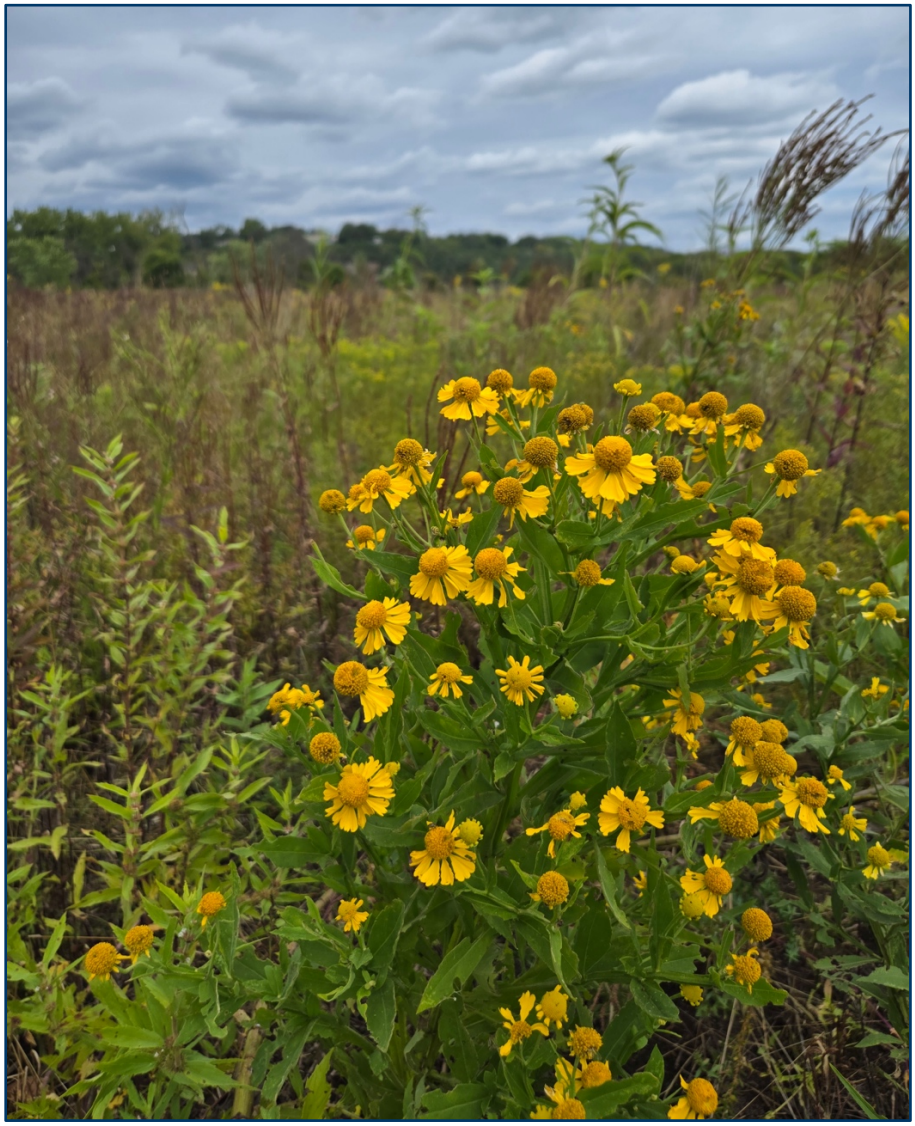
Hastings River Flats
Natural Resources Management Plan Update



Prepared for:
City of Hastings, Minnesota

Prepared by:
Friends of the Mississippi River
St. Paul, Minnesota
December 2025

SITE INFORMATION

OWNER NAME, CITY/TOWNSHIP, COUNTY, STATE:

City of Hastings
Hastings, Dakota County, Minnesota

SECTION, TOWNSHIP, RANGE:

Section 21, Township 115 North, Range 17 West

WATERSHED:

