August 14, 2015

WISCONSIN FIELD OFFICE TECHNICAL GUIDE
450-11-TECHNICAL GUIDE
FOTG NOTICE WI-73

SUBJECT: WISCONSIN FIELD OFFICE TECHNICAL GUIDE

Purpose: Revisions to Wisconsin Conservation Practice Standards and Specifications

The following revisions to the Wisconsin FOTG have been posted on the Wisconsin e-FOTG website:

Section IV: Conservation Practice Standards and Specifications:

- Index
- Brush Management (Code 314)
- Cover Crop (Code 340)
- Filter Strip (Code 393)
- Grassed Waterway (412)
- Heavy Use (Code 561)
- Seasonal High Tunnel (Code 325)
- Agronomy Technical Note 7, Cover and Green Manure Crops
- Agronomy Technical Note 10, Filter Strip
- Forestry Technical Note 1, Native Tree and Shrub Planting
- Brush Management Job Sheet (314)
- Cover Crop Job Sheet (340)
- Filter Strip Job Sheet (393)
- Forest Stand Improvement Job Sheet (666)
- Seasonal High Tunnel Job Sheet (325)
- Cover Crop Termination Guidelines

Explanation of Changes/Revisions:

Brush Management (Code 314) - The revised Standard incorporates more detail in Brush Management methods. The Job Sheet for Brush Management provides documentation that matches the practice Standard and specification requirements.

Cover Crop (Code 340) - The specification was revised to simplify seed mixes and address changes to the National Standard including language on tested seed, mixes based on straight rates, language on termination. Job Sheet 340 for Cover Crops provides documentation that matches the practice Standards and specification requirements.

Filter Strip (Code 393) – The specification was revised to include update materials from the SOC standard update process. Job sheet 393 for Filter Strip was updated to provide documentation that matches the practice standards and specification requirements.

Forest Stand Improvement (Code 666) – The Job Sheet provides documentation that matches the practice Standards and specification requirements

Grassed Waterway (Code 412) – The revised standard incorporates minor changes to the national standard and specifications.

Heavy Use Protection (Code 561) – The revised standard incorporates minor changes to the national standard and specifications.

Seasonal High Tunnel (Code 325) – The Job Sheet provides documentation that matches the practice Standards and specification requirements.

Agronomy Technical Note 1 (Tree and Shrub Establishment) – This is a new Technical Note that provides support to the following practice standards- Alley cropping (311), tree and Shrub Establishment (612), Early Successional Habitat Development/management (647), Farmstead and feedlot Windbreaks (380), Field Windbreaks (392), Hedgerow Planting (422), Restoration and management of Declinsing Habitats (643), Wildlife Upland Habitat management *645), Wildlife Wetland Habitat management (6440 and other conservation practices that include the establishment of trees and/or shrubs.

Agronomy Technical Note 7 (Cover and Green Manure Crops)– The updates to this Technical Note simplify seed mix calculations, match Practice Standard 340, and streamline planning certification processes.

Forestry Technical Note 1 (Native Tree and Shrub Establishment) – This is a new Technical Note that provides details to support Practice Standard updates to Tree and Shrub Establishment (code 612)

Remove the following outdated Standards from any printed copies of the WI FOTG:

- Brush Management (Code 314)
- Conservation Crop Rotation (Code 328)
- Cover Crop (Code 340)
- Filter Strip (Code 393)
- Grassed Waterway (412)
- Heavy Use (Code 561)
- Seasonal High Tunnel (Code 325)
- Agronomy Technical Note 1, Tree and Shrub Establishment
- Agronomy Technical Note 7, Cover and Green Manure Crops
- Agronomy Technical Note 10, Filter Strip
- Forestry Technical Note 1, Native Tree and Shrub Planting
- Brush Management Job Sheet (314)
- Cover Crop Job Sheet (340)
- Filter Strip Job Sheet (393)
- Nutrient Management Job Sheet (590)

A link to the Wisconsin FOTG is located on the Wisconsin NRCS website at:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/

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NRCS Cover Crop Termination Guidelines
Wisconsin

Cover crops on a field in Black Hawk County, Iowa.
Photo: Lynn Betts, NRCS

Background:

To ensure that USDA policies are coordinated and up to date with evolving cover crop practices, the administrators of the Natural Resources Conservation Service (NRCS), Risk Management Agency (RMA) and Farm Service Agency (FSA) organized an interagency workgroup to develop consistent, simple and flexible policy across the three agencies. National and local experts, along with multiple stakeholders, were involved in the process. Research literature, plant growth, soil hydrology models, and input from national/local experts in cover crop management provided the basis for developing cover crop termination guidelines to achieve their conservation benefits while minimizing risk of reducing yield to the following crop due to soil water use. These guidelines will be applicable to all USDA programs.

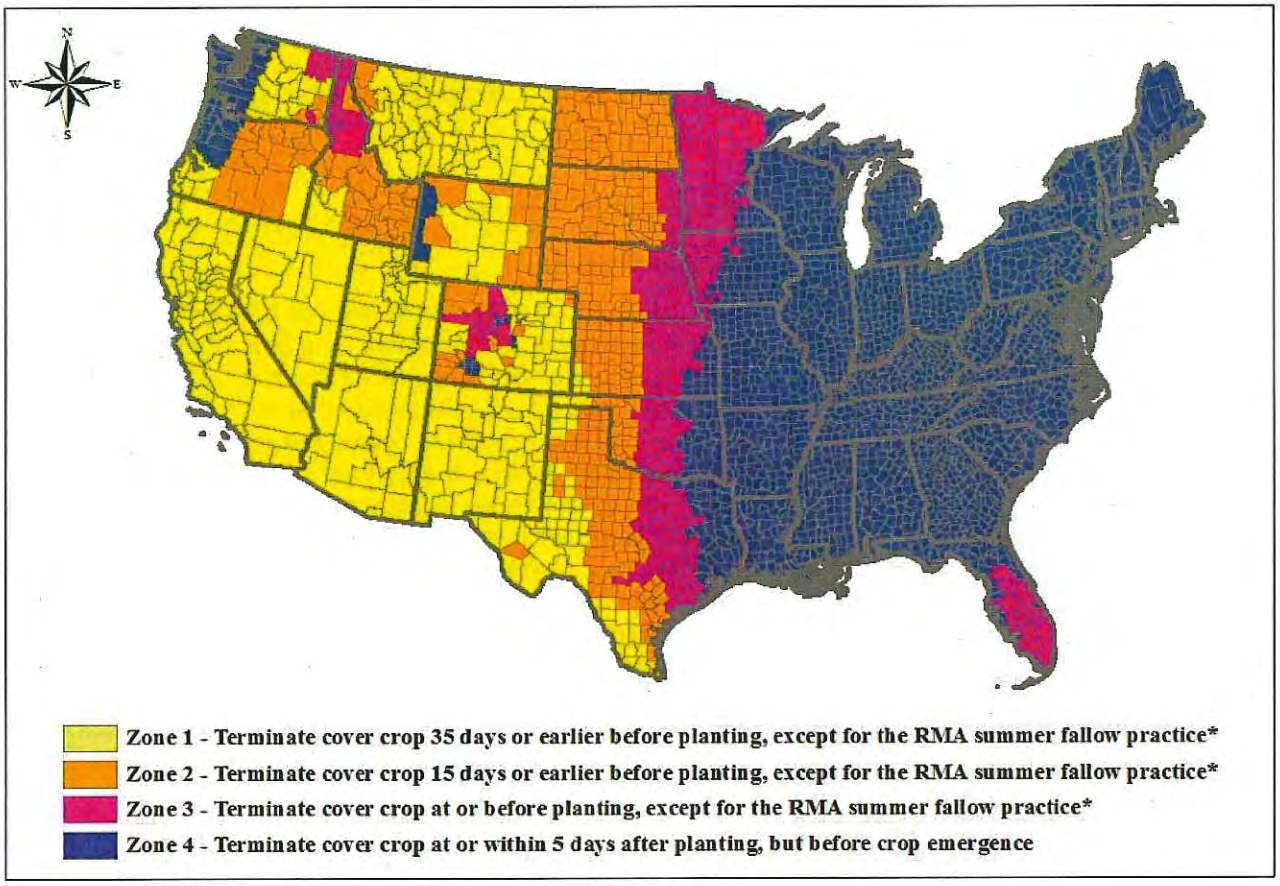
These guidelines only apply to non-irrigated cropland, including systems that contain a fallow period. The cover crops in irrigated cropping systems should be terminated based on the crop system and the conservation purpose, but before the planted crop emerges.

NRCS Cover Crop Termination Guidelines for Management Zones

Zone 4 - See Map
Terminate cover crop, at, or within 5 days after planting, but before crop emergence.

Cover Crop Termination Zones

Produced by: NRCS | ESD
December 2013



*See guidelines for details on the RMA summer fallow practice.

Photo: Justin Fritsher, NRCS

Cover crops in an orchard reduce soil erosion.
Photo: Gary Kramer

No-till planting of corn into cover crop of barley. Washington County, Virginia.
Photo: Jeff Vanuga

Additional Cover Crop Termination Considerations:

1. If the season is drier than normal nearing cover crop termination time, consider an earlier termination to conserve soil moisture.
2. If the spring season is wetter than normal at cover crop termination time, consider a later termination to use excess soil moisture and improve seedbed condition.
3. If the cover crop is part of a no-till system, termination can be delayed up to 7 days from the above termination period guideline, but terminated prior to crop emergence for all zones and systems.
4. Early vs. Later Spring Seeded Crops – Crops planted as early as possible after the spring thaw are considered early spring crops (e.g., spring wheat, spring barley, oats).
5. New Technology – Where new technology has at least three years of satisfactory performance (achieves historical yield) based on farm records and the written approval of two "agricultural experts" as defined by RMA or recommended by Extension or Ag Industry, the cover crop may be terminated closer to planting or planted during a different time period.
6. Cover Crop Grazing or Forage Harvest – Cover crops may be grazed or harvested as hay or silage, unless prohibited by RMA crop insurance policy provisions or specific USDA program rules. Cover crops cannot be harvested for grain or seed.
7. Herbaceous Wind Barriers – There are specific cropping situations when seasonal cover is needed to protect young seedlings from wind erosion abrasion. The typical seasonal covers may include such crops as wheat, rye, or oats that are planted in rows, e.g., 20 feet apart (single or double row of small grain). These seasonal covers fall under the *NRCS Conservation Practice Code 603 – Herbaceous Wind Barriers*. These barriers are not considered cover crops.
8. Short Season Cover Crops – There are specific cropping situations where the producer will plant the intended crop, plus a short term seasonal cover crop (*NRCS Conservation Practice Code 340 – Cover Crop*) prior to or at the same time as planting the main or insured crop. In this case the seasonal cover emerges first and provides short term wind erosion protection until the main crop becomes established and provides its own protection from wind erosion. These seasonal cover crops are terminated by cultivation, frost /winterkill, or herbicides once the main crop is established. The seasonal covers used for the purpose of early crop establishment must be appropriate species for the area and the planned purpose.
9. Early Crop Planting – When earlier than normal planting occurs due to favorable weather or soil conditions, cover crop termination will naturally occur closer to planting. For example, if planting occurs 2 weeks earlier than normal, the cover crop termination period may be 2 weeks earlier (closer to planting).
10. 10. RMA Summer fallow Practice – If a crop, or a cover crop, is planted on summer fallow acreage in a fallow year, the following planted crop will not meet the RMA Summer fallow Practice definition until the acres lie fallow for a full crop year. For the 2015 crop year, if a cover crop was planted during the fallow year, the acreage may be insured under the "continuous cropping practice" (if available in your county), or by written agreement (if continuous cropping is not available in your county). For the 2016 and succeeding crop years, if a cover crop is planted during the fallow year, the acreage may be insured under the "continuous cropping practice" (if available in your county), or by written agreement (if continuous cropping is not available in your county) provided the cover crop is terminated at least 90 days prior to planting for summer and fall seeded crops. For early spring seeded crops, terminate the cover crop in the fall or as early as possible in the spring. Please contact your crop insurance agent for more information.

Definitions:

1. Over-Seeding/Inter-seeding – Both terms can be defined as planting one or more cover crop species into an existing or established crop. Common uses that involve over-seeding or inter-seeding include: (1) over-seeding a grass and/or legume cover crop into an existing stand of small grain at an appropriate time for the cover and germination, or (2) seeding a cover crop into an existing crop (e.g., corn or soybeans) at a time that will not impact the yield or harvest of the insured crop.
2. Inter-planted – This involves multiple crop species grown together, with no distinct row pattern and does not permit separate agronomic maintenance or management. For RMA purposes, this means if a cover crop and cash crop are planted in a way that does not permit separate agronomic maintenance or management, then RMA will not insure the cash crop. This would also apply to cover crops if inter-planted into the main crop and the cover crop interfered with the agronomic management and harvest of the main crop.
3. Relay Cropping – The practice of inter-seeding a second crop into the first crop well before the first crop is harvested. The relay cropping strategy is used to enable production of a second crop in areas where time for seeding the second crop following harvest of the first is considered inadequate for double cropping. This is not considered a cover cropping practice, but a method of double cropping and may fall under the RMA 1st / 2nd crop rules.
4. Double-Cropping – RMA and NRCS term: Producing at least 2 crops for harvest from the same acreage in the same crop year. This does not include cover crops.
5. Cover Crop – Crops including grasses, legumes and forbs for seasonal cover and other conservation purposes. Cover crops are primarily used for erosion control, soil health improvement, and water quality improvement. A cover crop managed and terminated according to these guidelines is not considered a "crop" for crop insurance purposes. The cover crop may be terminated by natural causes such as frost, or intentionally terminated through chemical application, crimping, rolling, tillage, or cutting.
6. Termination – Termination means growth has ended.
7. Good Farming Practice – RMA term - The production methods utilized to produce the insured crop and allow it to make normal progress toward maturity and produce at least the yield used to determine the production guarantee or amount of insurance, including any adjustments for late planted acreage, which are: (1) for conventional or sustainable farming practices, those generally recognized by agricultural experts for the area; or (2) for organic farming practices, those generally recognized by organic agricultural experts for the area or contained in the organic plan.
8. Continuous Cropping – RMA Term – Any non-irrigated production practice that does not qualify as a summer fallow practice.

INTRODUCTION

This technical note is intended to be used by resource professionals as a guide for planting and direct seeding tree and shrub species for reforestation, afforestation and the installation of Alley Cropping (311), Tree and Shrub Establishment (612), Early Successional Habitat Development/Management (647), Farmstead and Feedlot Windbreaks (380), Field Windbreaks (392), Hedgerow Planting (422), Restoration and Management of Declining Habitats (643), Riparian Forest Buffer (391), Shoreland Habitat (643A), Wildlife Upland Habitat Management (645), Wildlife Wetland Habitat Management (644), and other conservation practices that include the establishment of trees and/or shrubs. Refer to the previous standards for specific practice purposes and requirements. This technical note is intended to be used for all programs and by resource professionals regardless of agency affiliation.

BACKGROUND

Appendix A to this technical note (found at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/technical/cp/?cid=nrcs142p2_020842) includes most, but not all of the native tree and shrub species for Wisconsin. Other native species may be planted if they serve the intended purpose of the planting and are approved by Wisconsin NRCS State Forester.

Species selection should be based on local site conditions, professional judgment, and availability of planting stock/seed.

The Major Land Resource Area (MLRA) and county-specific tables provided in Appendix A can be modified by the NRCS State Forester with concurrence from WDNR Division of Forestry and local Resource Professionals.

SPACING AND LAYOUT REQUIREMENTS

Tree/shrub spacing and densities vary depending on the purpose of planting, and the type of stock being planted. Typical ranges are listed below.

Seedlings (bare root or plugs and cuttings):

- Timber production:
- Hardwoods - 545-900/ac.
- Conifers - 600-1000/ac.
- Wildlife Plantings: 302-1200/ac. Certain wildlife plantings may require densities outside this range. Contact the Michigan NRCS State Biologist for guidance.
- Christmas Trees: 726-1200/ac.
- Supplemental Underplanting: 200-300 / ac. evenly distributed over the area needing treatment.
- Erosion control: 1000-1200 /ac.
- For other applications or approval of planting densities outside these listed ranges, contact the Michigan NRCS State Forester or State Biologist.

Larger stock, including air-root pruned, containerized, and balled and burlapped stock:

- 20+ per acre if natural regeneration is expected.
- 50+ trees per acre if natural regeneration is not expected.

For minimum planting stock sizes, refer to the next section.

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' in which case use a minimum setback of 20 feet. Refer to the Conservation Tree/Shrub Guide (CTSG) Tool in eFOTG, Section II for 20-year plant heights.

Where subsurface drains (tile lines) cross through a tree/shrub planting, and where these drains will 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.

Additional Layout information for Supplemental Underplanting

Ensure that there is adequate sunlight available for the species to be planted. Use the CTSG tool to determine the shade tolerance of the species to be underplanted.

- Intolerant tree/shrub species (I) require full sun and require openings ½ to ⅔ acre in size (diameter of opening: 160-200 feet, measured at tree crown level).

» Species with intermediate shade tolerance (M) require canopy closure of 30-50%, which can be approximated with openings ¼ to ½ acres in size (diameter of opening: 120-160 feet, measured at tree crown level).

» Shade tolerant species (T) can grow in full shade, although 60-80% canopy closure will accelerate the growth and development of underplanted trees/shrubs when compared to 100% canopy closure. Small openings of 1/10th acre or less (diameter of opening: 80 feet or less, measured at tree crown level) will favor regeneration of shade tolerant species.

All underplanted seedlings will benefit from additional cutting or killing of overstory trees 2 or more years after establishment to maintain or increase the amount of light reaching the ground.

MINIMUM PLANTING STOCK SIZE

Bare-root Stock

Conifers: Minimum height 9 inches with a minimum root length of 8 inches OR minimum caliper 3/16 inch.

Hardwoods: Minimum height of 12 inches with a minimum root length of 8 inches OR minimum caliper* of ¼ inch. Exceptions: hickory species may have a minimum height of 6 inches and root length of 8 inches OR ¼ inch caliper*.

Containerized Stock

One year old plug container seedlings must have root volumes of at least 7 cubic inches.

Potted Stock

Minimums for potted stock, including air-root pruned: height 3 feet, container size 1 gallon, caliper* 3/8 inch.

Cuttings (Hybrid Aspen, Willow, Cottonwood, etc.)

Minimum 10 in. in length with 3/8 in. caliper*.

Balled and Burlapped Stock

Conifers:

Tree Height	Minimum Diameter Ball
18-24 in.	10 in.
2-3 ft.	12 in.
3-5 ft.	14 in.
5-6 ft.	20 in.

Hardwoods:

Tree Height	Minimum Diameter Ball	Caliper*
5-6 ft.	12 in.	½ in.
6-8 ft.	14 in.	¾ in.
8-10 ft.	16 in.	1 in.

* Caliper (diameter at ground level) shall be measured at the root collar.

ADDITIONAL RESOURCES

Site resource information such as microclimate, soil type, soil drainage classification and moisture regime, exposure and purpose of the planting must be gathered before deciding on species recommendations. Some county soil surveys contain information about the original vegetation for each soil type. Other references include the "Original Vegetation Cover of Wiscosnin" map that can be found at www.dnr.state.wi.us/org/at/geo/map_gal/dancov/orgveg. Early Vegetation of Wisconsin map found in Section I of the Wisconsin NRCS Field Office Technical Guide (FOTG), and "Vegetation of Wisconsin". Also refer to "Forest Communities and Habitat Types of Central and Southern Wisconsin" and "Forest Communities and Habitat Types of Northern Wisconsin", by John Kotar for information on natural forest communities and the sites on which they developed. These references along with Appendix A will allow the planner to develop sound planting/seeding species recommendations.

» Identify the Major Land Resource Area (MLRA) and the county where the practice will be applied. The map titled "Major Land Resource Areas for Wisconsin" can be found in Section I of the Wisconsin NRCS Field Office Technical Guide.

» Identify the soil type(s) and the drainage classification of the soils on site. Drainage class for each soil series on site can be found in the soil series description in the published County Soil Survey or at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Manipulations of the natural drainage class identified in the County Soil Survey must be considered when developing species recommendations.

» Consider the intended and potential uses of the planting.

» Determine whether the planting will be in open (cropland or pastureland conversion), partial shade (under-stocked existing stand), or shade (100% canopy-mainly for shrub plantings) and aspect (exposure).

» Select species based on the criteria identified in steps 1 through 4. See Appendix A, Wisconsin Native Tree and Shrub Guides. Similar common name does not always mean same species. When in doubt, use scientific names to identify species selected.

Method of Establishment (Seeding vs. Planting)

Direct seeding, if successful, allows the establishment of more trees per acre at a comparable cost to planting seedlings. It can be particularly useful on sites that otherwise are difficult to plant due to spring wetness or shallow soils. Areas that are difficult to plant with seedlings because of spring wetness can be seeded at a dryer time of year and areas with very shallow topsoil are easier to seed because of shallow seeding depths versus planting depths. It also allows a more natural-appearing stand of trees to develop which can be further encouraged by planting a variety of species.

Direct seeding is not well suited for under-planting in poorly stocked stands and may not be a viable option every year because many species only produce good seed crops every 3-5 years and seed may not be available. It should not be used on slopes steeper than 6% without considering a cover crop or other measure for erosion control. Direct seeding is not well suited for sites that will be used for specialty plantings (Christmas trees, windbreaks, and alley cropping).

The direct seeding method is best suited to sites being converted from intensive agricultural production because of historic weed control practices. Weed control is very critical to establishment of trees and shrubs using the direct seeding method. Competition must be controlled for a minimum of 3 years after seeding and should be checked for follow up control measures until tree crowns are above the competition.

The large number of seeds per acre increases the chance that trees will benefit from the best available micro-sites. Enough trees will generally escape deer and rabbit browse to develop a stand of trees when heavily planted. Squirrels and other rodents can destroy much of the seed in years when snow cover is light.

Locally collected seed can be used to ensure compatibility with local conditions. However, seed should only be collected from high-quality source trees and at the right time of year. If unsure about seed collecting techniques, check with local resource professionals first.

Planting of nursery stock allows for better density control (specialty plantings such as windbreaks and Christmas trees) and is more desirable for sites that require intensive weed control, especially where mechanical control is the preferred option. By using seedlings, several years of development are realized with a new planting. Planting of seedlings is a more efficient use of genetically improved seed. Sites that are excessively well drained are usually more successful if planted because the developed root systems have a better chance of obtaining enough moisture to become established. Nursery stock is better suited to slopes greater than 6% than is direct seeding, but additional conservation practices such as cover crops and planting on the contour should be considered when planting fields being converted from intensive agriculture (exposed soil).

For sites that have existing grass/herbaceous cover, planting seedlings is a better choice than seeding if the competing vegetation is controlled by band spraying within rows and/or by mechanical control between the rows. Nursery stock plantings produce a more uniform stand, and are well suited for under-planting in poorly stocked stands. Planting can be designed with future management/land use activities in mind.

TREE PLANTING/DIRECT SEEDING TIMELINE

August/September prior to planting nursery stock, begin site preparation on sites with existing vegetation (on row crop fields site preparation may begin after the crop is harvested). Site preparation will be site and species specific. Direct seeding is not recommended on sites with severe competition from existing vegetation (old hay fields with dense sod and or areas of Reed Canary Grass). Identify commercial or local seed sources for sites to be direct seeded. For commercially purchased seed, make sure the supplier can confirm the seed is from the Lake States Area and purchase from a source as close to the site to be seeded as possible.

» Order seed or begin collecting seeds in season and plant as soon after collection as possible. If buying commercially available seed, use the supplier's listing of percent sound seed, to determine final seeding rates. Most seed is very difficult to store and self-storage is not recommended.

» For locally collected seed, collect enough seed to meet the required rates and account for defective seed. Visually inspect seed looking for proper color, form, insect and mechanical damage. Separate debris, caps and wings from seed.

» The float test may be useful for separating good from poor acorns and nuts; floaters are removed off the top of the tub of water and discarded. However, it is not always accurate to determine that all sinkers are viable, as other factors are also

important. The husks around nuts such as black walnut and hickories, must be removed prior to floating. Always cut a sample of floaters and sinkers to be sure of the effectiveness of flotation to separate them. Seed embryo color should be white or creamy yellow.

» A cut test can be used to determine the amount of sound seed being collected. Inspect by species, at least 10 randomly selected seeds per 3,000 seeds collected. Cut open the seed to be sure that seed is filled, moist and normal colored.

Site Preparation

The single most important part of planting trees is protecting them from competitive vegetation. All plants compete for light and water and many grasses produce natural chemicals that suppress tree and shrub growth. If not managed, competition from weeds, grasses and unwanted woody vegetation, will choke out the planting. Mechanical and/or chemical site preparation techniques can be used depending on site conditions and client objectives.

Mechanical Site Preparation

Reduce the competition from a thick grass sod by moldboard plowing, disking and establishing a cover crop the year prior to planting. On slopes greater than 6%, leave strips of sod between 6-foot wide tilled strips and plant as near to the contour as possible to prevent erosion. For sites with a clean tilled row crop existing, address weed problems and see "Cover Crop" Standard 340 for ground cover options. Annual rye, winter wheat, and white clover perform well as cover crops for tree planting purposes.

Chemical Site Preparation

Weed and/or grass competition can be controlled with herbicide use. On sites with slopes greater than 6%, band spraying of the row is preferable over broadcast spraying of the entire site. Effective control depends on four factors:

» Timing of application,

» Herbicide selected,

» Weather conditions, and

» Application rate.

A combination of chemical and mechanical site preparation may be required on very difficult, heavy sod sites. Very dry conditions will limit the effectiveness of most herbicides. Be sure to follow label directions for application rates, as rates differ depending on soil type and herbicide being used.

Direct Seeding

The amount of seed required for direct seeding varies by species and site conditions. Use Table 1 as a guide. Rates are based on single species planting. For drilling of mixed species, the total seeds/acre should be at least 3,000. For broadcasting mixed species, the total seeds/acre should be at least 1,000. Ideal seedings contain a mix of drilled and broadcast species.

The following chart shows the row spacing and seed spacing combinations that will result in 3,000 seeds per acre. Adjust planting rate based on sound seed percentage from seed inspection.

4-foot row spacing = 3.6-foot spacing within row

5-foot row spacing = 2.9-foot spacing within row

6-foot row spacing = 2.4-foot spacing within row

7-foot row spacing = 2.0-foot spacing within row

8-foot row spacing = 1.8-foot spacing within row

9-foot row spacing = 1.6-foot spacing within row

10-foot row spacing = 1.5-foot spacing within row

Heavy seeded species, those suitable for drilling, will usually comprise the main part of the stand. Lighter seeded species, those suitable for broadcast seeding, will be used for diversity and micro-site establishment within the stand.

Plant acorns 1-3 inches deep and nuts 2-5 inches deep. A good rule of thumb is to plant to a depth that is twice the diameter of the seed. For light seeded species that are broadcast, cultipack the site after seeding. Plant seed from seed suppliers or seed collected as close to the site as possible.

White oak, bur oak, and swamp white oak acorns must be planted as soon as possible after collection. It is extremely important that the site is prepared for planting before the acorns are received or collected. These acorns sprout in the fall and begin growing before the ground freezes and do not require the cold stratification that the red oak family, the walnuts, and the hickories require.

Red oak acorns can be stored, if necessary, if kept in cold damp conditions 35 to 40 degrees F. Fall seeding is preferred over storage and seeding should be done immediately after receiving or collecting seed. Many species require cold stratification to stimulate germination in spring and it is difficult to create the required conditions unless climate controlled storage is available. Immersing acorns in water prior to planting will restore any moisture lost during collection. Soak

from 4 to 24 hours. If seeding is delayed more than a few days, seed will be placed in porous bags, such as onion bags, in cold storage, 35 to 40 degrees F. Keep heavy seeded species moist, but not wet until planting. Keep light seeded species dry until planting. Do not allow seed to heat up and never place seed in the sun. Inspect seeds for storage losses prior to planting.

October/November of the year before planting, order nursery stock and/or begin direct seeding as appropriate for the species.

Nursery Stock Spacing

Density of plantings will vary by species, intent of the planting, soil site conditions, and other factors. For most multiple purpose plantings, use Table 2 when planning the amount of planting stock required. **Specific Program requirements (CRP, Managed Forest Law, etc.) may dictate the amount of stock needed and spacing.**

For specialty plantings (windbreaks, Christmas trees) consult specific standards and/or fact sheets.

April/May of planting year inspect sites to be planted for weed problems and apply chemical or mechanical weed control as needed prior to planting. Inspect sites direct seeded the previous fall for weed problems and treat as necessary. Plant tree and shrub seedlings from late March until early May as soon as they arrive. Seedlings may be planted by hand using a shovel or planting bar, or with a tree planting machine. Many counties have planting machines available for rent.

Planting Information

Plant seedlings as soon as they arrive. Do not allow seedlings to lay in the sun or dry out. Do not take large amounts of seedlings to the field where they will dry out before planting. Take small amounts and store the rest in a cool, shaded location and keep moist, but not wet until planted. Do not open the shipping containers until ready to plant. If stock in bundles has been exposed to warm temperatures, the bundles should be opened to prevent heating. Wet roots if needed. Keep tops dry.

Stock to be planted in a few days can be stored in a cellar, open shed, or similar cool place. Stock held over a week should be stored in a cooler.

During planting, keep roots wet. Dry roots mean dead trees/shrubs.

Plants developing "J" roots will die. Seedling roots should hang free and just touch the bottom of the hole. When the root length on seedlings exceeds the depth of the planting tool being used, roots may be pruned to the proper length. Use a sharp tool such as a large scissors, pruning shears, or a machete. Root systems can be pruned at 8-10 inches below the root collar provided a shoot to root ratio of 2:1 or less can be maintained. Dip the roots in water immediately but do not leave roots submerged in water. Moisture enhancers or root gels may be used to keep roots moist and repack the trees in the original containers. Removal of any part of the root system will have an adverse impact on seedling vigor so pruning is not recommended. It is better to modify the depth of planting whenever possible, than to prune roots.

Tree planting machines are available in most counties. If the site is suitable for machine planting, this method is usually cheaper.

Hand planting may be done with shovel, hoe, planting bar, mattock, or other hand tool. The hole should be large enough to avoid doubling of roots.

If cuttings are used, they must be kept moist and cool until planted. Cuttings should be buried, except for exposed tip, with at least two buds above ground.

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Table 1

Species	Planting Method	Collect	Sound Seeds Per Acre	Pounds Per Acre
Northern Red Oak	Drilled	Sept - Oct	3,000	24 lbs.
White Oak	Drilled	Sept - Oct	3,000	25 lbs.
Bur Oak	Drilled	Aug - Nov	3,000	40 lbs.
Swamp White Oak	Drilled	Sept - Oct	3,000	25 lbs.
Black Walnut	Drilled	Sept - Oct	3,000	75 lbs.
Shagbark Hickory	Drilled	Sept - Oct	3,000	30 lbs.
Ash	Broadcast	Aug - Oct	1,000	.13 lb.
Sugar Maple	Broadcast	Sept - Oct	1,000	.16 lb.
Red Maple	Broadcast	Apr - July	1,000	.04 lb.
Basswood	Broadcast	Oct - Nov	1,000	.2 lb.
Black Cherry	Broadcast	Aug - Oct	1,000	.2 lb.

Table 2: Common Tree/Shrub Spacings

Spacing (feet)	Plants Per Acre
6 x 6	1210
6 x 8	907
5 x 10	871
6 x 10	726
7 x 7	889
7 x 10	622
8 x 8	681
8 x 10	544
8 x 12	453
9 x 9	538
10 x 10	436
10 x 12	363
12 x 12	302

INTRODUCTION

This technical note is intended to be used by resource professionals as a guide for planting and direct seeding tree and shrub species for reforestation, afforestation and the installation of Alley Cropping (311), Tree and Shrub Establishment (612), Early Successional Habitat Development/Management (647), Farmstead and Feedlot Windbreaks (380), Field Windbreaks (392), Hedgerow Planting (422), Restoration and Management of Declining Habitats (643), Riparian Forest Buffer (391), Shoreland Habitat (643A), Wildlife Upland Habitat Management (645), Wildlife Wetland Habitat Management (644), and other conservation practices that include the establishment of trees and/or shrubs. Refer to the previous standards for specific practice purposes and requirements. This technical note is intended to be used for all programs and by resource professionals regardless of agency affiliation.

BACKGROUND

Appendix A to this technical note (found at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/technical/cp/?cid=nrcs142p2_020842) includes most, but not all of the native tree and shrub species for Wisconsin. Other native species may be planted if they serve the intended purpose of the planting and are approved by Wisconsin NRCS State Forester.

Species selection should be based on local site conditions, professional judgment, and availability of planting stock/seed.

The Major Land Resource Area (MLRA) and county-specific tables provided in Appendix A can be modified by the NRCS State Forester with concurrence from WDNR Division of Forestry and local Resource Professionals.

SPACING AND LAYOUT REQUIREMENTS

Tree/shrub spacing and densities vary depending on the purpose of planting, and the type of stock being planted. Typical ranges are listed below.

Seedlings (bare root or plugs and cuttings):

- Timber production:
- Hardwoods - 545-900/ac.
- Conifers - 600-1000/ac.
- Wildlife Plantings: 302-1200/ac. Certain wildlife plantings may require densities outside this range. Contact the Michigan NRCS State Biologist for guidance.
- Christmas Trees: 726-1200/ac.
- Supplemental Underplanting: 200-300 / ac. evenly distributed over the area needing treatment.
- Erosion control: 1000-1200 /ac.
- For other applications or approval of planting densities outside these listed ranges, contact the Michigan NRCS State Forester or State Biologist.

Larger stock, including air-root pruned, containerized, and balled and burlapped stock:

- 20+ per acre if natural regeneration is expected.
- 50+ trees per acre if natural regeneration is not expected.

For minimum planting stock sizes, refer to the next section.

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'in which case use a minimum setback of 20 feet. Refer to the Conservation Tree/Shrub Guide (CTSG) Tool in eFOTG, Section II for 20-year plant heights.

Where subsurface drains (tile lines) cross through a tree/shrub planting, and where these drains will 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.

Additional Layout information for Supplemental Underplanting

Ensure that there is adequate sunlight available for the species to be planted. Use the CTSG tool to determine the shade tolerance of the species to be underplanted.

- Intolerant tree/shrub species (I) require full sun and require openings ½ to ⅔ acre in size (diameter of opening: 160-200 feet, measured at tree crown level).

» Species with intermediate shade tolerance (M) require canopy closure of 30-50%, which can be approximated with openings ¼ to ½ acres in size (diameter of opening: 120-160 feet, measured at tree crown level).

» Shade tolerant species (T) can grow in full shade, although 60-80% canopy closure will accelerate the growth and development of underplanted trees/shrubs when compared to 100% canopy closure. Small openings of 1/10th acre or less (diameter of opening: 80 feet or less, measured at tree crown level) will favor regeneration of shade tolerant species.

All underplanted seedlings will benefit from additional cutting or killing of overstory trees 2 or more years after establishment to maintain or increase the amount of light reaching the ground.

MINIMUM PLANTING STOCK SIZE

Bare-root Stock

Conifers: Minimum height 9 inches with a minimum root length of 8 inches OR minimum caliper 3/16 inch.

Hardwoods: Minimum height of 12 inches with a minimum root length of 8 inches OR minimum caliper* of ¼ inch. Exceptions: hickory species may have a minimum height of 6 inches and root length of 8 inches OR ¼ inch caliper*.

Containerized Stock

One year old plug container seedlings must have root volumes of at least 7 cubic inches.

Potted Stock

Minimums for potted stock, including air-root pruned: height 3 feet, container size 1 gallon, caliper* 3/8 inch.

Cuttings (Hybrid Aspen, Willow, Cottonwood, etc.)

Minimum 10 in. in length with 3/8 in. caliper*.

Balled and Burlapped Stock

Conifers:

Tree Height	Minimum Diameter Ball
18-24 in.	10 in.
2-3 ft.	12 in.
3-5 ft.	14 in.
5-6 ft.	20 in.

Hardwoods:

Tree Height	Minimum Diameter Ball	Caliper*
5-6 ft.	12 in.	½ in.
6-8 ft.	14 in.	¾ in.
8-10 ft.	16 in.	1 in.

* Caliper (diameter at ground level) shall be measured at the root collar.

ADDITIONAL RESOURCES

Site resource information such as microclimate, soil type, soil drainage classification and moisture regime, exposure and purpose of the planting must be gathered before deciding on species recommendations. Some county soil surveys contain information about the original vegetation for each soil type. Other references include the "Original Vegetation Cover of Wiscosnin" map that can be found at www.dnr.state.wi.us/org/at/geo/map_gal/dancov/orgveg. Early Vegetation of Wisconsin map found in Section I of the Wisconsin NRCS Field Office Technical Guide (FOTG), and "Vegetation of Wisconsin". Also refer to "Forest Communities and Habitat Types of Central and Southern Wisconsin" and "Forest Communities and Habitat Types of Northern Wisconsin", by John Kotar for information on natural forest communities and the sites on which they developed. These references along with Appendix A will allow the planner to develop sound planting/seeding species recommendations.

» Identify the Major Land Resource Area (MLRA) and the county where the practice will be applied. The map titled "Major Land Resource Areas for Wisconsin" can be found in Section I of the Wisconsin NRCS Field Office Technical Guide.

» Identify the soil type(s) and the drainage classification of the soils on site. Drainage class for each soil series on site can be found in the soil series description in the published County Soil Survey or at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Manipulations of the natural drainage class identified in the County Soil Survey must be considered when developing species recommendations.

» Consider the intended and potential uses of the planting.

» Determine whether the planting will be in open (cropland or pastureland conversion), partial shade (under-stocked existing stand), or shade (100% canopy-mainly for shrub plantings) and aspect (exposure).

» Select species based on the criteria identified in steps 1 through 4. See Appendix A, Wisconsin Native Tree and Shrub Guides. Similar common name does not always mean same species. When in doubt, use scientific names to identify species selected.

Method of Establishment (Seeding vs. Planting)

Direct seeding, if successful, allows the establishment of more trees per acre at a comparable cost to planting seedlings. It can be particularly useful on sites that otherwise are difficult to plant due to spring wetness or shallow soils. Areas that are difficult to plant with seedlings because of spring wetness can be seeded at a dryer time of year and areas with very shallow topsoil are easier to seed because of shallow seeding depths versus planting depths. It also allows a more natural-appearing stand of trees to develop which can be further encouraged by planting a variety of species.

Direct seeding is not well suited for under-planting in poorly stocked stands and may not be a viable option every year because many species only produce good seed crops every 3-5 years and seed may not be available. It should not be used on slopes steeper than 6% without considering a cover crop or other measure for erosion control. Direct seeding is not well suited for sites that will be used for specialty plantings (Christmas trees, windbreaks, and alley cropping).

