

A wide-angle photograph of a lush meadow. The foreground and middle ground are filled with tall, vibrant green grasses, interspersed with small white and yellow wildflowers. The meadow extends to a flat horizon line under a sky filled with large, dramatic, grey and white clouds. The overall scene is bright and natural.

**Restoring Your Woody-
Invaded Meadow to
Utility Meadow**

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Cover photo taken at Pankratz Prairie by Justin Meissen.



Restoring Your Woody-Invaded Meadow to “Utility Meadow”

In this guide, you will learn the basic steps to restore a degraded meadow invaded by woody species to a utility meadow. The precise restoration actions will depend on the particular features of your site as well as your budget, preferences and project goals.

When planning your restoration, we recommend you consult with restoration professionals to evaluate your site’s unique characteristics. Please visit nature.org/MNPrairieRestorationGuides for more information on who to contact or other publications that cover site assessment protocols.

What is utility meadow?

Utility meadow is a wet grassland designed to maximize production and palatability for forage, while still supporting basic conservation goals. It occurs on poorly-drained, wet to moderately wet soils that are saturated up to 8 weeks following snowmelt and are prone to temporary ponding after large rainfall events. Utility meadow often occurs in a transition zone between emergent marsh and upland prairie and may be either sedge-dominated (“sedge meadow”) or grass-dominated (“wet prairie”) depending on the duration of soil saturation. Utility meadow is distinguished from conventional hay fields and pasture by its emphasis on native species and greater diversity.

Compatible land uses include:

- Conservation grazing using cattle or bison¹
- Hay production
- Commercial seed harvest
- Recreational activities such as hunting

Conservation benefits include improved water quality, flood control, and habitat for birds, animals and insects. Utility meadow can also serve as a buffer for other high-quality native meadows and prairies and support threatened and endangered plants and animals that depend on large contiguous areas of grassland.

Why restore woody-invaded meadows?

Meadows that are not burned, grazed or mowed are often invaded by woody trees and shrubs. In wet meadow prairies, shrub and tree cover is tied to fire frequency. Fire suppression can lead to increased cover of native shrubs, such as sandbar willow, and invasion by native trees, such as quaking aspen and balsam poplar. Over time, the wet grassland may transition to wet brush prairie or even woodlands. Returning fire to wet meadows and controlling trees and shrub invasion is important to protect and maintain wet meadow systems.

For the purposes of this guide, we define a woody-invaded meadow as having a canopy cover of more than 10% trees and shrub thickets, and an understory dominated by native species (>75% cover), although this native understory may be sparse as a result of shading by trees and shrubs². Meadows are also often invaded by herbaceous (non-woody) perennial weeds, such as reed canary grass. This guide assumes that woody invasion is the greater threat on a site, but if other invasive species are abundant (greater than 25% cover) they will also require control measures.³

¹ Very wet sites are vulnerable to damage by trampling and are dominated by sedges, which are not preferred forage for cattle. Moderately wet sites, which are dominated by grasses and have a shorter duration of seasonal ponding, will generally be more suitable for grazing.

² Woody-invaded prairies and meadows are not the same as oak savannas. Oak savannas occur on mesic to dry soils, have a mature oak canopy and a prairie/savanna understory, and are a rare and highly-valued landscape.

³ Refer to restoration guide “Restoring your Degraded Grassland to Utility Meadow” for more information on selective control of invasive perennial weeds.

Woody seedlings and saplings may be controlled by herbicide applications and fire, in a manner similar to invasive perennial weeds, but larger trees and dense shrub thickets require mechanical removal. The bare or sparsely-vegetated patches left behind after woody species removal are vulnerable to invasion by exotic species. Reintroducing prescribed burns will help promote greater biomass production and cover of meadow species. Interseeding may also prevent the encroachment of invasive plants by more quickly filling in the gaps left behind by tree removal.

Additionally, if the site has been drained with drainage tiles or ditches, restoring hydrology by breaking tiles, plugging ditches, and—in some cases—installing water control devices, will be required. This guide assumes that your site is wet to moderately wet and has been drained via tiles or ditches⁴. Sites that have not been drained will not require the additional steps to restore the hydrology.