Vermillion River Watershed

PARCEL IDENTIFICATION NUMBER:

19-02100-70-020

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EXECUTIVE SUMMARY

This Natural Resources Management Plan (NRMP) presents the site analysis and recommended land use activities for Hastings River Flats Park in Hastings, Minnesota. This document was drafted by Friends of the Mississippi River (FMR) in 2025 and is intended to further the work of the original, 2002 NRMP for this site. Ecological restoration has drastically improved habitat conditions over the past 20 years, converting this land from an oil tank storage site into a restored wet prairie/meadow. Those changes were largely guided by the 2002 planning effort. Now that the initial restoration implementation in the park is complete, an updated NRMP is needed to focus long-term maintenance efforts on persistent problems and guide the next decade of work at the site.

This NRMP provides a framework for continuing to improve habitat quality. Current vegetation conditions and opportunities for habitat enhancement are documented. This includes suggested timing and costs for those improvements, as well as long-term management strategies to be implemented on-site moving forward. Additionally, partnership opportunities between several stakeholders are outlined.

Overall, significant strides have been made in restoring Hastings River Flats to a native plant community. The park is still at risk from threats from climate change, invasive species, and park development. Continued investment will ensure the habitat quality is maintained and improved.

BACKGROUND

Hastings River Flats is a natural area in the City of Hastings located to the east of Lake Rebecca Park and to the north of Jaycee Park. The Lake Rebecca Park – Hastings River Flats complex is an important natural area because of its geographic location and size. This flat, floodplain area consists of nearly 200 acres of natural habitat that is sandwiched between Lake Rebecca to the south, Lock and Dam 2 to the north, and the Mississippi River to the east.

Efforts have been made to document natural resources and improve habitat in this area for more than two decades. In 2002, a natural resources management plan (NRMP), written by Friends of the Mississippi River, included a characterization of the natural plant communities and habitat restoration recommendations. This NRMP, although titled Hastings River Flats, encompassed the entire floodplain area accessible by Lock and Dam Road. Since that time, this area has been split into three separate parks. (Figure 1, Table 1).