The direct seeding method is best suited to sites being converted from intensive agricultural production because of historic weed control practices. Weed control is very critical to establishment of trees and shrubs using the direct seeding method. Competition must be controlled for a minimum of 3 years after seeding and should be checked for follow up control measures until tree crowns are above the competition.

The large number of seeds per acre increases the chance that trees will benefit from the best available micro-sites. Enough trees will generally escape deer and rabbit browse to develop a stand of trees when heavily planted. Squirrels and other rodents can destroy much of the seed in years when snow cover is light.

Locally collected seed can be used to ensure compatibility with local conditions. However, seed should only be collected from high-quality source trees and at the right time of year. If unsure about seed collecting techniques, check with local resource professionals first.

Planting of nursery stock allows for better density control (specialty plantings such as windbreaks and Christmas trees) and is more desirable for sites that require intensive weed control, especially where mechanical control is the preferred option. By using seedlings, several years of development are realized with a new planting. Planting of seedlings is a more efficient use of genetically improved seed. Sites that are excessively well drained are usually more successful if planted because the developed root systems have a better chance of obtaining enough moisture to become established. Nursery stock is better suited to slopes greater than 6% than is direct seeding, but additional conservation practices such as cover crops and planting on the contour should be considered when planting fields being converted from intensive agriculture (exposed soil).

For sites that have existing grass/herbaceous cover, planting seedlings is a better choice than seeding if the competing vegetation is controlled by band spraying within rows and/or by mechanical control between the rows. Nursery stock plantings produce a more uniform stand, and are well suited for under-planting in poorly stocked stands. Planting can be designed with future management/land use activities in mind.

TREE PLANTING/DIRECT SEEDING TIMELINE

August/September prior to planting nursery stock, begin site preparation on sites with existing vegetation (on row crop fields site preparation may begin after the crop is harvested). Site preparation will be site and species specific. Direct seeding is not recommended on sites with severe competition from existing vegetation (old hay fields with dense sod and or areas of Reed Canary Grass). Identify commercial or local seed sources for sites to be direct seeded. For commercially purchased seed, make sure the supplier can confirm the seed is from the Lake States Area and purchase from a source as close to the site to be seeded as possible.

» Order seed or begin collecting seeds in season and plant as soon after collection as possible. If buying commercially available seed, use the supplier's listing of percent sound seed, to determine final seeding rates. Most seed is very difficult to store and self-storage is not recommended.

» For locally collected seed, collect enough seed to meet the required rates and account for defective seed. Visually inspect seed looking for proper color, form, insect and mechanical damage. Separate debris, caps and wings from seed.

» The float test may be useful for separating good from poor acorns and nuts; floaters are removed off the top of the tub of water and discarded. However, it is not always accurate to determine that all sinkers are viable, as other factors are also

important. The husks around nuts such as black walnut and hickories, must be removed prior to floating. Always cut a sample of floaters and sinkers to be sure of the effectiveness of flotation to separate them. Seed embryo color should be white or creamy yellow.

» A cut test can be used to determine the amount of sound seed being collected. Inspect by species, at least 10 randomly selected seeds per 3,000 seeds collected. Cut open the seed to be sure that seed is filled, moist and normal colored.

Site Preparation

The single most important part of planting trees is protecting them from competitive vegetation. All plants compete for light and water and many grasses produce natural chemicals that suppress tree and shrub growth. If not managed, competition from weeds, grasses and unwanted woody vegetation, will choke out the planting. Mechanical and/or chemical site preparation techniques can be used depending on site conditions and client objectives.

Mechanical Site Preparation

Reduce the competition from a thick grass sod by moldboard plowing, disking and establishing a cover crop the year prior to planting. On slopes greater than 6%, leave strips of sod between 6-foot wide tilled strips and plant as near to the contour as possible to prevent erosion. For sites with a clean tilled row crop existing, address weed problems and see "Cover Crop" Standard 340 for ground cover options. Annual rye, winter wheat, and white clover perform well as cover crops for tree planting purposes.

Chemical Site Preparation

Weed and/or grass competition can be controlled with herbicide use. On sites with slopes greater than 6%, band spraying of the row is preferable over broadcast spraying of the entire site. Effective control depends on four factors:

» Timing of application,

» Herbicide selected,

» Weather conditions, and

» Application rate.

A combination of chemical and mechanical site preparation may be required on very difficult, heavy sod sites. Very dry conditions will limit the effectiveness of most herbicides. Be sure to follow label directions for application rates, as rates differ depending on soil type and herbicide being used.

Direct Seeding

The amount of seed required for direct seeding varies by species and site conditions. Use Table 1 as a guide. Rates are based on single species planting. For drilling of mixed species, the total seeds/acre should be at least 3,000. For broadcasting mixed species, the total seeds/acre should be at least 1,000. Ideal seedings contain a mix of drilled and broadcast species.

The following chart shows the row spacing and seed spacing combinations that will result in 3,000 seeds per acre. Adjust planting rate based on sound seed percentage from seed inspection.

4-foot row spacing = 3.6-foot spacing within row

5-foot row spacing = 2.9-foot spacing within row

6-foot row spacing = 2.4-foot spacing within row

7-foot row spacing = 2.0-foot spacing within row

8-foot row spacing = 1.8-foot spacing within row

9-foot row spacing = 1.6-foot spacing within row

10-foot row spacing = 1.5-foot spacing within row

Heavy seeded species, those suitable for drilling, will usually comprise the main part of the stand. Lighter seeded species, those suitable for broadcast seeding, will be used for diversity and micro-site establishment within the stand.

Plant acorns 1-3 inches deep and nuts 2-5 inches deep. A good rule of thumb is to plant to a depth that is twice the diameter of the seed. For light seeded species that are broadcast, cultipack the site after seeding. Plant seed from seed suppliers or seed collected as close to the site as possible.

White oak, bur oak, and swamp white oak acorns must be planted as soon as possible after collection. It is extremely important that the site is prepared for planting before the acorns are received or collected. These acorns sprout in the fall and begin growing before the ground freezes and do not require the cold stratification that the red oak family, the walnuts, and the hickories require.

Red oak acorns can be stored, if necessary, if kept in cold damp conditions 35 to 40 degrees F. Fall seeding is preferred over storage and seeding should be done immediately after receiving or collecting seed. Many species require cold stratification to stimulate germination in spring and it is difficult to create the required conditions unless climate controlled storage is available. Immersing acorns in water prior to planting will restore any moisture lost during collection. Soak

from 4 to 24 hours. If seeding is delayed more than a few days, seed will be placed in porous bags, such as onion bags, in cold storage, 35 to 40 degrees F. Keep heavy seeded species moist, but not wet until planting. Keep light seeded species dry until planting. Do not allow seed to heat up and never place seed in the sun. Inspect seeds for storage losses prior to planting.

October/November of the year before planting, order nursery stock and/or begin direct seeding as appropriate for the species.

Nursery Stock Spacing

Density of plantings will vary by species, intent of the planting, soil site conditions, and other factors. For most multiple purpose plantings, use Table 2 when planning the amount of planting stock required. **Specific Program requirements (CRP, Managed Forest Law, etc.) may dictate the amount of stock needed and spacing.**

For specialty plantings (windbreaks, Christmas trees) consult specific standards and/or fact sheets.

April/May of planting year inspect sites to be planted for weed problems and apply chemical or mechanical weed control as needed prior to planting. Inspect sites direct seeded the previous fall for weed problems and treat as necessary. Plant tree and shrub seedlings from late March until early May as soon as they arrive. Seedlings may be planted by hand using a shovel or planting bar, or with a tree planting machine. Many counties have planting machines available for rent.

Planting Information

Plant seedlings as soon as they arrive. Do not allow seedlings to lay in the sun or dry out. Do not take large amounts of seedlings to the field where they will dry out before planting. Take small amounts and store the rest in a cool, shaded location and keep moist, but not wet until planted. Do not open the shipping containers until ready to plant. If stock in bundles has been exposed to warm temperatures, the bundles should be opened to prevent heating. Wet roots if needed. Keep tops dry.

Stock to be planted in a few days can be stored in a cellar, open shed, or similar cool place. Stock held over a week should be stored in a cooler.

During planting, keep roots wet. Dry roots mean dead trees/shrubs.

Plants developing "J" roots will die. Seedling roots should hang free and just touch the bottom of the hole. When the root length on seedlings exceeds the depth of the planting tool being used, roots may be pruned to the proper length. Use a sharp tool such as a large scissors, pruning shears, or a machete. Root systems can be pruned at 8-10 inches below the root collar provided a shoot to root ratio of 2:1 or less can be maintained. Dip the roots in water immediately but do not leave roots submerged in water. Moisture enhancers or root gels may be used to keep roots moist and repack the trees in the original containers. Removal of any part of the root system will have an adverse impact on seedling vigor so pruning is not recommended. It is better to modify the depth of planting whenever possible, than to prune roots.

Tree planting machines are available in most counties. If the site is suitable for machine planting, this method is usually cheaper.

Hand planting may be done with shovel, hoe, planting bar, mattock, or other hand tool. The hole should be large enough to avoid doubling of roots.

If cuttings are used, they must be kept moist and cool until planted. Cuttings should be buried, except for exposed tip, with at least two buds above ground.

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Table 1

Species	Planting Method	Collect	Sound Seeds Per Acre	Pounds Per Acre
Northern Red Oak	Drilled	Sept - Oct	3,000	24 lbs.
White Oak	Drilled	Sept - Oct	3,000	25 lbs.
Bur Oak	Drilled	Aug - Nov	3,000	40 lbs.
Swamp White Oak	Drilled	Sept - Oct	3,000	25 lbs.
Black Walnut	Drilled	Sept - Oct	3,000	75 lbs.
Shagbark Hickory	Drilled	Sept - Oct	3,000	30 lbs.
Ash	Broadcast	Aug - Oct	1,000	.13 lb.
Sugar Maple	Broadcast	Sept - Oct	1,000	.16 lb.
Red Maple	Broadcast	Apr - July	1,000	.04 lb.
Basswood	Broadcast	Oct - Nov	1,000	.2 lb.
Black Cherry	Broadcast	Aug - Oct	1,000	.2 lb.

Table 2: Common Tree/Shrub Spacings

Spacing (feet)	Plants Per Acre
6 x 6	1210
6 x 8	907
5 x 10	871
6 x 10	726
7 x 7	889
7 x 10	622
8 x 8	681
8 x 10	544
8 x 12	453
9 x 9	538
10 x 10	436
10 x 12	363
12 x 12	302

Measuring the Benefits of the Cover Crop Practice

One of the goals of conservation planning is to consider the effects of conservation practices and systems on soil quality. A number of assessments tools exist to measure the impact of the Cover Crop practice.

Assessing Cover Crop Value as it relates to Soil Quality Benefits

1. The Revised Universal Soil Loss Equation (RUSLE2) and Wind Erosion Prediction System (WEPS) planning software is used to evaluate the impact of cover crop management decisions have on soil loss levels. In addition, RUSLE2 has the Soil Condition Index (SCI) that determines a relative value for anticipated Organic Matter based on management of the cover crop.
2. A soil health assessment is used to determine existing soil characteristics. Typical soil health assessments include soil organic matter levels, soil respiration rates, soil bulk density, soil penetrometer readings, soil infiltration rates and observation of soil cohesion utilizing the slake test.
3. Observable reduction in soil erosion (sheet, rill, ephemeral, and gully). Cover crops increase vegetative and residue cover during periods when erosion energy is high. The addition of cover crops to low residue cropping systems such as corn silage and vegetables can substantially decrease soil erosion.
4. Observable soil porosity improvements due to an increase of biomass, that when decomposed, increases soil organic matter content promoting increased microbial activity and aggregation of soil particles. As a result, soil porosity is increased and bulk density is decreased. **Caution**: avoid planting cover crops when soils are saturated to avoid compaction, or use alternative establishment methods such as aerial over seeding.
5. Observable soil aggregate stability which results in less soil crusting. Cover crops reduce soil crusting by protecting the soil surface from the direct impact of rain drops. The resulting increase of soil organic matter, improved infiltration, and increased aggregate stability will further reduce soil crusting and improve the uniformity of seed germination.
6. Adequate soil surface cover and the improved aggregate stability will reduce erosion and surface water run-off and increase water infiltration rates. Channels created by cover crop roots and earthworms form macropores that further improve infiltration. Cover crops, especially small grains, can effectively capture and utilize excess nitrogen to prevent infiltration below the crop root zone.
7. Cover crops reduce the volume of surface runoff resulting in reduced nutrient losses. Decomposition of cover crop or green manure biomass provides a slow release of nutrients to the root zone. Legume crops fix atmospheric nitrogen and provide nitrogen for the main crop. Legumes also capture more phosphorus than grass or small grains. Small grains are useful as catch crops to utilize end of season nitrogen, which reduces the potential for nitrogen leaching. Planting cover crops on continuous corn silage fields with a history of repeated manure applications during late summer is highly beneficial.
8. Nutrient Immobilization can be observed when decomposition releases available nitrogen to the next crop.

   The carbon-to-nitrogen (C:N) ratio is a relative estimate of the nitrogen necessary to decompose an organic matter (crop residue) source. A C:N ratio of 50:1 or higher will temporarily "immobilize" soil nitrogen. The immobilization is a result of microbes consuming readily available soil nitrogen during the decomposition of crop residue. The nitrogen will remain immobilized until the microbes deplete the crop residue or other organic matter sources.

   Young cereal rye plants have a 14:1 C:N ratio as compared to corn stalks with a 60:1 C:N ratio. The C:N ratio for most clover plants is generally 15:1, which allows nitrogen to quickly become available to the following crop.
9. Cover crops can reduce pesticide loss by reducing surface water runoff resulting in reduced pesticide losses. Increased organic matter increases soil biological activity that can increase the breakdown of pesticide residues.

10. Visible reduction in weed pressure is due to reduced light, seed/soil contact and soil temperatures. The release of chemical compounds by the cover crop (allelopathy) may also inhibit weed growth.

    The potential for a negative impact on the primary crop can be reduced by killing the cover crop two to three weeks prior to planting and ensuring good seed/soil contact during seed placement.

11. Soil moisture can be improved when cover crops and green manure crops remove excess moisture from wet soils, resulting in reduction of "waterlogging" in poorly drained soils.

Specie Selection and Seed Quality

- Select species that are adapted to soil, climatic, and ecological site conditions.
- Select species suited for the planned purpose and specific site conditions.
- Do not plant species identified as restricted or prohibited by law.
- Inoculate legumes with the proper Rhizobium bacteria.
- Non-commercial seed can be used, as long as the seed has been tested for pure seed (purity), germination, and other mechanical qualities, such as inert matter and other crop or weed seeds.
- Seeding rates are based on pure live seed. Producer needs to be able to prove seeding was completed on a pure live seed basis.

Seedbed Preparation and Seeding

Site preparation shall be adequate to assure weed suppression and to promote germination and growth of the species planted. Seedbed preparation and seeding methods are determined as a result of the following:

- Resource concern and/or objective for planting the cover crop
- Cover crop life cycle (overwintering)
- Current soil surface conditions, moisture levels, existing biomass (surface cover)
- Planned harvest date of the primary crop
- Estimated growing degrees units remaining prior to the average killing frost
- Availability of labor/time and equipment

Seeding Methods

Wisconsin NRCS Conservation Practice Standard 340 - Cover Crop, supports several seeding and planting options to establish cover crops. Successful cover crop plantings require seeding within the recommended dates, seeding methods that ensure adequate seed to soil contact and sufficient soil moisture to support seedling growth.

Cover crops may be drilled, no-tilled, slurry applied, broadcast inter-seeded, over-seeded or frost seeded with or without incorporation depending on field conditions. Incorporation of seed following planting by light shallow tillage, or use of a ring roller, culti-packer or similar tool to embed the seed will result in a more uniform seedling emergence. The following non-traditional establishment methods can be used to expand the settings where cover crops can be utilized.

Slurry Seeded Cover Crops - Slurry-enriched seeding is a process that combines low-disturbance tillage, manure application and the seeding of cover crops into one operation. This technique is efficient and effective in untilled crop fields. Cover crop seed is mixed directly with liquid manure in the manure tanker. Cover crop species best suited to plant with this system include; cereal rye, wheat, annual ryegrass, oil seed radish, red, ladino and crimson clover.

For additional details on slurry seeding refer to the following link: http://www.mccc.msu.edu/SlurrySeeding.html.

Frost Seeding is categorized as broadcast or aerial seeding occurring mid to late March through early April during the active freezing and thawing cycle. Warm daytime temperatures combined with low overnight temperatures cause the surface of the soil to freeze and crack. Frost seeding takes skill in determining the exact conditions that are favorable and in assuring the crop will not freeze after emergence.

Guidelines when frost seeding cover crops:

1. Seedbed conditions must favor good seed to soil contact: a) un-tilled winter wheat or soybean residue fields are ideal seedbed conditions, b) frost seeding SHALL NOT occur on un-disturbed heavy residue corn fields or similar conditions, c) when seedbed preparation is necessary to prepare a uniform seedbed in the fall prior to freeze-up and maintain 30-70% residue surface cover.
2. Frost seeding SHALL NOT occur on areas covered with solid ice or snow cover depth greater than 2 inches.
3. Frost seeding shall be completed before the end of the freeze and thaw cycle. Note: Ideal frost seeding conditions vary from year to year, and in certain years the window for seeding may amount to a few days.

CAUTION: Because the risk for failure is high, this practice requires a variance from the Area Resource

Conservationist or State Agronomist except for the red clover inter-seeded into dormant winter wheat.

Refer to UW-Publication— "Frost Seeding Red Clover in Winter Wheat" for additional details: http://ipcm.wisc.edu/downloads/nutrient-managment/

Broadcast inter-seeding or over-seeding without incorporation may be used to establish a cover crop into a fully mature crop scheduled for harvest in the near future. The terms inter-seeding and over-seeding, are used interchangeably defining seeding techniques where the cover crop is seeded over the top of an un-harvested crop without incorporation into the soil.

When broadcasting cover crops, seed germination depends on the presence of adequate moisture at the soil surface or within the crop residue layer. Dry conditions will result in poor germination due to limited seed to soil contact. The following guidelines will reduce the risk of seeding failure, when cover crops are broadcasted.

Guidelines for broadcasting cover crops:

1. Assess site for one or more of the following conditions: a) moist, friable soil surface, b) 30% soil surface residue cover to conserve surface moisture for seed germination and c) high probability of rainfall after seeding.
2. Seeding as early as possible within the recommended seeding dates will improve stand density and vigor.
3. Select species known to have the highest germination rate may favor broadcast methods. Below are specie groupings in numeric order beginning with the highest probabilities of successfully germinating:
   - » Group 1: small grains
   - » Group 2: annual/perennial rye grass
   - » Group 3: small seed brassicas
   - » Group 4: small seed legumes

Note: Large legume seed crops are not recommended for aerial seeding.

Additional guidelines when broadcasting cover crops into standing crops:

1. Corn for grain: Do not over-seed cover crops when corn is immature or green. Cover crops should be over-seeded after the corn has begun to dry down, silks are brown and leaves are dried up to the ear and turned down. This timing will minimize the potential for seed to be trapped in leaf whorls and will allow sunlight to reach the ground between the rows.
2. Corn for silage: Cover crops should not be over-seeded into corn that will be harvested as silage, more than 21 days prior to the planned harvest date.
3. Soybeans: Over-seed cover crops into standing un-harvested soybeans when 50% of the leaves are yellow and/or prior to 50% leaf drop.
4. Red clover into winter wheat: Over-seed red clover into dormant winter wheat by frost seeding during the active freeze and thaw cycle (late February to mid-March).
5. Red clover into snap beans: Over-seed red clover during the last cultivation of snap beans.

Fertilization

Cover crops usually follow heavily fertilized crops and do not require fertilization. Fall-planted fibrous rooted grasses or small grains will scavenge leftover nitrogen from the previous crop. Legume cover crops will add nitrogen to the system for the following crop. For these reasons, fertilizer is not required unless the site condition warrants it.

Seed Mixtures for Cover Crops

The seeding mixture used will depend on the objective and identified resource concern. Cover crops can include a diverse mix of grass, non-legume broadleaf and legume plants. The seed mixture should create a balanced stand of above ground biomass and root structure to enhance soil building. Seed mixtures that develop a full canopy will maximize snow retention, soil surface coverage, reduce soil erosion and may be utilized for livestock forage. A mixture of grasses, non-legume broadleaf (brassicas, buckwheat, etc.) and legume plants will improve the soil's biological activity. A mixture of plant species will feed beneficial organisms, improve soil structure, reduce compaction, improve water infiltration/water holding capacity and increase the amount of available nutrient exchange sites in the soil.

Cover crop mixtures are often recommended when the goal is to address multiple objectives and resource concerns. When considering multiple species mixtures, consider the effects of; specie growth characteristics, anticipated growing conditions, nutrient needs, planned seeding rate and the termination method and date.

Use the following references to evaluate cover crop species for growth characteristics and conservation benefits: Table 2 "Identification and Comparison of Cover Crop Performance and Benefits by Species".

Table 3 "Morphology, Physiology and Growth Requirements". "Midwest Cover Crop Decision Tool" http://mccc.msu.edu/index.htm.

Single and Multiple Species Seeding Rate Calculation

When designing cover crop seed mixtures, the seeding rate recommendation is based on the seeding method selected. Cover crops that are drilled, no-tilled, or broadcast and incorporated, the minimum recommended seeding rate or higher can be planned. Cover crop seeding methods such as broadcast over-seeding or inter-seeding, slurry seeded, frost seeded and other methods, where seed to soil contact is of concern, a higher recommended seeding rate is required. When designing multiple cover crop seed mixtures, multiply the minimum seeding rate for each selected plant species by the planned percentage of each species. The "planned percentage" represents a general proportion of the seed to be planted per species and is not a direct calculation of seeds per square foot or an estimate of canopy cover or plant dominance of a given species. Refer to Table 1 "Cover Crop Species Recommended for Planting in Wisconsin" for the recommended seeding rate per species.

A waiver from the State Agronomist or Area Resource Conservationist for NRCS is required when:

1. Less than **one pound** of seed per plant species is required when designing seed mixtures.
2. More than 4 species are included in the seed mixtures.
3. Cover crops are planted later than the recommended ending seeding date.

Calculating Seeding Rates and Mixes:

Minimum Table 1 seeding rate range or higher per species multiplied by the planned percentage of each species will determine the pounds of seed per plant species to be planted per acre.

Round up to the next full pound of seed if the seeding rate calculation results in a decimal of 0.5 or larger.

Example Seeding Mixture Calculation Results

Spring Mix—Cover crop will be drilled into soybean stubble. The landowner selected the seed mixture below:

40% oats…minimum seeding rate 30 lbs./ac. (Table 1)

40% oilseed radish 4 lbs./ac. (Table 1)

20% field pea 65 lbs./ac. (Table 1)

Actual seeding rates:

Oats= 30 lbs X 40% = 12 lbs for the mix per acre

Radish=4 lbs X 40%= 1.6 which rounded up is 2 lbs for the mix per acre

Pea=65 lbs X 20%=13 lbs for the mix per acre

Cover Crop Attributes

The following summary of cover crop attributes provides additional information (advantages and disadvantages) regarding the species listed in Table 1. Refer to Table 2 for performance and roles of cover crops.

Alfalfa (Medicago sativa)

- Advantages: nitrogen fixer, crude protein: 14-22%, forms arbuscular mycorrhizal associations, attracts pollinators, good at scavenging nitrogen from the soil, and break up compaction.
- Disadvantages: produces autotoxcity and will not tolerate wet sites.

Annual Ryegrass (Lolium multiflorum)

- Advantages: quick-growing non-spreading bunchgrass, establishes quickly even in gravelly or wet soils, excellent for trapping nitrogen, dense shallow root system improves water infiltration and enhances tilth, improves early season weed control, attracts few insect pests and generally can help reduce insect pest level, can be over-seeded into corn or soybeans after leaves turn yellow, self-pollinating, and forms arbuscular mycorrhizal associations.
- Disadvantages: can host high densities of Penetrans Root-Lesion Nematode.

Barley, Spring/Winter (Hordeum vulgare)

- Advantages: produces a deep fibrous root system, produces more biomass than any other small grain crop, will scavenge significant amounts of nitrogen, releases allelopathic chemicals that help suppress weeds, drastically reduces root-knot nematode populations, has a higher nutritional value than oats or wheat, works well in cocktail mixtures, prefers mesic soil conditions.
- Disadvantages: fusarium head blight can be a problem when other small grains are planted within one year and disease problems (especially with tan spot) can be problematic, avoid planting barley after winter wheat.

Berseem Clover (Trifolium alexandrinum)

- Advantages: extremely vigorous tall annual white clover, tolerant of wet conditions, crude protein: 27-29%, excellent nitrogen fixer, forms arbuscular mycorrhizal associations, flowers attract bees, excellent weed suppressor.
- Disadvantages: none.

Buckwheat (Fagopyrum esculentum)

- Advantages: provides quick soil cover, excellent weed suppressor, provides nectar for pollinators and other beneficial insects, loosens topsoil, rejuvenates low fertility soils, dense fibrous root cluster in the top 10 inches of soil providing an extensive root surface area for nutrient uptake, extracts soil phosphorus from the soil better than most grain-type cover crops, residue decomposes quickly releasing nutrients to the next crop, excellent choice to follow early vegetables, popular honey bee pollinator.
- Disadvantages: sets seed quickly, will reseed and may become a weed if flowers mature, frost sensitive, will not germinate/thrive in cold soils, and highly attractive to Japanese Beetles.

Canola/Rape (Brassica napus)

- Advantages: flowers attract pollinators, good at scavenging nitrogen from the soil, crude protein: hay 16%, grain 21%, silage 12%, pasture 17%.
- Disadvantages: susceptible to sclerotinia, host for Penetrans Root-Lesion Nematode.

Cereal Rye, Winter (Secale cereale)

- Advantages: tremendous biomass production, can be seeded later in the fall than other cover crops, germinate at temperatures as low as 34°F and produce vegetative growth at 38°F, reduces nitrate leaching, excellent weed suppressor, secrete compounds that will inhibit germination of weeds such as lambquarters, redroot pigweed, dandelions, and Canada thistle, few diseases affect rye as compared to other small grains, can be over-seeded in field crops, can be grown on a wide range of soils and will increase the concentration of exchangeable K near the surface by means of its fibrous root system, tolerates triazines herbicides, excellent for scavenging nitrogen, medium water use.
- Disadvantages: may become a weed when terminated too late, not recommended before corn in rotation, host for Penetrans Root-Lesion Nematode.

Chicory (Cichorium intybus)

- Advantages: rapid growth, excellent forage crop, crude protein: 20-32%, attracts pollinators, rooting depth 4 to 5 feet, forms arbuscular mycorrhizal associations, used in mixtures, grows well under droughty conditions.
- Disadvantages: none.

Cow pea (Vigna unguiculata)

- Advantages: provides 50 to 100 pounds of nitrogen, attracts pollinators, forms arbuscular mycorrhizal associations.
- Disadvantages: none.

Crimson Clover (Trifolium incarnatum)

- Advantages: grows well on poorly drained soils, use as a winter kill annual, utilize as hay, pasture, favored legume of organic farmers, attracts pollinators, grows well in extreme heat.
- Disadvantages: host for root knot nematode and Penetrans Root-Lesion Nematode.

Field Pea (Pisum satuvum)

- Advantages: residue breaks down and releases nitrogen quickly, provide nitrogen at a rate of 50 to 100 pounds per acre, mix well with oats and barley, excellent for soil building and water use is low.
- Disadvantages: can lead to aphanomyces problems when in rotations with alfalfa, susceptible to sclerotinia.

Forage/Oilseed Radish (Raphanus sativa)

- Advantages: deep root crop, excellent for compaction control, crude protein: 26-30%, good for scavenging nitrogen from the soil, flowers attract pollinators and excellent for grazing.
- Disadvantages: winter kills at 25°F, odor during decay, host for root knot nematode, Penetrans Root-Lesion Nematode, and sugarbeet cyst nematode.

Forage Turnips (Brassica rapa)

- Advantages: root crop, crude protein: leaf tops 16%, root 12-14%, forms arbuscular mycorrhizal associations, rated good for scavenging Nitrogen, flowers attract pollinators, excellent for grazing.
- Disadvantages: can become a serious weed if allowed to go to seed, host for root knot nematode, Penetrans Root-Lesion Nematode, and sugarbeet cyst nematode.

Hairy Vetch (Vicia villosa)

- Advantages: provides 60 to 120 pounds of nitrogen, attracts pollinators, used in a cocktail mixtures, only vetch species that can

be fall seeded and reach maturity the next year, can withstand trampling from grazing animals during May and June, adapted to a wide range of soil types, but prefers loamy and sandy soils.

» Disadvantages: stems are weak and have a tendency to lodge, when seeded with a small grain, the weak stems are supported by the tangling of the tendrils with the small grain stalks, do not plant hairy vetch with a winter grain if you desire to harvest grain for feed or sale, fall seeded hairy vetch will winterkill with temperatures less than 15 degrees with no snow cover, certain species of nematodes increase with hairy vetch, Spring/summer seeding is less successful.

Japanese Millet (Echinochloa frumentacea)

» Advantages: fast growing annual grass, tolerates frequent clipping, makes excellent forage and hay, tolerate both droughty and wet soils, excellent feed source, good choice for converting land to vegetable production.

» Disadvantages: will not germinate/thrive in cold soil, host for Penetrans Root-Lesion Nematode.

Oats (Avena sativa)

» Advantages: provide quick weed suppressing biomass, naturally occurring compounds in roots and residue can hinder weed growth, excellent nutrient catch crop, improves productivity of legumes when planted in mixes, inexpensive to establish.

» Disadvantages: slow to release nitrogen to following crops, unless growth is terminated in mid-vegetative stage (12 to 18 inches), host for Penetrans Root- Lesion Nematode.

Pearl Millet (Pennisetum glaucum)

» Advantages: forms arbuscular mycorrihizal associations, excellent for grazing, low water use requirements, self-pollinator.

» Disadvantages: slower to establish than sorghum or sudangrass, will not germinate/ thrive in cold soil.

Red Clover (Trifolium pratense)

» Advantages: provides 70 to 120 pounds of nitrogen, crude protein: 15%, flowers attract bees and can be used in cocktail mixtures.

» Disadvantages: host for root knot nematode and Penetrans Root-Lesion Nematode.

Sunflower (Helianthus annuus)

» Advantages: deep rooted, effective in mining mobile nutrients deep in the soil profile, attracts pollinators, forms arbuscular mycorrhizal associations, can be used cocktail mixtures.

» Disadvantages: may increase sclerotinia inoculum.

Sorghum-Sudangrass Hybrids (Sorghum bicolor x S. bicolor var. Sudanese)

» Advantages: tall fast-growing heat-loving summer annual, suppress some nematodes species, seedling, shoots, leaves and roots secrete allelopathic compounds that suppress weeds, has an aggressive root system that relieves compaction, mowing stalks increases root mass 5 to 8 times compared with un-mowed stalks and forces the roots to penetrate deeper making the root system an excellent subsoil aerator, drought tolerant, will tolerate a pH range of 5 to 9, nutrient uptake increases on sandy soils, self-pollinator, medium water use required, forms arbuscular mycorrhizal associations.

» Disadvantages: requires fertile soils, mature plants terminated by frost-killed become quite woody.

Sudangrass (Sorghum bicolor)

» Advantages: tall fast-growing heat-loving summer annual, suppress some nematodes species, seedling/shoots/leaves and roots secrete allelopathic compounds that suppress weeds, has an aggressive root system that relieves compaction, mowing stalks increases root mass 5-8 times compared with un-mowed stalks and forces the roots to penetrate deeper, making the root system an excellent subsoil aerator, drought tolerant, will tolerate a pH range 5-9, nutrient uptake increases on sandy soils, self-pollinator, medium water use required, forms arbuscular mycorrhizal associations.

» Disadvantages: requires fertile soils, frost damaged plants can cause prussic acid poisoning in livestock, drought stressed plants can cause nitrate poisoning, host for Penetrans Root-Lesion Nematode.

White Clover (Trifolium repens)

» Advantages: crude protein 24-30%, forms arbuscular mycorrhizal associations, flowers attracts bees.

» Disadvantages: will not tolerate droughty soils and has a shallow root system.

Triticale, Winter (Triticum x Secale)

» Advantages: crude protein: hay 9-16%, grain 17%, self-pollinator, forms arbuscular mycorrhizal associations, excellent weed suppressor and excellent for grazing.

» Disadvantages: seed is more expensive than wheat or rye.

Wheat, Winter/Spring (Triticum aestivum)

» Advantages: excellent weed suppressing crop, can be over-seeded into corn or soybeans, produces a tremendous amount of biomass, excellent nitrogen scavenger.

» Disadvantages: host for Penetrans Root-Lesion Nematode, when planted in rotation with other small grains within a year there can be disease problems (especially with tan spot).

Termination of Cover Crops:

Cover crops will be terminated by frost, harvest or grazing for forage, roller crimping, tillage, and/or with proper herbicide selection. Timely termination of in season cover crops is required to reduce soil moisture depletion, nitrogen immobilization, allelopathy and to prevent unwanted re-seeding. Timing of cover crop termination must meet the purpose of the cover crop as specified in the conservation plan. Manage cover crop surface residue and biomass production to meet objectives specified in the conservation plan. In vineyards and small fruit operations, grow cover crop in aisles, mow as necessary for mulch cover and maintain as short stubble. Adjust nitrogen application rates for the subsequent crop based on nitrogen credits for specific cover crop species from University of Wisconsin nutrient guidelines.

(a) Herbicide Termination:

Herbicide selection for termination must be made by a Certified Pesticide Applicator, Certified Crop Advisor or qualified Extension Specialist following pesticide labeling and must be compatible with the following main crop to grown.

(b) Winter Kill Termination:

Insure that planned cover and biomass production levels can be achieved for the specific cover crop purpose from the conservation plan when using cover crop species that terminate by frost or winter kill. When the objective of the conservation plan is to allow fall manure applications to in high Nitrogen Leaching soils, winter kill termination is not an option and winter hardy cover crops must be used.

(c) Grazing/Haying Termination:

Cover crops grazed or harvested for forage as a termination method will have a specified amount of target residual biomass left in the field to meet the cover crop objective(s) outlined in the conservation plan. Employ additional termination methods as needed once grazing/haying has concluded and target biomass is achieved and documented. When cover crops are grazed, potential adverse reactions from cover crop consumption by grazing animals must be monitored at all times.

(d) Tillage Termination:

Use inversion type tillage implements that will adequately bury and kill the cover crop.

(e) Roller/Crimper Termination:

Rolling/crimping will take place at the proper cover crop growth stage to limit regrowth potential. For small grains this stage is at the boot or grain head stage, for legumes the flowering stage. Direction of rolling/crimping will coincide with planting direction when no-till planting the subsequent crop. Crimpers must break the plant stems in three or more places to be effective. Crimping must be done prior to seed set stage in order to prevent tillering or reseeding of the cover crop.

For additional NRCS cover crop termination criteria refer to: "NRCS Cover Crop Termination Guidelines". http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/

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Midwest Cover Crop Decision Tool: http://mcccdev.anr.msu.edu/

Planting Winter Cereal Rye after Corn Silage: http://www.soils.wisc.edu/extension/covercrop.php

NRCS Cover Crop Termination Guidelines: http://www.nrcs.usda.gov/wps/portal/nrcs/main/ national/landuse/crops/

National Agricultural Aviation Association website: http://www.agaviation.org/

UW Extension Publications: Cover Crop Termination, Forage Herbicide Quick Sheet – Cereal Rye Forage after Corn Silage, Forage Herbicides Quick Sheet – Spring-Seeded Forages after Corn and Herbicide Rotation Restrictions in Forage and Cover Cropping Systems located at the Wisconsin Crop Weed Science Website: http://wcws.cals.wisc.edu

Table 1: Cover Crop Species Recommended for Planting in Wisconsin

Species	[1] Minimum Seeding Rate in lbs. bu./ac. (incorporated seed)		[2] Minimum Seeding Rate in lbs. bu./ac. (non-incorporated seed)		Seeding Date (statewide)	Planting Depth (inches)
GRASSES	lbs.	bu.	lbs.	bu.		
Annual Ryegrass (Lolium multiflorum)	15	0.7	20	0.8	4/10-6/1, 8/1-9/1	¼ to ½
Barley, Spring (Hordeum vulgare)	50	1.0	63 to 75	1.3 to 1.6	4/10-6/15, 7/15-9/1	¾ to 1½
*Japanese Millet (Echinochloa frumentacea)	22	0.5	28	0.6	6/1-7/15	½ to ¾
*Sorghum□Sudangrass (Sorghum bicolor x S. bicolor var. Sudanese)	28	0.6	33	0.7	6/1-7/15	½ to 1½
*Sudangrass (Sorghum biclor)	28	1.0	33	1.2	6/1-7/15	½ to 1
*Pearl Millet (Pennisetum glaucum)	22	0.5	28	0.6	6/1-7/15	½ to ¾
Wheat, Spring (Triticum aestivum)	50	0.8	70 to 90	1.2 to 1.5	4/10-6/15, 7/15-9/1	¾ to 1½
Barley, Winter (Hordeum vulgare)	50	1.0	63 to 75	1.3 to 1.6	8/15-9/15	¾ to 1½
Cereal Rye, Winter (Secale cereale)	60	0.9	90 to 120	1.6 to 2.1	7/15-10/15	¾ to 1½
Oats (Avena sativa)	30	0.9	45 to 60	1.4 to 1.9	4/10-9/1	½ to 1½
Wheat, Winter (Triticum aestivum)	50	0.8	70 to 90	1.2 to 1.5	8/1-10/1	¾ to 1½
Triticale, Winter (Triticum x Secale)	50	1.0	70 to 90	1.3 to 1.9	8/1-10/1	¾ to 1½
NON-LEGUMES BROADLEAF	lbs.	bu.	lbs.	bu.		
*Buckwheat (Fagopyrum esculentum)	20	0.4	35	0.7	5/15-8/1	½ to 1
**Oilseed Radish (Raphanus sativus)	4	--	12	--	4/10-6/15, 7/15-8/15	½ to ¾
*Sunflower (Helianthus annuus) (part of a mix)	1	--	2	--	6/1-7/15	1 to 1½
*Chicory (Cichorium intybus) (part of a mix)	1	--	2	--	4/10-6/1, 8/1-9/1	½ to ¾
Rapeseed/Canola (Brassica napus)	2	--	6	--	4/10-6/15, 8/1-8/15	½ to ¾
Forage Turnips (Brassica rapa)	1	--	5	--	4/10-6/15, 7/15-8/15	¼ to ½
LEGUMES	lbs.	bu.	lbs.	bu.		
Alfalfa (Medicago sativa)	13	--	16	--	4/15-6/1, 8/1-8/30	¼ to ½
Berseem Clover (Trifolium alexandrinum)	9	--	17	--	6/1-8/1	¼ to ½
*Cowpea (Vigna unguiculata)	55	0.9	99	1.7	6/1-7/15	1 to 1½
*Field Pea (Pisum satuvum)	65	2.6	100	4.0	4/10-6/15	1 to 1½
Hairy Vetch (Vicia villosa)	15	--	20	--	4/10-6/15, 7/15-9/15	1 to 1½
*Peas, Winter (Pisum sativum subsp. arvense)	65	2.6	100	4.0	8/1-9/1	1 to 1½
Red Clover (Trifolium pratense)	9	--	13	--	4/10-8/15	¼ to ½
White Clover (Trifolium repens)	7	--	9	--	4/15-6/1, 8/1-8/30	¼ to ½
Crimson Clover (Trifolium incarnatum)	11	--	17	--	6/1-8/1	¼ to ½

[1] Incorporated seed—Seeding methods used that provide good seed to soil contact (drilled, no-tilled, or broadcast and incorporated).