What will it involve?

Meadow restoration typically includes these basic steps:

- **Site Assessment**— Identify the site characteristics and define goals for the restoration.
- **Vegetation Removal** – Remove existing weeds and undesired vegetation from the site to prevent aggressive weedy species from out-competing native meadow plants.
- **Seedbed Preparation** – Prepare a seedbed to ensure good seed-soil contact and promote germination of planted seeds.
- **Seeding/Planting** – Select seed mixes and seeding methods that are well suited to the site and project goals. Or, in the case of small sites of less than half an acre,

consider hand-planting plugs for quicker results⁵.

- **Hydrologic Restoration** – Remove drainage features by breaking tile or plugging ditches to restore the site’s original soil moisture and seasonal flooding patterns.
- **Establishment & Aftercare** – Control weeds and promote the establishment and growth of meadow plants through the first few years after seeding.
- **Long-term Management** – Maintain the health and diversity of native meadow into the future.

How long will it take?

Removal of invasive woody species can be accomplished within a single growing season, depending on the extent of the invasion and resources available. Removal should precede interseeding with native species. The more you invest in up front weed control, the less time and effort you will need to spend controlling weeds in the long term. After the year it’s seeded, expect to spend at least three years on aftercare to ensure good establishment of the utility meadow. This period is referred to as the establishment phase of restoration.

After establishment, often around year 4, the long-term management phase begins. Management actions are typically less frequent and intensive than during the establishment phase, but are critical for maintaining the health and diversity of the meadow into the future.



Cattle on a utility meadow ©TNC\Steve Chaplin

⁴ For sites with moderate to dry soil moisture, refer to the restoration guide “Restoring your Woody-Invaded Grassland to Utility Prairie”.

⁵ Plugs are young plants sold in 4- or 6-packs. Plugs cost substantially more than seed, but they establish rapidly and can produce a resilient and visually appealing meadow more quickly than seeding, so it is often a preferred option for smaller sites.

What will it cost?

The cost of the restoration will be influenced by:

- Management level required to control weeds
- Species and number of species selected for the seed mix
- Cost of seed, which fluctuates from year to year
- Hydrologic factors, such as drainage type, size and depth; soil type and sediment deposits; and whether management of wetland discharge is required
- Labor and equipment available for the project

The cost estimate in this document will give you a baseline for what you can expect to spend through the initial establishment phase of your restoration (i.e. through three years after seeding). It may be tempting to cut costs by reducing the number of species planted or the frequency of weed control activities. Be aware that these investments on the front end can actually save costs in the long run. A healthy and diverse meadow will be more resilient to disturbance, invasion by exotic species, and extreme weather events such as drought.



Willow and dogwood invaded meadow near Lake Johanna Eskers Preserve
©TNC\ Steve Chaplin

Woody-invaded Meadow to Utility Meadow Restoration Guidelines

Site assessment

A successful meadow restoration is highly dependent on specific characteristics of a site. Important considerations when planning a restoration include:

- Has the site had herbicide treatments that would prohibit seed from germinating?
- Is there a risk of herbicide drift from neighboring croplands?
- Are the soils dry, moderate or wet?
- How long are the soils saturated in the spring?
- Has the site been drained with drainage tiles or ditches?
- Is there a substantial buildup of sediments on site that may require excavation?
- Are there steep slopes that may be vulnerable to erosion?
- What types of vegetation are currently present on the site?

If you are new to meadow restoration, we strongly encourage enlisting someone who has restoration experience to help you assess the characteristics of the site and develop a restoration plan suited to your site's specific features and your project goals.

Woody-invaded meadows typically require a combination of mechanical removal, selective herbicide treatments, and prescribed fire to control invasive trees and shrubs and prepare the site for interseeding native meadow species. Tree seedlings and smaller saplings (diameter < ½ in.) can often be managed with controlled burns, but larger trees require mechanical removal. Chemical stump treatment is also usually needed to prevent re-sprouting.

