



Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
FOREST STAND IMPROVEMENT
Code 666
(Ac.)

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 (WI NRCS CPS), Alley Cropping (311), Multi-story Cropping (379), Windbreak/Shelterbelt Establishment (380) operation and maintenance, or Windbreak/Shelterbelt Renovation (650).

IV. CRITERIA

A. General Criteria

1. 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).
2. Separate stands with different cover types or timber types into separate management units (stands) and plan them individually.

3. 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).
4. 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
5. Plan post-treatment basal appropriately for community/cover type. See WI NRCS CPS, Forest Stand Improvement (666) Job Sheet for more information.
6. 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
7. If needed, supplement mechanical cutting, girdling, or frilling with an application of herbicide to increase mortality and decrease stump sprouting.
8. Time tree cutting to avoid a buildup of insect or disease populations.
9. 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*).
10. 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.
11. 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
12. Refer to WI NRCS CPS, Forest Trails and Landings (655) for more information about trail establishment and maintenance.
13. 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.
14. Protect all forestland from livestock grazing.
15. Retain a minimum of 2 large (>12" DBH) active den trees per acre, if possible.
16. Retain or create a minimum of 2 large (>12" DBH) snags per acre, if possible.

17. 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.
18. 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)

1. 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.
2. 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.
3. 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.
4. See WI CPS, Forest Stand Improvement (666) Job Sheet for more information.

C. Additional Criteria to Develop Renewable Energy Systems

1. 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

1. 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

1. 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.
2. 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

1. Reduce stocking rates of trees to minimize crown-to- crown spread of fire.
2. Remove "ladder" fuels to minimize the risk of crown fires.
3. Further treat or eliminate slash accumulations next to roads and trails.
4. Reduce or eliminate species with high volatility.
5. For additional wildfire risk and damage reduction, refer WI CPS, Firebreak (394).

G. Additional Criteria to Improve Wildlife Habitat

1. Manage for a variety of native tree species and stocking rates that meet desired wildlife and pollinator species' food and cover requirements.
2. 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.
3. Create and/or maintain adequate down woody material to meet requirements of desired wildlife.

4. Minimize improvement actions that disturb seasonal wildlife activities.
5. 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.

V. CONSIDERATIONS

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.

Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

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.

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.

The practice should be timed to minimize disturbance of seasonal wildlife activities.

Timing of treatment and retention of dead or dying trees will minimize impacts on nesting wildlife.

Consider wildlife food and cover needs.

In areas where heavy brush or weeds may cause severe competition for moisture and nutrients, it may be necessary to reduce competing vegetation by:

Mechanical release of target residual trees.

Chemical or mechanical treatment to release tree seedlings from heavy brush.

Consider environmental effects of harvest on threatened and endangered species and natural areas where present.

VI. PLANS AND SPECIFICATIONS

1. Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.
2. 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

VII. 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.

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 forest stand improvement. 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.

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's Forestry Best Management Practices for Water Quality. <http://dnr.wi.gov/>

Wisconsin Department of Natural Resources. 2009. Herbicides for Forest Management. Madison, WI. <http://dnr.wi.gov/topic/foresthealth/herbicides.html>