[2] Non-incorporated seed—Seeding methods used when broadcasting seed without mechanical incorporation (aerial, over-seeding/inter-seeding and frost seeding.

Cover crop seed mixture designs must include a minimum of 1 pound of seed per specie planted.

Note: lbs_bu/ac represent the numbers in sequence in the Table. For example: 15/0.7 refers to 15 lbs. or 0.7 bushel per acre.-

* Species with asterisk are not recommended for aerial seeding. Large seed legumes (cowpea, etc.) and summer annuals (Japanese millet, etc.) require adequate seed to soil contract.

** Spring seeding of oil seed radish must include the termination strategy to prevent the production of viable seed.

Table 2: Identification and Comparison of Cover Crop Performance and Benefits by Species

Species	Use [1]	N-Source	SoilBuilder	Erosion Fighter	Weed Fighter	Pest Fighter	N-Scavenger	Grazing	Quick Growth	Non-Fragile Residue	Pollinator	Deep Rooted
Alfalfa (Medicago sativa) [3]	C	4	3	3	3	1	2	3	3	1	3	4
Annual Ryegrass (Lolium multiflorum)	C	0	3	3	2	2	3	4	4	2	0	2
Barley, Spring (Hordeum vulgare)	C	0	3	3	3	1	3	3	3	4	0	2
Berseem Clover (Trifolium alexandrinum) [3]	C	4	2	2	2	1	1	4	2	1	3	1
Buckwheat (Fagopyrum esculentum)	C	0	2	3	3	1	3	1	4	0	4	4
Canola/Rapeseed (Brassica napus)	C	0	2	3	2	1	3	4	4	1	3	3
Cereal Rye, Winter (Secale cereale)	C	0	4	4	4	3	4	4	4	4	0	3
Chicory (Cichorium intybus)	E	0	2	2	2	0	2	3	2	1	2	3
Cowpea (Vigna unguiculata)	C	3	2	2	2	0	2	3	3	1	2	1
Crimson Clover (Trifolium incarnatum)	E	3	2	3	2	1	2	4	3	1	4	2
Field Pea (Pisum satuvum)	C	2	2	2	1	1	1	2	3	1	2	2
Forage Turnips (Brassica rapa)	C	0	1	3	2	0	3	4	3	1	1	1
Forage/Oilseed Radish (Raphanus sativus)	E	0	2	3	2	1	4	3	3	1	3	3
Hairy Vetch (Vicia villosa)	C	4	2	2	3	2	1	0	2	1	2	4
Japanese Millet (Echinochloa frumentacea)	C	0	3	3	3	3	3	3	4	4	1	3
Oats (Avena sativa)	C	0	3	3	3	2	3	4	4	2	0	2
Peas, Winter (Pisum sativum subsp. arvense)	C	2	2	2	1	1	1	2	3	1	2	2
Pearl Millet (Pennisetum glaucum)	C	0	3	3	4	2	3	4	4	4	1	2
Red Clover (Trifolium pratense)3	C	4	3	3	3	1	2	4	3	2	4	3
Sorghum-Sundangrass (Sorghum bicolor x S. bicolor var. Sudanese)	C	0	4	4	4	2	4	4	4	4	2	3
Sunangrass (Sorghum biclor)	C	0	4	3	4	3	4	4	4	4	2	3
Sunflower (Helianthus annuus)	E	0	2	2	2	1	3	1	3	3	3	4
Triticale, Winter (Triticum x Secale)	C	0	3	3	3	2	3	4	3	4	0	2
Wheat, Spring/Winter (Triticum aestivum)	C	0	3	3	3	2	3	4	3	4	0	2
White Clover (Trifolium repens) [3]	C	2	2	1	1	2	3	3	3	3	2	0

[1] Use: C=Common Use – Considerable state knowledge regarding species use.
E=Emerging Use – Limited state knowledge regarding species use.

[2] Attribute Ratings: 0=Poor, 1=Fair, 2=Good, 3=Very Good, 4=Excellent

[3] Legumes such as alfalfa and red clover may cause bloating of ruminant animals. Take necessary precautions to prevent bloat when grazing cover crops that contain these legumes.

Table 3: Morphology, Physiology and Growth Requirements

Species	Life Cycle	Growth Height	Preferred pH	Minimum Germination Temp	Heat Tolerance	Drought Tolerance	Shade Tolerance	Flood Tolerance	Low Fertility Tolerance	Winter Survival Dry Matter Production (.lbac/yr)		Termination Information
GRASSES												
Annual Ryegrass (Lolium multiflorum)	winter annual	upright	5.5 - 7.0	40	good	good	very good	very good	good	seldom	1000 - 6000	freeze, tillage, chemical
Barley, Spring (Hordeum vulgare)	cool season annual	upright	6 to 8	38	fair	good	fair	good	very good	never	2000 - 5000	freeze, tillage, mow, chemical, roller crimper
Barley, Winter (Hordeum vulgare)	winter annual	upright	6.0 - 8.0	38	fair	good	fair	good	very good	expected	2000 - 5000	tillage, mow, chemical, roller crimper
Cereal Rye, Winter (Secale cereale)	cool season annual	upright	5.0 - 7.0	34	fair	very good	good	very good	excellent	expected	2500 - 6000	freeze, tillage, mow, chemical, roller crimper
Japanese Millet (Echinochloa frumentacea)	summer annual	upright	4.6 - 7.0	65	excellent	excellent	fair	fair	very good	never	1500 - 3500	freeze, tillage, chemical
Oats (Avena sativa)	cool season annual	upright	4.5 - 6.0	38	fair	good	good	very good	very good	never	2000 - 6000	freeze, mow, tillage, chemical
Pearl Millet (Pennisetum glaucum)	summer annual	upright	5.5 - 7.0	65	excellent	excellent	fair	fair	excellent	never	2000 - 6000	freeze, tillage, chemical
Sorghum-Sundangrass (Sorghum bicolor x S. bicolor var. Sudanese)	summer annual	upright	5.5 - 7.0	65	excellent	excellent	fair	good	good	never	3000 - 8000	freeze, tillage, chemical
Sunangrass (Sorghum biclor)	summer annual	upright	5.5 - 7.0	65	excellent	excellent	fair	good	good	never	3000 - 8000	freeze, tillage, chemical
Triticale, Winter (Triticum x Secale)	winter annual	upright	5.2 - 7.0	38	fair	good	fair	good	good	expected	2000 - 5000	tillage, mow, chemical, roller crimper
Wheat, Spring (Triticum aestivum)	cool season annual	upright	6.0 - 7.0	38	fair	good	fair	good	good	never	2000 - 5000	freeze, tillage, mow, chemical, crimper
Wheat, Winter (Triticum aestivum)	winter annual	upright	6.0 - 7.0	38	fair	good	good	good	good	expected	2000 - 5000	tillage, mow, chemical, roller crimper
NON-LEGUMES BROADLEAF												
Buckwheat (Fagopyrum esculentum)	summer annual	upright to semi-upright	5.0 - 7.0	50	excellent	good	fair	fair	very good	never	1500 - 2500	freeze, tillage, chemical, mow
Chicory (Cichorium intybus) (part of a mix)	short-lived perennial	upright	5.0 - 7.0	50	very good	very good	good	good	very good	expected	1500 - 2000	tillage chemical
Forage Turnips (Brassica rapa)	cool season annual	upright	5.3 - 6.0	45	good	fair	good	fair	good	seldom	1200 - 3000	freeze, tillage, chemical
Oilseed Radish (Raphanus sativus)	cool season annual	upright	6.0 - 7.0	45	good	very good	good	fair	good	seldom	1200 - 3000	freeze, tillage, chemical
Rapeseed/Canola (Brassica napus)	winter/cool season	upright	5.5 - 8.0	41	good	good	good	fair	good	seldom	1000 - 2500	freeze, tillage, chemical
Sunflower (Helianthus annuus) (part of a mix)	summer annual	upright	5.7 - 8.0	44	excellent	excellent	good	fair	very good	never	250 - 500	freeze, tillage, chemical, mow
LEGUMES												
Alfalfa (Medicago sativa)	cool season perennial	upright	6.5 - 7.0	42	good	good	fair	poor	poor	expected	3000 - 8000	tillage chemical
Berseem Clover (Trifolium alexandrinum)	summer annual	upright	5.0 - 7.0	42	very good	good	fair	fair	fair	never	1200 - 3000	freeze, tillage, chemical
Cowpea (Vigna unguiculata)	summer annual	semi-upright to climbing	5.5 - 6.0	58	excellent	very good	fair	very good	very good	never	2000 - 3600	freeze, tillage, chemical, mow
Crimson Clover (Trifolium incarnatum)	winter annual	upright to semi-upright	5.5 - 7.0	42	very good	good	fair	very good	very good	never	3500 - 5500	freeze, tillage, chemical
Field Pea (Pisum satuvum)	cool season annual	climbing	6.0 - 7.0	41	fair	fair	fair	fair	fair	seldom	1200 - 3000	tillage, mow, chemical
Hairy Vetch (Vicia villosa)	winter/cool season annual	climbing	5.5 - 7.0	60	fair	good	good	good	good	expected	1800 - 4000	tillage, chemical, roller crimper
Peas, Winter (Pisum sativum subsp. arvense)	winter annual	climbing	6.0 - 7.0	41	fair	fair	fair	fair	fair	seldom or expected	1200 - 3000	tillage, mow, chemical
Red Clover (Trifolium pratense)	short-lived perennial	upright	5.0 - 8.0	41	very good	good	very good	good	very good	expected	2000 - 5000	tillage chemical
White Clover (Trifolium repens)	cool season annual	upright	5.5 - 6.5	42	fair	fair	fair	good	fair	expected	600 - 1000	tillage chemical

USDA United States Department of Agriculture

Wisconsin Agronomy Technical Note 10

Companion Document for Wisconsin Practice Standard 393 Filter Strip

Planning, Design, Management and Maintenance of Vegetative Filter Strips (VFS)

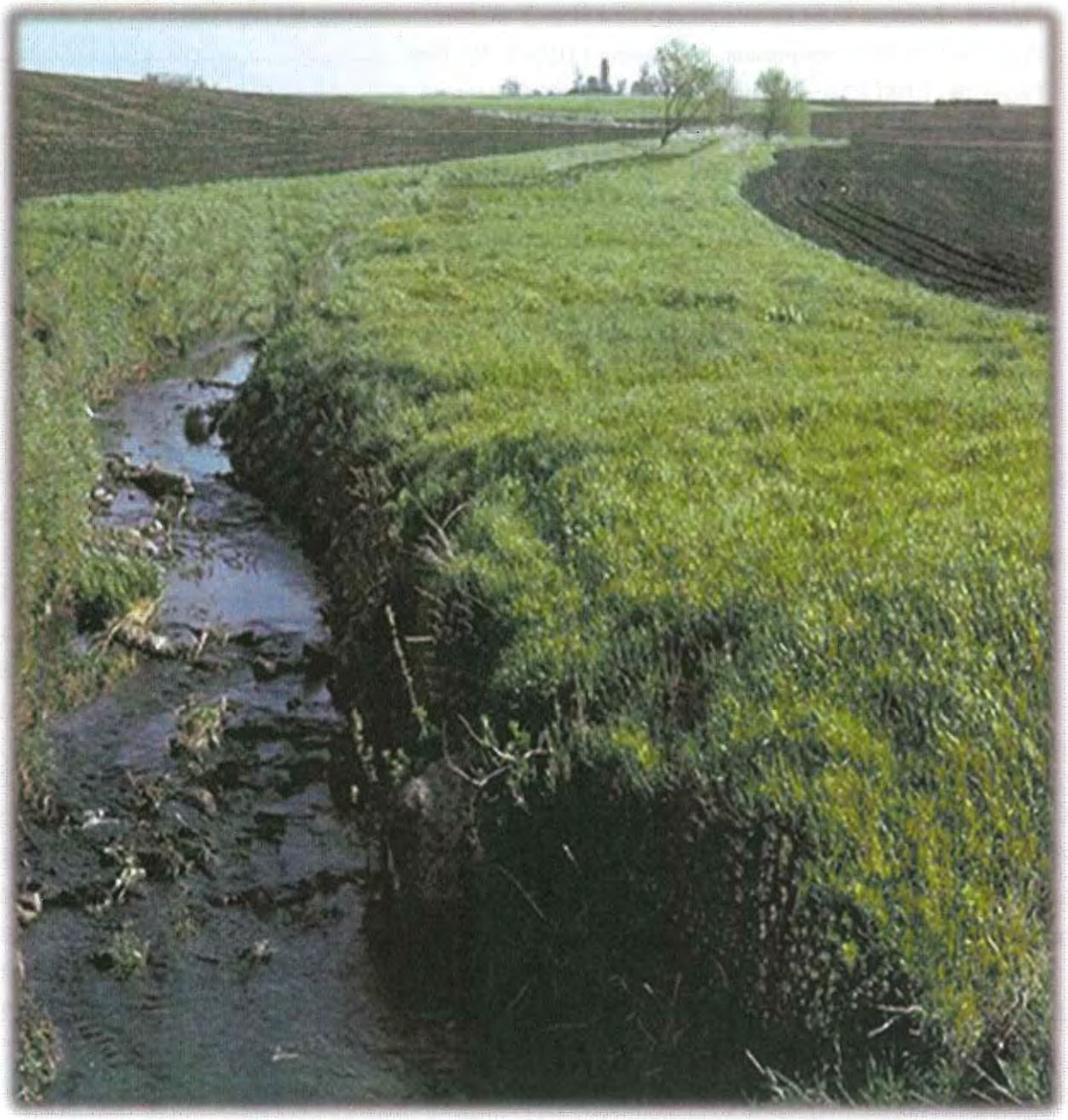


TABLE OF CONTENTS

A filter strip is a strip or area of herbaceous vegetation that removes contaminates from overland flow runoff. The two primary resource concerns are: 1) reduce suspended solids and associated contaminants in runoff, and 2) reduce dissolved contaminants in runoff and leaching of dissolved contaminants to groundwater.

INTRODUCTION

The objective of Wisconsin Agronomy Technical Note 10 is to serve as a companion document to Wisconsin NRCS Practice Standard 393 Filter Strip and provide technical guidance to conservation planners when planning, designing, managing, and maintenance of vegetative filter strips (VFS).

Accurate designs will help ensure that filter strips will achieve a desired level of protection. The width of a filter strip is an important design variable for determining the level of impact and the cost of installation.

CRITERIA FOR VEGETATED FILTER STRIP DESIGN WIDTH

NOTE: *Filter strips can be strategically located in the upper reaches of the landscape and are not required to be contiguous to Environmentally Sensitive Areas (ESA). See Figures 6-10 for examples of VFSs located adjacent to ESAs.*

Designing Filter Strips:

1. Calculate the size of the contributing area, and average erosion rates. Calculate the average slope and erosion rates occurring within 300 feet of the planned VFS. There is no resource concern when the discharge of surface water to the VFS is 0 or the VFS has no contributing drainage area.
2. The VFS shall be located down slope from the source area of runoff.
3. Overland flow entering the filter strip shall be uniform sheet flow.
4. Areas of concentrated flow in the contributing drainage area shall be evaluated and treated by dispersing concentrated flow conditions, where practical. When dispersing concentrated flow is not possible, the concentrated flow area shall be seeded to perennial vegetation.
5. The drainage area above shall have a slope of 1 percent or greater.
6. The maximum row gradient along the leading edge of the filter strip shall not exceed 5 percent.
7. Noncontiguous filter strips shall be located within 700 feet of the ESA needing protection.
8. For filter strips noncontiguous to the ESA, the following assessment guidance shall be implemented:
    a. The following additional VFS design assessment is required when an existing buffer is not immediately contiguous to the ESA. The Filter Strip cannot be over 700 feet from the ESA.
    b. The soil loss and sediment delivery for the area between the lower edge of the planned

noncontiguous filter strip and the ESA shall be computed using RUSLE2. The upper filter strip must reduce the delivery.

9. The VFS width shall be at least 20 feet or 30 feet if dissolved contaminants in runoff are the resource concern. The minimum width must be equivalent or greater than the 10-year life span width based on the Revised Universal Soil Loss Equation (RUSLE2) computations for the maximum sediment accumulation within the planned VFS.

10. Determine the minimum width based on the following design parameters:
    1. dominant hydrologic soil group within the footprint of the planned VFS,
    2. average slope within 100 feet upstream of the lower edge, and
    3. average slope within 100 to 300 feet upstream of the lower edge of the planned VFS.

    Refer to Table 1 and 2 to determine the minimum VFS width for the identified resource concern by following the steps below:
    1. Determine the point score in category 1, 2 and 3.
    2. Add the points from each of the categories.
    3. The minimum VFS width is based on the composite score for the identified resource concern using Table 2.

Table 1 - Design Parameters for Determining Minimum Filter Strip Width

Table 2 - Minimum VFS Width Requirements

Direct Contributing	Factor Points
1. Hydrologic Soil Group	
A	0
B	10
C	20
D	30
2. Average slope within 100 feet upstream of the low edge of the filter	
0-1%	0
>1-	5
>3-	15
>6-	30
3. Average slope from 100 - 300 feet upstream of the low edge of the filter	
0-1%	0
>1-	5
>3-	10
>6-	15
>12	20

Total Point Range	Minimum Filter Strip Width for Sediment Trapping[1]	Minimum Filter Strip Width for Dissolved Contaminants[1,2]
0-10	20 Feet	70 Feet
15-20	30 Feet	70 Feet
25-30	40 Feet	70 Feet
35	50 Feet	80 Feet
40	60 Feet	80 Feet
45	70 Feet	90 Feet
50	80 Feet	100 Feet
>50	100 Feet	120 Feet

[1]Soil hydrology group designation can be located at http://websoilsurvey.nrcs.usda.gov. Select the dominant hydrologic soil group that occupies the footprint of the planned VFS.

[1]The minimum VFS width is determined based on the sediment delivery rate in tons per acre, percent trapping efficiency and the ratio of the contributing area to the planned VFS.

[2]Dissolved contaminants include nitrogen, phosphorus, and pesticide active ingredients with high water solubility characteristics and other pollutants identified in runoff as a resource concern.

NOTE: *Minimum VFS design width, may be increased when recommended by the Conservation Planner.*

Verifying the ten year life span:

To verify the designed width does not need to be expanded use RUSLE2 to estimate sediment delivery from the contributing area, trapping efficiency and sediment accumulation in the VFS footprint following the procedure below.

1. Using RUSLE2, compute the soil loss delivered to the upper edge of the planned VFS in units of tons/acre/year (t/ac/yr.). ***NOTE:*** *Soil loss shall not exceed the tolerable rates for all map units in the contributing area.*

2. Compute the amount of sediment trapped in the VFS in t/ac/yr. and percent trapping efficiency.

3. Determine the ratio of the contributing area in acres to the VFS area in acres. ***NOTE:*** *The contributing area only allows for sheet flow entering the VFS.*

4. Determine the time to accumulate 6 inches of sediment in the VFS to verify the 10-year life span complies with the standard criteria.

NOTE: *Refer to APPENDIX 2 "Using RUSLE2 to Design and Estimate Sediment Deposition in the*

Vegetative Filter Strips" for instructions to determine the VFS 10 year life span and Exhibit 2 "Excel Spreadsheet for Determining the Lifespan of the VFS".

Identifying the Resource Concern(s)

Identify suspended solids and associated contaminants in surface runoff as a resource concern:

1. Using RUSLE2 to estimate soil losses and a reduction in sediment delivery as a result of the implementation of the VFS. A minimum soil loss of 0.5 t/ac/yr. from the contributing area must exist before suspended solids in surface runoff is identified as a problem.
2. Using Snap Plus to estimate phosphorus delivery amounts and potential reductions as a result of implementing the VFS.
3. Evaluating tillage systems that leave less than 30% surface cover after planting in the contributing area.
4. Evaluating fields or sub-fields with eroding conditions exceeding T.

Identifying dissolved contaminant loadings in surface runoff and leaching to groundwater as a resource concern:

1. Nutrient and pesticide applications are surface applied without incorporation.
2. Winter spreading of manure on frozen or snow-covered ground.
3. Snap Plus computations verify measureable amounts of dissolved phosphorus leaving the field edge.
4. WIN-PST hazard ratings of Intermediate, or higher is an indication of potential pesticide movement in surface runoff and the leaching of pesticides to ground water is highly probable.
5. Fields or sub-fields with eroding conditions exceeding tolerable rates.

USING RUSLE2 TO ESTIMATE SEDIMENT DEPOSITION IN THE VEGETATIVE FILTER STRIP

VFSs are designed to trap sediment and in time will fill with sediment and inhibit the filtering and trapping efficiency. The life span of the VFS for sediment removal purposes is dependent upon: 1) the rate of soil loss or sediment delivery rate to the upper edge of the VFS from the "contributing area", computed by RUSLE2 using the "overland flow slope length" (Figure 1), 2) the ratio of contributing area to the area of the VFS and, 3) sediment trapping efficiency.

NOTE: *An excel spreadsheet is available to compute the VFS life span. See Exhibit 2—Excel Spreadsheet for Determining the Lifespan of the VFS.*

Determine the Sediment Delivery Rate and Sediment Trapping Efficiency

The RUSLE2 VFS design procedure requires the use of the "Summary", or "Science" profile templates. These templates provide the options to input multiple slope segments with changes in slope, soil type, or management change within the "Overland Flow Slope Length" (Figure 1). The "Overland Flow Slope Length" is defined as the slope length from the point of origin of sheet flow to the upper edge of the VFS or to the point where concentrated flow originate.

NOTE: *Overland flow slope length differs from the slope length used for conservation planning.*

The slope length used for conservation planning purposes are usually shorter. Figure 1 demonstrates the difference between slope length for conservation planning purposes and overland flow slope length on a convex/concave slope.

Figures 2, 2A, 2B, 2C, 3 and 3A represent RUSLE2 screen shots that illustrate the use of the "Profile" view in the "Science" template. Figures 2 and 3A illustrate the overland flow slope length of 350 feet. This is the length from the point of overland flow until the slope reached the VFS or overland flow changes to concentrated flow. The slope is broken into 3 segments for this example. The number of slope segment breaks will vary depending on the site condition. See figure 3A.

The soil loss for this example is 3.0 t/ac/yr., where the slope enters the VFS and the estimated sediment yield leaving the lower (exit) portion of the VFS is 1.6 t/ac/yr. The results in fig. 3B, the planner can calculate the amount of sediment trapped (3.0 tons entering minus (-) 0.65 tons leaving the VFS lower edge, equates to 2.3 t/ac/yr. trapped in the VFS). The trapping efficiency can be calculated by dividing the "sediment trapped" by the "soil loss rate entering the VFS". The sediment trapped (2.3) divided by soil loss (3.0) equals a 77% trapping efficiency.

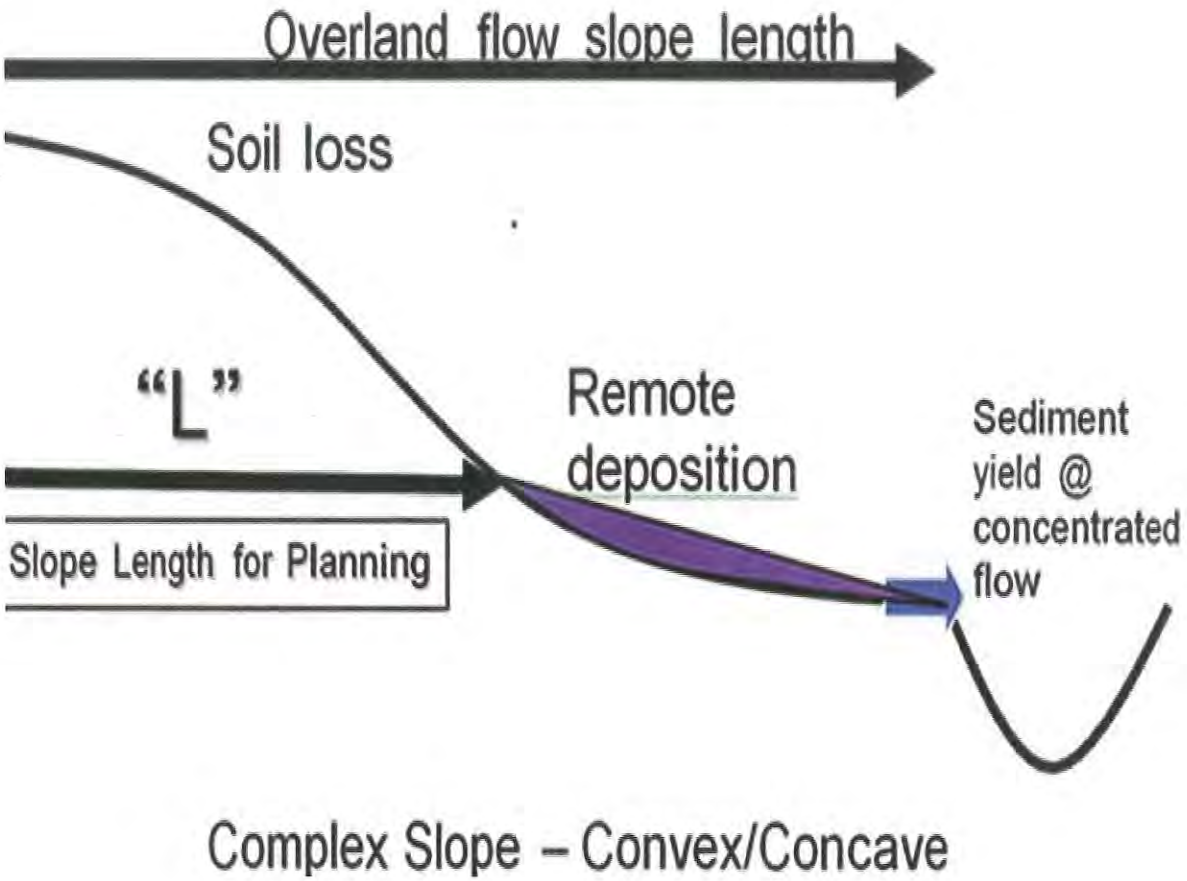
Figures 1, 2, 2A-2C, 3, and 3A illustrates and clarify the procedures for designing VFSs and verifying the 10 yr. lifespan of the practice. Below is a brief explanation of the following figures:

- Fig.1—Comparison of "L" for conservation planning vs. slope segments for VFS designs.
- Fig. 2—Example RUSLE2 calculation with a slope topography consisting of 3 segments and computations used to design the VFS

for this example.

- Fig. 2A—RUSLE2 computation for segment 1 of fig. 2.
- Fig. 2B—RUSLE2 computation for segment 2 of fig. 2.
- Fig. 2C—RUSLE2 computation for segment 3 of fig. 2.
- Fig. 3—RUSLE2 computation for sediment delivered to the end of "L" with a 30 ft., VFS designed at the mid-point of "L".
- Fig. 3A—No RUSLE2 input changes; slope topography consisting of 5 segments, including two additional segments as a result of the 30 ft. VFS designed at the end of "L".

Figure 1 - Overland Flow Slope Length versus Slope Length used for Conservation Planning.



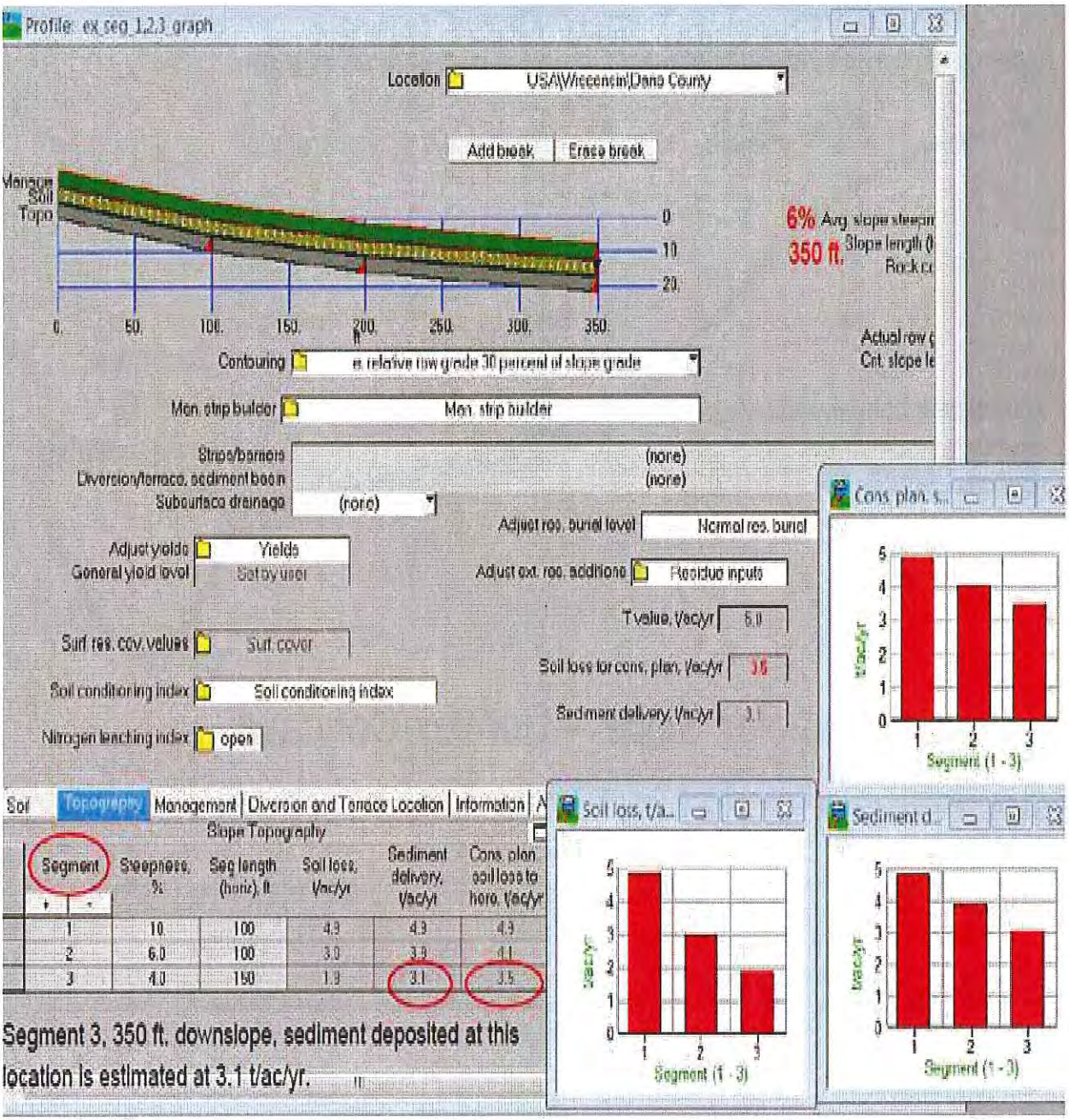
The terms and definitions below will help clarify the RUSLE2 computations output data in Figure 2 through 3A.

1.Soil Loss for Conservation Planning is the average soil loss over the length of the slope, where partial credit is given if deposition occurs on the slope and is the value for slope detachment (mass of sediment produced on the slope) reduced by the credit given for the deposition that occurs on the slope.

2.Sediment Delivery is the amount of sediment delivered to the end of the overland flow slope length, at visible deposition locations or where concentrated flow conditions originate.

3.Soil Loss is the **net loss** computed for the soil/topography management segment (s).

Figure 2 - Example RUSLE2 calculation with a Slope Topography consisting of 3 segments.



Figures 2A, 2B and 2C are example RUSLE2 calculations of each segment individually for tracking sediment deposited along the hill slope. Soil loss and sediment delivery rates displayed in Figure 2A, 2B and 2C will vary when compared to the overland flow slope length RUSLE2 computations displayed in Figure 2.

Figure 2A - RUSLE2 computation for Segment 1 (10% @ 100 feet).

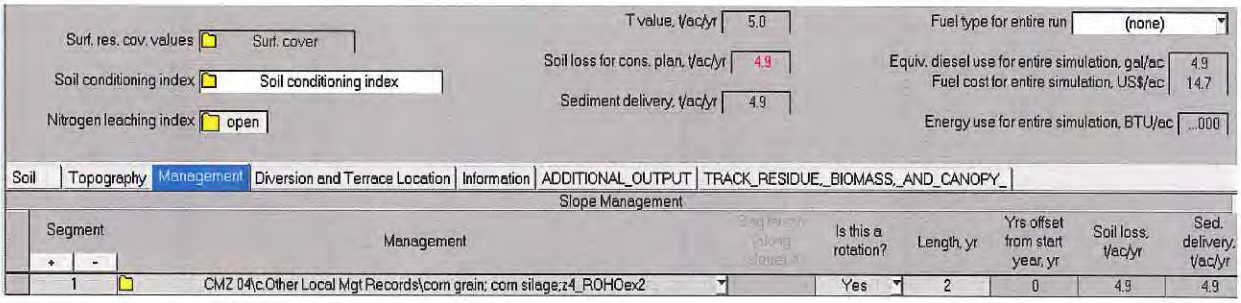


Figure 2B - RUSLE2 computation for Segment 2 (6% @ 100 feet).

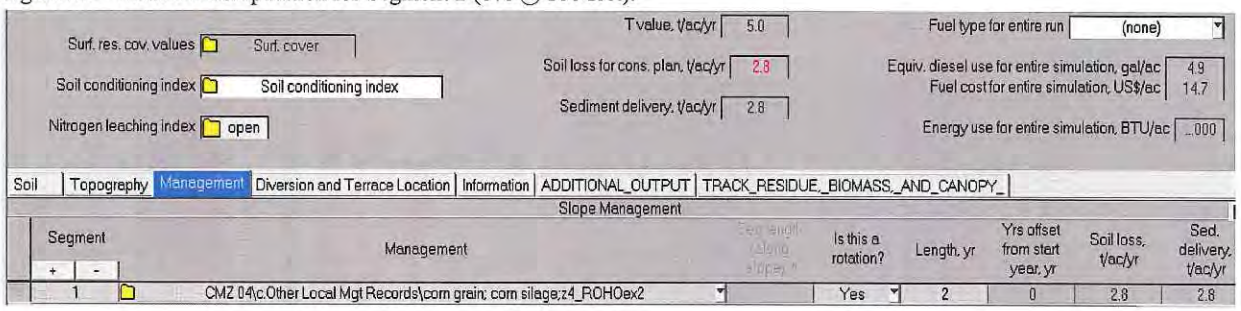


Figure 2C - RUSLE2 computation for Segment 3 (4% @ 150 feet).