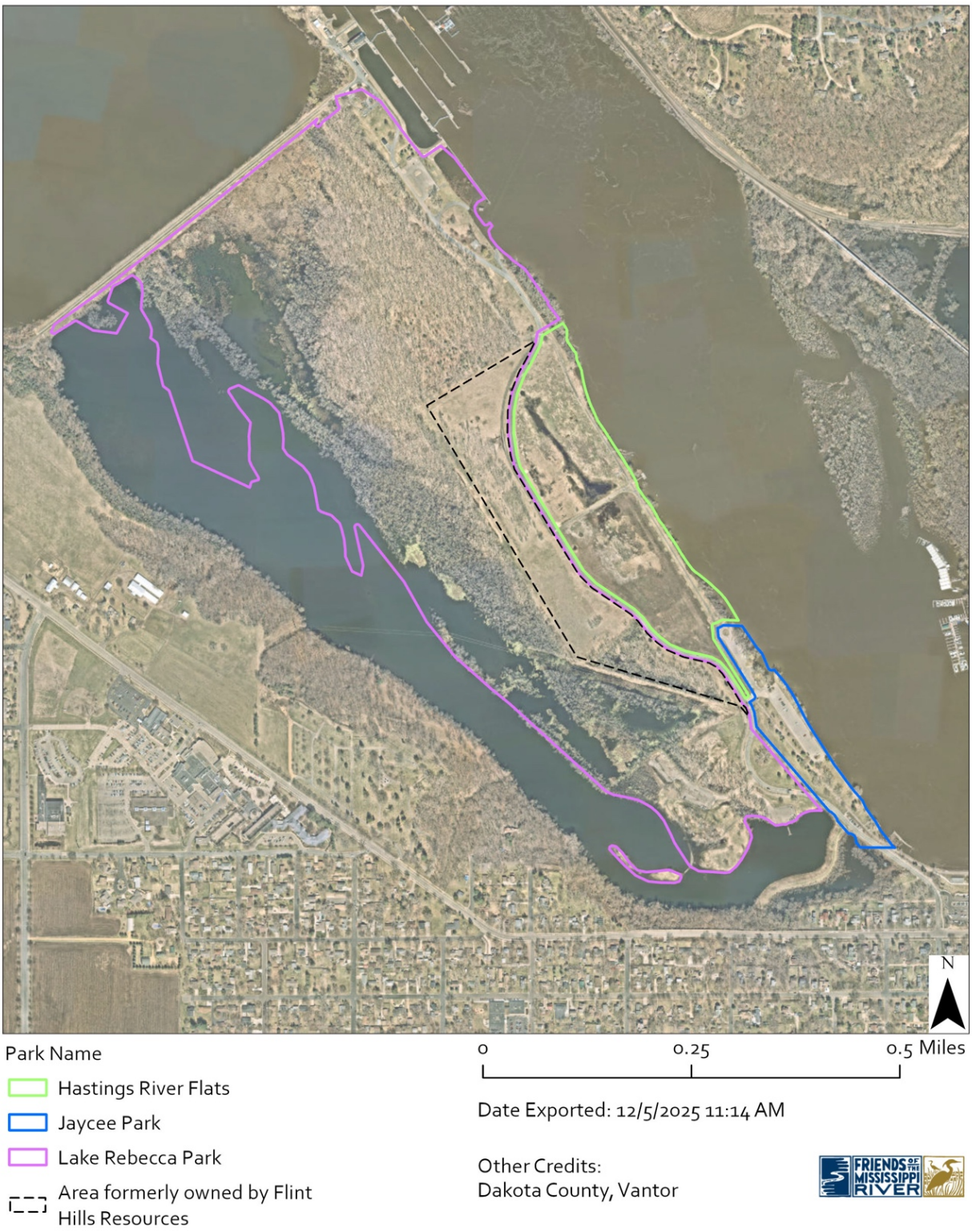

Figure 1: Map of park boundaries for three City of Hastings parks.

The largest park is Lake Rebecca Park, covering approximately 180 acres depending on water levels. Most of this land is owned by the US Army Corps of Engineers (USACE) and leased by the City of Hastings. The 2002 Hastings River Flats NRMP included an inventory and management recommendations for all acres of Lake Rebecca Park owned by the USACE. In addition, there was a 2017 general forest management plan completed by the USACE for 133 acres within this park. Most recently, the City of Hastings completed a master plan for Lake Rebecca Park in 2024, which included an updated natural resources management plan for the area. Importantly, the 2024 plan was the first to include the 15-acre parcel that was formerly owned by Flint Hills Resources (Figure 1). This parcel was acquired by the City of Hastings in 2022-2023. The 2024 master plan included initial restoration implementation steps for this parcel. Future habitat management of this area will happen in conjunction with restoration of Hastings River Flats Park because these acres contribute to contiguous prairie habitat, despite different city park designations.

Jaycee Park is approximately 10 acres and is the smallest park within this land matrix. This park, owned by the City of Hastings, features traditional city park land, complete with mowed turf, stately shade trees, and amenities such as picnic benches and a parking lot. This park includes a boat access ramp to the Mississippi River.

Hastings River Flats is the third park area. It is approximately 28 acres in size and is situated between Lock and Dam Road to the west and the Mississippi River to the east, north of Jaycee Park. Historically, this land was also owned by Flint Hills Resources, and in the 2002 NRMP, it is referred to as the tank farm unit. It was acquired by the City of Hastings in the early 2000's, decades ahead of the parcel within Lake Rebecca Park across the road. Because it is owned outright by the City of Hastings, it was not included in the 2017 forest management plan completed by USACE. The 25 acres of natural area within the park is the focus of this NRMP update.

