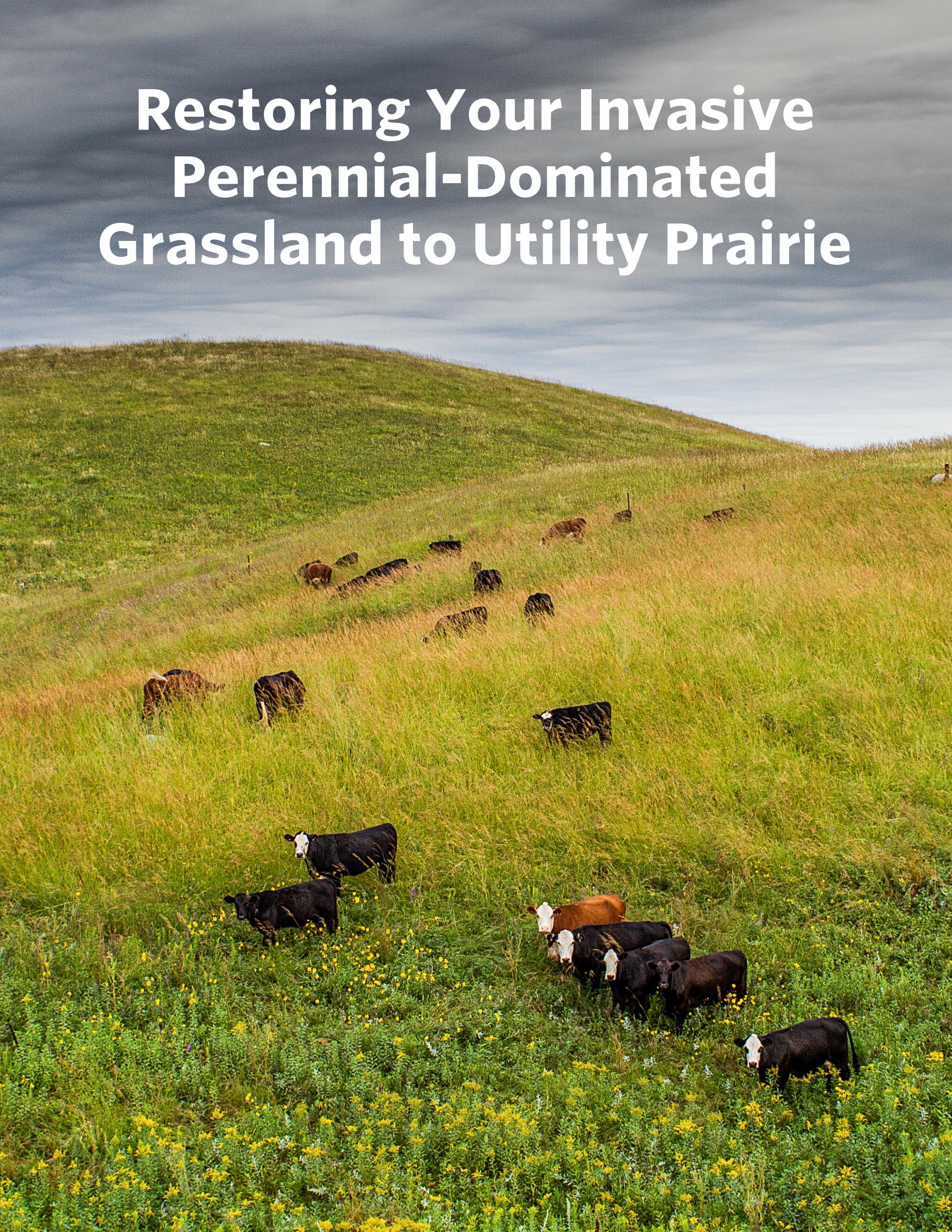
Restoring Your Invasive Perennial-Dominated Grassland to Utility Prairie



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Funding for the development of this restoration guide was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR) through grant LCCMR092C. The Trust Fund is a permanent fund constitutionally established by the citizens of Minnesota to assist in the protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources. Currently 40% of net Minnesota State Lottery proceeds are dedicated to building the Trust Fund and ensuring future benefits for Minnesota's environment and natural resources.

Additional funding for the update and redesign of the guide was provided by a Working Lands Initiative grant from the Minnesota Department of Natural Resources.

Cover photo taken at Sheepberry Fen Preserve by Alison Mickelson, Greater Good Photography.

Invasive Perennial-Dominated Grassland to "Utility Prairie"

In this guide, you will learn the basic steps to restore a grassland dominated by invasive perennial weeds to a utility prairie. 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 that 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 prairie?