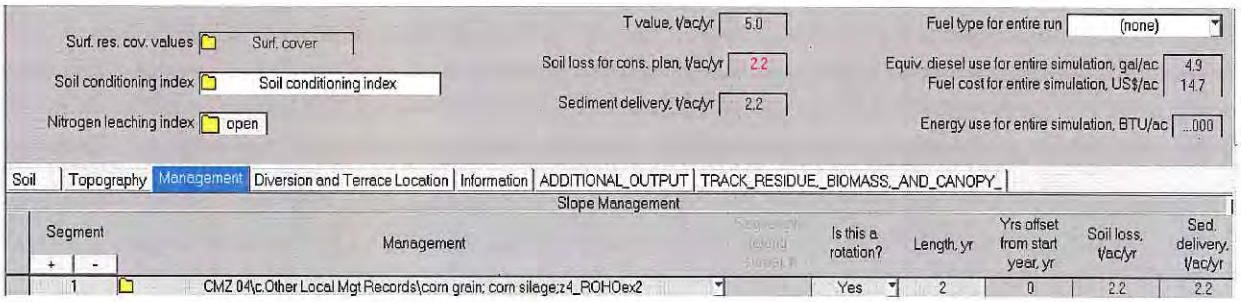
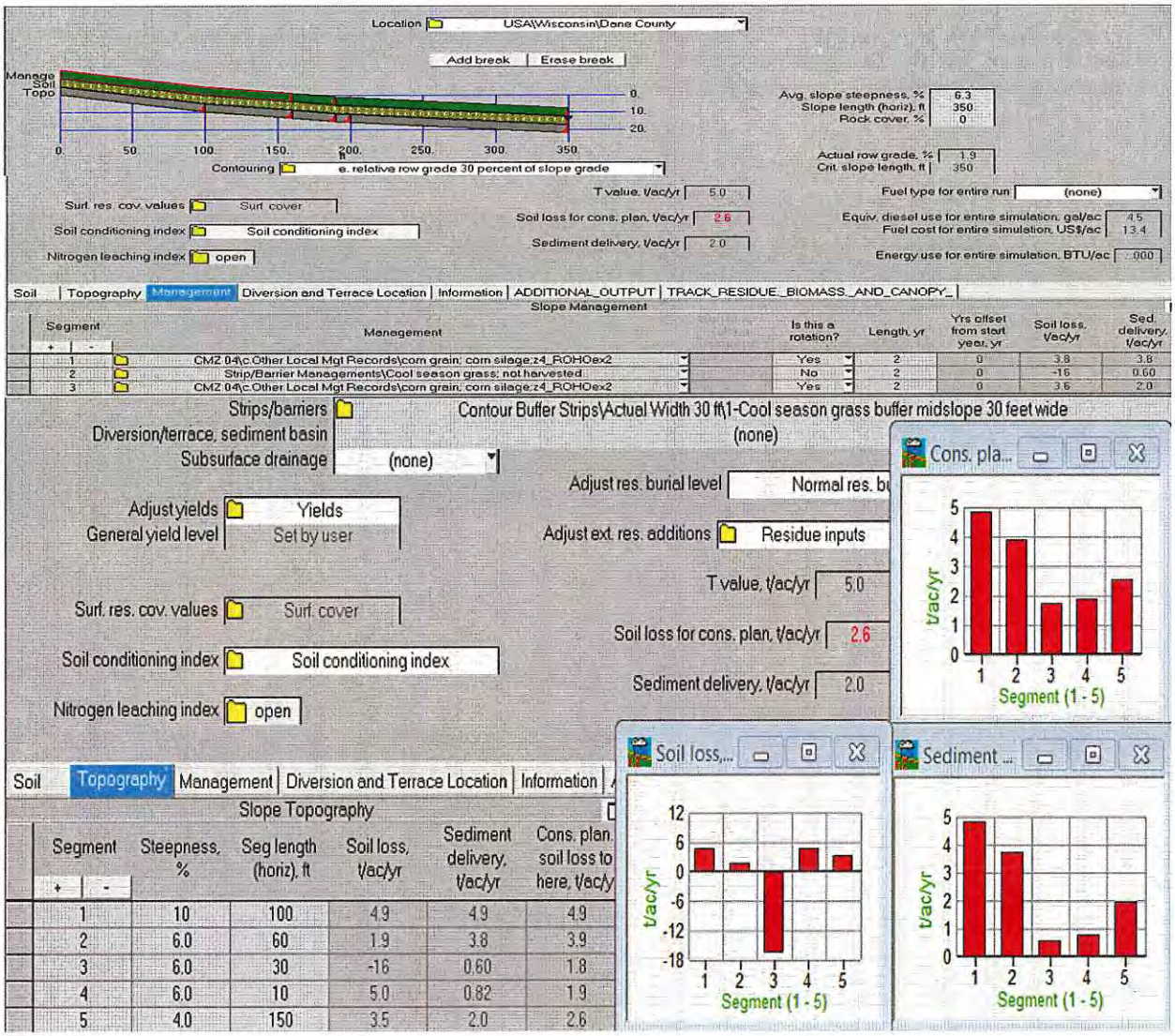
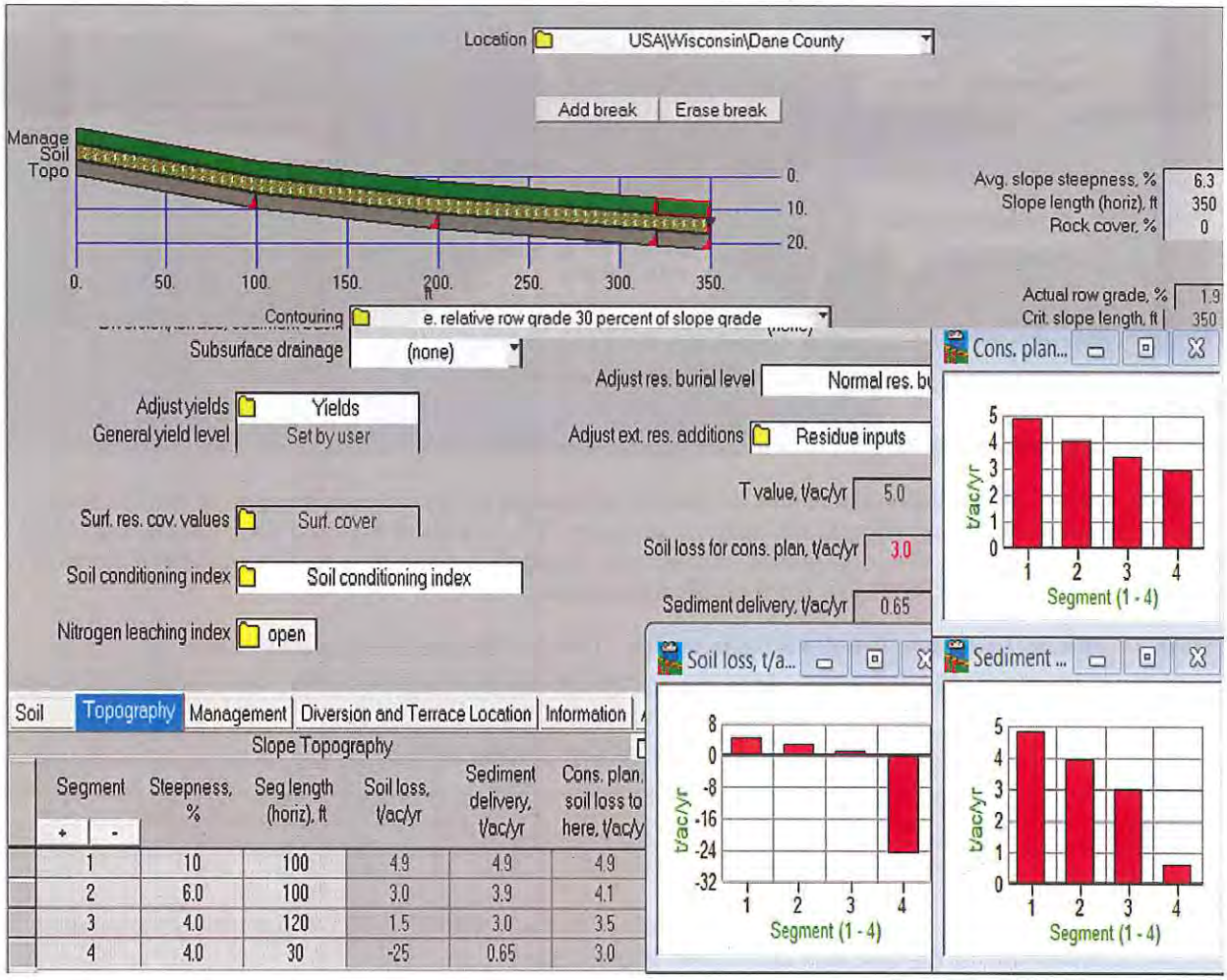


Figure 3 - RUSLE2 computation for sediment delivery at the end of "L" with a 30 foot VFS designed at the mid-point of "L".



Slope topography consisting of 5 segments, including two additional segments as a result of the 30 foot VFS designed at the mid-point of "L.

Figure 3A 1RUSLE2 computation for sediment delivery to the end of "L" with a 30 foot (non-harvested) VFS designed at the bottom of "L" or 350 feet downslope.



Multiple vegetative filter strips management files were developed to include various harvesting intervals. These management files include the following harvesting frequencies: 1) vegetation removed once per year, every other year, 2) vegetation removed once per year, 3) non-harvested VFS, 4) vegetation removed May 24th, July 7th and September 2nd per year, and 5) vegetation removed May 24th, July 7th and September 2nd every other year. These VFS management files are located in the crop management zone 1 and 4 templates in the c: folder of RUSLE2.

Calculate the ratio of "Contributing Area" (CA) to "VFS Area"

Figure 4 is a display of several "contributing areas" above the VFS that contributes sheet flow to the VFS.

NOTE: *Acres that reach the VFS as concentrated flow are excluded from the CA acres.*

The ratio can be calculated using the following method: (Ratio of C area to VFS area)

- Measure the CA that sheet flows VFS.
- Measure the area of the planned VFS.
- Divide the CA by the planned VFS— (20 acre CA / 0.8 acre VFS). The ratio of the CA to the VFS is 25:1.

VFSs are designed to have a minimum life span of ten (10) years. To maintain the VFS, the rate of sediment accumulation should not exceed 0.6 inches per year (Dillaha and Hayes). At this rate of accumulation, vegetation should be able to adjust and survive. When the accumulation reaches six (6) inches in depth, the VFS may require re-grading/shaping and reseeding.

Figure 4 - Example illustration showing the contribution area, VFS area, and ratio of contributing area to VFS area

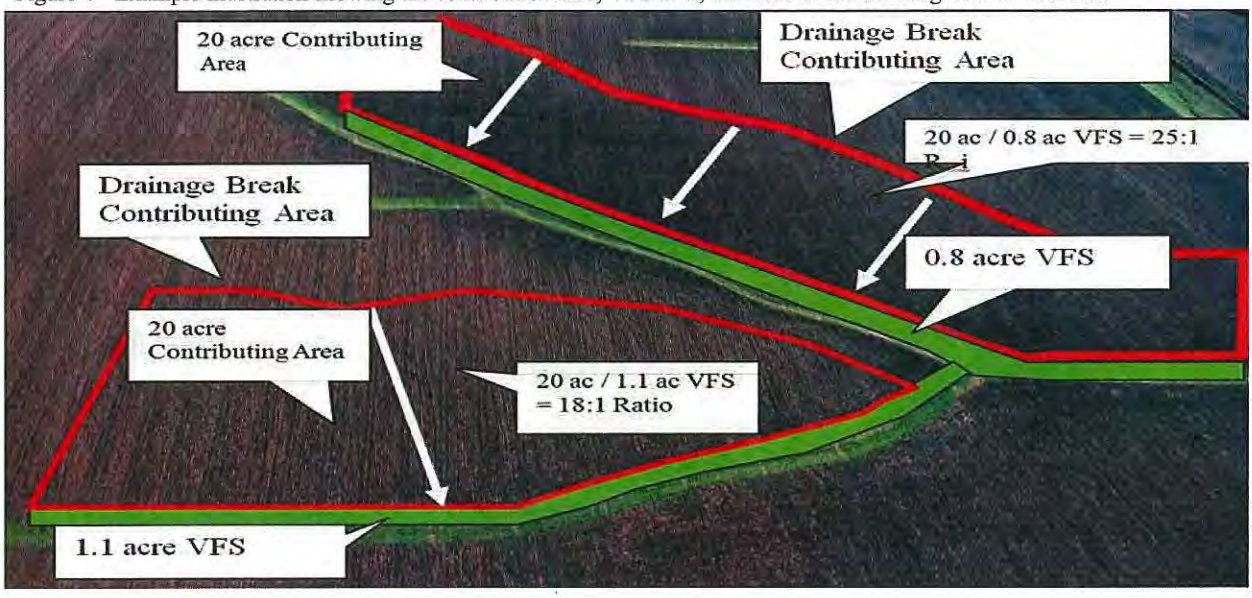


Exhibit 1 below, depicts the estimated time (in years) to accumulate six (6) inches of sediment in the VFS based on the following conditions: (1) sediment delivery rate to the VFS, (2) ratio of the CA to the VFS area, and (3) the trapping efficiency of the VFS. The shaded (yellow) cells display the number of years to accumulate 6 inches of sediment and verify the VFS 10 year projected life span criteria.

Exhibit 1 - Time to Accumulate Six Inches of Sediment in the VFS with a Trapping Efficiency of 75 Percent

Sed. Delivery Tons/Ac/Yr @ upper edge of VFS	Time (years) to accumulate 6 inches of sediment (in years) with a 75% trapping efficiency based on the contributing area to VFS ratio.						
	Ratio of Contributing Area to VFS						
	5:1	10:1	20:1	50:1	75:1	100:1	200:1
1.1	208.0	104.0	52.0	20.8	13.9	10.4	5.2
2.2	104.0	52.0	26.0	10.4	6.9	5.2	2.6
4.5	52.0	26.0	13.0	5.2	3.5	2.6	1.3

Note: *When the soil loss is 5 t/ac/yr. or less and the ratio of the CA to the VFS is 20:1 or less, time to accumulate 0.5 feet of sediment in the VFS will meet the 10-year lifespan criteria.*

Four Step Process to Determine the 10 year Life Span of the VFS

Below is the systematic procedure to determine the 10-year lifespan of the VFS using RUSLE2 input data results in fig. 3A. The following 4-step procedure can also be used to calculate the number of years to accumulate six (6) inches of sediment in the VFS. The weight of sediment, pounds per cubic feet and the number of cubic feet/ton will depend on the map unit soil texture in the CA, used in the RUSLE2 analysis. Below are estimated weights of sediment in pounds per cubic foot specific to soil texture:

- Organic soils—15 lbs./ft^3 and 133 ft^3/ton
- Silty soils—85-90 lbs./ft^3 (87) and 23 ft^3/ton
- Loamy soils—91-95 lbs./ft^3 (92) and 21.7 ft^3/ton
- Sandy soils—96-100 lbs./ft^3 (98) and 20 ft^3/ton
- Clayey soils—101-115 lbs./ft^3 (108) and 18.5 ft^3/ton

Sediment delivered to the VFS (t/ac/yr.) shall be converted to cubic feet/acre/year. The sediment delivered from the CA to the VFS using RUSLE2 is estimated at 3.0 t/ac/yr., to the interface of the upper edge of the filter strip and sediment delivered beyond the lower edge of the VFS is estimated at 0.70 t/ac/yr. The VFS is trapping an average of 2.3 t/ac/yr., and 0.70 t/ac/yr., will exit the VFS lower edge. The VFS trapping efficiency is the difference between sediment delivered to VFS and the sediment leaving or delivered beyond the VFS lower edge divided by the sediment delivered to the VFS. Use the steps below to determine the VFS lifespan for this example.

I. Sediment delivered to the VFS is 3.0 t/ac/yr. Convert t/ac/yr. to ft.^{3}/ac/yr. using the formula below:

   a. 3.0 t/ac/yr. X 21.7 ft^3/ton equates to 65.1 ft^3/ac/yr. The 21.7 is the number of ft^3 /ton of soil consisting of a loamy texture weighting 92 lbs. /ft^3.

   b. Sediment delivery to the VFS is 65.1 ft^3 /ac/yr.

   c. Sediment leaving the VFS is 0.70 t/ac/yr.

   d. Sediment trapped in the footprint of the VFS is 2.3 t/ac/yr.

   e. Trapping efficiency of 77%: 1) 3.0 t/ac/yr. minus 0.70 t/ac/yr. / 3.0 t/ac/yr., or 2) 2.3 t/ac/yr. / 3.0 t/ac/yr., multiplied by 100.

   f. Ratio of the 20 acre CA to the 0.8 acre VFS is 25 or 25 to 1.

II. Sediment Delivery in ft^3/ac/yr. X the Trapping Efficiency X the Ratio = ft^3 trapped in the VFS/ ac/yr.

   a. 65.1 ft^3 /ac/yr. x 0.77 x 25 = 1,253.2 ft^3 / ac/yr. in the VFS.

III. Cubic feet trapped in VFS/acre/yr. / 43,560 ft^2/ac. X 12 inches per foot = Accumulated depth (inches per year).

   a. [1,253.2 ft^3/ac/yr. / 43,560 ft^2 per acre] X 12 inches foot = 0.35 inches per year accumulates in the VFS.

IV. 6 inches (Maximum Accumulation) /Accumulated depth (inches/year) = Years to accumulate 6 inches.

   a. 6 inches per 10 years / 0.35 inches per year = 17.1 years to accumulate 6 inches of sediment in the VFS.

NOTE: *For this example, the VFS design is acceptable and the VFS will function as intended for a minimum of 10 years. When the VFS design will exceed the maximum annual sediment accumulation, resulting in the practice lifespan of less than 10 years , the planner shall consider the following options: 1) reduce the soil loss from the contributing area, and or increase the size of the VFS.*

An excel spreadsheet for determining the lifespan of the VFS is available for use to verify the number of years, the VFS is expected to function before sediment removal or re-grading is required (see exhibit 2). The spreadsheet allows actual values to be entered and reduces the need to manually perform calculations to determine trapping efficiency and the ratio of contributing area to the VFS area.

Exhibit 2 - Four Step Process to Determine the VFS Life Span

Step 1. Enter Sediment Delivery in t/ac/yr calculated from RUSLE2
Step 2. Enter the Measured "Contributing Areas" for the VFS
Step 3. Enter the Area (in Acres) of the VFS
Step 4. Enter the Sediment Leaving the "downslope" side of the VFS calculated from RUSLE2

Step 1	Step 2	Step 3	Step 4	Calculated	Calculated	Calculated	Calculated	Calculated
Sed. Delivery to VFS (t/ac/yr)	Contibuting Area (ac)	VFS (ac)	Sed. Leaving VFS (t/ac/yr)	Trapping Efficiency %	Sed.In VFS (Ft^3/Yr)	Sed. Depth (in.) Accum/yr in VFS	Years to Accum 0.5 Ft.	Meets 10 yr Life Span
3	20	0.8	0.65	78%	1277	0.352	17.1	YES

Note: *The input data for Step 1 and 4 are computations of output data using the RUSLE2 program (see fig. 3A). Compare the computations using the excel spreadsheet and the example computations on the previous page. The attached spreadsheet is available to verify the 10 yr. lifespan requirement.*

Worksheet in H 2
Work Tech Notes FY 2

APPENDIX 3 "USING SNAP-PLUS AND THE WINDOWS PESTICIDE SCREENING TOOLS TO ASSESS THE MOVEMENT OF SUSPENDED SOLIDS IN SURFACE RUNOFF AND TO ASSESS THE LEACHING OF DISSOLVED CONTAMINANTS TO GROUNDWATER"

Using the Snap-Plus Nutrient Management Planning Tool to Assess the Movement of Suspended Solids in Surface Runoff and Assess the Leaching of Dissolved Contaminants to Groundwater

Soil Nutrient Application Planner (Snap Plus) is Wisconsin's nutrient management planning software program that helps farmers make the best use of their on-farm nutrients, and justification of commercial fertilizer purchases. The planning tool can compute the potential soil and phosphorus runoff losses on a field-by-field basis. SNAP+ can predict the following:

1) Average rotational and annual phosphorus index (particulate P and dissolved P) losses
2) Average rotational and annual soil losses.

Snap Plus can be used to assess and design VFS under the following conditions:

Criteria for designing VFS using Snap Plus

- The VFS shall have a 10-year lifespan for sediment deposition determined from RUSLE2 output data.
- A minimum 20 ft. width for reducing or minimizing contaminated suspended solids in runoff.
- A minimum of 30 ft. width for reducing or minimizing dissolved contaminants in runoff.

  NOTE: *In the section - criteria for VFS design width, all specifications must comply.*

Using the Windows Pesticide Screening Tool (WIN-PST) to Assess the Movement of Suspended Solids in Surface Runoff and Assess the Leaching of Dissolved Contaminants to Groundwater

WIN-PST is the NRCS supported technical tool that is used to assess relative pesticide leaching, solution runoff, and sediment adsorbed runoff risk to water quality and non-targeted organisms. WI N-PST analysis of pesticide impacts on water quality are divided into four separate pesticide loss pathways: leaching, solution runoff, adsorbed runoff, and drift.

NOTE: *Technical Note 10 is design to minimize the movement of dissolve pollutants (nitrogen, phosphorus, pesticides and other identified dissolved contaminants) in water by the three pathways identified below:*

1. *Water percolating below the root zone.*
2. *Surface water consisting of dissolved constituents leaving the field edge.*
3. *Sediment leaving the field edge in solution runoff.*

WIN-PST analysis is based on soil properties, pesticide physical properties, pesticide toxicity data, broadcast/banded/spot treatment (area treated), surface-applied/incorporated/foliar (application method), standard/low rate/ultra-low rate (amounts), and humid/dry (irrigated or non-irrigated).

The WIN-PST output data will not provide quantitative computations, only qualitative information for analyzing and assessing the resource conditions.

Conducting a WIN-PST Analysis

Step 1: Choose all the major soil types for the field or planning area (generally those that cover 10 percent or more of the area).

Step 2: Choose all the pesticides that the client is planning to use.

NOTE: *Each pesticide can be chosen by product name, EPA registration number, or active ingredient name. The final ratings are specific to each active ingredient.*

Step 3: Analyze the results for each soil/pesticide interaction.

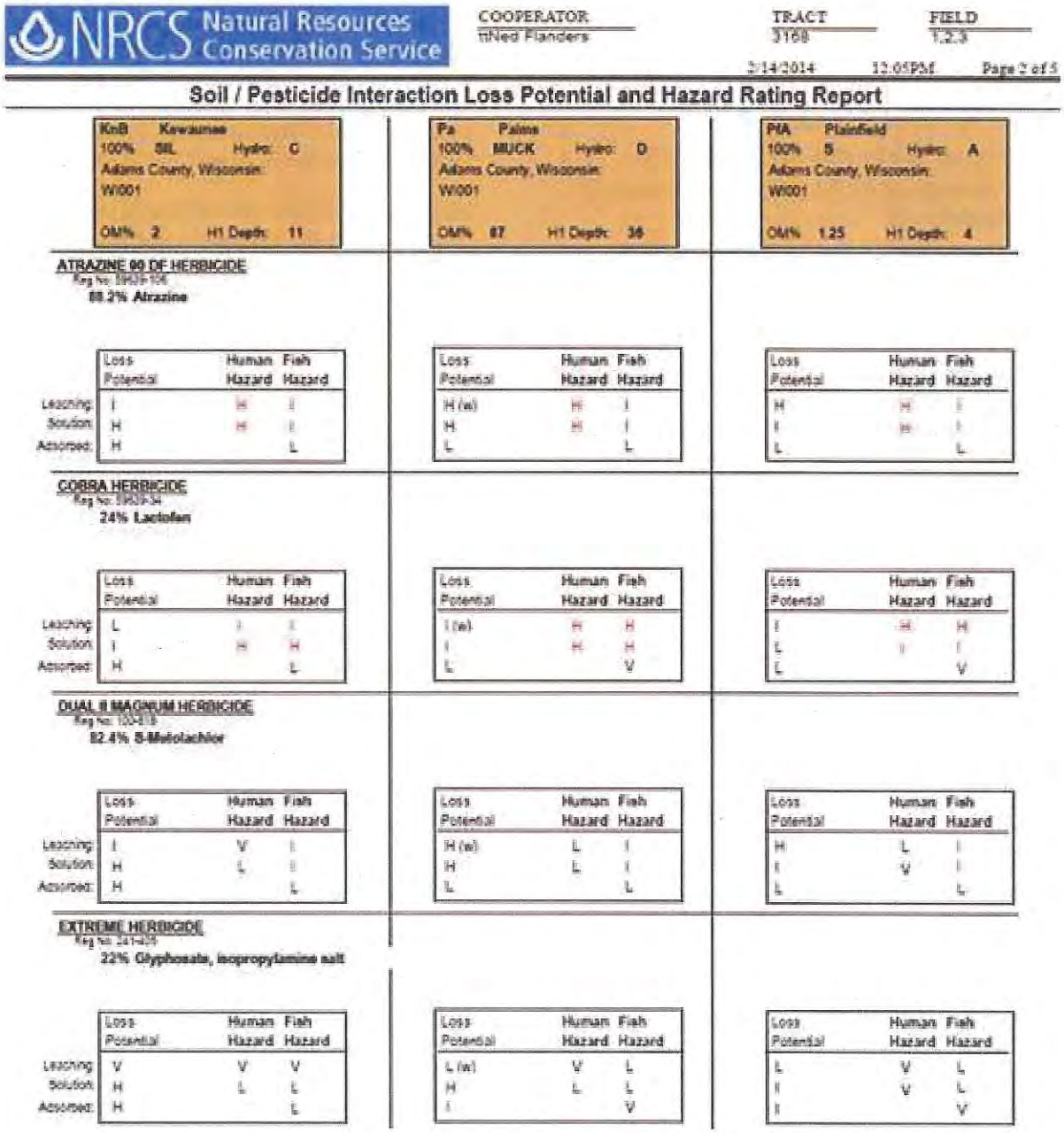
Step 4: Select the highest hazard rating for the soil/pesticide combination to identify all resource concerns (leaching, dissolved contaminants and sediment in solution runoff. The final WIN-PST Soil/Pesticide Interaction Hazard ratings retrieved via WIN-PST analysis are: Very Low (VL), Low (L), Intermediate (I), High (H), and Extra High (X). Intermediate and higher is an indication that a pesticide is most likely to move with solution runoff or leach to groundwater. The planner should refer to Appendix 1 for additional information when assessing the need for implementation of VFSs.

NOTE: *The rating may be used to justify the need for a VFS. The planner should use WIN-PST to adjust*

management activities such as reduce rates, band applications, or the use of alternative products, to enhance the functionality of the VFS.

WIN-PST can be accessed and downloaded at the following website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/technical/cp/. The Wisconsin WIN-PST soils database for use with WIN-PST can be accessed and downloaded at the following website: http://websoilsurvey.nrcs.usda.gov/. Refer to Wisconsin Agronomy Technical Note 2 - Companion Document to WI-Practice Standard 595 Integrated Pest Management for additional information. This companion document can be located at the following location: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_019954.pdf

Figure 5 – Example WIN-PST assessment.



NRCS Natural Resources Conservation Service

COOPERATOR: tiNed Flanders | TRACT: 3168 | FIELD: 1,2,3

2/14/2014 12:05PM Page 2 of 5

Soil / Pesticide Interaction Loss Potential and Hazard Rating Report

KnB Kewaunee	Pa Palms	PtA Plainfield
100% SIL Hydro: C	100% MUCK Hydro: D	100% S Hydro: A
Adams County, Wisconsin WI001	Adams County, Wisconsin WI001	Adams County, Wisconsin WI001
OM% 2 H1 Depth: 11	OM% 87 H1 Depth: 36	OM% 1.25 H1 Depth: 4

ATRAZINE 90 DF HERBICIDE
Reg No: 8959-104
80.2% Atrazine

	KnB Loss Potential	KnB Human Hazard	KnB Fish Hazard	Pa Loss Potential	Pa Human Hazard	Pa Fish Hazard	PtA Loss Potential	PtA Human Hazard	PtA Fish Hazard
Leaching:	I	H	I	H (w)	H	I	H	H	I
Solution:	H	H	I	H	H	I	I	H	I
Adsorbed:	H		L	L		L	L		L

COBRA HERBICIDE
Reg No: 59639-34
24% Lactofen

	KnB Loss Potential	KnB Human Hazard	KnB Fish Hazard	Pa Loss Potential	Pa Human Hazard	Pa Fish Hazard	PtA Loss Potential	PtA Human Hazard	PtA Fish Hazard
Leaching:	L	I	I	I (w)	H	H	I	H	H
Solution:	I	H	H	I	H	H	L	I	I
Adsorbed:	H		L	L		V	L		V

DUAL II MAGNUM HERBICIDE
Reg No: 100-818
82.4% S-Metolachlor

	KnB Loss Potential	KnB Human Hazard	KnB Fish Hazard	Pa Loss Potential	Pa Human Hazard	Pa Fish Hazard	PtA Loss Potential	PtA Human Hazard	PtA Fish Hazard
Leaching:	I	V	I	H (w)	L	I	H	L	I
Solution:	H	L	I	H	L	I	I	V	I
Adsorbed:	H		L	L		L	L		L

EXTREME HERBICIDE
Reg No: 241-405
22% Glyphosate, isopropylamine salt

	KnB Loss Potential	KnB Human Hazard	KnB Fish Hazard	Pa Loss Potential	Pa Human Hazard	Pa Fish Hazard	PtA Loss Potential	PtA Human Hazard	PtA Fish Hazard
Leaching:	V	V	V	L (w)	V	L	L	V	L
Solution:	H	L	L	H	L	L	I	V	L
Adsorbed:	H		L	I		V	I		V

APPENDIX 4 "SITE ASSESSMENT REQUIREMENTS AND SITE ASSESSMENT DOCUMENTATION WORKSHEET"

The site assessment is an onsite inventory and evaluation, required by WI-Practice Standard 393 Filter Strip (V.A.5.) of natural (physical, chemical, and biological characteristics), man-made features, and the client's management activities. This worksheet and Job Sheet 393 are used to document details that assure the Filter Strip will be effective in reducing sediment and suspended pollutants for the length of the practice.

Contributing Area (CA):

1. Dominant soil texture and average land slope in the contributing area.
2. Average slope within 300 ft. of the VFS.
3. Percentage of the CA consisting of frequently flooded soils.
4. Acres of the CA flowing through the VFS.
5. Acres of the CA entering the VFS as concentrated flow (identified on plan map) and overland sheet flow.
6. Average Soil Loss in the CA and within 300 ft. of the VFS. Identified ephemeral and gully erosion areas on the plan map. These sites shall be addressed.
7. Verification that CA is being farmed at or below tolerable soil loss and there are no concentrated flow channels contributing to the runoff loads.

Vegetated Filter Strip (VFS):

1. Site preparation, seeding mix and establishment criteria follows NRCS standards.
2. Pesticides and nutrients used for crop production in the CA are taken into consideration.
3. Average slope within 100 feet upstream of the low edge of the VFS.
4. Average slope from 100-300 feet upstream of the low edge of the VFS.

Environmentally Sensitive Area (ESA):

1. Identification of the ESA.
2. Existing area of protection (buffer) contiguous to the ESA.
3. Distance of the ESA from the low edge of the planned VFS.

For a printout of the worksheet, refer to Exhibit A. The worksheet can be used to document the data collected.

*Hydrologic Soil Group – The hydrologic soil group is a classification or rating assigned to each soil map unit based on estimates of runoff potential or the minimum rate of infiltration obtained for a bare soil, after prolonged wetting. Each soil is assigned to one of four groups (A, B, C, D) according to the rate of water infiltration. Below are the group descriptions:

Group - A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of sands and gravels that are deep, well drained to excessively drained, and have a high rate of water transmission (greater than 0.30 in/hr.).

Group - B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of soils that are moderately deep to deep, moderately well drained to well drained, and have moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15 to 0.30 in/hr.).

Group - C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils having a layer that impedes downward movement of water and consist chiefly of soils with moderately fine-to-fine textures. These soils have a slow rate of water transmission (0.05 to 0.15 in/hr.).

Group - D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, permanent high water table, clay pan or clay layer at or near the surface, and may have shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0 to 1.5 in/hr.).

This information can be found at: http://websoilsurvey.nrcs.usda.gov/.

*Soil Map Unit Flooding Frequency - Flooding frequency is the probability of temporary covering of the soil surface by flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, or any combination of sources. The occurrence of flooding is described in one of six categories below:

1. None - No reasonable possibility of flooding; one of 500 probability of flooding in any year or less than 1 time in 500 years.
2. Very Rare - Flooding is very unlikely but is possible under extremely, unusual weather conditions; less than a 1 percent chance of flooding in any year or less than 1 time in 100 years, but more than 1 time in 500 years.
3. Rare - Flooding is unlikely, but is possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or

nearly 1 to 5 times in 100 years.

4. Occasional - Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or 5 to 50 times in 100 years.
5. Frequent - Flooding is likely to occur often under usual weather conditions, more than a 50 percent chance of flooding in any year, 50 times in 100 years, but less than a 50 percent chance of flooding in all months in any year.
6. Very Frequent - Flooding is likely to occur very often under usual weather conditions, more than a 50 percent chance of flooding in all months of any year.

Management and Maintenance of Vegetative Filter Strips

This section will address key management and maintenance activities identified in the filter strip standard.

Filter Strip Inspections

- The VFS should be inspected after intense storm events.
- Sediment deposits at the interface of the filter strip will require more intense maintenance as compared to the low edge or exit area of the VFS.
- Any development of rills and gullies upstream and within the filter strip must be minimized and immediately repaired.
- Remove unevenly deposits of sediment accumulation that will disrupt sheet flow and re-seed disturbed areas

Grazing and Mechanical Harvesting of VFS Biomass

Consistent removal of biomass will result in improved water quality by exporting nutrients deposited in the VFS. The harvesting of plant materials should show a substantial reduction in phosphorus and other nutrients in the soil profile. Critical to the functioning of the VFS is the availability of living plant biomass to retard the flow of runoff from the contributing area, when the probability of runoff events are high. Caution is required when managing the filter strip nutrient loading by harvesting the plant material either mechanically or grazing critical runoff periods. Below is criteria and guidance to minimize offsite movement of dissolved and particulate pollutants when harvesting biomass in the VFS:

- Greater than 50% of the seed mixture consists of grass species.
- Vegetation cannot be harvested or removed consistently until planned vegetation is well established (12 - 16 plants per square foot).
- Introduced species shall not be cut shorter than 4 inches and native species shall not be cut shorter than 7 inches.
- Filter strips shall not have the biomass removed mechanically before May 20th or after September 15th for introduced species and no later than September 1st for native species.

Prescribed Grazing Mitigation Requirements

When grazing vegetative filter strips, an approved grazing plan shall comply with the criteria of WI-Practice Standard 528 Prescribed Grazing and include a grazing system that allows quick, intensive foraging under good soil conditions. Implement the following prescribed grazing techniques and requirements:

- Continuous grazing system is not allowed.
- Livestock is not allowed when soil is wet.
- Livestock must be excluded from the environmentally sensitive areas.
- Defer 1/3 of the filter strip acres from grazing during the nesting/fawning season each year.
- Grazing shall not occur after September 15th to allow regrowth.

Wildlife Mitigation Requirements

Implement the following guidance and wildlife mitigation techniques when harvesting biomass in the VFS during the primary nesting season (05-15 through 08-01):

I. Deferred harvesting - Apply and maintain a. or b of the following management activities to minimize the loss of wildlife species:

   a. Do not cut vegetation on at least 1/3 of the acres each year. Idle strips or blocks should be at least 30 feet wide.
   b. For at least 1/3 of the acreage, harvesting of vegetation should be either before and/or after the primary nesting season (May 15th – August 2nd).

Figure 6, 7, 8 and 9 – Filter Strip Variations

Figure 6
Filter Strip with no Slopes Exceeding 12%

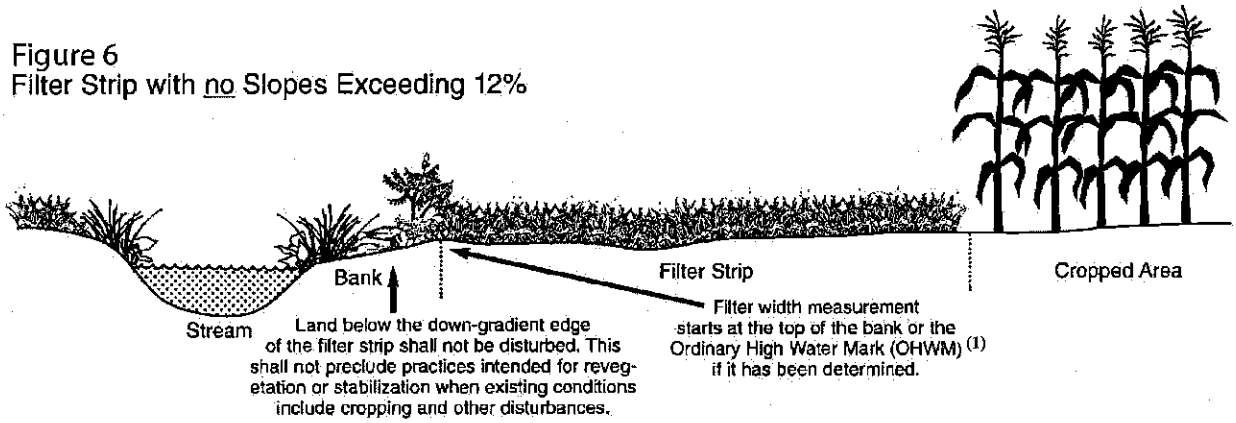


Figure 7
Establishing the Filter Location where Slope Exceeds 12%

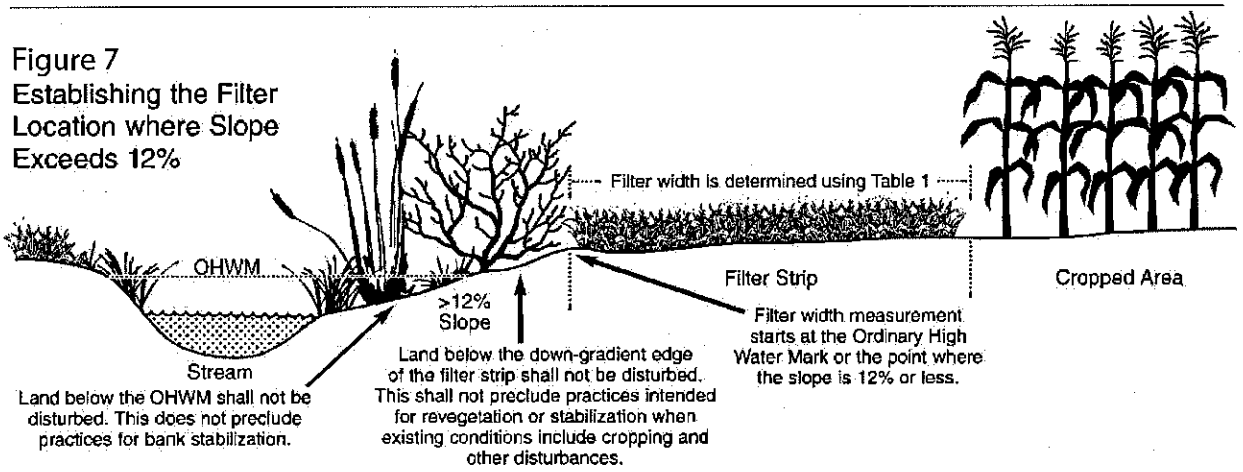


Figure 8
Filter Strip for Wetland

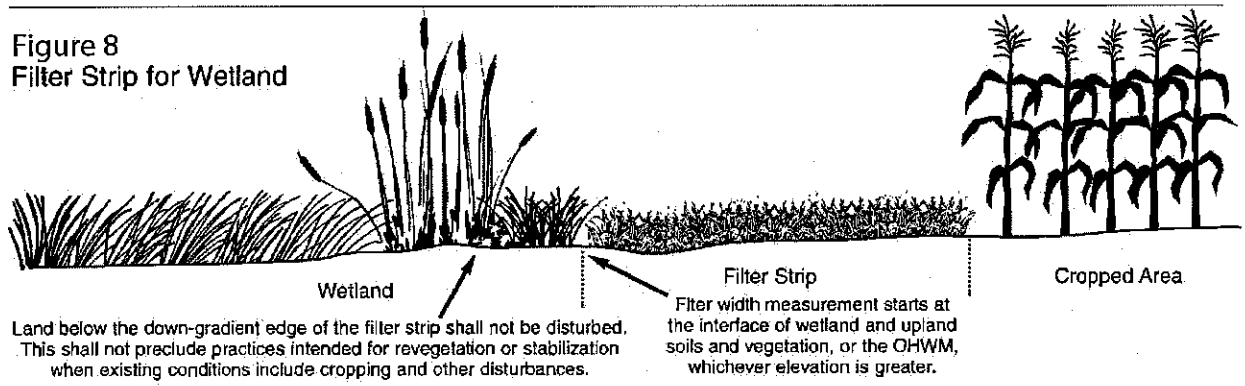
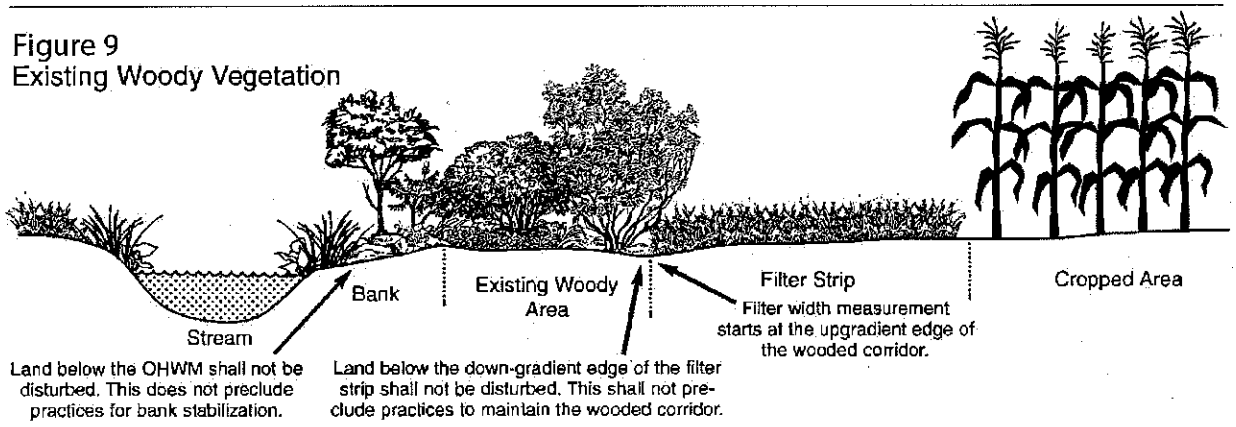


Figure 9
Existing Woody Vegetation



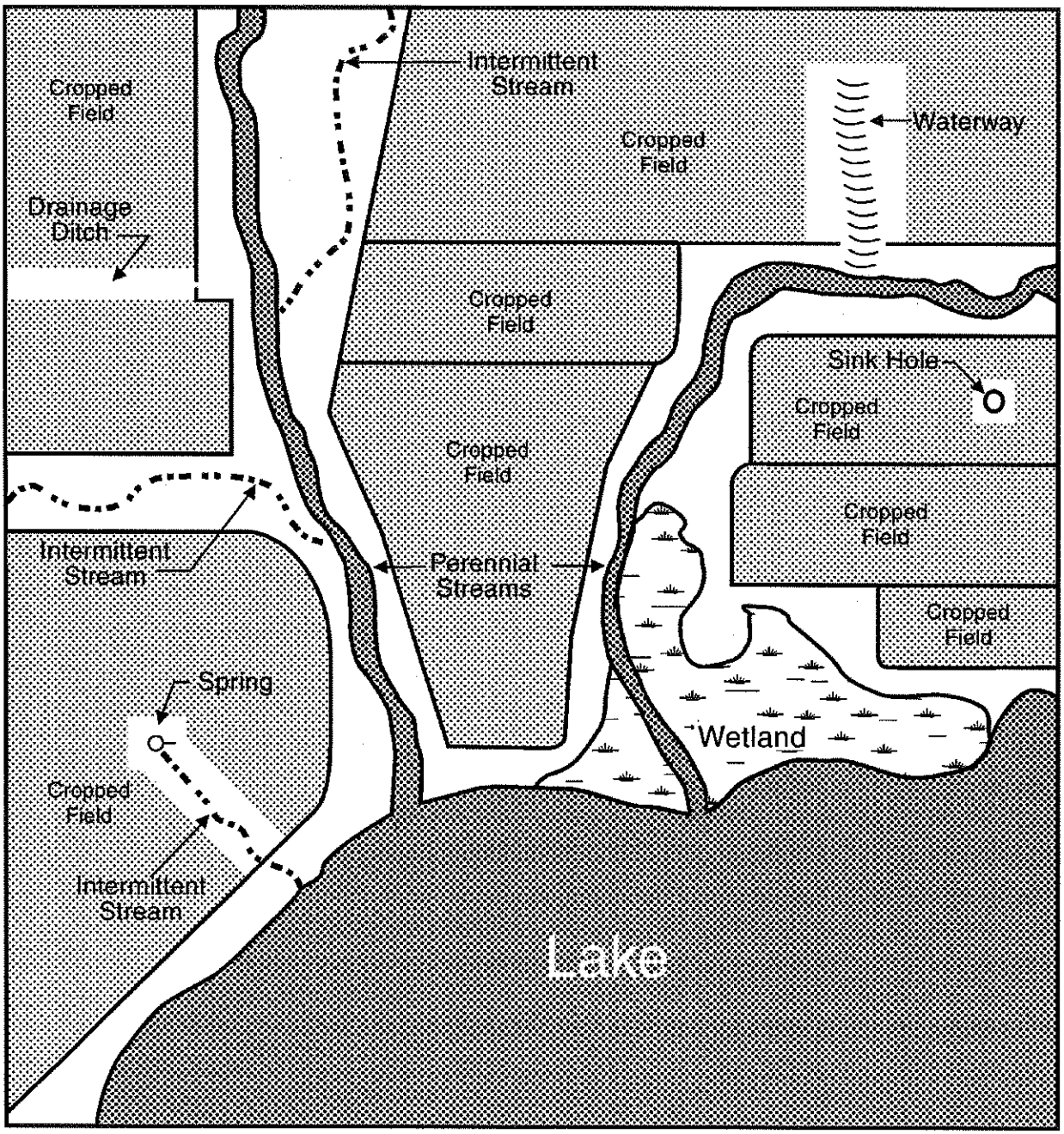
(1) The ordinary high-water mark (OHWM) is the point on the bank or shore up to which the presence and action of water is so continuous as to leave a distinct mark, either by erosion, destruction of terrestrial vegetation, or other easily recognized characteristic.