In most cases, tree and shrub removal can be carried out in a single season prior to interseeding utility meadow. Equipment options include brush hogs, slashers, brush cutters and chain saws. The most efficient and effective methods of tree and shrub removal will depend on the species, size, density and spatial pattern of the targeted species, as well as the soil moisture conditions (saturated soils will not support heavy machinery). Degraded meadows that are invaded by trees and shrubs will often also have some invasive perennial weeds, such as reed canary grass. If reed canary grass is present, carefully-timed selective herbicide treatments will be required⁶.

Recommended protocol:

- Cut dense brush thickets that are unlikely to be controlled by fire alone using brush cutters or similar equipment.
- Cut trees more than 1 inch in diameter with chainsaws or slashers.
- Treat stumps with appropriate herbicide, e.g. Triclopyr (Garlon 4), Picloram (Tordon), and glyphosate (Roundup).
 - Note: if standing water is present, an aquatic-approved herbicide (e.g. Rodeo) must be used
- Haul and pile woody slash using tractor-mounted skid steers or grapple attachments.
- If woody invasion is more extensive, slash should be piled and burned, or chipped in a woodchipper and removed.
 - If woody cover is relatively low (<10%), slash may be distributed and left to rot or burn during a prescribed fire.
- Burn site or mow/hay vegetation to a 4 inch height to kill woody seedlings and remove thatch prior to seeding.

⁶ Refer to restoration guide "Restoring your Degraded Grassland to Utility Meadow" for more information on selective control of invasive perennial weeds.

- Invading stands of clonal species, such as aspen, may be controlled more gradually by girdling.
- Cropping and disking are not recommended for woody-invaded meadows.



Using a carbide cutter in winter to remove woody vegetation ©TNC\Jared Culbertson

Seedbed preparations

Minimal seedbed preparation is recommended when interseeding into existing vegetation. This helps avoid disturbing the native species on site and bringing additional weed seeds and rhizomes to the soil surface. If invasive species are minimal and the site is dominated by a few highly competitive native species, selective disking or tilling (for example, in patches or strips covering 25-50% of the site) is sometimes used to reduce competition from existing natives and create openings for seedling establishment. However, if a diversity of native species is present, we recommend avoiding soil disturbance and instead broadcasting seed into newly burned ground after a fall burn. Native remnants (unplowed meadow) should never be disked or tilled. Avoid soil disturbance on these sites.

Recommended protocol:

- Forgo site preparation to minimize soil disturbance and subsequent reinvasion. Frost-seeding, snow seeding or ash seeding may help incorporate seeds into soil.
- Burn prior to seeding to remove thatch (see vegetation removal).

Seeding

The key to establishing a successful meadow is to maximize seed-to-soil contact during planting. Broadcast seeding with a spreader mounted to a tractor or ATV is recommended for interseeding meadows, because wet soils often cannot support heavy machinery such as seed drills, and many wet meadow species have very small, light-sensitive seeds that can be buried too deeply by a seed drill. Broadcasting also allows access into difficult site conditions, such as rocky or uneven soils, while drilling into an untilled site can disturb the soil conditions and be hard on the drill. However, if the seedbed is dry and firm, grasses may be seeded with a no-till drill, followed by broadcasting forbs (flowering plants) and sedges. The use of no-till drills on remnant meadows should be limited to large, low-diversity sites with few remaining native species.

If broadcasting seed, native-seed broadcasters such as a Vicon seeder should be used. They are designed to spread mixes with different sized seeds. If planting with a drill, use a seed drill designed specifically to plant prairie grasses and flowers. In some cases, the wettest areas may need to be hand-seeded.

If the site is remnant (unplowed) prairie, seeding should be undertaken with caution to avoid negatively impacting remnant vegetation, soil communities and wildlife. Seed mixes should exclude aggressive species that may outcompete existing vegetation, and species already present on site should not be planted unless the seed is harvested on site. Whenever possible, locally-harvested seed should be used, and species selection should be based on historical records and/or reference sites.

Recommended protocol:

- How to seed:
 - Broadcast seeds into existing vegetation using an agitating spreader such as a Vicon seeder mounted to a tractor or ATV, following a fall burn or mow to remove thatch. Or plant by hand if selectively seeding small patches.
 - Incorporate the seeds into the soil with a light drag, such as a piece of chain link



Native seed mixes should be planted with equipment designed to handle different-sized seeds ©Justin Meissen

fence or packer pulled behind the tractor/ATV while broadcasting.