Utility prairie is designed to maximize production and palatability for forage, while still supporting basic conservation goals. It 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 bison
- Hay production
- Commercial seed harvest
- Recreational activities such as hunting

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

Why restore invasive perennial-dominated grasslands?

Restoring invasive perennial-dominated grasslands to utility prairie increases the diversity of species on the site and provides valuable habitat for prairie wildlife and pollinators. Additionally, the species mix includes both "cool-season" and "warm-season" grasses, which ensures forage availability through spring, summer and fall.

Invasive perennial-dominated grasslands have substantial coverage (>75%) of exotic invasive perennials, such as smooth brome, reed canary grass, and birdsfoot trefoil. Often used as pasture or hay fields, these sites are dominated by aggressive species that persist for many years and can quickly outcompete and suppress planted natives.

Invasive perennial-dominated grasslands are one of the most challenging starting conditions for restoration, because they require substantial investment of time before and after seeding prairie species. Restoring these sites may require multiple seasons of vegetation control prior to seeding, and attentive management through the seedling establishment phase and beyond. When possible, cropping these fields is an increasingly popular and more affordable option for

Cattle on utility prairie near Glacial Lakes State Park
©TNC\Steve Chaplin

achieving the level of weed control required for successful restoration.

This guide assumes that your site has moderate to dry soil moisture and has not been drained. Wet sites in particular are often dominated by reed canary grass, which can be particularly difficult to control—it often requires multiple years of repeated treatments. Relatively wet fields that have been drained via drainage tiles or ditches are better suited for restoring to wet meadow. This may require additional steps to restore the hydrology[1]. If invasive trees and shrubs are present on site, additional removal strategies may be required[2].

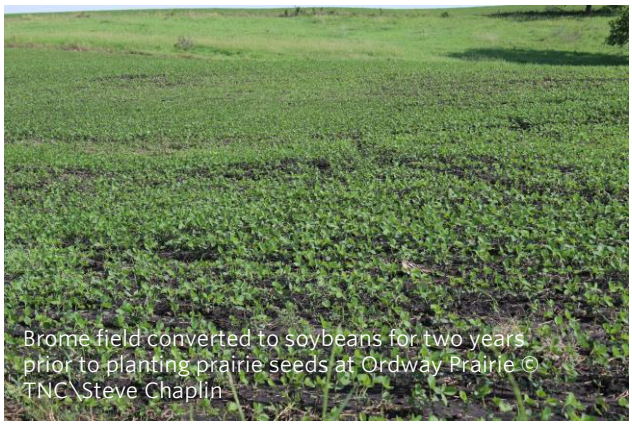
What will it involve?

Prairie 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 prairie 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. In the case of small sites of less than half an acre, consider hand-planting plugs for quicker results[3].
- **Establishment & Aftercare** – Control weeds and promote the establishment and growth of prairie plants through the first few years after seeding.
- **Long-term Management** – Maintain the health and diversity of the prairie into the future.

How long will it take?

Restoring grassland dominated by invasive perennial weeds requires at least one full growing season of vegetation removal prior to seeding. The more you invest in weed control up front, 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 prairie. This period is referred to as the establishment phase of restoration.



Brome field converted to soybeans for two years prior to planting prairie seeds at Ordway Prairie © TNC\Steve Chaplin

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 prairie into the future.

[1] Refer to the restoration guide "Restoring your Crop Field to Utility Wet Meadow" for more information on hydrologic restoration.

[2] Refer to the restoration guide "Restoring your Woody-Invaded Prairie to Utility Prairie" for more information on removing and controlling invasive trees and shrubs.

[3] 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 prairie 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
- 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 prairie will be more resilient to disturbance, invasion by exotic species, and extreme weather events such as drought.

Smooth brome dominated pasture near Bluestem Prairie ©TNC/Steve Chaplin

Invasive Perennial-Dominated Grassland to Utility Prairie Restoration Guidelines

Site assessment

A successful prairie 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 cropfields?
- Are the soils dry, moderate or wet?
- 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 prairie 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.

Vegetation removal

Invasive perennials, such as reed canary grass, birdsfoot trefoil, and smooth brome, can out-compete native prairie species. Thorough and repeated control is critical prior to planting in order to minimize re-invasion, particularly because post-seeding control methods are costly and can harm planted prairie species. At least one full growing season of invasion control is recommended prior to seeding utility prairie.

Invasive perennial weeds are typically controlled with repeated herbicide applications combined with mowing, haying or burning to remove thatch. The required frequency of herbicide applications will depend on the vigor and persistence of the invasive species. For example, a weak stand of smooth brome may be controlled with a single herbicide application. In most cases, however, a minimum of two herbicide applications is needed.