Figure 10 – Riparian Bnffer Applications

Conceptual

Riparian Buffer Applications

White areas indicate filter strips.



WI – PRACTICE STANDARD 393 FILTER STRIP - SITE ASSESSMENT DOCUMENTATION WORKSHEET FOR PLANNING AND DESIGN OF VEGETATIVE FILTER STRIPS

Document the following Criteria and Specifications for the Contributing Area (CA), Vegetated Filter Strip (VFS) and Environmentally Sensitive Area (ESA).

CA DOCUMENTATION:

CA drainage acres:	
CA free of untreated concentrated flow channels (locate on plan map):	
Dominant soil texture and average land slope in the CA:	
Dominant slope within 100 feet upstream of the VFS:	
Average soil loss in the CA and within 300 feet of the VFS:	
Average slope within 300 feet of the VFS:	
Percentage of the CA consisting of frequently flooded soils:	
Dominant Hydrological Soil Group in the VFS footprint:	
Verify that the site is not frequently inundated with water; and large loads of sediment are not frequently deposited in the VFS, resulting in the failure of the VFS:	

Seeding Design:

1. Perennial vegetation selected is suitable for the soil moisture regime: Y N
2. Soil test results and/or soil amendment recommendations support planned vegetation selected for use, where applicable: Y N

   Legumes that are used in the VFS, soil test verify the proper pH for maximum growth and survivability of the legume specie: Y N
3. Any concerns with Proximity of VFS to natural plant communities: Y N
   Natural communities, such as remnant prairies, located within ¼ mile of the planned VFS, if so, use of local genotypes is the first preference, when applicable and be certain to not use invasive cover choices.
4. Pesticides concerns within the CA: Y N

1. If VFS is continuous or within 700 feet of ESA Y N
2. RUSLE2 shows the VFS life span is ten years or more. Y N

Direct Contributing		Factor Points
4.	Hydrologic Soil Group	
☐	A	0
☐	B	10
☐	C	20
☐	D	30
5.	Average slope within 100 feet upstream of the low edge of the filter	
☐	0-1%	0
☐	>1-	5
☐	>3-	15
☐	>6-	30
6.	Average slope from 100 - 300 feet upstream of the low edge of the filter	
☐	0-1%	0
☐	>1-	5
☐	>3-	10
☐	>6-	15
☐	>12	20

Total Point Range	Minimum Filter Strip Width for Sediment Trapping[1]	Minimum Filter Strip Width for Dissolved Contaminants[1,2]
0-10	20 Feet	70 Feet
15-20	30 Feet	70 Feet
25-30	40 Feet	70 Feet
35	50 Feet	80 Feet
40	60 Feet	80 Feet
45	70 Feet	90 Feet
50	80 Feet	100 Feet
>50	100 Feet	120 Feet

References

C.X. Jin, M.J.M. Romkens. "Experimental Studies of Factors in Determining Sediment Trapping in Vegetative Filter Strips." Transactions of the ASAE. Vol. 44(2). October 2000. 277-288.

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Daniels, R. B., and J. W. Gilliam. "Sediment and Chemical Load Reduction by Grass and Riparian Filters." Soil Sci. Soc. Am. J (60) 1. 1996. 246-251.

Dillaha, T.A., J.H. Sherrard, and D. Lee. "Long-Term Effectiveness and Maintenance of Vegetative Filter Strips." VPI-VWRRC Bulletin 153. 1986.

Johnson, A. W., and D. M. Ryba. "A Literature Review of Recommended Buffer Widths to Maintain Various Functions of Stream Riparian Areas." King County Surface Water Management Division, Washington, 1992.

Theo A. Dillaha, Ph.D., P.E. and John C. Hayes, Ph.D., P.E. "A Procedure for the Design of Vegetative Filter Strips." 1991.

University of Wisconsin Cooperative Extension Service. Field Crops Pest Management Guide in Wisconsin. UWEX-A3646.

USDA. "Companion Document to Practice Standard 595 Integrated Pest Management." NRCS Wisconsin Agronomy Technical Note 2.

USDA. "Cover and Green Manure Crops - Benefits to Soil Quality." NRCS Wisconsin Agronomy Technical Note 7.

USDA. "Establishing and Maintaining Introduced Grasses and Legumes." NRCS Wisconsin Agronomy Technical Note 6.

USDA. "Establishing and Maintaining Native Grasses, Forbs and Legumes." NRCS Wisconsin Agronomy Technical Note 5.

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NRCS Revised Universal Soil Loss Equation (RUSLE2). Vers. 1.26.64. 13 November 2006. USDA. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/technical/cp/?cid=nrcs142p2_020801>.

USDA. "NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications: 327 Conservation Cover, 342 Critical Area Seeding, 560 Access Road, 590 Nutrient Management, 645 Wildlife Upland Habitat Management."

USDA. "Using RUSLE2 for Design and Prediction Effectiveness of Vegetative Filter Strips (VFS) for Sediment." NRCS National Agronomy Technical Note Number 2.

Windows Pesticide Screening Tool. Vers. 3.1.13. USDA. <http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/crops/npm/?cid=stelprdb1044769>.

UW. Wisconsin SNAP-Plus Nutrient Management Planning Software Tool. Vers. 2.132. UW. <http://snapplus.wisc.edu>.

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NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

BRUSH MANAGEMENT

CODE 314

(ac.)

DEFINITION

The management or removal of woody (non-herbaceous or succulent) plants including those which are invasive and noxious.

PURPOSES

- Create the desired plant community consistent with the ecological site.
- Restore or release desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality or enhance stream flow.
- Maintain, modify, or enhance fish and wildlife habitat.
- Reduce risk of wildfire.
- Improve forage accessibility, quality and quantity for livestock and wildlife.
- Manage fuel loads to achieve desired conditions.
- Manage noxious woody plants.

CONDITIONS WHERE PRACTICE APPLIES

On all lands except active cropland where the removal, reduction, or manipulation of woody (non-herbaceous or succulent) plants is desired.

This practice does not apply to removal of woody vegetation by prescribed fire. Use Wisconsin NRCS Conservation Practice (CSP), *Prescribed Burning (338)*, or Wisconsin NRCS CSP, *Land Clearing (460)* for removal of woody vegetation to facilitate a land use change.

CRITERIA

General Criteria Applicable For All Purposes

Design brush management to achieve the desired plant community based on species composition, structure, density, and canopy (or foliar) cover or height.

Brush management will be applied in a manner to achieve the desired control of the target woody species and protection of desired species. This will be accomplished by mechanical, chemical, or biological methods either alone or in combination. To manipulate tree species composition, structure or stocking, use Wisconsin NRCS CSP, *Forest Stand Improvement (666)*. When prescribed burning is used as a method, Wisconsin NRCS CSP, *Prescribed Burning (338)* will also be applied.

When the intent is to manage trees for silvicultural purposes, use Wisconsin NRCS CSP, *Forest Stand Improvement (666)*.

NRCS will not develop biological or chemical treatment recommendations except for biological control utilizing grazing animals. In such cases, Wisconsin NRCS CSP, *Prescribed Grazing (528)* is used to ensure the desired results are achieved and maintained. NRCS may provide clients with acceptable biological and/or chemical control references.

Follow-up treatments may be necessary to achieve objectives.

Additional Criteria for Creating the Desired Plant Community Consistent with the Ecological Site

Use applicable Ecological Site Description (ESD) State and Transition models, to develop specifications that are ecologically sound and defensible.

Treatments must be congruent with dynamics of the ecological site(s) and keyed to state and plant community phases that have the potential and capability to support the desired plant community. If an ESD is not available, base specifications on the best approximation of the desired plant community composition, structure, and function.

Additional Criteria for Restoring or Releasing Desired Vegetative Cover to Protect Soils, Control Erosion, Reduce Sediment, Improve Water Quality or Enhance Stream Flow

Choose a method of control that results in the least amount of soil disturbance if soil erosion potential is high and revegetation is slow or uncertain

leaving the site vulnerable to long-term exposure to soil loss.

In conjunction with other conservation practices, the number, sequence and timing of soil disturbing operations shall be managed to maintain soil loss within acceptable levels using approved erosion prediction technology.

Additional Criteria to Maintain, Modify or Enhance Fish and Wildlife Habitat

Brush management will be planned and applied in a manner to meet the habitat requirements for wildlife species of concern as determined by an approved habitat evaluation procedure.

Conduct treatments during periods of the year that accommodate reproduction and other life-cycle requirements of target wildlife and pollinator species.

Additional Criteria to Manage Fuel Loads to Achieve Desired Conditions

Control undesirable woody plants in a manner that creates the desired plant community, including the desired fuel load, to reduce the risk of wildfire, facilitate the future application of prescribed fire.

CONSIDERATIONS

Consider using Wisconsin NRCS CPS, *Integrated Pest Management (595)* in support of brush management.

Consider the appropriate time period for treatment. Some brush management activities can be effective when applied within a single year; others may require multiple years of treatment(s) to achieve desired objectives.

Consider impacts and consequences to obligate species (species dependent on the target woody species) when significant changes are planned to existing and adjacent plant communities.

Consider impacts to wildlife food supplies, space, and cover availability when planning the method and amount of brush management.

State issued licenses may be required when using chemical pesticide treatments.

For air quality purposes, consider using chemical methods of brush management that minimize chemical drift and excessive chemical usage and consider mechanical methods of brush management that minimize the entrainment of particulate matter.

PLANS AND SPECIFICATIONS

Plans and specifications for the treatment option(s) selected by the decision maker will be recorded for each field or management unit where brush management will be applied.

Prepare brush management plans and specifications that conform to all applicable federal, state, and local laws. These documents will contain the following data as a minimum:

1. Goals and objectives clearly stated.
2. Pre-treatment cover or density of the target plant(s) and the planned post-treatment cover or density and desired efficacy.
3. Maps, drawings, and/or narratives detailing or identifying areas to be treated, pattern of treatment (if applicable), and areas that will not be disturbed.
4. A monitoring plan that identifies what should be measured (including timing and frequency) and that documents the changes in the plant community (compare with objectives) will be implemented.

For Mechanical Treatment Methods: Plans and specifications will include items 1 through 4, above, plus the following:

- Types of equipment and any modifications necessary to enable the equipment to adequately complete the job;
- Dates of treatment to best effect control;
- Operating instructions (if applicable); and
- Techniques or procedures to be followed.

For Chemical Treatment Methods: Plans and specifications will include items 1 through 4, above, plus the following:

- Acceptable chemical treatment references for containment and management or control of target species;
- Evaluation and interpretation of herbicide risks associated with the selected treatment(s);
- Acceptable dates or plant growth stage at application to best effect control and dampen reinvasion;
- Any special mitigation, timing considerations or other factors (such as soil texture and organic matter content) that must be considered to ensure the safest, most effective application of the herbicide; and
- Reference to product label instructions.

For Biological Treatment Methods: Plans and specifications will include items 1 through 4, above, plus the following:

- Acceptable biological treatment references for containment and management or control of target species;
- Kind of grazing animal to be used (if applicable);
- Timing, frequency, duration and intensity of grazing or browsing;
- Desired degree of grazing or browsing use for effective control of target species;
- Maximum allowable degree of use on desirable non-target species; and
- Special mitigation, precautions, or requirements associated with the selected treatment(s).

OPERATION AND MAINTENANCE

Operation: Brush management practices shall be applied using approved materials and procedures. Operations will comply with all local, state, and federal laws and ordinances.

Success of the practice shall be determined by evaluating post-treatment regrowth of target species after sufficient time has passed to monitor the situation and gather reliable data. Length of evaluation periods will depend on the woody species being monitored, proximity of propagules (seeds, branches, and roots) to the site, transport mode of seeds (wind or animals) and methods and materials used.

The operator will develop a safety plan for individuals exposed to chemicals, including telephone numbers and addresses of emergency treatment centers and the telephone number for the nearest poison control center. The National Pesticide Information Center (NPIC) telephone number in Corvallis, Oregon, may also be given for non- emergency information: **1-800-858-7384** Monday to Friday 6:30 a.m. to 4:30 p.m. Pacific Time.

The National Chemical Transportation Emergency Center (CHEMTRAC) telephone number is: **1-800-424-9300**

- Follow label requirements for mixing/loading setbacks from wells, intermittent streams and rivers, natural or impounded ponds and lakes, and reservoirs.
- Post signs, according to label directions and/or federal, state, tribal, and local laws, around fields that have been treated. Follow restricted entry intervals.
- Dispose of herbicides and herbicide containers in accordance with label directions and adhere to federal, state, tribal, and local regulations.
- Read and follow label directions and maintain appropriate Material Safety Data Sheets (MSDS). MSDS and pesticide labels may be accessed on the Internet at: http://www.greenbook.net/
- Calibrate application equipment according to recommendations before each seasonal use and with each major chemical and site change.
- Replace worn nozzle tips, cracked hoses, and faulty gauges on spray equipment.
- Maintain records of brush/shrub control for at least two years. Herbicide application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Record-keeping Program and state-specific requirements.

Maintenance: Following initial application, some regrowth, resprouting, or re-occurrence of brush may be expected. Spot treatment of individual plants or areas needing re-treatment should be completed as needed while woody vegetation is small and most vulnerable to desired treatment procedures.

Review and update the plan periodically in order to:

- Incorporate new IPM technology;
- Respond to grazing management and complex plant population changes; and
- Avoid the development of plant resistance to herbicide chemicals.

FEDERAL, TRIBAL, STATE AND LOCAL LAWS

Users of this standard are responsible for compliance with applicable federal, tribal, state and local laws, rules or regulations. This standard does not contain the text of federal, tribal, state or local laws. Implementation of this standard may not eliminate the discharge of pollutants to the area protected.

REFERENCES

USDA, NRCS Wisconsin Conservation Planning Technical Note 2, Pest Management.

Wisconsin's Manual of Control Recommendations for Ecologically Invasive Plants: http://dnr.wi.gov/topic/invasives/control.html

The Invasive Plant Association of Wisconsin (IPAW): http://www.ipaw.org

Forest Herbicides for Weed Control in the Great Lakes States 1990, Lantagne, D.O. et al, Michigan State University Extension Bulletin E-2219, April, 1990.

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DEFINITION

Brush management is the management or removal of woody (non-herbaceous or succulent) plants. Invasive and noxious woody species are included as target species for management or removal.

PURPOSE

- Create the desired plant community consistent with the ecological site.
- Restore or release desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality or enhance stream flow.
- Maintain, modify, or enhance fish and wildlife habitat.
- Reduce risk of wildfire
- Improve forage accessibility, quality and quantity for livestock and wildlife.
- Manage fuel loads to achieve desired conditions.
- Manage noxious woody plants.

PLANNING REQUIREMENTS

Plans and specifications for the treatment option(s) selected by the decision maker will be recorded for each field or management unit where brush management will be applied.

Prepare brush management plans and specifications that conform to all applicable federal, state, and local laws. These documents will contain the following data as a minimum:

- Goals and objectives clearly stated.
- Pre-treatment cover or density of the target plant(s) and the planned post-treatment cover or density and desired efficacy.
- Maps, drawings, and/or narratives detailing or identifying areas to be treated, pattern of treatment (if applicable), and areas that will not be disturbed.
- A monitoring plan that identifies what should be measured (including timing and frequency) and that documents the changes in the plant community (compare with objectives) will be implemented.

BRUSH MANAGEMENT METHODS

Mechanical Treatments, such as hand cutting or mowing, frilling, or girdling will be done at a time that is most critical to control the target brush species. In some cases, forage production may have to be sacrificed to control brush. In addition to items 1-4 above, include the following:

- Type of equipment and modifications to enable the job to be adequately complated.
- Dates of treatment to best effect control.
- Operating instructions (if applicable).
- Tehcniques or procedures to follow.

Chemical Treatment methods include 1-4 above and the following:

- Acceptable chemical treatment references for containment and management or control of target species
- Evaluation and interpretation of herbicide risks associated with selected treatment

- » Acceptable dates or plant growth stage at application to best effect control and slow reinvasion
- » Special mitigation, timing, or other factors such as soil texture and organic content that must be considered to ensure safety, effectiveness and
- » Reference to product label instructions

Foliage Stem Spraying – Herbicide sprays are applied to the stem and foliage. This type of application is least effective on resprouting species. Application should be made from the time that leaves are fully expanded in the spring until fall color. Preventing drift to surrounding areas is more difficult with this method. Low pressure coarse spraying with drift reduction additives is recommended.

Basal Bark Application – Basal spraying is a technique to deaden small trees, shrubs and occasionally vines by spraying the green bark of the lower trunk (12 to 18 inches or 30 to 46 cm) with herbicide. Herbicides used for basal spraying are generally applied with oil carriers. The technique is **effective** on species less than four to six inches in diameter. Care must be taken when herbicide is applied to minimize the amount that runs into the soil.

Cut Stump Application – The chemical is applied to freshly cut stump surfaces. Treat before the cut surface dries (within two to three hours after cutting) for the optimum control. Stump treatment with the water-soluble herbicides must be done immediately after cutting the tree or vine in order to be effective. The critical area of the stump must be treated to prevent sprouting in the sapwood and bark of the stump's cut surface. Oil-based carrier herbicides do not move readily within the plant, but penetrate the bark. To be effective in suppressing stump sprouting, the entire stump, and particularly the bark and exposed roots, must be thoroughly sprayed. Treatment with an oil-based carrier herbicide is recommended in the spring when treating species that exhibit a spring "sap flow".

Frill, Hatchet, or Girdling Application – Frilling and girdling are methods of controlling standing trees and shrubs that may be done with or without a herbicide. The bark around the base of the trunk is cut and the herbicide is either applied as a separate step or injected simultaneously in the cambium area. These techniques require a considerable amount of time and labor to implement.

Tree Injection with Spaced Cuts Application – Tree injection involves introducing a herbicide into the undesirable species through spaced cuts made around the trunk of the woody plant with an axe, hatchet, or tree injector. The amount of herbicide to be placed in the cut is specified on the herbicide label. There are various tree injectors available such as "hypo-hatchet," which is a hatchet constructed to inject herbicide when it is struck into the tree.

Soil Application – This type of treatment includes pellets, beads, granules or concentrated liquids applied to the soil at the base of the plant within the dripline. Soil-applied herbicides usually remain active in the soil for several months or even years. Treatments can be made at any time of the year when the ground is not frozen, but control will only occur after sufficient rain has fallen. This method should only be used on non-erosive soils. Nearby trees may be injured or killed if their roots extend into the treated area.

Biological Treatment methods include biological agents, such as insects that feed on or disrupt the functions of the target species and the use of livestock trained or managed to graze and/or browse the target species. NRCS will only develop biological treatment plans utilizing grazing animals. The grazing animals may be livestock owned and managed by the landowner or trained herds/flocks leased by the landowner. To ensure an enduring desired response to brush management, the conservation plan will included Wisconsin NRCS Conservation Practice Standard, "Prescribed Grazing" (528).

OPERATION AND MAINTENANCE

- » Evaluate the post-treatment regrowth of target species. Monitor over time. Site conditions will determine how much monitoring will be needed and is based on seed sources, and methods of control used.
- » A safety plan for individuals exposed to chemicals will include phone numbers and addresses of emergency treatment centers, poison control centers, mixing and loading setbacks, signs defining label directions, restricted entry information.
- » Dispose of herbicides and containers in accordance to all laws and label directions.

- Read and follow label directions
- Calibrate application equipment according to recommendations.
- Replace worn nozzle tips and defective hoses and faulty gauges on equipment.
- Maintain records of brush control for two years or more. Records will be according to USDA Agricultural Marketing Services Pesticide Record-keeping Program.
- Spot treat regrowth as needed while woody material is small.
- Update IPM plan with new technology.
- Respond to grazing management plans and plant population changes.
- Avoid plan resistance to herbicides by mechanical treatment to resistant species.

GENERAL INFORMATION

Client name: _____

County: _____ Acres to be treated: _____

Purpose and objectives for using brush management: _____

Target species to be controlled: _____

Species to be benefited: _____

BRUSH MANAGEMENT DESIGN SPECIFICATIONS

Brush canopy and/or species count or transect line locations and percent canopy or species numbers per acre of the target plant(s): _____% canopy in current condition ***OR*** _____ (number) of _____ (species).

Photopoint picture taken as documentation? ☐ Yes ☐ No | _____%planned control of target species.

Treated and untreated areas are designated on: ☐ Map

Map or sketch included in client folder? ☐ Yes

Year and season of planned treatment(s): _____
(date treatment should be planned to achieve best control by selected method)

Treatment method:
☐ Chemical* ☐ Mechanical
☐ Biological ☐ Prescribed Burning (338) required

(mark all that apply)
**Chemical treatment - any herbicide used to control woody species must be federally and locally registered and must be applied strictly in accordance with registered uses, direction on the label, and other federal or state policies and requirements. The safety measures for the user must be adhered to at all times.*

Planned application method:
☐ Foliage Stem ☐ Basal Bark
☐ Cut Stump ☐ Girdling/Frill with Herbicide
☐ Tree/Shrub Injection ☐ Soil

Evaluation & interpretation of herbicide risk:
WINPST attached; discussed with landowner? ☐ Yes ☐ No

Chemical treatment reference(s) (list all or attach): _____

_____

_____

Chemical product label reference(s) (list all or attach): _____

_____

_____

Acceptable planned date ranges or growth stages for application: _____

Any special mitigation, timing considerations, or other factors that must be considered to ensure the safest, most effective application of herbicide (drift reduction, soil texture and organic matter, for example): _____

_____

MECHANICAL TREATMENT

Planned treatment date listed above is selected as the opportune time for best control of target species:

_____

Planned application method:

- ☐ Girdling. Equipment needed: _____
- ☐ Hand cutting. Equipment needed: _____
- ☐ Brush-hog mowing
- ☐ Flail mowing
- ☐ Dozer/Backhoe/Bucket
- ☐ Other, as described: _____

Operating instruction, as applicable: _____

BIOLOGICAL TREATMENT

Grazing plans will be include periods of targeted grazing to achieve planned utilization of target species. Temporary fencing may be required to limit access to other forage. There should be enough livestock to completely defoliate (100%) the brush within 3-5 days. Multiple (more than 3) defoliations are generally necessary the first year, with fewer needed each year thereafter.

Planned application method: ☐ Targeted grazing with livestock.
Describe kind of livestock: _____

Time, frequency, duration and intensity of grazing and/or browsing: _____

Planned utilization of target species _____ %

Maximum allowable utilization of desirable non-target species: _____

Special mitigation, precautions, or requirements associated with the selected treatment: _____

_____

Year and season of planned treatment(s): _____
(date of treatment should be planned to achieve best control by selected method)

Name: _____ Phone Number: _____

- ☐ National Pesticide Information Center: 1-800-858-7384
- ☐ National Chemical Transportation Emergency Center (CHEMTRAC): 1-800-424-9300

Follow label requirements for mixing/loading setbacks from wells, intermittent streams and rivers, natural or impounded ponds, lakes, and reservoirs.

Post signs according to label directions and/or federal, state, tribal or local laws, around fields that have been treated. Follow restricted entry intervals.

Dispose of herbicide and herbicide containers in accordance with label directions and adhere to federal, state, tribal, and local regulations. Read and follow label directions and maintain appropriate Material Safety Data Sheets.

Calibrate application equipment according to manufacturer's recommendations before each seasonal use and with each major chemical and site change.

Replace worn nozzle tips, cracked hoses, and faulty gauges on spray equipment. Maintain records of brush/shrub control for at least 2 years. Records shall be in accordance with USDA AMS Pesticide Record-keeping Program and Wisconsin Department of Agriculture requirements.

DESIGN APPROVAL

I certify that this practice has been designed with specifications to meet Wisconsin NRCS Conservation Practice Standard, Brush Management (314), and that the client has been advised of installation and layout elements and given a completed job sheet 314.

NRCS or TSP* (print) (sign) Date

MONITORING PLAN

Target species and protected desirable species will be monitored during the growing season each year. When grazing and/or browsing animals are used as a biological treatment method, monitoring will occur at least once per week during the growing season.

Records will be kept. Document treatment effects with photopoint snapshots of the treatment area before and after treatment.

Measure and document:

- ☐ Target species, weekly
- ☐ Target species monthly
- ☐ Other, describe:_____
- ☐ Evaluate post-treatment regrowth of the target species: _____
- ☐ Record forms completed for each treatment application
- ☐ Photopoint monitoring pictures submitted

OPERATIONS AND MAINTENANCE

Brush management practices shall be applied using approved materials and procedures.

Operations will comply with all local, state, and federal laws and ordinances.

Evaluation of practice success is an on-going operation.

Spot treatment of individual plant or areas needed re-treatment should be completed as needed while woody vegetation is small and most vulnerable to treatment effects.

- ☐ Chemical Safety Plan
- ☐ Emergency Services: 911
- ☐ Local hospital emergency number:
- ☐ Local police or sheriff:
- ☐ Ambulance:
- ☐ In case of emergency, notify:

REVIEW AND UPDATE PLAN PERIODICALLY

- ☐ Incorporate new IPM technology
- ☐ Respond to grazing management and complex plant population changes
- ☐ Avoid the development of plant resistance to herbicide chemicals

INSTALLATION CERTIFICATION

The Brush Management (314) Practice has been installed according to the Wisconsin NRCS Practice Standard as specified above, and meets the minimum removal rate of _____ percent (target is 95% kill). A site visit was conducted and results verifited.

- ☐ Site map is red lined, verifying treament location(s)
- ☐ Photots were taken in the field and include:
  - » Who took the photo
  - » When the photo was taken
  - » What is pictured
- ☐ Actual date of treatment:
- ☐ Treatment acres match planned acres?

Practice Certification (NRCS USE ONLY)

I certify that the practice as installed is complete and meets the applicable Wisconsin NRCS Conservation Practice Standard and all applicable practice specifications. Any changes to the original practice design have been approved and are documented on the original practice design "as installed."

Certified Planner (print) (sign) Date

STATEMENT OF WORK

USDA, Natural Resources Conservation Service

Wisconsin

Brush Management (314)

DESIGN (911)

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM part 503-Safety, Section 503.00 through 503.22)
    d. List all required and/or facilitating practices
    e. Practice standard criteria-related computations and analyses to develop plans and specifications including, but not limited to:
        i. Timing and sequence
        ii. Consideration of soil erosion potential
        iii. Vegetation establishment
2. Written plans and specifications, including sketches and drawings, that adequately describe the requirements to install the practice and obtain necessary permits shall be provided to the client.
3. Identify fields where practice is to be applied on a farm or ranch plan map.
4. Operation and maintenance plan.
5. Certification that the design meets practice standard criteria and complies with applicable laws and regulations. Wisconsin NRCS Brush Management conservation sheet may be used for this.
6. Design modifications during installation as required.

INSTALLATION (912)

Deliverables:

1. Pre-installation conference with client.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation guidance as needed.
5. Facilitate and implement required design modifications with client and original designer.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meet design and permit requirements. Wisconsin NRCS Brush Management conservation sheet may be used.

CHECKOUT (913)

Deliverables:

1. Records of application.
    a. Extent of practice units applied
    b. Actual materials used
2. Certification the application meets NRCS standards and specifications and is in compliance with permits.
3. Progress reporting.
4. Exit conference with client and contractor.

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard, Brush Management (314)
- NRCS National Range and Pasture Handbook
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook client and contractor.

CERTIFICATION OF COMPLETION

Brush Management (314)

Program Participant Information

Name (print):_____

Contract Number:_____ Contract Item #(s):_____

Technical Service Provider Information

Name (print):_____

TSP ID Number:_____ Expiration Date:_____

Technical Service Provided

- ☐ Design (911)
- ☐ Installation (912)
- ☐ Checkout (913)

I hereby certify that the technical services I provided as a Technical Service Provider for this compnent(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservotion practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this compnent, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS Staff) ***Date***

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

COVER CROP

CODE 340

(Acre)

I. DEFINITION

Grasses, small grains, legumes, forbs, and/or other herbaceous plants established for seasonal cover and conservation purposes.

II. PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Improve soil health and condition
- Improve soil structure/biodiversity
- Increase soil organic matter
- Manage excess nutrients in the soil
- Minimize and reduce soil compaction
- Promote biological nitrogen fixation
- Reduce wind abrasion damage
- Provide supplemental forage
- Reduce particle emissions
- Reduce water and wind erosion
- Soil moisture management
- Suppress weeds and break pest cycles

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all lands requiring seasonal vegetative cover for natural resource protection or improvement.

IV. CRITERIA

A. General Criteria Applicable To All Purposes

1. Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with Wisconsin Agronomy Technical Note 7, "*Cover and Green Manure Crops*". Soil and site conditions will be evaluated.
2. Cover crop seed will be tested. Seed mixes are based on Pure Live Seed rates.
3. Select species and planting dates that will not compete with the production crop yield or harvest.
4. The cover crop plant species selected will be compatible with the current cropping system, previously applied herbicides, nutrient and pest management plans and other components of the conversation plan.
5. Cover crops shall meet the grower's objective and follow termination guidance in Wisconsin Agronomy Technical Note 7 Cover and Green Manure Crops.
6. Do not burn cover crop residue.
7. When grazing or hayng a cover crop follow pesticide label restrictions Grazing or haying of the cover crop shall not compromise the performance of the crop to meet conservation purposes.
8. Soil testing and nutrient applications are not required for the establishment of cover crops.

B. Additional Criteria To Reduce Erosion From Wind And Water

1. Time cover crop establishment in conjunction with other practices so that the soil will be adequately protected during the critical erosion period(s).
2. Select plants that have the physical characteristics necessary to produce adequate root structure and protect the soil during critical periods.

3. Use the current erosion prediction technology (RUSLE2 or WEPS) to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective.

C. Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

1. Cover crop species will be selected on the basis of producing higher volumes of organic material and root mass to maintain or increase soil organic matter.
2. The planned crop rotation, including the cover crop management activities, will score a Soil Conditioning Index (SCI) value > 0, as determined using the current approved NRCS SCI procedure.
3. The cover crop shall be planted as early as possible and be terminated as late as practical for the producer's cropping system to maximize and plant biomass production. Allow time to prepare the field for planting the next crop, and to avoid soil moisture depletion.

D. Additional Criteria To Reduce Water Quality Degradation By Utilizing Excessive Soil Nutrients

1. Cover crops will be established and actively growing before expected periods of high precipitation can cause nutrient leaching.
2. Cover crop species shall be selected for their ability to adsorb large amounts of nutrients from the rooting profile of the soil. Use fibrous-rooted cereal grains or grasses to maximize the utilization of excess nitrogen.
3. Cover crops harvested for feed (hay/balage) shall be suitable for the planned livestock, and capable of removing the excess nutrients present.
4. The above ground biomass shall be removed from the field when maximum nutrient removal efficiency is required. Cover crop termination method and timing shall be determined based on the objectives for managing nutrients in the soil profile. Terminate the cover crop as late as practical to maximize plant biomass production and nutrient uptake.
5. Deep-rooted cover crops shall be used to extract excessive nutrients in the soil profile.
6. Nitrogen credits from legume cover crops shall be accounted for in the following crop year nutrient management plan using current University of Wisconsin recommendations.

E. Additional Criteria To Suppress Excessive Weed Pressures And Break Pest Cycles

1. Select cover crops for their life cycles, growth habits, and other biological, chemical or physical characteristics to provide one or more of the following:
   - Suppress or compete with weeds such as Allelophatic (chemically suppress), compete for light, moisture, and/or nutrients.
   - Break pest life cycles or suppress plant pests or pathogens.
   - Provide food or habitat for natural enemies of pests.
2. Select cover crop species that do not harbor pests or diseases known to affect subsequent crops in the rotation.

F. Additional Criteria To Improve Soil Moisture Use Efficiency

1. In areas of limited soil moisture, terminate sufficiently early to conserve soil moisture for the subsequent crop. Utilize the NRCS Cover Crop Termination Guidelines found in Wisconsin Agronomic Technical Note 7, "*Cover and Green Manure Crops*" to determine the appropriate timing for termination.

2. Cover crops established for moisture conservation shall be left on the soil surface until the subsequent crop is planted.

3. In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to soil moisture removal.

G. Additional Criteria to Minimize Soil Compaction

1. Select cover crop species that have the ability to root deeply and capacity to penetrate or prevent compacted layers, increase soil organic matter, improve soil structure and increase infiltration.

V. CONSIDERATIONS

1. Plant cover crops in a timely matter and when there is adequate moisture to establish a good stand.

2. When applicable, ensure cover crops are managed and are compatible with the client's crop insurance criteria.

3. Optimal cover crop benefits are usually accomplished when the plant density is at least 25 stems per square foot; the combined canopy and surface cover is at least 80 percent, and the above ground (dry weight) biomass production is at least 2700 pounds per acre.

4. Higher density cover crop stands promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve weed competitiveness.

5. Consider designing cover crop mixtures with at least one grass and one legume.

6. Consider that grasses utilize primarily soil nitrogen, and legumes utilize both soil nitrogen and phosphorus.

7. Consider the use of cover crops to improve site conditions for establishment of perennial species.

8. Consider the risk for seed produced by cover crops to provide weed competition to subsequent crops. Termination of covers may need to be done timely to avoid this risk.

9. Consider the use of plant species that may attract beneficial pollinators. Refer to Wisconsin Biology Technical Note 8, "*Pollinator Biology and Habitat*" for a list of diverse legumes and other forbs that promote pollinator habitat that can be used in cover crop mixes.