Table 1: Summary of ownership and planning efforts for three City of Hastings parks.

PARK	OWNER	AREA INCLUDED IN THE FOLLOWING PLANNING EFFORTS:				
		2002 NRMP	2017 FOREST MANAGEMENT PLAN	2024 LAKE REBECCA PARK NRMP	2025 MISSISSIPPI RIVER GREENWAY NRMP	2025 HASTINGS RIVER FLATS NRMP
Hastings River Flats	City of Hastings	Yes, referred to as "tank farm"	No	No	Yes	Yes
Jaycee Park	City of Hastings	Yes	No	No	Yes	No
Lake Rebecca Park	US Army Corps of Engineers, leased to City of Hastings through 2032	Yes	Yes	Yes	Yes	No
Lake Rebecca Park	City of Hastings (current), Flint Hills Resources (former)	No	No	Yes	No	No

The purpose of the 2025 Hastings River Flats NRMP update is to document existing site conditions and natural resource improvements that can be implemented now that initial restoration efforts are complete. There have been two periods of time since the 2002 NRMP was written where habitat restoration has been implemented. From 2003-2007, initial prairie restoration steps occurred. Invasive species were managed and the "tank farm" area was seeded with a wet prairie seed mix. From 2013-2015, the north unit of that restoration work was impacted by bridge reconstruction in Hastings. The area was seeded and habitat was monitored in 2017. A second round of restoration was implemented from 2020-2023. Invasive species management occurred, as well as prescribed burning and overseeding to increase forb diversity. In 2025, over two decades after the initial restoration of the south unit and one decade after the restart of the north unit, the habitat in this park is entering its long-term maintenance phase, which necessitates updated, site-specific recommendations to guide habitat management into the future.

A detailed account of background information for the site can be found in the 2002 NRMP. This includes abiotic conditions, such as geology and soils, as well as extensive documentation of the land use history. Modern-day Hastings River Flats is referred to as the former tank farm unit in the 2002 NRMP. For ease of comparison, vegetation and bird data throughout the years of habitat restoration at this park are included in Appendices A and B of this NRMP update.

PARTNERSHIPS

Several stakeholders are involved in the success of habitat restoration at Hastings River Flats Park, and effective coordination between groups is vital to restoration success. The City of Hastings is the landowner. Friends of the Mississippi River has partnered with the City of Hastings to restore this area for 20+ years, in addition to other natural areas throughout the city. The Mississippi River Greenway runs along the eastern side of the park adjacent to the River. Dakota County maintains an easement along this greenway and could assist with restoration funding within this easement into the future. Finally, this park is directly adjacent to Lake Rebecca Park, which is owned and maintained by the U.S. Army Corps of Engineers. Restoration efforts that occur within Hastings River Flats, and within the city-owned parcel of Lake Rebecca, should be coordinated with the USACE to potentially reduce costs and increase habitat improvement impact. Specifically, coordinating prescribed burning operations, interseeding, and invasive species management in prairie and oak savanna areas, with all stakeholders prior to implementation is important.

CULTURAL RESOURCES

Hastings River Flat's location as floodplain habitat within the Mississippi River floodplain positions it squarely in an area with a long history of Indigenous use. Although the size and shape of this area have been highly altered by engineering solutions to increase river navigability since the 1900's, its position on the landscape near the confluence of two large rivers (Mississippi and St. Croix) makes it likely this area was specifically important. The Office of the State Archaeologist (OSA) notes four cultural resource sites within the public land survey system (PLSS) boundary that overlap the southern third of this park. While publicly available OSA occurrence data does not specify the type of resource or occurrence, it demonstrates that the area has a history of Indigenous activity and that care should be taken to restore the land with respect to Dakota culture.