The significant control effort and costs required to produce a successful restoration outcome may be unfeasible for some heavily invaded sites. Consider cropping these fields for 2-3 years prior to initiating restoration to exhaust the seed/rhizome bank.

Recommended protocol:

- Mow or hay vegetation to a 4-inch height, or burn site, in spring or early summer.
- When weed regrowth reaches 4-6 inches (usually 2-4 weeks), apply appropriate herbicide, such as glyphosate (broadcast application, i.e. with tractor-mounted boom sprayer).
    - See Smith 2010 (Chapter 4) and Packard and Mutel 2007 (Chapter 16) for lists of recommended herbicides.
- Repeat herbicide applications (broadcast or spot-treatment) to regrowth monthly or as needed throughout the summer and into early fall.
- Wait at least 2 weeks following last herbicide application to seed.
- If invasive woody species are present, saplings less than ½ inch in diameter can be herbicide- treated along with invasive

perennials, but larger trees will require mechanical removal[4].

- If reed canary grass is present, apply glyphosate in September for maximum effect.[5]
- An alternative option to the above sequence is to crop field for 1-4 years to deplete invasive perennial seed bank, ending on a rotation of Roundup Ready soybeans[6]
- A second alternative option is to start with spring mowing/burn and herbicide application. Then disk the site repeatedly, every 3-4 weeks, throughout the growing season to maximize control of invasive perennial rhizomes. Follow with additional herbicide applications as needed.
    - This risks bringing additional invasive seeds and rhizomes to the soil surface and should be done in conjunction with multiple herbicide treatments to control regrowth.
    - Not recommended for highly erodible sites.

Seedbed preparations

The best method of seedbed preparation in an invasive perennial-dominated site is influenced by the site conditions, the amount of resources available for continued vegetation management, and the intended seeding method.

If the soil surface is uneven or severely compacted, harrowing or disking may be required to prepare the site. This often results in a flush of new invasive perennial growth, as seeds and rhizomes are brought to the soil surface. If soil cultivation is required, invasive perennial regrowth should be treated with repeated herbicide applications prior to seeding.

Alternatively, several rounds of deep tillage may be used intentionally to break up rhizomes and bring them to the surface for winter kill. However, most practitioners prefer to avoid soil disturbance to prevent bringing seeds and rhizomes to the soil surface and minimize both reinvasion and the need for continued intensive management.

For this utility prairie restoration guide, no-till drills are the recommended seeding method.

Recommended protocol:

- No site preparation is needed if seeding with no-till drill, unless:
    - If soil surface is uneven with numerous soil clods, lightly harrow to create a smoother surface for drilling. Treat invasive regrowth with repeated herbicide applications prior to native seedling establishment.
    - If soils are severely compacted, multiple rounds of tilling and disking to a 4-inch depth may be used to loosen soil and break up invasive rhizomes. Finish soils by harrowing with a drag harrow or chain link fence. Treat invasive regrowth with repeated herbicide applications prior to native seed germination.

Disking a seedbed ©DNR\Carmelita Nelson

[4] Refer to the restoration guide "Restoring your Woody-invaded Prairie to Utility Prairie" for more information on controlling invasive trees and shrubs.

[5] Refer to the restoration guide "Restoring your Invasive Perennial-Dominated Grassland to Utility Meadow for more detailed information on controlling reed canary grass.

[6] Refer to the restoration guide "Restoring your Crop to Utility Prairie" for more information on restoration from a crop field.

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

Seeding

The key to establishing a successful prairie is to maximize seed-to-soil contact during planting. If planting with a drill, use a seed drill designed specifically to plant prairie grasses and flowers. If broadcasting seed, native-seed broadcasters such as a Vicon seeder should be used. They are designed to spread mixes with different sized seeds.

Recommended protocol:

- How to seed:
  - Drill seeds directly into crop residue, or prepared seedbed, using a no-till drill such as a Truax.
  - Alternative seeding method: broadcast seeds, then cultipack or roll the site, if possible, to incorporate seeds into soil.
- 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.
  - Growing season plantings should occur May 1 to July 1 OR when the soil temperature is at least 60 degrees F[7]. Spring/early summer seeding promotes warm season grasses.
  - Dormant seeding should occur Dec. 1 to April 30 OR after soil temperatures fall below 50 degrees F for a consistent period of time[8]. When possible, timing the seeding before a snowfall may help prevent loss of seed that is consumed by wildlife over the winter months. Dormant seeding in late fall, also known as frost seeding, can be done with a seed drill or until the ground is frozen. Seed can also be broadcast over snow in winter/early spring, although results of snow seeding are more variable and dependent on weather conditions. Dormant seeding promotes cool season grasses and flowering plants.
- Seed mixes will vary but should take into account:
  - Consider soil moisture conditions of the site.
  - Choose palatable species that can tolerate grazing or haying.