10. Consider the benefits of cover crop species with desired forage traits, and palatable to livestock, that will not interfere with the production of the subsequent crop.

11. Select a mixture of two or more cover crop species from different plant families to achieve one or more of the following: (1) species mix with different maturity dates, (2) attract beneficial insects, (3) attract pollinators, (4) increase soil biological diversity, (5) serve as a trap crop for insect pests, or (6) provide food and cover for wildlife habitat management.

12. Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to achieve biological nitrogen fixation. Select cover crop mixture, timing, and method of termination that will maximize efficiency of nitrogen utilization by the following crop. Use University of Wisconsin recommended to capture nitrogen credits from the legume.

13. Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage.

A. Additional Considerations to Reduce Erosion by Wind or Water

1. To reduce erosion, best results are achieved when the combined canopy and surface residue cover attains 90

percent or greater during the period of potentially erosive wind or rainfall.

B. Additional Considerations to Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

1. Use deep-rooted species to maximize nutrient recovery.
2. When appropriate for the crop production system, mowing certain grass cover crops (e.g., sorghum-sudan grass, pearl millet) prior to heading and allowing the cover crop to regrow can enhance rooting depth and density, thereby increasing their subsoiling and nutrient-recycling efficiency.

C. Additional Considerations to Increase Soil Health and Organic Matter Content

1. Increase the diversity of cover crops (e.g., mixtures of several plant species) to promote a wider diversity of soil organisms, and thereby promote increased soil organic matter.
2. Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to provide nitrogen through biological nitrogen fixation.
3. Legumes add the most plant-available N if terminated when about 30 percent of the crop is in bloom.

VI. PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for each field according to planning criteria. Plans for the establishment of cover crops shall include:

- Field number and acres,
- Species of plant(s) to be established,
- Seeding rates,
- Seeding dates,
- Establishment procedure,
- Rates, timing and forms of nutrient application (if needed),
- Dates and method of cover crop termination,
- Other information pertinent to establishing and managing the cover crop such as specifics for haying or grazing planning.

All Specifications shall be recorded using Wisconsin Job Sheet 340, "*How to Establish Cover and Green Manure Crops*".

VII. OPERATION AND MAINTENANCE

1. Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.
2. Terminate cover crop according to design (timing/method) to prevent negative impact on primary crop.
3. Maintain adequate biomass on the soil surface to meet the intended use of the practice, when the cover crop will be grazed or harvested.

VIII. FEDERAL, TRIBAL, STATE AND LOCAL LAWS

Users of this standard should be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing cover crops. This standard does not contain the text of federal, tribal, state or local laws.

IX. REFERENCES

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

USDA, NRCS Wisconsin Agronomy Technical Note 7, "*Cover and Green Manure Crop Benefits to Soil Quality*".

USDA, NRCS Wisconsin Biology Technical Note 8, "*Pollinator Biology and Habitat*".

USDA, NRCS Wisconsin Job Sheet 340, "*How to Establish Cover and Green Manure Crops*".

Cover Crops on the Intensive Market Farm, University of Wisconsin – Madison, Center for Integrated Agricultural Systems, College of Agricultural and Life Sciences.

A. Clark 2007. Managing Cover Crops Profitably, 3rd Edition, Sustainable Agriculture Network Handbook Series; Handbook K9.

Magdoff, Fred, and Harold Van Es. Building Soils for Better Crops – Sustainable Soil Management 3rd Edition, Handbook Series Book 10.

Moyer, Jeff, Organic No-Till Farming – Advancing No-Till Agriculture, Crops, Soil, Equipment.

Midwest Cover Crop Council: http://www.mccc.msu.edu/index.htm

Midwest Cover Crop Decision Tool: http://mcccdev.anr.msu.edu/

NRCS Cover Crop Termination Guidelines: http://efotg.sc.egov.usda.gov/references/public/ UT/CoverCropTerminationGuidelines.pdf

UW Extension Publications: Cover Crop Termination, Forage Herbicide Quick Sheet – Cereal Rye Forage after Corn Silage, Forage Herbicides Quick Sheet – Spring-Seeded Forages after Corn and Herbicide Rotation Restrictions in Forage and Cover Cropping Systems located at the Wisconsin Crop Weed Science Website: http://wcws.cals.wisc.edu

USDA United States Department of Agriculture

HOW TO ESTABLISH COVER AND GREEN MANURE CROPS

Wisconsin Job Sheet 340

WHAT IS A COVER CROP?

Grasses, small grains, legumes, forbs, and/or other herbaceous plants established for seasonal cover and conservation purposes.

PURPOSE

- Improve soil health and condition
- Improve soil structure/biodiversity
- Increase soil organic matter
- Manage excess nutrients in the soil
- Minimize and reduce soil compaction
- Promote biological nitrogen fixation
- Reduce wind abrasion damage
- Provide supplemental forage
- Reduce particle emissions
- Reduce water or wind erosion
- Soil moisture management
- Suppress weeds and break pest cycles

PLANNING REQUIREMENTS

Plans and specifications will be prepared for each field. Plans for the establishment of cover crops shall be included in the tables on page three of this job sheet.

OPERATION AND MAINTENANCE

Time the cover crop establishment to maximize competition with weeds and volunteer plants.

Terminate cover crops according to the plan (timing/method) to prevent a negative impact on the next cover crop in the crop rotation.

Evaluate the cover crop to determine if it is meeting the planned purpose(s). If the cover crop is not meeting the intended purpose(s), adjust the current management, change the species of future cover crops, or choose a different establishment and/or termination method.

PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for each field according to planning criteria. Plans for the establishment of cover crops shall include:

- Field number and acres
- Species of plant(s) to be established
- Seeding rates,
- Seeding dates,
- Establishment procedure,
- Rates, timing and forms of nutrient application (if needed)
- Dates and method of cover crop termination.
- Other information pertinent to establishing and managing the cover crop such as specifics for haying or grazing planning.

NOTE

For more specific deteal, refer to Wisconsin Agronomy Technical Note 7 and Field Office Technical Guide, Section IV, Standard 340, Cover Crop.

Insurance may require additional termination guidelines such as terminating prior to, or within 5 days of plating (pre-emergence).

COST SHARE DOCUMENTATION FOR CASE FILE

Before payment is made, the following information is required to be in the case file:

- ☐ Location map and seeding sheets are complete and installed
- ☐ Photographs of established cover crop that must include:
  - Statement "Photo was taken in the field by (enter name)"
  - Date photo was taken in the field
  - Statement of what the photo represents if it needs clarification
- ☐ Field verification is documented and a certified planner verified "as installed" this practice meets NRCS standards and specifications.

I verify the cover crop practice meets NRCS standards and specifications		
Certified Planner (print)	(sign)	Date

Cover and Green Manure Crops

Client Name: _____ Planner Name: _____

Practice Purpose: _____

PLANNED PRACTICE LOCATION AND EXTENT

Contract Number	Contract Identification Number (CIN)	Tract Number	Field Number(s)	Acres Contracted	Acres Planned	Actual Acres Applied (NRCS USE ONLY)

*A completed copy of this page must be submitted for a financial assistance payment to be processed.

SEEDING PLAN

ATTENTION: Contact NRCS Prior to making any changes to cover crop species, seeding rate, or seeding date.

Tract No.	Field No.	Acres	Species	Seeding Rate* (lbs./ac)	Total Pounds Seed To Purchase	Seeding Date	Actual Seeding Date	Existing Cover/Crop Type	Seeding Method	Termination Stage/Date	Termination Method

USDA United States Department of Agriculture

HOW TO ESTABLISH COVER AND GREEN MANURE CROPS

Wisconsin Job Sheet 340

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PLANNING REQUIREMENTS

Plans and specifications will be prepared for each field. Plans for the establishment of cover crops shall be included in the tables on page three of this job sheet.

OPERATION AND MAINTENANCE

Time the cover crop establishment to maximize competition with weeds and volunteer plants.

Terminate cover crops according to the plan (timing/method) to prevent a negative impact on the next cover crop in the crop rotation.

Evaluate the cover crop to determine if it is meeting the planned purpose(s). If the cover crop is not meeting the intended purpose(s), adjust the current management, change the species of future cover crops, or choose a different establishment and/or termination method.

PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for each field according to planning criteria. Plans for the establishment of cover crops shall include:

- Field number and acres
- Species of plant(s) to be established
- Seeding rates,
- Seeding dates,
- Establishment procedure,
- Rates, timing and forms of nutrient application (if needed)
- Dates and method of cover crop termination.
- Other information pertinent to establishing and managing the cover crop such as specifics for haying or grazing planning.

NOTE

For more specific deteal, refer to Wisconsin Agronomy Technical Note 7 and Field Office Technical Guide, Section IV, Standard 340, Cover Crop.

Insurance may require additional termination guidelines such as terminating prior to, or within 5 days of plating (pre-emergence).

COST SHARE DOCUMENTATION FOR CASE FILE

Before payment is made, the following information is required to be in the case file:

- ☐ Location map and seeding sheets are complete and installed
- ☐ Photographs of established cover crop that must include:
  - Statement "Photo was taken in the field by (enter name)"
  - Date photo was taken in the field
  - Statement of what the photo represents if it needs clarification
- ☐ Field verification is documented and a certified planner verified "as installed" this practice meets NRCS standards and specifications.

I verify the cover crop practice meets NRCS standards and specifications		
Certified Planner (print)	(sign)	Date

Cover and Green Manure Crops

Client Name: _____ Planner Name: _____

Practice Purpose: _____

PLANNED PRACTICE LOCATION AND EXTENT

Contract Number	Contract Identification Number (CIN)	Tract Number	Field Number(s)	Acres Contracted	Acres Planned	Actual Acres Applied (NRCS USE ONLY)

*A completed copy of this page must be submitted for a financial assistance payment to be processed.

SEEDING PLAN

ATTENTION: Contact NRCS Prior to making any changes to cover crop species, seeding rate, or seeding date.

Tract No.	Field No.	Acres	Species	Seeding Rate* (lbs./ac)	Total Pounds Seed To Purchase	Seeding Date	Actual Seeding Date	Existing Cover/Crop Type	Seeding Method	Termination Stage/Date	Termination Method

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Cover Crop (340)

DESIGN (911)

Deliverables:

1. Design documentation that will demonstrate the criteria in the NRCS practice standard have been met and are compatible with other planned and applied practices.
    a. Practice purpose(s) are identified and are compatible with the conservation plan and, where applicable, client's crop insurance.
    b. List of required permits to be obtained by the client.
    c. List all required and/or facilitating practices.
    d. Practice standard criteria related computations, and analyses to develop plans and specifications including but not limited to:
        i. Planting dates
        ii. Site and seedbed preparation
        iii. Soil amendments required
        iv. Species selection and seeding rates
        v. Cover crop termination time and method
        vi. Soil loss calculations, soil conditioning index, soil tillage intensity rating data using RUSLE2 and WEPS
2. Written plans and specification shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits. Plans and specifications shall be developed in accordance with the requirements of conservation practice standard Cover Crop (Code 340).
3. Operation and maintenance plan.
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations.
5. Documentation including design modifications during practice installation.
6. Itemized cost estimate.

INSTALLATION (912)

Deliverables

1. Documentation of pre-installation discussion and verification that client has obtained required permits.
2. Application guidance as needed.
3. Facilitate and implement required design modifications with client and original designer.
4. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during application.
5. Certification that the application process and materials meet design and permit requirements and, where applicable, client's crop insurance.

CHECKOUT (913)

Deliverables

1. Records of application
    a. Extent of practice units applied and location identified on plan map.
    b. Actual materials used.
2. Certification that the application meets NRCS standards and specifications and is in compliance with permits, where applicable.
3. Documentation of exit conference with client and contractor progress reporting.

REFERENCES

- WI NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard 340, Cover Crop
- NRCS National Agronomy Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

CERTIFICATION OF COMPLETION

Cover Crop (340)

Program Participant Information

Name (print): _____

Contract Number: _____ Contract Item #(s): _____

Technical Service Provider Information

Name (print): _____

TSP ID Number: _____ Expiration Date: _____

Technical Services Provided

☐ Design (911)

☐ Installation (912)

☐ Checkout (913)

I hereby certify that the technical services I provided as a Technical Service Provider for this component(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservation practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this component, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS staff) ***Date***

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FILTER STRIP

CODE 393

(Acre)

I. DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

II. PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

1. Reduce suspended solids and associated contaminants in runoff – Resource concerns (WATER QUALITY DEGRADATION – Excess nutrients in surface and ground waters, pesticides transported to surface and ground waters, excess pathogens and chemicals from manure, bio-solids or compost applications, and excessive sediment in surface waters).
2. Reduce *dissolved contaminant* loading in runoff – Resource concerns (WATER QUALITY DEGRADATION – Excess nutrients in surface and ground waters, pesticides transported to surface and ground waters, and excess pathogens and chemicals from manure, bio-solids or compost applications).

Installation of a properly designed filter strip will reduce water quality degradation resource concerns caused by delivery of excessive nutrients, sediment, pesticides and/or pathogens from manure, bio-solids or compost applications transported by runoff to surface waters, and/or by leaching to ground water resources.

III. CONDITIONS WHERE PRACTICE APPLIES

A. Filter strips are established where *Environmentally Sensitive Areas (ESA)* need protection from sediment and other suspended solids and dissolved contaminants in surface water runoff from cropland, pastures, and perennial cropped areas such as orchards and tree nurseries.

B. This practice **DOES NOT** apply under the following conditions:

1. The treatment of conditions where high levels of pollutants can be anticipated from areas such as: a) animal feed lots, b) feed storage areas, c) milking center waste areas, d) manure stacking areas, e) *direct runoff from manure land application*, f) construction sites, g) urban storm water runoff and h) timber harvest locations.
2. Where soil loss is above *Tolerable "T"* rates within the contributing watershed.
3. Where the predominant source of runoff is *concentrated flow*.
4. Where the creation, restoration, or enhancement of wildlife habitat or movement corridors is the primary purpose.

IV. CRITERIA

A. General Criteria Applicable To All Purposes

Detailed filter strip planning and design criteria are located in Wisconsin NRCS Agronomy Technical Note 10, "Design Planning, Management and Maintenance of Vegetative Filter Strips" (WI NRCS TN-10).

1. Resource Assessment – tools listed in the Wisconsin NRCS Field Office Technical Guide Section III: "Guidelines for Resource Management System Quality Criteria and Human Considerations" or other NRCS recognized assessment tools and methods will be used to identify when potential resource problems exist. When surface water discharge to the VFS is 0 or the VFS has no contributing drainage area there is no resource concern.

    a. Suspended Solids in Runoff:

        1) Sediment volume - *Revised Universal Soil Loss Equation (RUSLE2).* Soil loss over 0.5 tons per acre per year from the contributing area will create a potential resource concern due to suspended solids in surface runoff.

        2) Risk of transport of agricultural chemicals attached to sediment *Windows Pesticide Screening Tool (WIN-PST).*

    b. Dissolved Contaminants in Runoff:

        1) Risk of transport of dissolved nutrients in runoff – *Snap Plus Nutrient Management Tool.*

        2) Risk of transport of agricultural chemicals dissolved in runoff – Windows Pesticide Screening Tool (WIN-PST).

2. Filter Strip Siting.

    a. Locate the filter strip downslope from the contaminant source.

    b. The drainage area above the filter strip shall have a slope of 1 percent or greater.

    c. The filter strip may be sited in locations that are not contiguous / immediately adjacent to the ESA.

Noncontiguous filter strips shall be located within 700 feet or less of the ESA needing protection.

For filter strips noncontiguous to the ESA, the following assessment guidance shall be implemented:

1) No further assessment is required if:

    a) The planned noncontiguous filter strip is located within 300 feet of the ESA, and

    b) The ESA is contiguous to an additional existing vegetative buffer that meets the minimum filter strip widths for the identified resource concern.

2) The following additional filter strip design assessment is required when; an existing buffer is not immediately contiguous to the ESA, or the noncontiguous filter strip is located greater than 300 feet and less than 700 feet from the ESA:

    a) The soil loss and sediment delivery for the area between the lower edge of the planned noncontiguous filter strip and the ESA shall be computed using RUSLE2. The resulting sediment delivery to the ESA shall be equivalent or less than the calculated delivery to the low end of the upslope filter strip.

    b) The dissolved contaminant delivery for the area between the lower edge of the planned noncontiguous filter strip and ESA shall be computed using the same protocol in V. 2. a).

NATURAL RESOURCES CONSERVATION SERVICE

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Installation of a properly designed filter strip will reduce water quality degradation resource concerns caused by delivery of excessive nutrients, sediment, pesticides and/or pathogens from manure, bio-solids or compost applications transported by runoff to surface waters, and/or by leaching to ground water resources.

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    a) The soil loss and sediment delivery for the area between the lower edge of the planned noncontiguous filter strip and the ESA shall be computed using RUSLE2. The resulting sediment delivery to the ESA shall be equivalent or less than the calculated delivery to the low end of the upslope filter strip.

    b) The dissolved contaminant delivery for the area between the lower edge of the planned noncontiguous filter strip and ESA shall be computed using the same protocol in V. 2. a).

3. The maximum row gradient along the leading edge of the filter strip shall not exceed 5 percent.
4. Overland flow entering the filter strip shall be uniform sheet flow. Concentrated flow shall be dispersed before runoff enters the filter strip as necessary to meet the design criteria.
5. A site assessment shall be conducted to select plant species adaptable to the buffer setting and to maximize interception of runoff constituents identified as causing the resource concern(s). The site investigation shall include an evaluation of:
   - Soil characteristics
   - Soil fertility
   - Slope
   - Aspect
   - Moisture regime
   - Flooding frequency
   - Proximity to natural plant communities
   - Identification and treatment of concentrated flow areas
   - Herbicide application history
   - Site history
6. Utilize the site investigation results to identify any physical, chemical, or biological condition that could affect the successful establishment or long term survival of the filter strip vegetation. Data collected during the inventory and site assessment, shall be documented on the site assessment documentation worksheet.

B. <u>Criteria to Reduce Suspended Solids and Associated Contaminates in Runoff</u>

1. Use the design procedure in WI NRCS TN-10 to determine the minimum flow length through the filter strip, which shall be no less than 20 feet.
2. The filter strip shall be designed to have a 10-year life span determined using the procedure outlined in WI NRCS TN-10. The design procedure estimates sediment delivery as a result of the average annual rotational soil loss using RUSLE2.

C. <u>Criteria to Reduce Dissolved Contaminates in Runoff</u>

1. Use the design procedure in WI NRCS TN-10 to determine the minimum flow length through the filter strip, which shall be no less than 30 feet which must be calculated using Technical Note 10.
2. The filter strip will be designed to have a 10-year life span determined using the procedure outlined in WI NRCS TN-10 by estimating sediment delivery as a result of the average annual rotational soil loss of the contributing area using RUSLE2.
3. When removal of dissolved contaminants is identified as a primary design consideration, at least 50 percent of the vegetation shall be deep-rooted. Most native grasses are deep rooted. Refer to Wisconsin NRCS Agronomy Technical Note 6, "Establishing and Maintaining Introduced Grasses and Legumes" (Wisconsin NRCS TN-6), Table III, "Plant Morphology and Physiology Characteristics," for introduced species identified as deep-rooted.
4. When pesticides in solution runoff have been identified as a resource concern, use WIN-PST to evaluate the water solubility characteristics of pesticides applied in the contributing drainage area. A hazard rating of intermediate, high and very high is an indication of conditions that may have negative impacts on water quality. Refer to WI NRCS TN-10 for guidance when using WIN-PST to evaluate, mitigate and minimize pesticide movement in surface runoff and leaching to groundwater.

5. Use the "Identify Resource Concerns" assessment procedure in WI NRCS TN-10 for assessing crop management activities that may increase the probability for dissolved contaminants in surface water runoff.

D. Additional Criteria to Design and Establish Vegetative Cover

1. Vegetation Species Selection and Seed Quality.

   a. Species identified as noxious or invasive by law shall not be planted.

   b. Filter strips will not be used as travel lanes for equipment or livestock.

   c. Species selected for planting shall be compatible to current site conditions, intended use, and be resistant to diseases and insects common to the site location.

   d. The filter strip shall be established to perennial herbaceous vegetation and species selected shall be:

      1) Able to withstand partial burial from sediment deposition,

      2) Tolerant of herbicides used within the drainage area that contributes runoff to the filter strips, and

      3) Primarily sod forming species with stiff stems and a high stem density near the ground surface.

   e. Tested Seed shall be used. The seed tag or laboratory test results shall be available to the individual certifying the practice as complete.

   f. Actual PLS adjusted seeding rates will be used to establish the seeding. Calculations used to determine the actual adjusted seeding rate shall be available to the individual certifying the practice as complete.

   g. Untested introduced and native grass and forb seed are not approved for planting.

   h. When more than 20 percent legume seed is hard seed, increase the seeding rate for legumes by the percentage of hard seed.

   i. Introduced and native legume seed shall be inoculated immediately prior to planting. Rhizobia inoculant shall be specific to the legume seeded. When more than one legume specie is used, each species will be inoculated separately.

   j. Criteria for seed mixture development.

      1) Wisconsin NRCS Practice Standard (WI CPS), *Critical Area Planting (342)* shall be used when one or more conditions exist:

         a) The filter strip footprint is located in the floodplain and flooding occurs frequently - determined using the NRCS soil survey map unit interpretations,

         b) The average up gradient land slopes within 300 feet of the upper edge of the filter strip exceeds 6 percent,

         c) The design objective is to maximize filter strip performance.

      2) WI CPS, *Conservation Cover (327)* should be used in when high seeding density is not required including areas where the client prefers to establish native plant species which will not meet the Filter Strip Standard.

3. The maximum row gradient along the leading edge of the filter strip shall not exceed 5 percent.
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6. Utilize the site investigation results to identify any physical, chemical, or biological condition that could affect the successful establishment or long term survival of the filter strip vegetation. Data collected during the inventory and site assessment, shall be documented on the site assessment documentation worksheet.

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5. Use the "Identify Resource Concerns" assessment procedure in WI NRCS TN-10 for assessing crop management activities that may increase the probability for dissolved contaminants in surface water runoff.

D. Additional Criteria to Design and Establish Vegetative Cover

1. Vegetation Species Selection and Seed Quality.

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   b. Filter strips will not be used as travel lanes for equipment or livestock.

   c. Species selected for planting shall be compatible to current site conditions, intended use, and be resistant to diseases and insects common to the site location.

   d. The filter strip shall be established to perennial herbaceous vegetation and species selected shall be:

      1) Able to withstand partial burial from sediment deposition,

      2) Tolerant of herbicides used within the drainage area that contributes runoff to the filter strips, and

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   e. Tested Seed shall be used. The seed tag or laboratory test results shall be available to the individual certifying the practice as complete.

   f. Actual PLS adjusted seeding rates will be used to establish the seeding. Calculations used to determine the actual adjusted seeding rate shall be available to the individual certifying the practice as complete.

   g. Untested introduced and native grass and forb seed are not approved for planting.

   h. When more than 20 percent legume seed is hard seed, increase the seeding rate for legumes by the percentage of hard seed.

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         a) The filter strip footprint is located in the floodplain and flooding occurs frequently - determined using the NRCS soil survey map unit interpretations,

         b) The average up gradient land slopes within 300 feet of the upper edge of the filter strip exceeds 6 percent,

         c) The design objective is to maximize filter strip performance.

      2) WI CPS, *Conservation Cover (327)* should be used in when high seeding density is not required including areas where the client prefers to establish native plant species which will not meet the Filter Strip Standard.

2. Nutrient and Soil Amendment Requirements

   When seeding introduced species, soil fertility and pH level shall be amended to satisfy the needs of the plant species to be established. Fertilizer and lime recommendations will be determined by a soil test, and all nutrients will be applied following WI CPS, *Nutrient Management (590)*. If no soil test is available, apply a minimum of 150 pounds of 20-10-10 fertilizer and 2 tons of 80-89 lime or equivalent per acre. The required application of soil amendments may be waived with approval by a Wisconsin NRCS certified conservation planner. The basis for waiving the use of soil amendments shall be documented in the client's case file.

   For establishment of native species, use of soil amendments is not required.

3. Seedbed Preparation

   a. Prior to planting into cropland fields, verify that herbicides previously applied to the site will not "carry over" and damage the new seeding.

   b. Site preparation shall be adequate to suppress weed competition and to promote uniform germination and growth of the species planted.

   c. Planting equipment type, use, and timing shall be appropriate for site conditions, soil conditions, physical characteristics of the seeds (size, etc.) and selected to assure uniform seed placement and germination.

   d. For detailed information on seedbed preparation, refer to Wisconsin NRCS Agronomy Technical Note 5, "Establishing and Maintaining Native Grasses, Forbs and Legumes" (WI NRCS TN-5); and Wisconsin NRCS Agronomy Technical Note 6, "Establishing and Maintaining Introduced Grasses and Legumes" (WI NRCS TN-6).

4. Seeding Periods

   a. The specific date that provides the best chance for success will vary from south to north and from year to year with prevailing moisture and temperature conditions. Late summer seeding is generally riskier than spring seeding. Planting at either end of the allowable range is riskier than the middle of the range. Refer to Figure 1 for planting zones and Tables 1 and 2 for seeding dates.

   b. Seeding outside of the recommended dates must be approved by the NRCS Area Resource Conservationist or State Agronomist.

   c. Dormant and frost seeding are approved seeding methods for filter strip vegetation establishment using WI CPS, *Conservation Cover (327)* when site conditions meet the criteria in section (V.**A**.1.i.).

5. Mulching, Temporary Cover and Companion Crops

   a. Mulching, temporary cover, and companion crops are vital practices utilized to support the establishment of permanent vegetation. These practices may suppress weed growth and limit soil erosion during the establishment period. Use will vary according to site conditions, method of planting, and seed mixture.

   b. For further details on temporary cover and companion crop recommendations, refer to WI NRCS TN-5 and WI NRCS TN-6.

V. CONSIDERATIONS

Additional design recommendations which may

enhance this practice, but are not required to ensure its basic conservation function are as follows:

A. General Considerations

1. Consider marking filter strip boundaries with permanent highly visible markers to prevent encroachment.
2. Filter strips with the leading edge on the contour will function better than those with a gradient along the leading edge.
3. Consider locations of vehicle and/ or livestock crossings to minimize disturbance of the filter strip. Refer to WI CPS, *Access Road (560)* for planning and design criteria.
4. Increase the filter strip width beyond the minimum requirement to increase trapping potential, increase carbon sequestration, and capture contaminants in runoff before entering sensitive features on the landscape.
5. Seeding rates that establish higher stem density will be more effective in the trapping and treating of contaminants.
6. Organic producers may be required to submit plans and specifications to their certifying agent for approval prior to installation, as part of the producer's Organic System Plan.
7. Consider using this practice to protect National Register listed or eligible (significant) archaeological sites and culturally significant sites from potential damaging contaminants.

B. Additional Considerations for Reducing Suspended Solids and Associated Contaminates in Runoff

1. Filter strips should be strategically located within the upper reaches of the watershed, to reduce runoff and increase infiltration and ground water recharge throughout the watershed.
2. To reduce phosphorus loading to the filter strip, utilize the Snap Plus Nutrient Management Tool to assess, monitor, and lower the Phosphorus Index, when applicable.
3. To maximize nutrient removal and minimize nutrient discharge, harvest the biomass in the filter strip. Refer to WI NRCS TN-10 for guidance when removing biomass from the footprint of the VFS.
4. Increase the size of the filter strip to trap additional contaminants.

C. Additional Considerations for Reducing Dissolved Contaminants in Runoff

1. To minimize leaching and shallow subsurface flow of dissolved contaminants, harvest the biomass in the filter strip. Refer to WI NRCS TN-10 for guidance when removing biomass from the footprint of the VFS.
2. To reduce phosphorus loading to the filter strip, utilize the Snap Plus Nutrient Management Tool to assess, monitor, and lower the Phosphorus Index, when applicable.
3. Increase the width of the filter strip beyond the minimum required width to increase the potential for capturing the contaminants in the runoff.

D. Additional Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators

1. Where site appropriate, use native grass species that fulfill the purposes of the practice while also providing habitat for priority wildlife.
2. Include herbaceous plant species such as native forbs in the filter strip seeding mix that are beneficial to wildlife and pollinators and compatible with one of the listed purposes. Changes to the seeding mix should not detract from the purpose for which the filter strip was

2. Nutrient and Soil Amendment Requirements

   When seeding introduced species, soil fertility and pH level shall be amended to satisfy the needs of the plant species to be established. Fertilizer and lime recommendations will be determined by a soil test, and all nutrients will be applied following WI CPS, *Nutrient Management (590)*. If no soil test is available, apply a minimum of 150 pounds of 20-10-10 fertilizer and 2 tons of 80-89 lime or equivalent per acre. The required application of soil amendments may be waived with approval by a Wisconsin NRCS certified conservation planner. The basis for waiving the use of soil amendments shall be documented in the client's case file.

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3. Seedbed Preparation

   a. Prior to planting into cropland fields, verify that herbicides previously applied to the site will not "carry over" and damage the new seeding.

   b. Site preparation shall be adequate to suppress weed competition and to promote uniform germination and growth of the species planted.

   c. Planting equipment type, use, and timing shall be appropriate for site conditions, soil conditions, physical characteristics of the seeds (size, etc.) and selected to assure uniform seed placement and germination.

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V. CONSIDERATIONS

Additional design recommendations which may

enhance this practice, but are not required to ensure its basic conservation function are as follows:

A. General Considerations

1. Consider marking filter strip boundaries with permanent highly visible markers to prevent encroachment.
2. Filter strips with the leading edge on the contour will function better than those with a gradient along the leading edge.
3. Consider locations of vehicle and/ or livestock crossings to minimize disturbance of the filter strip. Refer to WI CPS, *Access Road (560)* for planning and design criteria.
4. Increase the filter strip width beyond the minimum requirement to increase trapping potential, increase carbon sequestration, and capture contaminants in runoff before entering sensitive features on the landscape.
5. Seeding rates that establish higher stem density will be more effective in the trapping and treating of contaminants.
6. Organic producers may be required to submit plans and specifications to their certifying agent for approval prior to installation, as part of the producer's Organic System Plan.
7. Consider using this practice to protect National Register listed or eligible (significant) archaeological sites and culturally significant sites from potential damaging contaminants.

B. Additional Considerations for Reducing Suspended Solids and Associated Contaminates in Runoff

1. Filter strips should be strategically located within the upper reaches of the watershed, to reduce runoff and increase infiltration and ground water recharge throughout the watershed.
2. To reduce phosphorus loading to the filter strip, utilize the Snap Plus Nutrient Management Tool to assess, monitor, and lower the Phosphorus Index, when applicable.
3. To maximize nutrient removal and minimize nutrient discharge, harvest the biomass in the filter strip. Refer to WI NRCS TN-10 for guidance when removing biomass from the footprint of the VFS.
4. Increase the size of the filter strip to trap additional contaminants.

C. Additional Considerations for Reducing Dissolved Contaminants in Runoff

1. To minimize leaching and shallow subsurface flow of dissolved contaminants, harvest the biomass in the filter strip. Refer to WI NRCS TN-10 for guidance when removing biomass from the footprint of the VFS.
2. To reduce phosphorus loading to the filter strip, utilize the Snap Plus Nutrient Management Tool to assess, monitor, and lower the Phosphorus Index, when applicable.
3. Increase the width of the filter strip beyond the minimum required width to increase the potential for capturing the contaminants in the runoff.

D. Additional Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators

1. Where site appropriate, use native grass species that fulfill the purposes of the practice while also providing habitat for priority wildlife.
2. Include herbaceous plant species such as native forbs in the filter strip seeding mix that are beneficial to wildlife and pollinators and compatible with one of the listed purposes. Changes to the seeding mix should not detract from the purpose for which the filter strip was

established. See Wisconsin NRCS Biology Technical Note 8, "Pollinator Biology and Habitat" (WI NRCS TN-8) for more information.

3. Consider enlarging the filter strip beyond the minimum size to provide connectivity with adjoining wildlife habitat and other non-cultivated areas as well as providing additional habitat for priority wildlife and pollinators.

4. Consider using this practice to enhance the conservation of declining species of wildlife, including those that are classified as threatened or endangered. Refer to WI CPS, *Upland Wildlife Habitat Management (645)*.

5. Management activities, such as mowing, burning, or light disking, on the filter strip should be completed outside of primary nesting, fawning, and calving seasons. Activities should be timed to allow for regrowth before the growing seasons ends. This management activity should not occur more often than every other year with frequency dependent on geographical location to maintain the purposes of the practice.

VI. PLANS AND SPECIFICATIONS

1. Plans for the filter strip shall be prepared for each field, where the filter strip will be installed. The plan includes information about the location, construction sequence, vegetation establishment, operation and maintenance requirements. The plan shall include the following information:

   a. Site assessment documentation shall include: the identified resource concern (s), Environmentally Sensitive Area to be protectedan assessment documenting that the contributing area is entering the filter strip as sheet flow.

   b. The average watershed slope draining to the filter strip,

   c. Documentation of soil loss calculations within the contributing area to the filter strip, the amount of sediment trapped in the filter strip and the amount of sediment leaving the field edge.

   d. Minimum filter strip design length and width (flow length through the filter) to accomplish the planned purpose and maintenance activities.

   e. Seed mixture design documenting the species, seeding rate and methods used.

   f. Planting dates, seed data (PLS) statement that PLS viable high quality seed is required, and legumes were innoculated.

   g. Document the before sediment delivered beyond the low edge of the filter strip and the sediment delivered beyond the low edge of the filter strip when biomass is harvested and document the adequacy of vegetation exist to minimize pollutant delivery to environmentally sensitive areas during critical runoff periods.

   h. Operation and Maintenance Plan with adequate detail for long term maintenance of Filter Strip practice.

VII. OPERATION AND MAINTENANCE

1. Introduced grasses: Mowing shall be done as needed to reduce the competition from woody vegetation, better filter contaminants, encourage dense upright growth and maintain vigorous sod. Introduced plants shall not be mowed shorter than 4 inches and no later than September 15th to allow time for adequate regrowth in the fall.

2. Native grasses: Mowing shall be done as needed to reduce the competition from woody vegetation, generally no more than once every three years. Native plants shall not

be mowed shorter than 7 inches and no later than September 1st to allow time for adequate regrowth in the fall.

3. After mowing, the cut vegetation shall be removed if thick enough to impede regrowth.
4. Removal of cut vegetation is recommended to encourage dense growth, maintain an upright growth habit, and remove nutrients contained in the plant tissue.
5. If prescribed burning is used to manage and maintain the filter strip, an NRCS approved burn plan must be developed.
6. If grazing is used to harvest vegetation from the filter strip, the grazing plan must insure that the integrity and function of the filter strip is not adversely affected.
7. When supplemental nutrients are required to maintain the desired species composition and stand density of the filter strip, refer to WI CPS, *Nutrient Management (590)* and section (V.D.2.) of this standard.
8. Maintenance measures must be adequate to control the establishment and spread of noxious weeds and other invasive species.
9. Avoid damage to filter strip vegetation from herbicide application to nearby fields.
10. Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed or bare areas, and take other measures necessary to prevent concentrated flow conditions through the filter strip.
11. No-till inter-seeding may be done to improve or maintain stand density and vegetative diversity. Refer to WI NRCS TN-5 and WI NRCS TN-6 for guidance.
12. Organic producers may have to maintain records for five years as part of their Organic System Plan.
13. To maintain or restore the filter strip's function, periodically re-grade the filter strip area when sediment deposition at the filter strip field interface jeopardizes its function. Re-grading and re-establishment of the filter strip vegetation shall be approved and implemented under the direction of a qualified conservation professional.
14. Vehicular traffic shall be excluded from the filter strip except as necessary for establishment and maintenance activities. Non-routine crossing of the filter strip by equipment and livestock to reach adjacent areas is acceptable.
15. Increase the width of the filter strip as necessary to accommodate harvest and maintenance equipment.

VIII. FEDERAL, TRIBAL, STATE AND LOCAL LAWS

Users of this standard are responsible for compliance with applicable federal, tribal, state and local laws, rules or regulations. This standard does not contain the text of federal, tribal, state or local laws. Implementation of this standard may not eliminate the discharge of pollutants to the area protected.

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X. DEFINITIONS

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Aspect (V.A.5.) – The exposure of the site to direct sunlight, prevailing winds, and other factors that influence plant growing conditions. For example, a north slope tends to be cooler and moister while a south-facing slope tends to be drier and warmer.

Concentrated flow (III.B.3.) – Where runoff water collects and flows in defined depressional water courses that begin where overland flow converge to channelized flow conditions.

Conservation planning assessments shall document the location of concentrated flow areas and grassed waterways, regardless of the drainage area that discharge agricultural runoff directly to or within 300 feet of the ecological sensitive areas identified in WI NRCS TN-10.

Direct runoff from manure land application (III.B.1.e).) - The movement of undiluted liquid manure land applied using tankers, drag hoses or irrigation technology from the application site into areas not intended to receive manure or nutrients.

Dissolved Contaminant (II.2.) - For the purpose of implementing this standard, dissolved contaminants are defined as substances carried in solution form within surface runoff. Examples include; phosphorous and nitrogen from natural sources, derivatives of organic/synthetic fertilizer, pesticides, petroleum products, etc., that may negatively impact surface or groundwater quality.

Environmentally Sensitive Areas (III.A.) - An area that needs special protection due to its landscape position, environmental, ecological, or historical value.

For the purpose of implementing this standard, environmentally sensitive areas are primarily sites susceptible to contamination from agricultural runoff including surface water, ground water, wetlands and critical habitat areas.

Flooding frequency (V.A.5.) - The probability of the temporary inundation of the soil surface caused by rapid runoff from heavy rainfall events and/or periods of rapid snow melt. The occurrence of flooding is determined based on the soil mapping unit interpretations located in the NRCS Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm). Refer to WI NRCS TN-10 for more information.

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Noxious weed (V.D.1.a.) – An aquatic or terrestrial herbaceous or woody plant that is legally designated as being invasive and persistent, and is injurious to human values, such as public health, the environment, livestock, growing crops, natural areas or other lands.

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Overland Flow (V.A.4.) – See Sheet flow

Revised Universal Soil Loss Equation (RUSLE2) (V.A.1.a.1).) – The official USDA-NRCS conservation planning software model used to predict long-term, average-annual soil erosion (sheet/rill) by water.

Row Gradient (V.A.3.) – The orientation of ridges and furrows (the areas between ridges) with respect to the land slope, which is perpendicular to the contour lines of equal elevation.

Sheet flow (overland flow) (V.A.4.) – Sheet flow is flow over plane surfaces, where runoff water flows in a thin uniform sheet across the land before it collects in a concentrated flow channel. After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow.