- Note: If frost or snow seeding (late fall through early spring) or ash seeding (sowing into ash immediately following a burn), mechanical incorporation may not be needed. Freeze-thaw, snowmelt and rainfall action may naturally incorporate seeds into the soil.
- Alternative seeding method: If seedbed is dry and firm, drill grass seeds directly into crop residue, or prepared seedbed, using a no-till drill such as a Truax. Additional mechanical incorporation or packing is not required when using a no-till drill. Broadcast forb and sedge seed.
- For areas that are too wet for a tractor or ATV, a second alternative seeding method is to broadcast seed by hand.
- When to seed:
 - Planting dates will vary depending on the weather and location within the state. Consult with native seed suppliers or restoration specialists to determine the best planting dates for the year.
 - Dormant seeding is recommended for meadows, because the ground is more likely to be dry and firm in the late fall and early winter⁷. Dormant seeding should occur Dec. 1 to April 1 OR after

soil temperatures fall below 50 degrees F for a consistent period of time. Dormant seeding before the ground is frozen, sometimes called “frost seeding”, can be done with a seed drill or by broadcasting. When possible, timing the seeding before a snowfall may help prevent seed loss to birds and wildlife. After the ground is frozen in winter/early spring, seed can also be broadcast over snow, although results of snow seeding are more variable and dependent on weather conditions. Dormant seeding promotes cool season grasses, sedges and flowering plants.

Spring and growing season plantings (April 1 – July 1) are not typically recommended for wet meadows because the soils are often too saturated to support equipment, spring flooding may wash seeds away, and overwintering is necessary to trigger germination in many wetland sedges and flowering plants. However, when conditions allow, growing season seeding can yield satisfactory results, particularly for wetland grasses⁸.

- Seed mixes will vary but should take into account:
 - Consider soil moisture conditions of the site.

⁷ Early fall seeding is not recommended for meadows, because seed may germinate too early and not survive over winter.

⁸ Summer seeding after July 1 leads to poor seedling survival and is not recommended for wet meadows.

- Choose palatable species that can tolerate grazing or haying.
- Select a mix of both warm- and cool-season species to ensure availability of forage throughout the season⁹.
- Cover/nurse crops are not recommended for interseeding.
- Design:
 - Apply seed mixes to “seeding zones” on site based on soil moisture conditions and hydrology; for example: seed a wet prairie mix into areas that are saturated 3-4 weeks annually, and a sedge meadow mix into areas that are saturated 6-8 weeks annually.
 - If there are dry to moderately moist soils on the site, select a separate utility prairie seed mix for these seeding zones¹⁰.
- Seed rate:
 - Plant at a minimum of 160 seeds/sq. foot to reduce risk of weed invasion.
 - Seeding rates may need to be increased by 25% for dormant seedings to account for lower germination rates and loss of seed to wildlife.

Soil and Water Conservation District staff (www.maswcd.org).

Recommended protocol:

- Use a backhoe to break drainage tiles and/or plug drainage ditches.
- Break tile in strategic locations, for example: at the wetland’s outlet (it is usually not necessary to remove the entire length of tile).
- Hydrologic restoration should be implemented after vegetation removal. After the site is flooded, access will be limited and herbicide options are restricted to aquatic-approved formulas such as Rodeo.
- Time hydrologic restoration to occur in the fall or early winter in close conjunction with seeding, preferably 1-2 weeks following seeding (after flooding, site access will be limited).
- Reserve a small amount of seed to hand-broadcast over areas disturbed by backhoe operations.
- If transplanting live plant material or plugs, this can be done in the late spring following hydrologic restoration.