INVENTORY AND ASSESSMENT

A natural resources inventory and assessment was conducted by FMR ecologists during the summer of 2025 to determine existing plant communities, identify opportunities for habitat improvement, and develop guidance for long-term management actions. Hastings River Flats consists of two primary vegetation cover types: wet prairie and river shoreline. These cover types occur in three distinct units across the park.

The **prairie** units consist of restored prairie and are dominated by native grasses and forbs. They are fairly heterogenous, with low-lying wet prairie areas grading into mesic to dry prairie along the road corridor. There is some native shrub cover, particularly willows, aspen, and false indigo. The target plant community for these units is wet prairie.

The **riverbank** unit consists of semi-natural shoreline. Sandy slopes are partially vegetated, and the unit has patchy tree canopy cover. Riprap is present in some areas of high erosion potential. The target plant community for this unit is sand/gravel/cobble river shore.

MANAGEMENT UNITS AND RECOMMENDATIONS

MANAGEMENT UNITS OVERVIEW

A natural resources inventory and assessment was conducted by FMR ecologists during summer and fall of 2025 to determine restoration progress towards target plant communities identified in the 2002 NRMP, opportunities to enhance restoration progress, and to develop guidance for long-term management recommendations. Hastings River Flats consists of three management units and subunits: north prairie, south prairie and riverbank.

The following section includes a description of each management unit, the plant communities within each management unit, and possible management strategies. Each unit description also includes the recommended native plant community to guide restoration, which was determined in the 2002 NRMP. Finally, a letter-grade ranking for the current conditions of the native plant community is included, which can be used as a metric to measure restoration progress in the long- term. The conditions are ranked from A (excellent), B (good), C (fair), to D (poor). This ranking considers abundance of non-native species, diversity and health of native species, level of disturbance and degradation, and impacts or alterations to water features. Full descriptions of each native plant community recommended for the property can be found in Appendix C.