[7] Summer seeding after July 1 leads to poor seedling survival and is not recommended for prairies.
[8] Early fall seeding is not recommended for prairies, because seed may germinate too early and not survive over winter.

- Select a mix of both warm- and cool-season species to ensure availability of forage throughout the season[9].
- Cover/nurse crops such as oats are optional, but should be included with the seed mix when seeding steep slopes

- Design:
  - Seed the mix evenly across the site unless soil moisture is highly variable.
  - If there are wet to wet-mesic soils on the site, select a separate seed mix for wet conditions for these seeding zones[10].
- Seed rate:
  - Plant at a minimum of 40 seeds/sq. foot to reduce risk of weed invasion.
  - If there is minimal weed pressure and excellent site preparation, the rate can be reduced to 30 seeds/sq. foot.
  - Increase rate to 50 seeds/sq. foot on steep slopes (3:1 grade).
  - Seeding rates may need to be increased by 25% for dormant seedings to account for lower germination rates and loss of seed to wildlife.

Post-seeding aftercare and long-term management

Utility prairie establishment generally takes 3 to 5 years, but will vary depending on soil moisture and climate conditions. Early management (aftercare) is critical to preventing re-invading weeds and woody species from out-competing and displacing establishing natives.

Maintaining control of invasive perennials is the primary management concern in restorations from invasive perennial-dominated grasslands. Annual weeds may also rapidly colonize the restoration site and suppress native seedling establishment. Frequent mowing can prevent annuals from forming a dense canopy and building up thatch that can further suppress native seedlings.

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

- Mowing annual weeds
- Selective use of herbicide to control invasive perennials
- Prescribed fire to promote native prairie species and discourage further invasion
- Monitoring vegetation to evaluate establishment of prairie seedlings

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:

- Mow the field to a height of 4-6 inches when the annual weed canopy reaches a height of 12-18 inches. Most prairie plants will not reach this height in first year and will not be damaged by a mower. The frequency of mowing will depend on the height and density of weeds, and how much

[9] See nature.org/MNPrairieRestorationGuides for more information on seed mix design and an example utility prairie seed mix.

[10] See nature.org/MNPrairieRestorationGuides for examples of utility meadow seed mixes appropriate for wetter soils.

they are competing with the prairie seedlings for light and moisture.

- Locate and spot-treat invasive perennials using appropriate herbicides and application methods that minimize damage to natives, such as dormant season application or spot-treatment with backpack sprayer or wick applicator. Avoid applying on windy days to prevent drift.

Year 2:

- Mow field to a 12-inch height as needed.
- If annual weeds are limited to individual patches, may spot-mow, perhaps even with a string trimmer, instead of mowing whole field.
- If there is flush of annual/biennial noxious weeds, mow, pull, or spot-treat prior to flowering to prevent seed-set.
- Locate and spot-treat invasive perennials using appropriate herbicides and application methods that minimize damage to natives.

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 have achieved dominance. Mowing should no longer be needed. Spot-treat weeds as necessary using dormant season applications and/or back-pack sprayer/wick applicator to minimize damage to native species.
- 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.

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

- Burn every 3-5 years to stimulate productivity of native prairie plants and prevent invasion of perennial weeds and woody trees and shrubs.
- 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. Suggested interval is to burn one-third of the field annually, so that each patch has a 3 –year rotation.
- 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; e.g. an alternating biennial rotation

of grazing and haying within a 3-4 year burn rotation.

- Hay 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 weeds as needed by hand-pulling, back-pack sprayer, wick-applicator or dormant-season application.
    - Temporarily increase burn frequency, such as annual burns for 2 years, 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 dry prairie at Glacial Ridge © Gail Gilliland

Cost estimate

The estimated cost to restore an invasive perennial-dominated grassland to utility prairie is $1172 per acre, based on 2013 prices. Costs associated with site assessment and project planning are excluded from this estimate. This cost estimate assumes vegetation removal includes two broadcast herbicide applications and one mowing treatment, and the site is seeded with a no-till drill.

Post-seeding management costs include aftercare activities through year 3, specifically: eight mowing treatments, two selective herbicide treatments (spot-spray), and two controlled burns (one half of the site per burn). Actual project costs will be lower if a less-frequent mowing schedule is required. 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.

Monarch on Blazing Star
©TNC/Raymond Auger

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

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

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

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

The Tallgrass Prairie Center Guide to Prairie Restoration in the Upper Midwest. Smith, D. 2010. University of Iowa Press, Iowa City, IA.

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

What's Working: Invasive Species Control – MN Board of Water & Soil Resources
www.bwsr.state.mn.us/practices/whats_working-invasivespecies