Snap Plus Nutrient Management Tool (Snap Plus) (V.A.1.b.1).) – A nutrient management planning software program, designed to help farmers make the best use of their on-farm nutrients, as well as make informed and justified commercial fertilizer purchases, serve as an evaluation tool for farmers and environmentalist to analyze data and adjusting management when necessary to protect soil and water resources.

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/technical/cp/?cid=nrcs142p2_020801

Tolerable Soil Loss "T" (III. B.2.) –The average annual erosion rate that can occur with little or no long-term degradation of the soil resource on a field specific to the soil map unit. Soil loss tolerance values are assigned to each soil map unit.

Tested Seed (V.D.1.d.) – An analysis of seed quality, conducted by an accredited lab to determine pure seed (purity), germination, weed seed, other crop seed, and inert material. The testing procedures comply with the protocols established by the applicable state seed certification agency (Wisconsin Crop Production Association or equivalent for seed sourced from other states).

Untested (V.D.1.f.) – Seed that has no documented tests for pure seed and germination. Untested seed legally cannot be labeled.

Windows Pesticide Screen Tool (V.A.1.a.2).) - An environmental risk screening tool for pesticides. NRCS field office conservationists; extension agents, crop consultants, pesticide dealers and producers can use it to evaluate the potential of pesticides to move with water and eroded soil/ organic matter and the affect to non-targeted organisms.

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Tested Seed (V.D.1.d.) – An analysis of seed quality, conducted by an accredited lab to determine pure seed (purity), germination, weed seed, other crop seed, and inert material. The testing procedures comply with the protocols established by the applicable state seed certification agency (Wisconsin Crop Production Association or equivalent for seed sourced from other states).

Untested (V.D.1.f.) – Seed that has no documented tests for pure seed and germination. Untested seed legally cannot be labeled.

Windows Pesticide Screen Tool (V.A.1.a.2).) - An environmental risk screening tool for pesticides. NRCS field office conservationists, extension agents, crop consultants, pesticide dealers and producers can use it to evaluate the potential of pesticides to move with water and eroded soil/ organic matter and the affect to non-targeted organisms.

http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/crops/npm/?cid=stelprdb1044769

USDA United States Department of Agriculture

HOW TO DESIGN, ESTABLISH AND MAINTAIN FILTER STRIPS

Wisconsin Job Sheet 393

WHAT IS A FILTER STRIP?

A strip or area of herbaceous vegetation that removes contaminates from overland flow.

PURPOSE

» Reduce or minimize suspended solids and contaminants in runoff

» Reduce or minimize dissolved contaminants in runoff

» Reduce leaching of dissolved contaminants to groundwater

PLANS AND SPECIFICATIONS

» Locations, establishment, site assessment documentation.

» Documentation of soil loss calculations within the contributing area, the amount of sediment trapped in the filter strip and the amount of sediment leaving the field edge.

» Minimize filter strip design width for planned purpose.

» Designed seed mixture.

» Document baseline data.

OPERATIONS AND MAINTENANCE

» Control weeds during first year of establishment. Mow weeds as often as needed to avoid weeds from flowering. Remove clippings to avoid smothering the cover.

» Mowing shall be done as needed to reduce the competition from woody vegetation and maintain vigorous sod.

» Do not mow introduced plants shorter than 4 inches and no later that September 15th to allow time for adequate regrowth in the fall. Native plants shall not be mowed shorter than 7 inches and no later than September 1st to allow for adequate regrowth in the fall.

» Avoid damage to filter strip vegetation from herbicide application to nearby fields.

» Control the establishment and spread of noxious weeds and other invasive species.

» Do not use the filter strip as a travel lane for equipment or livestock.

» Inspect the filter strip after storm events and repair any gullies that have formed. Remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed or bare areas.

» Re-grade the filter strip area when sediment deposition jeopardizes it's function.

» If grazing the filter strip, the grazing plan must insure that the integrity and function of the filter strip is not adversely affected.

» When possible, avoid disturbance during nesting periods.

FILTER STRIP

Client Name: _____ County: _____

Planner Name: _____

Select the practice purpose used to address the identified resource concern(s):

- ☐ Reduce or minimize suspended solids and contaminants in runoff
- ☐ Reduce or minimize dissolved contaminants in runoff
- ☐ Reduce leaching of dissolved contaminants to groundwater

PLANNED PRACTICE LOCATION AND EXTENT

Contract Number	Contract Identification Number (CIN)	Tract Number	Field Number(s)	Acres Contracted	Acres Planned	Actual Acres Applied (NRCS USE ONLY)

*A completed copy of this page must be submitted for a financial assistance payment to be processed.

SEEDING PLAN

ATTENTION: Contact NRCS Prior to making any changes to cover crop species, seeding rate, or seeding date.

Tract No.	Field No.	Acres	Species	Seeding Rate* (lbs./ac)	Total PLS Pounds Seed To Purchase	Seeding Date	Actual Seeding Date	Existing Cover/Crop Type	Seeding Method

*Pure Live Seed (PLS) calculation required to increase the seeding rate for non-commercially sourced seed: Multiply the percent purity by the percent germination. Divide the seeding rate by the percent PLS to find the bulk seed needed per acre. For example: 98% purity x 60% germination = 0.588% PLS 10 lbs./acre ÷ 0.588% PLS = 17 lbs./acre.

Table 1 - Design Parameters for Determining Minimum Filter Strip Width

Direct Contributing	Factor Points	
1. Hydrologic Soil Group		
A	0	☐
B	10	☐
C	20	☐
D	30	☐
2. Average slope within 100 feet upstream of the low edge of the filter		
0-1%	0	☐
>1-	5	☐
>3-	15	☐
>6-	30	☐
3. Average slope from 100-300 feet upstream of the low edge of the filter		
0-1%	0	☐
>1-	5	☐
>3-	10	☐
>6-	15	☐
>12	20	☐

Table 2 - Minimum VFS Width Requirements

Total Point Range	Minimum Filter Strip Width for Sediment Trapping	Minimum Filter Strip Width for Dissolved Contaminants
0-10	20 feet	70 feet
15-20	30 feet	70 feet
25-30	40 feet	70 feet
35	50 feet	80 feet
40	60 feet	80 feet
45	70 feet	90 feet
50	80 feet	100 feet
>50	100 feet	120 feet
Final Filter Strip Design Width:		

Table 3 - Seeding Dates for Native Warm Season Mixtures

	Zone	Spring Seeding	Fall Dormant Seeding
☐	North	Thaw - 7/15	10/8 - Freeze Up
☐	Central	Thaw - 6/30	10/15 - Freeze Up
☐	South	Thaw - 6/30	10/20 - Freeze Up

Table 4 - Seeding Dates for Cool Season Introduced Grasses and Legumes and Companion Crops

	Zone	Spring	Late Summer	Dormant
☐	North	5/1-6/15	7/15-8/10	11/1 - Freeze Up
☐	Central	4/15-6/1	8/1-8/21	11/1 - Freeze Up
☐	South	4/1-5/15	8/7-8/29	11/1 - Freeze Up

FILTER STRIP COST SHARE DOCUMENTATION AND VERIFICATION FOR CASE FILE

- ☐ 393 Site Assessment Worksheet is complete and Tech Note 393 is being followed
- ☐ Practice amount applied is field verified by: _____ on: _____ (date)

Before payment is made, the following information is required to be in the case file:

- ☐ Photographs of established filter strip that must include:
  - Statement "Photo was taken in the field by (enter name)"
  - Date photo was taken in the field
  - Statement of what the photo represents if it needs clarification
- ☐ Field verification is documented and a certified planner verified "as installed" this practice meets NRCS standards and specifications.

Practice Certification (NRCS USE ONLY)

I certify that the practice as installed is complete and meets the applicable Wisconsin NRCS Conservation Practice Standard and all applicable practice specifications. Any changes to the original practice design have been approved and are documented on the original practice design "as installed."

Certified Planner (print) (sign) Date

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Filter Strip (393)

DESIGN (911)

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices.

   a. List all required and/or facilitating practices.

   b. Practice standard criteria-related computations and analyses to develop plans and specifications including but not limited to:

      i. Strip width, length and percent slope
      ii. Size and percent slope of area contributing runoff to the filter strip
      iii. Vegetative species selection
      iv. Erosion calculations

2. Written plans and specifications including location map, sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits. Plans and specification shall be developed in accordance with the requirements of conservation practice standard Filter Strip (Code 393).

3. Operation and maintenance plan.

4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations.

5. Documentation requirements for design modifications during practice installation.

CERTIFICATION OF COMPLETION

Filter Strip (393)

Design (911)

Program Participant Information

Name (print): _____

Contract Number: _____ Contract Item #(s): _____

Technical Service Provider Information

Name (print): _____

TSP ID Number: _____ Expiration Date: _____

I hereby certify that the technical services I provided as a Technical Service Provider for this component(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservation practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this component, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS staff) ***Date***

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Filter Strip (393)

INSTALLATION (912)

Deliverables

1. Documentation of pre-installation conference with client.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation guidance as needed.
5. Facilitate, implement and document required design modifications with client, original designer, permitting and funding agencies.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during application.
7. Certification that the installation process and materials meets design and permit requirements.

CERTIFICATION OF COMPLETION

Filter Strip (393)

Installation (912)

Program Participant Information

Name (print): _____

Contract Number: _____ Contract Item #(s): _____

Technical Service Provider Information

Name (print): _____

TSP ID Number: _____ Expiration Date: _____

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_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS staff) ***Date***

CHECKOUT (913)

Deliverables

1. Records of installation.
   a. Extent of practice units applied and location identified on a map.
   b. Actual types and quantities of plant materials used.
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits.
3. Provide the following information to the NRCS field office servicing the relevant land unit for entry into the Performance Results System (PRS):
   a. Technical Service Provider Name
   b. Customer name
   c. USDA program funding the practice (if known)
   d. Location of work (state, county, conservation district, land tract identifier)
   e. Land use of field where the practice was installed (cropland, etc.)
   f. NRCS practice name and quantity of practice installed in appropriate units
4. Documentation of exit conference with client and contractor.

CERTIFICATION OF COMPLETION

Filter Strip (393)

Checkout (913)

Program Participant Information

Name (print): _____

Contract Number: _____ Contract Item #(s): _____

Technical Service Provider Information

Name (print): _____

TSP ID Number: _____ Expiration Date: _____

I hereby certify that the technical services I provided as a Technical Service Provider for this component(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservation practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this component, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS staff) ***Date***

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Filter Strip (393)

REFERENCES

- WI NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard 393, Filter Strip
- NRCS National Agronomy Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

CODE 412

(ft.)

DEFINITION

A shaped or graded channel that is established with suitable vegetation to convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet.

PURPOSE

- To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- To prevent gully formation.
- To protect/improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied in areas where added water conveyance capacity and vegetative protection are needed to prevent erosion and improve runoff water quality resulting from concentrated surface flow.

CRITERIA

General Criteria Applicable To All Purposes

Plan, design, and construct grassed waterways to comply with all federal, state, tribal, and local laws and regulations.

Drainage areas must be treated to minimize sediment deposition to the grassed waterway.

Capacity. Design the waterway to convey the peak runoff expected from the 10-year frequency, 24-hours duration storm. Increase capacity as needed to account for potential volume of sediment expected to accumulate in the waterway between planned maintenance activities. When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. Ensure that the design capacity, at a minimum, will remove the water before crops are damaged.

Peak discharge for all storms will be determined by the method outlined in NRCS National Engineering Handbook (NEH), Part 650 - Engineering Field Handbook (EFH), Chapter 2; or Technical Release 55 (TR-55).

The vegetative retardance used shall consider the types of grasses to be seeded and the type of management anticipated. The retardance used shall be in accordance with the EFH, Chapter 7, Table 7-4.

Capacity of waterways shall be based on vegetative retardance A, B, or C.

Stability. Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in EFH, Chapter 7, Grassed Waterways; the Agricultural Research Service (ARS), Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels, or the Handbook of Channel Design for Soil and Water Conservation (SCS-TP-61).

Ensure that the vegetation species selected are suited to the current site conditions and intended uses. Select species that have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

Stability of waterways shall be based on vegetative retardance C, D, or E.

Stability of waterways shall convey the peak discharge expected from the design storm without exceeding the allowable effective stress or permissible velocity.

Design velocities shall not exceed the values shown in Table 1.

Table 1

Waterway Slope Range (%)	Permissible Velocity[1]	
	Erosion Resistant Soils[2] (ft./sec)	Easily Erosded Soils[3] (ft./sec)
0-5	7	5
5.1-10	6	4
Over 10	5	3

[1]Use velocities exceeding 5 ft./sec only where good cover and proper maintenance can be obtained.

[2]Cohesive (clayey) fine-grain soils and coarse-grain soils with cohesive fines with a plasticity index of 10 to 40 (CL, CH, SC, and GC).

[3]Soils that do not meet the requirements for erosion-resistant soils.

Width. Keep the bottom width trapezoidal waterways less than 100 feet unless multiple, or divided waterway, or other means are provided to control meandering of low flows.

Side slopes. Keep the side slopes flatter than a ratio of two horizontal to one vertical (2:1). Reduce the side slopes as needed to accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment so that damage to the waterway is minimized.

Depth. The capacity of the waterway must be large enough so that the water surface of the waterway is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway at design flow.

The minimum designed depth of the waterway shall be 0.6 feet.

Provide 0.5 foot freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth when the vegetation has the maximum expected retardance.

Drainage. When needed to establish or maintain vegetation on sites having prolonged flows, high water tables, or seepage problems, use Wisconsin NRCS Field Office Technical Guide, Section IV (WI Standards), *Subsurface Drain (606), Underground Outlet (620)*, or other suitable measures in waterway designs.

Where drainage practices are not practicable or sufficient to solve these seepage problems, use Wisconsin NRCS Conservation Practice Standard (WI CPS), *Lined Waterway or Outlet (468)* in place of WI CPS, *Grassed Waterway (412)*.

All grassed waterways shall have stable inlet areas. The area downstream of bridges, culverts, or other structures shall be stabilized with durable lining materials if vegetation cannot be established.

Outlets. Provide a stable outlet with adequate capacity. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

Grassed waterways that serve as terrace outlets shall be established with adequate vegetation prior to the terrace construction.

Crossings. Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation. Crossings shall be in accordance with the criteria contained in WI CPS, *Stream Crossing (578), Access Road (560), or Trail and Walkways (575)*.

Vegetative Establishment. Establish vegetation as soon as possible using the criteria listed under "Establishment of Vegetation" in WI CPS, *Critical Area Planting (342)*.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock or straw or hay bale dikes, fabric or rock checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g., small grains or millet, on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the waterway during establishment.

CONSIDERATIONS

Where environmentally-sensitive areas need to be protected from dissolved contaminants, pathogens, or sediment in runoff, consider establishment of an increased width of vegetation on the waterway above the flow area. Increasing the width of the waterway above the flow area will increase filtering of sediment and pathogens as well as increase infiltration of runoff and increase nutrient removal. Where sediment control is the primary concern, consider using vegetation in the waterway which can withstand partial burial and adding sediment control measures above the waterway such as residue management. Consider increasing

the channel depth and/or designing areas of increased width or decreased slope to trap and store sediment to reduce the amount of sediment that leaves a field. Be sure to provide for regular cleaning out of the waterway when trapping sediment in this manner.

Tillage and crop planting often takes place parallel to the waterway, resulting in preferential flow – and resulting erosion – along the edges of the waterway. Consider installation of measures that ensure that runoff from adjacent areas will enter the waterway. Measures such as directing spoil placement or small swales can direct this preferential flow into the grassed waterway.

Avoid areas where unsuitable plant growth limiting subsoil and/or substratum material such as salts, acidity, root restrictions, etc. may be exposed during implementation of the practice. Where areas cannot be avoided, seek recommendations from a soil scientist for improving the condition or, if not feasible consider over-cutting the waterway and add topsoil over the cut area to facilitate vegetative establishment.

Avoid or protect, if possible, important wildlife habitat, such as woody cover or wetlands when determining the location of the grassed waterway. If trees and shrubs are incorporated, they should be retained or planted in the periphery of grassed waterways so they do not interfere with hydraulic functions. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts and wetlands. When possible, select plant species that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

Water-tolerant vegetation may be an alternative to subsurface drains or stone center waterways on some wet sites.

Use irrigation in dry regions or supplemental irrigation as necessary to promote germination and vegetation establishment.

Wildlife habitat benefits can be provided by adding width of appropriate vegetation to the sides of the waterway. Care should be taken to avoid creating small isolated planting zones that could become population sinks where wildlife attracted to an area experience reproductive loss due to predation.

Consider including diverse legumes, forbs, and flowering plants such as milkweeds that provide pollen and nectar for native bees and other pollinators. In dry regions, these sites may be able to support flowering forbs with higher water requirements and thus provide bloom later in the summer

The construction of a grassed waterway can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for grassed waterways that describe the requirements for applying the practice according to this standard. This should include:

- A plan view of the layout of the grassed waterway.
- Typical cross sections of the grassed waterway(s).
- Profile(s) of the grassed waterway(s).
- Disposal requirements for excess soil material.
- Site specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

Provide an operation and maintenance plan to review with the landowner. Include the following items and others as appropriate in the plan.

- Establish a maintenance program to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect the waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization such as silt fences, mulching, hay bale barriers and etc. to stabilize grade during vegetation establishment.
- Minimize damage to vegetation by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only when a controlled grazing system is being implemented.

- Inspect grassed waterways regularly, especially following heavy rains. Fill, compact, and reseed damaged areas immediately. Remove sediment deposits to maintain capacity of grassed waterway.
- Avoid use of herbicides that would be harmful to the vegetation or pollinating insects in and adjacent to the waterway area.
- Avoid using waterways as turn-rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition. Mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.
- Lift tillage equipment off the waterway when crossing and turn off chemical application equipment.

REFERENCES

USDA, ARS. (1987). Stability design of grass-lined open channels. Washington, D.C.: U.S. Dept. of Agriculture, Agricultural Research Service.

USDA, NRCS (2007). National Engineering Handbook, Part 650, Engineering Field

Handbook, Chap. 7, Grassed waterways.

Stillwater Outdoor Hydraulic Laboratory (1954). Handbook of Channel Design for Soil and Water Conservation SCS-TP-61 (Revised. ed.). Washington: United States Department of Agriculture, Soil and Conservation Service.

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Grassed Waterway (412)

DESIGN (911)

Deliverables:

1. Design documentation that will demonstrate the criteria in the NRCS practice standard have been met and are compatible with other planned and applied practices.

    a. Compliance with NRCS national and state utility safety policy (NEM Part 503, Safety).

    b. List of associated eFOTG conservation practices included in the project.

    c. Practice standard criteria substantiating data, computations, and analyses to develop plans and specifications including but not limited to:

        i. Hydrology and hydraulics.
        ii. Outlet capacity and stability.
        iii. Seedbed preparation, soil amendments, and vegetation requirements.
        iv. Environmental considerations.

2. Adequate location map, plan view, profiles, cross sections, details, and specifications to ensure that the project can be properly constructed and permits secured.

    a. All waterways with drainage areas greater than 80 acres or a grade of less than 1 percent must have plotted profiles and cross sections.

    b. Any waterway with drainage tile to be installed must be shown on the waterway profile and cross section.

    c. Erosion control measures (filter barriers, rock checks, mulch, etc.) used to assist the establishment of vegetation must be shown.

3. Design Report and Quality Assurance Plan as appropriate (NEM Part 511, Design, and Part 512, Construction).

    a. The design report shall include, but is not limited to the following:

        i. Summary of project objectives and work to be completed.
        ii. Design documentation from item 1 listed above.

    b. The quality assurance plan must describe the type and frequency of testing, items requiring inspection, the documentation required, and the qualifications of the person doing the work.

4. Operation and maintenance plan.

5. Itemized engineer's cost estimate.

6. Certification that the design meets practice standard criteria and complies with applicable laws and regulations (NEM Part 505, Non-NRCS Engineering Services).

STATEMENT OF WORK

USDA, Natural Resources Conservation Service
Wisconsin

Grassed Waterway (412)

INSTALLATION (912)

Deliverables

1. Documentation of pre-construction conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout survey notes.
4. Installation inspection (according to quality assurance plan).
    a. Materials used.
    b. Inspection records.
    c. Maintaining a job diary with the dates and record of inspections made, testing completed, instruction provided to the contractor, etc., to document compliance with standards and specifications.
5. Facilitate, implement and document required design modifications with client, original designer, permitting and funding agencies.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meet design and permit requirements.

STATEMENT OF WORK

USDA, Natural Resources Conservation Service
Wisconsin

Grassed Waterway (412)

CHECKOUT (913)

Deliverables

1. Supporting documentation.
2. As-Built drawings
    a. Drawings with changes from the original construction plans clearly shown.
    b. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Part 505, Non-NRCS Engineering Services).
3. Extent of practice units applied and location identified on a map.
    a. Completed job diary noting inspections made, testing completed, etc.
    b. Materials documentation.
    c. Testing reports.
    d. Survey notes for layout, inspections, and final checkout documenting compliance with standards and specifications.
4. Provide the following information to the NRCS field office servicing the relevant land unit for entry into the Performance Results System (PRS):
    a. Technical Service Provider Name
    b. Customer name
    c. USDA program funding the practice (if known)
    d. Location of work (state, county, conservation district, land tract identifier)
    e. Land use of field where the practice was installed (cropland, etc.)
    f. NRCS practice name and quantity of practice installed in appropriate units

STATEMENT OF WORK

USDA, Natural Resources Conservation Service
Wisconsin

Grassed Waterway (412)

REFERENCES

- WI NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard 412, Grassed Waterway.
- NRCS National Engineering Manual (NEM) and Wisconsin Supplements
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook
- NRCS National Engineering Handbook, Part 650, Engineering Field Handbook (EFH) and Wisconsin Supplements
- NRCS Technical Release 55, Urban Hydrology for Small Watersheds (TR-55)
- Agricultural Research Service, Handbook 667, Stability of Grass-Lined Open Channels.

CERTIFICATION OF COMPLETION

Grassed Waterway (412)

Program Participant Information

Name (print): _____

Contract Number: _____ Contract Item #(s): _____

Technical Service Provider Information

Name (print): _____

TSP ID Number: _____ Expiration Date: _____

Technical Services Provided

☐ Design (911)

☐ Installation (912)

☐ Checkout (913)

I hereby certify that the technical services I provided as a Technical Service Provider for this component(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservation practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this component, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS staff) ***Date***

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

HEAVY USE AREA PROTECTION

CODE 561

(sq. ft.)

DEFINITION

Heavy use area protection is used to stabilize a ground surface that is frequently and intensively used by people, animals, or vehicles.

PURPOSE

Heavy use area protection is used:

- To provide a stable, non-eroding surface for areas frequently used by animals, people or vehicles.
- To protect or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where a frequently or intensively used area requires treatment to address one or more resource concerns.

CRITERIA

General Criteria Applicable To All Purposes

Design Load. Base the design load on the type and frequency of traffic, (vehicular, animal, or human) anticipated on the heavy use area.

Foundation. Evaluate the site foundation to ensure that the presumptive bearing capacity of the soil meets the intended design load and frequency use.

When necessary, prepare the foundation by removal and disposal of materials that are not adequate to support the design loads.

Use a base course of gravel, crushed stone, other suitable material, geotextile, or a combination of materials on all sites that need increased load bearing strength, drainage, separation of material and soil reinforcement. Refer to Natural Resources Conservation Service (NRCS), National Engineering Handbook (NEH), Part 642, Design Note 24, Guide for Use of Geotextiles; or NEH, Part 650, Engineering Field Handbook (EFH), Chapter 17, WI Supplement.

If there is the potential for groundwater contamination from the heavy use area, select another site or provide an impervious barrier. Option G in Table 1, Surface Material Criteria and Separation Distances, shall be used if protection from groundwater contamination is the primary objective.

Separation From Subsurface Saturation or Bedrock. The separation is the closest distance from any point on the top surface of the heavy use area protection to the feature from which separation is required. Separation distances are listed in Table 1.

Subsurface saturation and bedrock are defined in WI NRCS Conservation Practice Standard (WI CPS), *Waste Storage Facility (Code 313)*. The criteria for handling subsurface saturation and bedrock separation is also included in WI CPS 313.

Surface Treatment. Select a surface treatment that is stable and appropriate to the purpose of the heavy use area. Surfacing options are included in Table 1. Surface treatments must meet the following requirements according to the material used.

Concrete. Slabs-on-ground subject to cattle traffic or infrequent use by light agricultural equipment may utilize the surfacing options in Table 1.

Design slabs-on-ground subject to distributed stationary loads, light vehicular traffic, or infrequent use by heavy trucks or agricultural equipment in accordance with American Concrete Institute (ACI) *Guide for the Design and Construction of Concrete Parking Lots* (ACI 330R). Design slabs-on-ground subject to regular or frequent heavy truck or heavy agricultural equipment traffic in accordance with ACI *Guide to Design of Slabs-on-Ground* (ACI 360R). Design liquid-tight slabs in accordance with ACI Code *Requirements for Environmental Concrete Structures, Slabs-on-Soil* (ACI 350, Appendix H).

Design concrete structures in accordance with

NRCS National Engineering Manual (NEM), Part 536, Structural Engineering.

Bituminous Concrete Pavement. Refer to AASHTO Guide for Design of Pavement Structures or the applicable State highway department's specification for design criteria for bituminous concrete paving.

In lieu of a site-specific design for areas that will be subject to light use, pave with a minimum of 4 inches of compacted bituminous concrete over a subgrade of at least 4 inches of well-compacted gravel. Use bituminous concrete mixtures commonly used for road paving in the area.

Aggregate. Design aggregate surfaces for expected wear and intended use. In lieu of a site-specific design for areas that will be subject to cattle traffic or infrequent use by light agricultural equipment, utilize the surfacing options in Table 1.

For other applications, use NRCS Agricultural Engineering Note 4, *Earth and Aggregate Surfacing Design Guide*, or other appropriate methodology to design aggregate thickness.

Mulches. Use a minimum layer thickness of 6 inches for materials such as limestone screenings, cinders, tanbark, bark mulch, brick chips, or shredded rubber. Mulches are not recommended for livestock or vehicular applications.

Vegetation. Select vegetation that can withstand the intended use. Establish the vegetation in accordance with the criteria in WI CPS, *Critical Area Planting (Code 342)*.

Other. Other materials can be used if they will serve the intended purpose and design life.

Structures. When a roof is needed to address the resource concern, use WI CPS, *Roofs and Covers (Code 367)*. For non-waste applications, design structures according to the accepted engineering practice.

Drainage and Erosion Control. Include provisions in the design for surface and subsurface drainage, as needed. Include provisions for disposal and runoff without causing erosion or water quality impairment. To the extent possible, prevent surface water from entering the heavy use area.

Stabilize all areas disturbed by construction as soon as possible after construction. Refer to the criteria in WI CPS, *Critical Area Planting (Code 342)*, for establishment of vegetation. If vegetation is not appropriate for the site, use the criteria in WI CPS, *Mulching (Code 484)* to stabilize the disturbed area.

Additional Criteria for Livestock Heavy Use Areas

Other practices shall be utilized to collect, store, utilize, or treat manure and contaminated runoff where contaminated runoff will cause a resource concern.

Animal yards or lots shall be located a minimum of 50 feet from any well or sinkhole.

The animal yard area for various animal types and sizes; lot surfacing and feeding requirements shall be in accordance with the areas shown in the Wisconsin Supplement to Chapter 10 in the NRCS NEH Part 651, Agricultural Waste Management Field Handbook (AWMFH), or in livestock planning handbooks published by Midwest Plan Service.

Additional Criteria for Recreation Areas

The American Disabilities Act of 1990 (ADA) requires recreation areas that are used by the public to be accessible to people with disabilities. Address accessibility requirements for new construction and when existing facilities are being altered.

CONSIDERATIONS

Heavy use areas can have a significant impact on adjoining land uses. These impacts can be environmental, visual and cultural. Select a treatment that is compatible with adjoining areas. Consider such things as proximity to neighbors and the land use where the stabilization will take place.

Vegetated heavy use areas may need additional materials such as geogrids or other reinforcing techniques, or planned periods of rest and recovery to ensure that vegetative stabilization will succeed.

Consider the safety of the users during the design. Avoid slippery surfaces, sharp corners, or surfaces and structures that might entrap users. For heavy use areas used by livestock, avoid the use of sharp aggregates that might injure livestock.

Paving or otherwise reducing the permeability of the heavily used area can reduce infiltration and increase surface runoff. Depending on the size of the heavy use area, this can have an impact on the water budget of the surrounding area. Consider the effects to ground and surface water.

Installation of heavy use area protection on muddy sites can improve animal health. Mud transmits bacterial and fungal diseases and provides a breeding ground for flies. Hoof suctions makes it difficult for cattle to move around in muddy areas. In addition, mud negates the insulation value of hair coat and the animals must use more energy to keep warm. As temperatures fall, animal bunching may occur, which can reduce or eliminate vegetative cover and lead to erosion and water quality concerns.

To reduce the negative water quality impact of heavy use areas, consider locating them as far as possible from waterbodies or water courses. In some cases, this may require relocating the heavily used area rather than just armoring an area that is already in use.

To reduce the potential for air quality problems from particulate matter associated with a heavy use area, consider the use of WI CPS, *Windbreak/ Shelterbelt Establishment (Code 380), Herbaceous Wind Barriers (Code 603), Dust Control from Animal Activity on Open Lot Surfaces (Code 375), or Dust Control on Unpaved Roads and surfaces (Code 373)* to control dust from heavy use areas.

Consider ways to reduce the size of the heavy use areas as much as possible. This may require changes in how the livestock are managed, but in the long run, may result in less maintenance and a more efficient operation.

For areas that will need to be cleaned frequently by scraping, loose aggregate or other non-cementitious materials may not be the best choice. Consider a more durable surface such as concrete.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for heavy use area protection that describe the requirements for installing the practice according to this standard. As a minimum, the plans and specifications should include:

- A plan view showing the location and extent of the practice. Include the location and distances to adjacent features and known utilities.
- Typical section(s) showing the type and required thickness of paving or stabilization materials.
- A graded plan, as needed.
- Where appropriate, plans for required structural details.
- Method and materials used to stabilize areas disturbed by construction.
- Construction specifications with site specific installation requirements.

OPERATION AND MAINTENANCE

Prepare an Operation and Maintenance (O&M) plan and review with the operator prior to practice installation. The minimum requirements to be addressed in the O&M plan are:

1. Periodic inspections – annually and immediately following significant rainfall events.
2. Prompt repair or replacement of damaged components especially surfaces that are subjected to wear or erosion.
3. For livestock heavy use areas, include requirements for the regular removal and management of manure, as needed.
4. For vegetated heavy use areas, restrict use as needed to protect the stand and to allow vegetative recovery.

REFERENCES

American Concrete Institute (2006). Guide to Design of Slabs-on-Ground (ACI Standard 360R-06). Farmington Hills, MI: American Concrete Institute.

American Concrete Institute. Guide for the Design and Construction of Concrete Parking Lots. (ACI 330R-08). Farmington Hills, MI.: American Concrete Institute.

American Concrete Institute. Requirements for Environmental Concrete Structures, Slabs on Soil (ACI 350, Appendix H). Farmington Hills, MI: American Concrete Institute.

USDA, NRCS. National Engineering Handbook, Park 650, Engineering Field Handbook, Chapter 10.

USDA, NRCS (2014). Agricultural Engineering Note 4, Earth and Aggregate Surfacing Design Guide, Washington, DC.

Table 1: Surface Material Criteria and Separation Distances

Option	Fondation Condition	Cross Section Option	Separation to Bedrock or Subsurface Saturation (ft.)
A	Firm[1]	Raised Earth	3
B	Firm	Minimum 6" crushed stone[2]	3
C	Firm	Minimum 6" crushed stone over NRCS Wisconsin Construction Specification (WCS)-13, Geotextile, Class IV	3
D	Firm	Minimum 4" crushed stone over 6" base course of graded rock[3]	3
E	Firm	5" non-reinforced concrete with maximum control join spacing of 16" in both length and width, over 6" sand/gravel	2
F[4]	Firm	5" reinforced concrete with designed control joint spacing over 6" sand/gravel	2
G[5]	Firm	5" reinforced concrete with waterstop, over 6" sand/gravel	2
H	Firm	5" concrete reinforced with temperature and shrinkage steel only	2
I	Firm	Minimum 4" asphalt over 6" sand/gravel	3
J	Soft[1]	Minimum 4" crushed stone over 8" base course of graded rock over 6" of sand and fine gravel	3
K	Soft	Minimum 4" crushed stone over 8" base course of graded rock over NRCS WCS-13, Geotextile, Class IV	3
L	Soft	Minimum 4" crushed stone over 18" base course of graded rock	3
M	Soft	Minimum 4" crushed stone over 18" base course of graded rock over 6" sand and gravel	3
N	Soft	Minimum 8" crushed stone over geogrid over NRCS WCS-13, Geotextile, Class IV	3

[1]Guidance can be found in EFH Chapter 4 and Figure 4-14 for information regarding bearing capacity and foundation properties.

[2]Crushed Stone: 100% passing 3/4" sieve and 10% maximum passing the #200 sieve.

[3]Graded Rock: 100% passing the base course thickness dimension and a maximum of 10% passing the 3/4" sieve. All sizes between the limits shown on the drawings are to be represented.

[4]Reinforcing and control joint spacing according to Subgrade Drag Theory Design as found in ACI 360, Design of Slabs on Grade, or Engineering Field Handbook (EFH), Chapter 17.

[5]Option G is the only option that can be used where the potential for groundwater contamination is the resource concern.

- Option G requires deformed steel reinforcing bars and control joint spacing according to Subgrade Drag Theory Design.
- Option G requires the installation of embedded waterstops at all control, construction, and isolation joints.
- Waterstop to be in accordance with NRCS Wisconsin Construction Specification 4, Conrete.
- Maximum wheel load of 5000 pounds at spacing of 8 feet or to be designed using ACI 360, Design of Slabs on Grade.

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Heavy Use Area Protection (561)

DESIGN (911)

Deliverables:

1. Design documentation that will demonstrate the criteria in the NRCS practice standard have been met and are compatible with other planned and applied practices.

    a. Compliance with NRCS national and state utility safety policy (NEM Part 503 Safety).

    b. List of associated eFOTG conservation practices included in the project.

    c. Practice standard criteria substantiating data, computations, and analyses to develop plans and specifications including but not limited to:

        i. Type of traffic, design load, site foundation.
        ii. Kind of surface treatment including vegetation measures.
        iii. User safety.
        iv. Additional requirements for livestock or recreation areas.

2. Adequate location map, plan view, profiles, cross sections, details, and specifications to ensure that the project can be properly constructed and permits secured.

3. Design Report and Quality Assurance Plan as appropriate (NEM Part 511, Design and Part 512 Construction).

    a. The design report shall include, but is not limited to the following:

        i. Summary of project objectives and work to be completed.
        ii. Design documentation from item 1 listed above.

    b. The quality assurance plan must describe the type and frequency of testing, items requiring inspection, the documentation required, and the qualifications of the person doing the work.

4. Operation and maintenance plan.

5. Itemized engineer's cost estimate.

6. Certification that the design meets practice standard criteria and complies with applicable laws and regulations (NEM Part 505, Non-NRCS Engineering Services).

STATEMENT OF WORK

USDA, Natural Resources Conservation Service
Wisconsin

Heavy Use Area Protection (561)

INSTALLATION (912)

Deliverables

1. Documentation of pre-construction conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout survey notes.
4. Installation inspection (according to quality assurance plan).
   a. Materials used.
   b. Inspection records.
   c. Maintaining a job diary with the dates and record of inspections made, testing completed, instruction provided to the contractor, etc., to document compliance with standards and specifications.
5. Facilitate, implement and document required design modifications with client, original designer, permitting and funding agencies.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meet design and permit requirements.

STATEMENT OF WORK

USDA, Natural Resources Conservation Service
Wisconsin

Heavy Use Area Protection (561)

CHECKOUT (913)

Deliverables

1. Supporting documentation.
2. As-Built drawings
   a. Drawings with changes from the original construction plans clearly shown.
   b. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Part 505, Non-NRCS Engineering Services).
3. Extent of practice units applied and location identified on a map.
   a. Completed job diary noting inspections made, testing completed, etc.
   b. Materials documentation.
   c. Testing reports.
   d. Survey notes for layout, inspections, and final checkout documenting compliance with standards and specifications.
4. Provide the following information to the NRCS field office servicing the relevant land unit for entry into the Performance Results System (PRS):
   a. Technical Service Provider Name
   b. Customer name
   c. USDA program funding the practice (if known)
   d. Location of work (state, county, conservation district, land tract identifier)
   e. Land use of field where the practice was installed (cropland, etc.)
   f. NRCS practice name and quantity of practice installed in appropriate units

STATEMENT OF WORK
USDA, Natural Resources Conservation Service
Wisconsin

Heavy Use Area Protection (561)

REFERENCES

- WI NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard 561, Heavy Use Area Protection
- NRCS National Engineering Manual (NEM) and Wisconsin Supplements
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook
- NRCS National Engineering Handbook, Part 650, Engineering Field Handbook (EFH) and Wisconsin Supplements
- NRCS Agricultural Engineering Note 4, Earth and Aggregate Surfacing Design Guide

CERTIFICATION OF COMPLETION

Heavy Use Area Protection (561)

Program Participant Information

Name (print): _____

Contract Number: _____ Contract Item #(s): _____

Technical Service Provider Information

Name (print): _____

TSP ID Number: _____ Expiration Date: _____

Technical Services Provided

☐ Design (911)

☐ Installation (912)

☐ Checkout (913)

I hereby certify that the technical services I provided as a Technical Service Provider for this component(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservation practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this component, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS staff) ***Date***

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FOREST STAND IMPROVEMENT

CODE 666

(Acre)

I. DEFINITION

The manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation.

II. PURPOSES

- Increase the quantity and quality of forest products by manipulating stand density and structure.
- Timely harvest forest products.
- Initiate forest stand regeneration.
- Reduce the potential of damage from wildfire.
- Improve forest health by reducing the potential of damage from pests and moisture stress.
- Restore natural plant communities.
- Development of renewable energy systems.
- Achieve a desired plant community.
- Improve aesthetic and recreation values
- Improve wildlife habitat
- Improve water conservation and yield.
- Achieve a desired level of stocking and density.
- Increase carbon storage in selected crop trees.

III. CONDITIONS WHERE PRACTICE APPLIES

All forest land.

This standard is not applicable for Wisconsin NRCS Conservation Practice Standard (CPS), "Alley Cropping" (311), "Multi-story Cropping" (379), "Windbreak/Shelterbelt Establishment" (380) operation and maintenance, or "Windbreak/ Shelterbelt Renovation" (650).