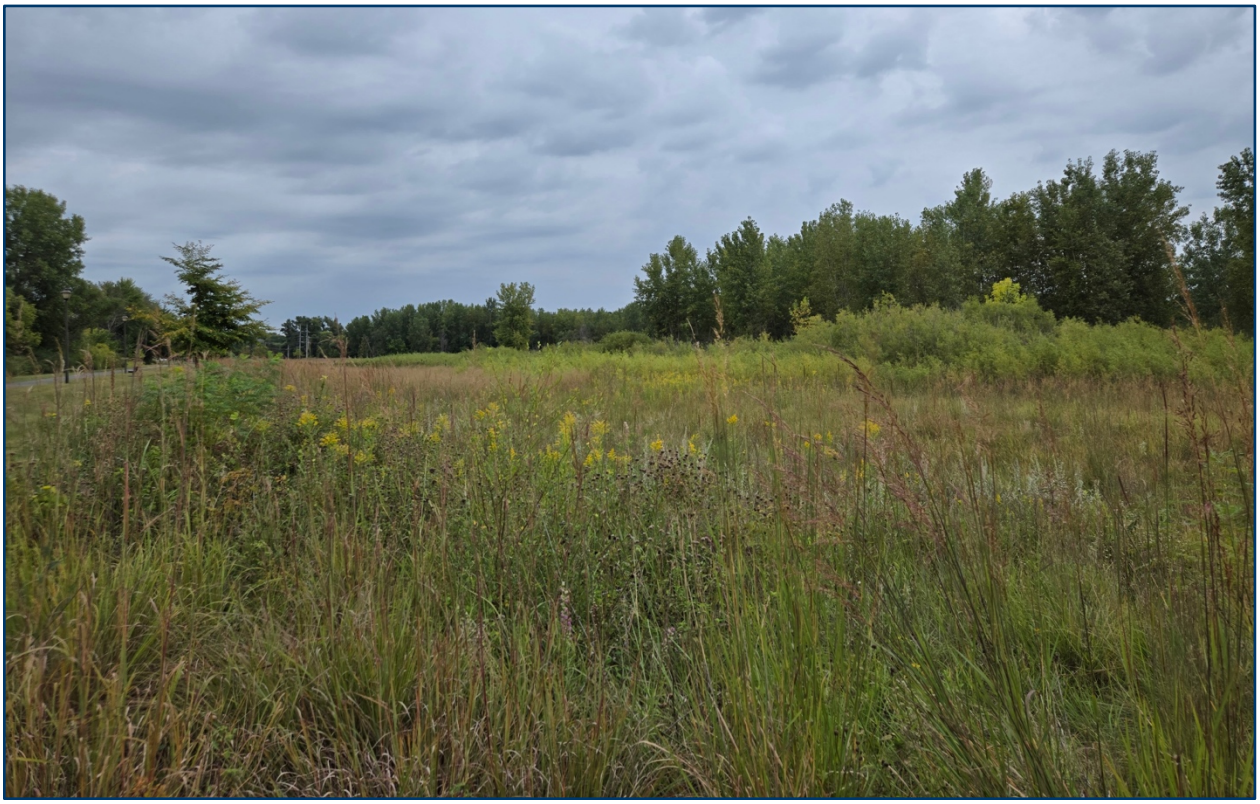

Image 1: View of South Prairie unit from edge of Mississippi River Greenway looking south.

NORTH PRAIRIE

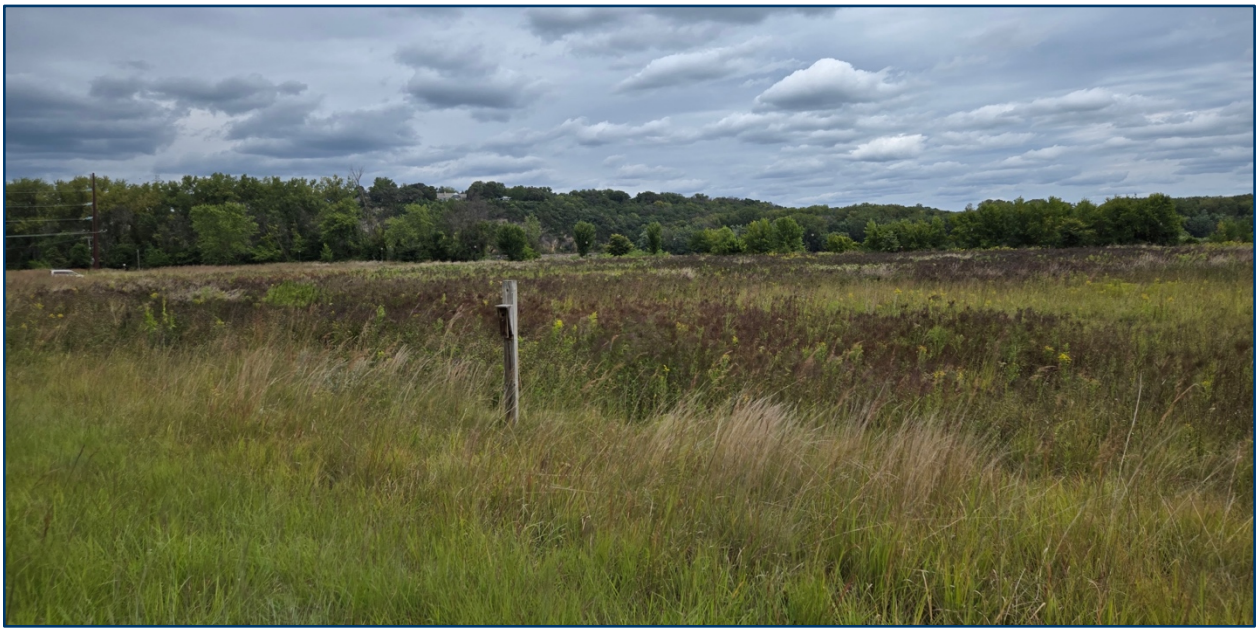

Image 2: A panoramic view of the north prairie taken from Lock and Dam Blvd., looking northeast. An area dominated by nonnative warm-season grasses is in the foreground, with native blue vervain and Canada goldenrod dominant in the background.