Hydrologic restoration

Nearly all wet meadow sites in western Minnesota have been impacted by altered hydrology. Restoring hydrology by removing drainage features is a critical component of wet meadow restoration. When planning a meadow restoration, take note of the following recommendations and refer to the [Minnesota Wetland Restoration Guide \(BWSR\)](#) or [Restoring Prairie Wetlands: an ecological approach](#) (Galatowitsch and van der Valk 1994) for additional information. For further guidance on evaluating and implementing the engineering aspects of hydrologic restoration, consult with experienced restoration professionals or local



Using a backhoe to break drainage tile
©DNR/Shawn Fritcher

⁹ See nature.org/MNPrairieRestorationGuides for more information on seed mix design and examples of utility meadow seed mixes.

¹⁰ See nature.org/MNPrairieRestorationGuides for examples of utility prairie seed mixes appropriate for dry to moderately moist soils.



Prescribed fire is an important tool in maintaining a utility meadow ©Chris Helzer/TNC

Post-seeding aftercare and long-term management

Interseeded utility meadow establishment generally takes 3 to 5 years. However, this will vary depending on soil moisture and climate conditions. Early management (aftercare) is critical to prevent re-invading woody species and invasive weeds like reed canary grass from out-competing and displacing establishing native meadow species.

Maintaining control of reinvading trees and shrubs and other weeds is the primary management concern in interseeded prairie restorations. However, when necessary, existing prairie vegetation should also be carefully managed to promote rapid establishment of planted natives. However, saturated conditions may limit management options, preventing access by heavy equipment.

Post-seeding aftercare goals include discouraging weeds and woody species and encouraging rapid and robust establishment of native species that can sustain grazing, haying and other uses. Management strategies during the establishment phase include:

- Selective mowing or haying to reduce competition
- Selective mechanical or chemical control of resprouting woody species
- Selective use of appropriately-timed aquatic-approved herbicide to control reed canary grass and other invasive perennials
- Prescribed fire to promote native meadow species and discourage further invasion, particularly in wet prairie zones

- Monitoring vegetation to evaluate establishment of meadow seedlings and detect invasive species problems. This is particularly important in wet sites, because site conditions may prevent management in some years.

Throughout the establishment phase and beyond, adjust management plans as necessary, including the option to reseed, to achieve the desired species composition and diversity.

Recommended management protocol:

Year 1:

- If necessary, spot-mow to reduce native competition when site is dry and firm, typically early to mid-summer. Selectively mow to a height of 4-6 inches to reduce competition from established natives and minimize thatch build-up. Most newly planted prairie plants will not reach this height in first year and will not be damaged by a mower.
 - If reed canary grass is present, avoid mowing reed canary grass except to prevent going to seed. Mowing may reduce effectiveness of herbicide and stimulate seed germination.
 - Note: if mowing is not possible, establishment of planted seedlings may be slower.
- If resprouting woody trees and brush are too dense to control via mowing, spot-control with brush cutters or cut-stump treatments.
- Scout for invading reed canary grass. If detected, spot-treat with aquatic-approved glyphosate such as Rodeo in September using methods that will minimize damage to

native seedlings. For example, use a backpack sprayer or wick applicator, and avoid windy days to minimize herbicide drift.

Year 2:

- Spot-control resprouting woody species as necessary.
- Scout for invading reed canary grass. If detected, spot-treat with aquatic-approved glyphosate in September using methods that will minimize damage to native meadow species.

Year 3:

- Begin prescribed burns after three growing seasons, or as soon as biomass accumulation is sufficient to carry a burn.
- Begin grazing or haying after three growing seasons, or when native grasses and sedges have achieved dominance.
- Spot-treat reed canary grass (in September) and other weeds as necessary with aquatic-approved herbicide.
- Conduct a stand evaluation to assess seedling establishment outcomes. If native plant density is less than 1 plant per square foot, interseed to increase cover and diversity.
 - Note: if mowing was not done in year 1, establishment rates may be slower. After stand evaluation, postpone burning, haying and grazing until year 5 if necessary.

Year 4 & beyond (long-term management phase):

- Burn every 4-7 years to stimulate productivity of native meadow plants (particularly in the wet prairie zone) and prevent invasion of perennial weeds and woody trees and shrubs.
 - Note: burning more frequently may negatively impact sedges.
- Burn and hay in rotations, disturbing no more than one half of a field at a given time, to maintain diversity and a local refuge for wildlife.