IV. FEDERAL, TRIBAL, STATE, AND LOCAL LAWS

Users of this standard should be aware of potentially applicable federal, tribal, state, and local laws, rules, regulations, or permit requirements governing forest stand improvement. This standard does not contain the text of federal, tribal, state, or local laws.

V. CRITERIA

A. General Criteria

The structure management strategy will be identified for all planned forest stand improvement activities:

- Uneven-aged management systems (single-tree selection, group selection).
- Even-aged management (clear-cut, seed-tree, shelterwood, coppice).

Separate stands with different cover types or timber types into separate management units (stands) and plan them individually.

Base all management decisions on a thorough and current forest inventory and the intended purpose. Crop tree inventories, fixed area plot inventories, and point sampling methods are examples of forest inventories. At a minimum, the inventory must be adequate to generate basal area (for even or uneven-aged stands) or average diameter at breast height (DBH) and average spacing/trees per acre (for even-aged stands).

Base forest stand improvement choices on the following selection criteria:

- Tree and forest health
- Tree size, position and spacing
- Crown size, position, and condition
- Bole quality
- Species
- Species diversity

Plan post-treatment basal appropriately for community/cover type. See WI NRCS CPS, "Forest Stand Improvement" (666) Job Sheet for more information.

Kill unwanted trees, shrubs, and vines by any of the following means:

- Cutting
- Girdling
- Frilling

- Stem injection of herbicides
- Foliar or basal bark spraying of herbicides

If needed, supplement mechanical cutting, girdling, or frilling with an application of herbicide to increase mortality and decrease stump sprouting.

Time tree cutting to avoid a buildup of insect or disease populations.

Conduct tree cutting in forest stands that contain oak species only during dormant seasons, October 1 through March 1, to reduce chance of infection to the residual stand by oak wilt disease (Ophiostoma fagacearum).

Perform forest stand improvement activities in such a way as to minimize soil erosion, compaction, rutting, damage to remaining vegetation, and hydrologic conditions, and other site resources.

Limit damage to the site by:

- Using directional felling compatible with skid trail layout
- Aligning cut tree stems for efficient skidding
- Cutting out forks and large branches
- Limiting trails to less than 15% of the site
- Logging when soils are dry or frozen
- Using the lowest-impact equipment available
- Using well-organized access trails

Refer to WI NRCS CPS, "Forest Trails and Landings" (655) for more information about trail establishment and maintenance.

Comply with applicable laws and regulations, including Wisconsin's Best Management Practices (BMPs) for forestland contained in "Sustainable Soil and Water Quality Practices on Forest Land," published by the Wisconsin Department of Natural Resources.

Protect all forestland from livestock grazing.

Retain a minimum of 2 large (>12" DBH) active den trees per acre, if possible.

Retain or create a minimum of 2 large (>12" DBH) snags per acre, if possible.

Treat slash and debris such that they do not present an unacceptable fire, safety, environmental, or pest hazard and will not interfere with the intended purpose or other management activities.

If burning is used to reduce slash and other debris on-site, follow WI NRCS CPS "Prescribed Burning" (338).

B. Additional Criteria to Increase the Quantity and Quality of Forest Products (Intermediate Thinning Treatments)

For management of, or conversion to, uneven-aged stands (hardwoods, conifers, or mixed forest types), perform Forest Stand Improvement when basal area is greater than 110 sq. ft. per acre. Remove 20 to 33% of the basal area, ensuring that residual basal area is no lower than 75 sq. ft. per acre to regenerate shade tolerant species, e.g., sugar maple, and no lower than 60 sq. ft. per acre to regenerate shade intolerant or intermediate species, e.g., red oak.

For even-aged hardwood stands, perform Forest Stand Improvement when basal area is greater than 110 sq. ft. per acre. Remove 20 to 33% of the basal area, ensuring that residual basal area is no lower than 75 sq. ft. per acre.

For even-aged conifer stands, perform Forest Stand Improvement when average tree spacing is less than D+4 or crown is less than one third of the total tree height. Increase average tree spacing to D+6, if possible, but do not remove more than half the trees in one treatment.

See WI NRCS CPS, "Forest Stand Improvement" (666) Job Sheet for more information.

C. Additional Criteria to Develop Renewable Energy Systems

Intensity and frequency of energy biomass removals will be managed to prevent long-term negative impacts on the stand. The harvesting of energy biomass shall be accomplished in a manner that will not compromise the other intended purpose(s) and functions. Refer to Wisconsin Biomass Harvesting Guidelines.

D. Additional Criteria to Increase Carbon Storage

Manage for tree species that are longer lived and stocking rates that have higher rates of growth and potential for carbon sequestration.

E. Additional Criteria to Harvest Forest Products and to Initiate Forest Stand Regeneration

Use a harvest-regeneration system appropriate for the growth characteristics and shade tolerance of the species and forest cover type to be

regenerated:

- For uneven-aged systems, follow guidance in previous section.
- For management of, or conversion to, even aged system, including pine plantations and aspen stands, use even-aged harvest- regeneration strategies, e.g., shelterwood, seed tree harvests, and clear-cutting.

If natural regeneration is not likely, or is not present two years after the harvest, initiate reforestation. Refer to WI NRCS CPS, "Tree/Shrub Establishment" (612).

F. Additional Criteria to Reduce Wildfire Hazard

Reduce stocking rates of trees to minimize crown-to- crown spread of fire.

Remove "ladder" fuels to minimize the risk of crown fires.

Further treat or eliminate slash accumulations next to roads and trails.

Reduce or eliminate species with high volatility.

For additional wildfire risk and damage reduction, refer WI NRCS CPS, "Firebreak" (394).

G. Additional Criteria to Improve Wildlife Habitat

Manage for a variety of native tree species and stocking rates that meet desired wildlife and pollinator species' food and cover requirements.

Create and/or maintain 2 to 5 snags per acre (12" DBH+), and 2 to 5 den trees per acre (12" DBH+), if possible, depending on the requirements of the desired wildlife species.

Create and/or maintain adequate down woody material to meet requirements of desired wildlife.

Minimize improvement actions that disturb seasonal wildlife activities.

Refer to WI NRCS CPS, "Early Successional Habitat Development/Management" (647), "Rare and Declining Habitat Management" (643), "Upland Wildlife Habitat Management" (645), and "Wetland Wildlife Habitat Management" (644) to further develop and manage wildlife-related activities.

VI. CONSIDERATIONS

A. Use of a professional forester (Technical Service Provider (TSP), professional consulting forester, etc.) to mark and layout practice will generally yield better results. This should be considered especially for large or complex sites.

B. Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

C. Successful regeneration of desirable species is usually dependent upon timely application of forest stand improvement and other practices, e.g., Prescribed Burning, Site Preparation, Tree and Shrub Establishment, Prescribed Grazing, and Use Exclusion.

D. Landowners should secure a written contract with any service provider that specifically describes the extent of activity, duration of activity, liability and responsibilities of each party and amount and timing of payments for services provided.

E. The practice should be timed to minimize disturbance of seasonal wildlife activities.

F. Timing of treatment and retention of dead or dying trees will minimize impacts on nesting wildlife.

G. Consider wildlife food and cover needs.

H. In areas where heavy brush or weeds may cause severe competition for moisture and nutrients, it may be necessary to reduce competing vegetation by:

I. Mechanical release of target residual trees.

J. Chemical or mechanical treatment to release tree seedlings from heavy brush.

K. Consider environmental effects of harvest on threatened and endangered species and natural areas where present.

VII. 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 plant, or other acceptable documentation.

Specifications will include, but are not limited to:

- Purpose(s) of treatment,
- Map indicating location of practice,
- The harvest regeneration strategy,
  - Uneven-aged management (e.g., single tree selection, group selection, coppice selection)
  - Even-aged management (e.g., clear-cut, seed-tree, shelterwood, coppice)
- Pre-treatment and post-treatment basal area (for even or uneven-aged stands) or average DBH and spacing/trees per acre (for even-aged stands)
- Number, species, and size class of trees to be removed
- The method, timing, and type of equipment to be used
- Mitigation measures, e.g., slash and debris disposal to mitigate wildfire or pest hazards
- Operation and Maintenance requirements

VIII. OPERATION AND MAINTENANCE

Periodic inspections during and after treatment activities are necessary to ensure that purposes are achieved and resource damage is minimized, e.g., assessment of insects, disease and other pests, storm damage, and damage by trespass. The results of inspections shall determine the need for additional treatment under this practice.

For treatments intended to initiate forest stand regeneration, inspect the site after 2 years to determine if natural regeneration is adequate. If not, initiate artificial regeneration using WI NRCS CPS, "Tree/Shrub Establishment" (612).

Forest Stand Improvement may be needed at 5 to 15 year intervals, depending on site type and site quality.

IX. REFERENCES

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

Smith, David Martyn, 1962. The Practice of Silviculture. 578 pp.

U.S. Department of Agriculture, Forest Service, 1965. Silvics of Forest Trees of the United States, Agriculture Handbook No. 271. 762 pp.

Stoddard, Charles H., 1968. Essentials of Forestry Practice. 362 pp.

Wisconsin Forestry Management Guidelines. http://dnr.wi.gov/topic/ForestManagement/guidelines.html

Wisconsin Forestry Best Management Practices. http://dnr.wi.gov/

Wisconsin Department of Natural Resources. 2009. Herbicides for Forest Management. Madison, WI. http://dnr.wi.gov/topic/foresthealth/herbicides.html

USDA United States Department of Agriculture

FOREST STAND IMPROVEMENT

Wisoconsin Job Sheet 666

DEFINITION

Forest Stand Improvement (FSI) is the manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation.

FSI can refer to both pre-commercial (intermediate) treatments and commercial harvesting operations.

PURPOSES

- Increase the quantity and quality of forest products by manipulating stand density and structure
- Harvest forest products
- Initiate forest stand regeneration
- Development of renewable energy systems
- Reduce wildfire hazard
- Improve forest health by reducing the potential of damage from pests and moisture stress
- Restore natural plant communities
- Achieve or maintain a desired native understory plant community for special forest products, grazing, and browsing
- Improve aesthetic and recreation values
- Improve wildlife habitat
- Alter water yield
- Increase carbon storage in selected trees

CONDITIONS WHERE PRACTICE APPLIES

All forest land.

CRITERIA

General Criteria Applicable to All Purposes

Base all management decisions on a thorough and current forest inventory and the intended purpose.

Base forest stand improvement choices on the following selection criteria:

- Tree and forest health
- Tree size, position and spacing
- Crown size, position, and condition
- Bole quality
- Species
- Species diversity

Kill unwanted trees, shrubs, and vines by any of the following means:

- Cutting
- Girdling
- Frilling
- Stem injection of herbicides
- Foliar or basal bark spraying of herbicides

If needed, supplement mechanical cutting, girdling, or frilling with an application of herbicide to increase mortality and decrease stump sprouting.

Use the safest available herbicide. Pesticides used improperly can be injurious to humans, animals, and plants. Follow all label precautions.

Conduct tree cutting in forest stands that contain oak species only during dormant seasons, October 1 through March 1, to reduce chance of infection to the residual stand by oak wilt disease (*Ophiostoma fagacearum*).

Limit damage to the site by:

- Using directional felling compatible with skid trail layout
- Aligning cut tree stems for efficient skidding
- Cutting out forks and large branches
- Limiting trails to less than 15% of the site
- Logging when soils are dry or frozen

» Using the lowest-impact equipment available
» Using well-organized access trails

Refer to Wisconsin NRCS Conservation Practice Standard (CPS), *Forest Trails and Landings (655)* for more information about trail establishment and maintenance.

Comply with applicable laws and regulations, including Wisconsin's Best Management Practices (BMPs) for forestland.

Protect all forestland from livestock grazing.

Retain a minimum of 2 large (>12" DBH) active den trees per acre, if possible.

Retain or create a minimum of 2 large (>12" DBH) snags per acre, if possible.

Treat slash and debris such that they do not present an unacceptable fire, safety, environmental, or pest hazard and will not interfere with the intended purpose or other management activities.

If burning is used to reduce slash and other debris on-site, follow Wisconsin CPS, *Prescribed Burning (338)*.

Additional Criteria to Increase the Quantity and Quality of Forest Products

For uneven-aged stands (hardwoods, conifers, or mixed forest types), perform Forest Stand Improvement when basal area is greater than 110 sq. ft. per acre. Remove 20 to 33% of the basal area, ensuring that residual basal area is no lower than 75 sq. ft. per acre, to regenerate shade tolerant species, e.g., sugar maple, and no lower than 60 sq. ft. per acre to regenerate shade intolerant or intermediate species, e.g., red oak.

For even-aged hardwood stands, perform Forest Stand Improvement when basal area is greater than 110 sq. ft. per acre. Remove 20 to 33% of the basal area, ensuring that residual basal area is no lower than 75 sq. ft. per acre.

For even-aged hardwood stands, these criteria can be achieved by following the guidance in Table 1.

For even-aged conifer stands, perform Forest Stand Improvement when average tree spacing is less than D+4 or crown is less than one third of the total tree height. Increase average tree spacing to D+6, if possible, but do not remove more than half the trees in one treatment. Refer to Table 2, for guidance on thinning to these spacing requirements.

Additional Criteria to Harvest Forest Products and to Initiate Forest Stand Regeneration

Use a harvest-regeneration system appropriate for the growth characteristics and shade tolerance of the species and forest cover type to be regenerated:

Table 1: Thinning Guidelines for Even-aged Hardwoods

Existing Stand:			Thin the stand to:		
Ave. DBH (in.)	Trees per acre	Average spacing between trees (ft.)	Trees/ Acre	Average spacing between trees (ft.)	Basal Area (sq. ft. per acre)
5	≥ 770	≤ 7	681	8	95
6	≥ 535	≤ 9	436	10	87
7	≥ 393	≤ 11	302	12	82
8	≥ 301	≤ 12	258	13	90
9	≥ 238	≤ 14	194	15	85
10	≥ 193	≤ 15	151	17	83
11	≥ 159	≤ 17	134	18	90
12	≥ 134	≤ 18	109	20	86
13	≥ 114	≤ 20	90	22	83
14	≥ 98	≤ 21	82	23	88
15	≥ 86	≤ 23	70	25	86
16	≥ 75	≤ 24	60	27	84
17	≥ 67	≤ 26	56	28	88
18	≥ 59	≤ 27	48	30	85
19	≥ 53	≤ 29	43	32	85
20	≥ 48	≤ 30	40	33	87
21	≥ 44	≤ 32	36	35	87
22	≥ 40	≤ 33	32	37	84
23	≥ 36	≤ 35	30	38	87
24	≥ 33	≤ 36	27	40	85

Table 2: Thinning Guidelines for Even-aged Conifers

Existing Stand:			Thin the stand to:		
Ave. DBH (in.)	Trees per acre	Average spacing between trees (ft.)	Trees/ Acre	Average spacing between trees (ft.)	Basal Area (sq. ft. per acre)
5	≥ 538	≤ 9	360	11	50
6	≥ 436	≤ 10	302	12	60
7	≥ 360	≤ 11	258	13	70
8	≥ 302	≤ 12	222	14	78
9	≥ 258	≤ 13	194	15	85
10	≥ 222	≤ 14	170	16	94
11	≥ 194	≤ 15	151	17	101
12	≥ 170	≤ 16	134	18	106
13	≥ 151	≤ 17	121	19	111
14	≥ 134	≤ 18	109	20	117
15	≥ 121	≤ 19	99	21	122
16	≥ 109	≤ 20	90	22	126
17	≥ 99	≤ 21	82	23	130
18	≥ 90	≤ 22	76	24	134
19	≥ 82	≤ 23	70	25	138
20	≥ 76	≤ 24	64	26	140
21	≥ 70	≤ 25	60	27	145
22	≥ 64	≤ 26	56	28	148
23	≥ 60	≤ 27	52	29	150
24	≥ 56	≤ 27	48	30	151

- » For uneven-aged systems, follow guidance in previous section.
- » For management of, or conversion to, even aged system, including pine plantations and aspen stands, use even-aged harvest-regeneration strategies, e.g., shelterwood, seed tree harvests, and clearcutting.

If natural regeneration is not likely, or is not present two years after the harvest, initiate reforestation. Refer to Wisconsin NRCS CPS, *Tree/Shrub Establishment (612)*.

Additional Criteria to Reduce Wildfire Hazard

Reduce stocking rates of trees to minimize crown-to-crown spread of fire.

Remove "ladder" fuels to minimize the risk of crown fires.

Further treat or eliminate slash accumulations next to roads and trails.

Reduce or eliminate species with high volatility.

For additional wildfire risk and damage reduction, refer to Wisconsin NRCS CPS, *Firebreak (394)*.

Additional Criteria to Improve Wildlife Habitat

Manage for a variety of native tree species and stocking rates that meet desired wildlife and pollinator species food and cover requirements.

Create and/or maintain 2 to 5 snags per acre (12" DBH+), and 2 to 5 den trees per acre (12" DBH+), if possible, depending on the requirements of the desired wildlife species.

Create and/or maintain adequate down woody material to meet requirements of desired wildlife.

Minimize improvement actions that disturb seasonal wildlife activities.

Refer to Wisconsin NRCS CPS, *Early Successional Habitat Development/Management (647), Rare and Declining Habitat Management (643), Upland Wildlife Habitat Management (645), and Wetland Wildlife Habitat Management (644)* to further develop and manage wildlife-related activities.

Additional Criteria to Increase Carbon Storage in Selected Trees

Manage for tree species and stocking rates that have higher rates of growth and potential for carbon sequestration.

CONSIDERATIONS

Use of a professional forester (Conservation District forester, professional consulting forester, etc.) to mark and layout practice will generally yield better results. This should be considered especially for large or complex sites.

The U.S. Forest Service North Central Research Station's "Manager's Handbook" series of publications provide excellent type-specific guidance for a variety of cover types. Search for "Manager's Handbook" here: http://www.ncrs.fs.fed.us/pubs/search.asp.

Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

The extent, timing, size of treatment area, or the intensity of the practice should be adjusted to minimize cumulative effects (onsite and offsite), e.g., hydrologic and stream alteration, habitat fragmentation, nutrient cycling, biodiversity and visual resources.

To encourage regeneration of oaks and other species with intermediate shade tolerance, consider group selection to permit more sunlight to reach the forest floor.

Cut material can be arranged into 3 to 4 brush piles per acre to provide additional wildlife cover.

Time the practice to minimize disturbance of seasonal pollinator and wildlife activities.

Landowners should secure a written contract with any service provider that specifically describes the extent of activity, duration of activity, liability and responsibilities of each party and amount and timing of payments for services provided.

Slash, debris and other vegetation (biomass) removed during stand improvement may be used to produce energy. Management alternatives should consider the amount of energy required to produce and convert the biomass into energy with the amount produced by the biomass. Wildlife and sustainability requirements should also be considered.

Control invasive or noxious woody vegetation.

Advise clients of their wildfire control responsibilities and consider the development of a wildfire control plan including "defensible" space, access routes, fire-season water source, and location of wildfire control facilities.

Timing of treatment and retention of dead or dying trees will minimize impacts on nesting wildlife.

Thinning of pine stands during the growing season (especially during dry periods) without proper treatment of logging slash, may subject the stand to increased risk of attack by bark beetles (Dendroctnus spp. and Ips spp.).

REFERENCES

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Wenger, K.F., ed. 1984. Forestry Handbook, Second Edition. Society of American Foresters publication Number SAF 84-11. John Wiley and Sons, Inc. New York, NY.

Wisconsin Department of Natural Resources. 2009. Herbicides for Forest Management. Madison, WI. http://dnr.wi.gov/forestry/Fh/weeds/herbicides.htm

General Information

Client Name*: _____

Stand No.: _____ Field No.*: _____ Planned Implementation Date*: _____

Total Stand Acres: _____ Total Acres of Practice Planned*: _____

Site Map - Attach a map or aerial photo indicating the location of area to be treated with FSI.*

Purposes (check all that apply)*

- ☐ Increase the quantity and quality of forest products by manipulating stand density and structure
- ☐ Harvest forest products
- ☐ Initiate forest stand regeneration
- ☐ Development of renewable energy systems
- ☐ Reduce wildfire hazard
- ☐ Improve forest health by reducing the potential of damage from pests and moisture stress
- ☐ Restore natural plant communities
- ☐ Achieve or maintain a desired native understory plant community for special forest products, grazing, and browsing
- ☐ Improve aesthetic and recreation values
- ☐ Improve wildlife habitat
- ☐ Alter water yield
- ☐ Increase carbon storage in selected trees

Stand Information

Forest Cover Type/Dominant Spp.*: _____

Dominant Soil Types: _____ Site Index: ____ (S.I. Spp.: _____)

Silvicultural (Harvest/Regeneration) System (complete applicable section below):			
☐ Uneven-aged System*		☐ Even-aged System*	
Basal Area:	sq. ft./ac.*	Avg. DBH*:	Trees per ac.*:
Type of Intermediate FSI Treatment*:	☐ Single tree selection ☐ Group selection ☐ Other:	Type of Intermediate FSI Treatment*:	☐ Single tree selection ☐ Row thinning ☐ Other:
Type of Harvest FSI Treatment*:	☐ Single tree selection ☐ Group selection ☐ Other:	Type of Harvest FSI Treatment*:	☐ Shelterwood ☐ Seed Tree ☐ Clearcut ☐ Other:

* Required for certification of practice completion

Forest Stand Improvement Implementation Details

Diameter Class[1]*:	Existing (pre-treatment)	Removals*:		Residual (post-treatment)*:
	☐ Trees/Ac. or ☐ B.A. (ft./ac.)	Trees/Ac. or B.A.	Species	Trees/Ac. or B.A.
Total Trees/Ac.:		*		
Total B.A.:	*	*		*

[1] Specify Diameter in two-inch classes, e.g., 6 = 5.0 – 6.9", or by timber size class, e.g., saplings, poletimber, sawtimber.

Additional information, including equipment to be used, and O&M details, necessary to install and maintain practice*:

Install according to the general criteria, all applicable additional criteria, and as detailed in this specification sheet.

DESIGN APPROVAL

I certify that this practice has been designed with specifications to meet Wisconsin NRCS Conservation Practice Standard, Forest Stand Improvement (666), and that the client has been advised of installation and layout elements and given a completed job sheet 666.

NRCS or TSP* (print) (sign) Date

Client Review and Acceptance

The client acknowledges that:

- ☐ They have received a copy of the specifications and understand the contents, including the scope and location of the practice.
- ☐ They have obtained all necessary permits and/or rights in advance of practice application, and will comply with all ordinances and laws pertaining to the application of this practice.
- ☐ No changes will be made in the installation of the job without prior concurrence of NRCS.
- ☐ Operation and Maintenance of the installed work is necessary for proper performance during the life of the practice. *The practice life is 10 years*.

Required Documentation and Verification

☐ Practice amount applied is field verified by*: _____ on: _____ (date)

Before payment is made, the following information is required to be in the case file:

☐ Photographs of established filter strip that must include*:

- Statement "Photo was taken in the field by (enter name)"*
- Date photo was taken in the field*
- Statement of what the photo represents if it needs clarification*

☐ Field verification is documented and a certified planner verified "as installed" this practice meets NRCS standards and specifications.*

Practice Certification (NRCS USE ONLY)

I certify that the practice as installed is complete and meets the applicable Wisconsin NRCS Conservation Practice Standard and all applicable practice specifications. Any changes to the original practice design have been approved and are documented on the original practice design "as installed."

Certified Planner (print) (sign) Date

STATEMENT OF WORK

USDA, Natural Resources Conservation Service

Wisconsin

Forest Stand Improvement (666)

DESIGN (911)

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
    a. Determination of the harvest-regeneration strategy and the species of tree and understory vegetation to be retained.
    b. Timing and method of removal for trees and understory to be eliminated.
    c. Mitigation of wildfire hazard, erosion, runoff, soil compaction and soil displacement to acceptable levels.
2. Written plans and specifications, including location map, sketches and drawings shall be provided to the client that adequately describe the requirements to install the practice and obtain necessary permits.
3. Documentation of needed operation and maintenance.
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations.
5. Documentation requirements for design modifications during practice installation.
6. Itemized cost estimate.

INSTALLATION (912)

Deliverables:

1. Documentation of pre-application conference with client.
2. Verification that client has obtained required permits.
3. Layout and, as applicable, sample marking of 'leave' trees or 'take' trees according to plans and specifications including applicable layout notes.
4. Application guidance as needed.
5. Facilitate, implement and document required design modifications with client, original designer, permitting and funding agencies.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the application process and materials meet design and permit requirements.

CHECKOUT (913)

Deliverables:

1. Records of application.
    a. Extent of practice units applied and location identified on a map.
    b. Actual improvement measures used and applied
2. Certification that the application meets NRCS standards and specifications and is in compliance with permits.
3. Provide the following information to the NRCS field office servicing the relevant land unit for entry into the Performance Results System (PRS):
    a. Technical Service Provider name
    b. Customer name
    c. USDA program funding the practice (if known)
    d. Location of work (state, county, conservation district, land tract identifier)
    e. Land use of field where the practice was installed (cropland, etc.)
    f. NRCS practice name and quantity of practice installed in appropriate units
4. Documentation of exit conference with client and contractor.

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard, Forest Stand Improvement (666).
- NRCS National Forestry Handbook (NFH), Park 636.4.
- NRCS National Environmental Compliance Handbook.
- NRCS Cultural Resources Handbook.

CERTIFICATION OF COMPLETION

Forest Stand Improvement (666)

Program Participant Information

Name (print):_____

Contract Number:_____ Contract Item #(s):_____

Technical Service Provider Information

Name (print):_____

TSP ID Number:_____ Expiration Date:_____

Technical Service Provided

- ☐ Design (911)
- ☐ Installation (912)
- ☐ Checkout (913)

I hereby certify that the technical services I provided as a Technical Service Provider for this component(s) checked above: (1) comply with all applicable Federal, State, Tribal, and Local laws and requirements, (2) meet applicable USDA NRCS conservation practice standards, specifications, and program requirements, (3) are consistent with and meet the particular conservation program goals and objectives, (4) that I have provided the above named Program Participant the Deliverables in this Statement of Work for this component, and (5) comply with all "Certification Terms" as identified in the Technical Service Provider Certification Agreement.

_____ _____

Technical Service Provider Signature ***Date***

_____ _____

Received By (NRCS Staff) ***Date***

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SEASONAL HIGH TUNNEL SYTEM

CODE 325

(Ft^2)

I. DEFINITION

An enclosed polyethylene, polycarbonate, plastic, or fabric covered structure that is used to cover and protect crops from sun, wind, excessive rainfall, or cold, to extend the growing season in an environmentally safe manner.

II. PURPOSE

Improve plant health and vigor.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land capable of producing crops. This practice applies where sun or wind intensity may damage crops, or where an extension of the growing season is needed due to climatic conditions.

This practice does not apply to crops grown in the non-natural soil profiles such as tables/benches, portable pots, and hydroponically.

IV. CRITERIA

1. Supportive conservation practices and or treatment measures shall be implemented to address all environmental concerns associated with the installation and use of the high tunnel systems (structures) such as erosion, irrigation, and runoff.
2. Crops must be grown in the natural soil profile. Raised beds may be installed to improve soil condition, fertility, and access. Raised beds shall not exceed 12 inches in depth.
3. This practice does not include greenhouses or low tunnel systems and shall not be used to provide shelter or housing for any livestock, or to store supplies or equipment.
4. The footprint of these structures shall be placed in locations, away from buried public utilities.
5. Structures shall be located near a viable water source for irrigation, where practical.
6. The high tunnel structure must be planned, designed, and constructed from a manufactured kit in accordance with manufacturers' recommendations. The high tunnel frame must be constructed of metal, wood, or durable plastic; and be at least 6 feet in height at the peak of the structure. If required for enclosure, end wall covering may be of greenhouse-grade plastic, polycarbonate, wood, or other recommended material. Structures shall be designed and sized to accommodate entry/exit points to facilitate movement of equipment and supplies needed for the production of planned crops.
7. Select the high tunnel covering material of a significant thickness to withstand the temperature change for the period required and shall have a 4-year-minimum lifespan. For polyethylene covers, use a minimum 6-mil greenhouse grade, UV-resistant material.
8. Organic producers, shall make sure that all permissible activities, design, material used, and material specifications are consistent with the USDA Agricultural Marketing Service National Organic Program, National Standards on Organic Agricultural Production and Handling.

9. These structures shall be constructed on level grade or naturally occurring slopes, of five percent or less.
10. Where snow loads may damage the structure, the tunnel cover shall be removed or rolled up at the end of the growing season unless the structure is designed by the manufacturer to withstand expected snow loads.
11. Where wind loads may damage the structure, select the tunnel cover and structure designed by the manufacturer to withstand expected wind loads or manage the tunnel system in a manner that limits wind damage.
12. Where the intensity or duration of sunlight can shorten the growing season, the appropriate thickness of shade cloth may be used in place of, or in addition to impervious plastic covers. When shade cloth is used alone, end walls are not required.
13. High tunnels shed a large amount of water and can create drainage and ponding issues where none previously existed. Direct runoff away from the structure to avoid ponding and provide detention basins, storage reservoirs, or stable outlet when runoff from tunnel covers empties onto the ground surface with potential to cause erosion.
14. Vegetate all exposed surface areas disturbed during construction in accordance with Wisconsin NRCS Practice Standard, Critical Area Planting (342).
15. Significant modifications to the high tunnel structure design must be verified and approved by the manufacturer prior to construction to ensure that any warranties remain in effect.

V. CONSIDERATIONS

1. Runoff may be captured and used for irrigation purposes, if allowed by state law.
2. Runoff should not be relied on as the only source of irrigation water. Use the criteria for Wisconsin NRCS Practice Standard Roof Runoff Structure (558), to design any structure needed to meet the runoff criteria above.
3. Runoff may empty into surface or underground outlets, or onto the ground surface when properly protected. Size surface and underground outlets according to the criteria for Wisconsin NRCS Practice Standard, Underground Outlet (620), to ensure adequate capacity. Surface or ground outlets such as rock pads, rock-filled trenches with subsurface drains, concrete and other erosion-resistant pads, or preformed channels may be used.
4. Consider managing the high tunnel system to maintain or improve soil health by following a soil management system that creates a favorable habitat for soil microbes by:
   - Minimizing soil disturbance, resulting in the improvement of the physical, chemical and biological, condition of the soil medium,
   - Using plant diversity in the rotation to increase diversity below ground,
   - Keeping a living root growing year round as much as possible, and
   - Keeping the soil covered with residue and growing plants year round.
5. Locate the high tunnel conveniently for ingress/egress of plant materials, equipment, and other operation and maintenance activities.
6. Remove or manipulate side covers to control internal temperatures and humidity.
7. Installation of vents, fans, or heaters should be considered and included in the manufacturer's design and recommendations. When the objective is to provide protection from the sun and extend the growing

season, consider a high tunnel structure that includes shade cloth.

8. Consider installing a supplemental manufacturer's kit to provide additional structural support.
9. Consider setting end posts in concrete, the use of heavier 12 to14 gauge steel, and a double layer of plastic to increase integrity of the structure.
10. Consider a minimum clearance of 10 to 20 feet between side by side high tunnel installations for snow removal and cover installation.
11. Consider potential shading of high tunnel structures by other structures or trees and consider locating the structure footprint at a distance of two times the height of the tree or structure.
12. Consider managing weed populations by using soil fabrics, covers, or mulches.
13. Consider additional conservation practices where appropriate to include:
    - Crop rotation
    - Irrigation water management
    - Salinity management
    - Nutrient management
    - Integrated pest management
    - Critical area planting
    - Mulching
    - Roof runoff structure
    - Diversion
    - Underground outlets
    - Heavy use protection
    - Cover crop

VI. VII. PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard.

As a minimum, the plans and specifications shall include the following:

- Identify purpose.
- Document the planned growing season.
- Layout and location of the high tunnel.
- Site preparations and the required supporting practices for erosion control, runoff, and vegetative cover according to the requirements of the corresponding conservation practice standard.
- The planned width and length of the seasonal high tunnel.
- Statement that the seasonal high tunnel will be installed per the manufacturer's recommendations.
- List of all material used and material specifications.
- Procedure and timing to remove or roll up the high tunnel cover prior to inclement weather conditions.
- Procedure and timing to add or replace shade cloth for protection from the sun for the high tunnel cover.

VII. OPERATION AND MAINTENANCE

1. Prepare an operation and maintenance (O&M) plan and review with the landowner and/or operator responsible for the practice. Provide specific instruction for proper operation and maintenance of each component of this practice and detail the level of repairs needed to maintain the effectiveness and useful life of the practice.
2. Periodically inspect the high tunnel and repair, reinstall, or replace materials, as needed to accomplish the intended purpose.
3. Manage the structure in a manner that limits wind and/or snow damage. Close sides and ends before storm events.
4. In areas that receive snow and ice, the structure shall be closed prior to winter weather.
5. Remove snow and ice from the structure cover and sides promptly to prevent structure failure.
6. When the structure is at serious risk of collapse due to weather conditions, consider slashing the plastic cover to relieve pressure and save the framework.

7. Perform soil tests regularly to monitor nutrients and to monitor salt build-up. The soils under immobile high tunnels may require periodic “flushing” to remove salt build-up. This is accomplished by removing the cover for a season to allow natural precipitation to infiltrate, or by artificially flooding the ground under cover.
8. Seed all disturbed earth surfaces outside of the high tunnel and maintain the vegetation throughout the structure’s life.
9. Removal of cover materials shall be consistent with the intended purpose and site conditions.
10. Plan for proper disposal of the cover at the end of its useful life.
11. Operation of equipment near and on the site shall not compromise the intended purpose of the high tunnel structure or its cover.

VIII. FEDERAL, TRIBAL, STATE AND LOCAL LAWS

Users of this standard shall be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing residue management. This standard does not contain the text of federal, tribal, state or local laws.

IX. REFERENCES

Community Garden Guide Season Extension - High Tunnel, NRCS. Rose Lake Plant Materials Center, East Lansing, Michigan.

“High Tunnel Production Manual". Penn State University College of Agriculture, Department of Horticulture. White, L. and Orzolek, M. 2003

"High Tunnels: Using Low-Cost Technology to Increase Yields, Improve Quality and Extend the Season". Ted Blomgren, Cornell Cooperative Extension, and Tracy Frisch, Regional Farm and Food Project. Published by the University of Vermont Center for Sustainable Agriculture. 2007.

“Minnesota high tunnel production manual for commercial growers”. Edited by: Terrance T. Nennich, Sr., University of Minnesota Extension and Suzanne Wold-Burkness, University of Minnesota. 2013.

“Growing Under Cover: A Guide to Polytunnel Options for Kansas Growers”; Kansas Rural Center; Kim Scherman, 2014.

United States Department of Agriculture

SEASONAL HIGH TUNNEL SYSTEM

Wisoconsin Job Sheet 325

DEFINITION

An enclosed polyethylene, plastic, or fabric covered structure that is used to cover and protect edible crops from sun, wind, excessive rainfall, or cold, or to extend the growing season in an environmentally safe manner.

PURPOSES

- Improve plan health and vigor
- Extend the growing season due to climatic conditions

PLANNING REQUIREMENTS

Supportive conservation practices and/or treatment measures shall be implemented to address all environmental concerns associated with the installation and use of the high tunnel system (structures) such as erosion, irrigation, and runoff.

Crops must be grown in the natural soil profile. Raised beds may be installed to improve soil condition, fertility, and access. Raised beds shall not exceed 12 inches in depth.

The high tunnel structure must be planned, designed, and constructed from a manufactured kit in accordance with manufacturers' recommendations. The high tunnel frame must be constructed of metal, wood, or durable plastic; and be at least 6 feet in height at the peak of the structure. If required for enclosure, end wall covering may be of greenhouse grade plastic, polycarbonate, wood, or other recommended material. Structures shall be designed and sized to accommodate entry/exit points to facilitate movement of equipment and supplies needed for the production of planned crops.

These structures shall be constructed on level grade or naturally occurring slopes, of five percent or less.

Select the high tunnel covering material of a significant thickness to withstand the temperature change from the period required and shall have a 4-year minimum lifespan. For polyethylene covers, use a minimum 6-mil greenhouse grade, UV resistant material.

OPERATIONS AND MAINTENANCE

Structures shall be designed and sized to accommodate entry/exit points to facilitate movement of equipment and supplies needed for the production of planned crops.

Periodically inspect the high tunnel and repair, reinstall, or replace materials as needed to accomplish the intended purpose. Manage the structure in a manner that limits wind and/or snow damage. Close sides and ends before storm events.

In areas that receive snow and ice, the structure shall be closed prior to winter weather.

Remove snow and ice from the strucure cover and sides promptly to precent structure failure.

Seed all disturbed earth surfaces outside of the high tunnel and maintain the vegetation throughout the structure's life.

PLANS AND SPECIFICATIONS

As a minimum, the plans and specifications shall include the following:

- Identify the purose.
- Document the planned growing season.
- Layout and location of the high tunnel.
- Site preparations and the required supporting practices for erosion control, runoff, and vegetative cover according to the requirements of the corresponding conservation practice standard.
- The planned width and length of the seasonal high tunnel.
- Statement that the seasonal high tunnel was installed per the manufacturer's recommendations.
- List of all material used and material specifications.
- Procedure and timing to remove or roll up te high tunnel cover prior to inclement weather conditions.
- Procedure and timing to add or replace shade cloth for protection from the sun for the high tunnel cover.

Client Name: _____

Planner Name: _____

Practice Purpose: Improve plant health and vigor

PLANNED PRACTICE LOCATION AND EXTENT

Contract Identification Number (CIN)	Tract Number	Field Number	Growing Season	Units Planned	Size Installed (Length x Width)	Units Applied (NRCS USE ONLY)

☐ Location map and siting criteria are defined in the case file.

REQUIRED DOCUMENTATION AND VERIFICATION

☐ Practice applied is field verified by: _____ on: _____ (date)

Before payment is made, the following information is required to be in the case file:

☐ Photographs of constructed seasonal high tunnel that must include:

- Statement "Photo was taken in the field by (enter name)"
- Date photo was taken in the field
- Statement of what the photo represents if it needs clarification

☐ The seasonal high tunnel was installed per the manufacture's recommendations and all materials used and material specifications are documented.

☐ Field verification is documented and a certified planner verified "as installed" this practice meets NRCS standards and specifications.

Practice Certification (NRCS USE ONLY)

I certify this practice (Seasonal High Tunnel) as installed is complete and meets the applicable Wisconsin NRCS Conservation Practice Standard and all applicable practice specifications. Any changes to the original practice design have been approved and are red lined and documented on the original practice design "as installed."

Certified Planner (print) (sign) Date