.**
- Seasonal wind directions needed to determine the orientation of the structure.
- Develop a plan for movement of the structure, if portable.
- Job sheets or construction drawings.
- Construction specifications including dimensions of the structure, and configuration.
- Materials, including the dimensions, amount, any coatings, and quality to be used.

VII. OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

The minimum requirements to be addressed in the O&M plan are:

- Inspect the structure annually and after major storm events.
- Maintain the structural components through the practice lifespan.
- Replace and/or repair maintenance coatings on structural steel components as necessary.
- Move portable structures periodically to prevent destruction of vegetation in the immediate area.
- If shelters are not moved frequently, collect and remove accumulated animal waste on a regular basis or specified time interval and utilize in accordance with NRCS CPS *Waste Recycling (Code 633) or Nutrient Management (Code 590)*, as appropriate.

VIII. REFERENCES

ASTM D A-36, A-120, D-751, D-1494, D-1682, D-1760, D1910.

Federal Specification TT-P-641.

Federal Test Method Standard No. 191, Method 5804.

"Warm Cows & Cool Breezes", Montana State University Extension Service; http://www.msuextension.org/counties/Stillwater/articles/Ag%20Articles/Windbreaks.pdf.

"Taming Blizzards for Animal Protection, Drift Control and Stock Water" 1991. R. L. Jairell and R.A. Schmidt, USDA Forest Service.

"Portable Animal Protection Shelter and Wind Screen" 1988. R. L. Jairell and R.A. Schmidt, USDA Forest Service.

"Effect of a Solid Windbreak in a Cattle Feeding Area" 1980. Earl M. Bates, Oregon State University and Ralph L. Phillips, Eastern Oregon Agricultural Research Center.

"Nutrient Export in Run-off from an In-Field Cattle Overwintering Site in East-Central Saskatchewan." (Unpublished master's thesis). 2011. A.B. Smith, University of Saskatchewan