- Graze at low to moderate intensities, or at stocking rates prescribed by a grazing management plan written to meet the objectives of the utility prairie. Avoid grazing in saturated conditions.
- Time burning, haying and grazing to allow sufficient biomass accumulation for each activity, for example: an alternating biennial rotation of grazing and haying with a 4-7 year burn rotation.
- Hay in late July or August to promote diversity and avoid grassland bird nesting season. Leave 6-8 inch stubble and regrowth for winter cover/spring nesting habitat.
- Adjust timing and intensity of burning, grazing and haying to maximize diversity and adjust species composition.
 - Grazing in late spring or early summer will favor warm season grasses.
 - Mid-late summer grazing will favor cool season grasses.
- Every 1 to 3 years, monitor vegetation composition and diversity.
 - Interseed as needed to increase native cover and diversity if native species are declining.
 - Adjust management plan, such as frequency and intensity of burning, haying, or grazing, if:
 - cover of native species is declining
 - desired composition is not being maintained
 - cover of invasive species is increasing
 - Spot-treat reed canary grass and other weeds as needed by hand-pulling, backpack sprayer, wick-applicator or dormant-season application. Note that reed canary grass may continue to emerge from the seed bank for 10 years!
 - Temporarily increase burn frequency if woody invasions increase in cover. Note that sustained burn intervals of less than 3 years will negatively impact cool-season natives and wildlife.



Restored utility meadow at Glacial Ridge ©
John Gregor/Coldsnap Photography

Cost estimate

The estimated cost to restore an invasive perennial-dominated grassland to utility meadow in Minnesota is \$1,568 per acre plus a \$700 flat rate, for a minimum total of \$2,268, based on 2013 prices. Costs associated with site assessment and project planning are excluded from this estimate.

This cost estimate assumes vegetation removal includes cutting trees and shrubs, piling and burning the slash, and burning the site one time. This cost estimate also assumes the site is broadcast seeded and cultipacked. The \$700 flat rate is a low-end estimate of hydrologic restoration (e.g. tile removal) that assumes a modest mobilization fee and includes the costs to excavate, remove tile, seal the ends, and backfill and compact the trench.

Post-seeding management costs include aftercare activities through year 3, specifically: selectively mowing four times, spot-spraying re-invading woody resprouts and/or perennial weeds one time, and conducting two prescribed burns (burning no more than one half of the site per season). Long-term management costs are not included in this cost estimate but can be quite variable depending on site needs. Costs assume services and seed are purchased from restoration contractors and native seed nurseries.

Useful references

Going Native: A prairie restoration handbook for MN Landowners – MN Dept. of Natural Resources
<http://files.dnr.state.mn.us/assistance/backyard/prairierestoration/goingnative.pdf>

Guidelines for inter-seeding to restore or enhance native species diversity – Minnesota Board of Water and Soil Resources
www.bwsr.state.mn.us/native_vegetation/inter-seeding.pdf

Invasive Plant Species Management & Identification – MN Dept. of Natural Resources
www.dnr.state.mn.us/invasives/terrestrialplants

Minnesota Noxious Weeds – MN Dept. of Transportation
www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf

Minnesota Wetland Restoration Guide – MN Board of Water & Soil Resources
www.bwsr.state.mn.us/restoration

Native Vegetation / Seed Mixes – MN Board of Water & Soil Resources
www.bwsr.state.mn.us/native_vegetation

Planting and Maintenance Recommendations for Wetland Restoration and Buffer Projects – MN Board of Water and Soil Resources.
www.bwsr.state.mn.us/native_vegetation/planting-maintenance-recs.pdf

Prairie Management: Woody Species Control [Video] – Tallgrass Prairie Center
www.youtube.com/watch?v=Tk_46D46Dg

Prairie Seedling and Seeding Evaluation. Bockenstedt, P. 2006. Bonestroo Rosene Anderlik & Associates.

Restoring Prairie Wetlands: An Ecological Approach. Galatowitsch, S. M. and A. G. van der Valk. 1994. Iowa State University Press.

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The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands. S. Packard and C. F. Mutel, editors. 2007. Island Press, Washington, D.C.