The North Prairie unit is approximately 10.5 acres and comprises the northwestern half of the park. It is situated between the Mississippi River Greenway (MRG) to the east and Lock and Dam Boulevard to the west. The southern boundary is a paved bike trail that connects Lock and Dam Blvd. to the MRG. The perimeter of this unit is mowed by City of Hastings staff to allow for visibility.

The hydrology in this unit is highly variable. There is a low depression in the center of the unit that receives stormwater runoff from culverts under the road. In wet areas, there is hybrid cattail, reed canary grass, and standing water. In 2023, there was a patch of invasive phragmites, but that was eradicated with mowing and imazapyr herbicide treatments. Outside of the wet depressional area, the dominant hydrologic regime in the unit is frequent flooding during storm events, with slow but complete drainage. In this depressional area, there are wet prairie and wet meadow species, including blue vervain, cardinal flower, great blue lobelia, sneezeweed, mountain mint, boneset, sawtooth sunflower, false indigo, and switchgrass. There are also scattered pockets of invasive purple loosestrife and Siberian motherwort. Nonnative, warm-season foxtail is the dominant grass species, followed in abundance by native warm-season grasses, including golden prairie grass *(Sorghastrum nutans)* and big bluestem, as well as *Equisetum* spp. The edges of the unit are hydrologically drier because they are upslope. There are also small microcosms throughout the unit that are much drier. Native species in these areas include bee balm, whorled milkweed, common milkweed, prairie sage, anise hyssop, and black-eyed Susan. Native grasses, including Canada

wild rye, side oats grama, purple lovegrass, and little bluestem, are also present. The drier areas are generally weedier, and include large populations of common mullein, daisy fleabane, yellow rocket, common ragweed, and foxtail.

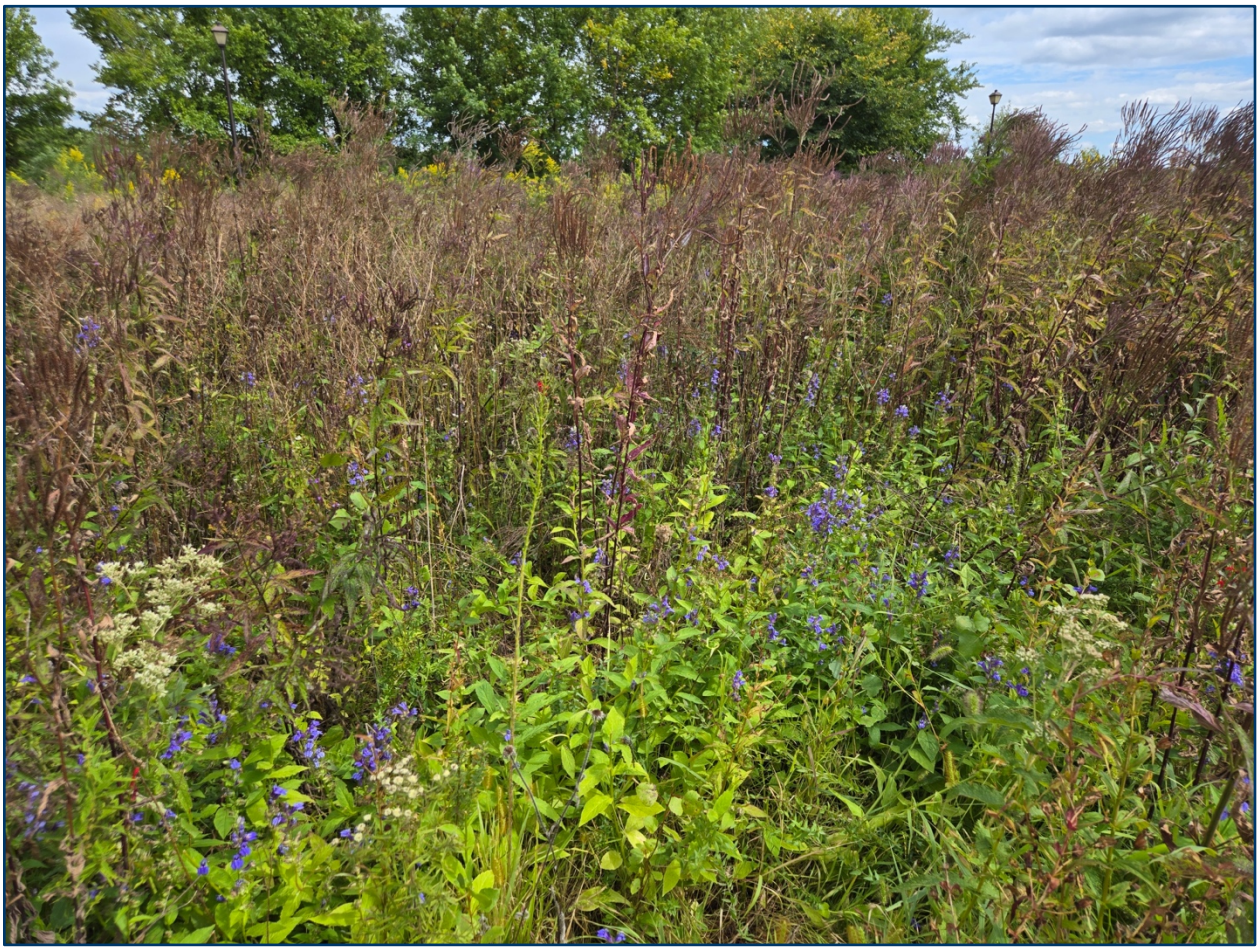

Image 3: An image of a dense patch of forbs located in the north prairie unit. The blue flowers in the foreground are great blue lobelia. Boneset is the white flower on the left side of the frame. One singular red cardinal flower can be seen in the middle of the Image. The brown plants in the background are a thick tangle of blue vervain.

Restoration in this unit was restarted between 2013 and 2015 after it was used as a laydown area for bridge reconstruction. Although there is significant cover of nonnative warm-season grasses, the overall presence and diversity of the native seed bank is impressive for similar restorations. The resulting grade for this wet prairie / wet meadow plant community is a “C”.

DESIRED FUTURE CONDITION

The trajectory for restoration of this unit as indicated in the 2002 management plan was a wet prairie/wet meadow complex. Progress has been made toward this goal, with the current plant community receiving a “C” ranking. A reasonable trajectory for this unit is to work towards a B-quality wet prairie/wet meadow complex, with reduced cover of non-

native/invasive species and increased cover of native grasses. A specific description of the Southern Wet Prairie (WPs54) and Southern Seepage Meadow (WMs83) can be found in Appendix C.

MANAGEMENT GOALS AND ACTIONS SUMMARY

The overarching goal in this unit is to increase native species diversity and continue to provide improved habitat for pollinators, migratory birds, and other animals. Woody species establishment is limited by regular prescribed burning. This can be accomplished by taking the following actions:

1) Continue to spot-manage invasive and weedy species by mowing, spot-spraying, and hand-pulling. Specifically, reduce size of foxtail population by mowing during tillering but before seed production annually in the summer.
2) Interseed native grasses and forbs as needed during invasive species management to increase diversity and native cover.
3) Enhancement of habitat through regular prescribed burning. This unit should be burned on a 2-3 year rotation to prevent woody encroachment. Burn during the dormant season (October 10 – April 9) to eliminate impacts to rusty patched bumblebee.
4) Continue ecological monitoring and adaptive management as conditions evolve.

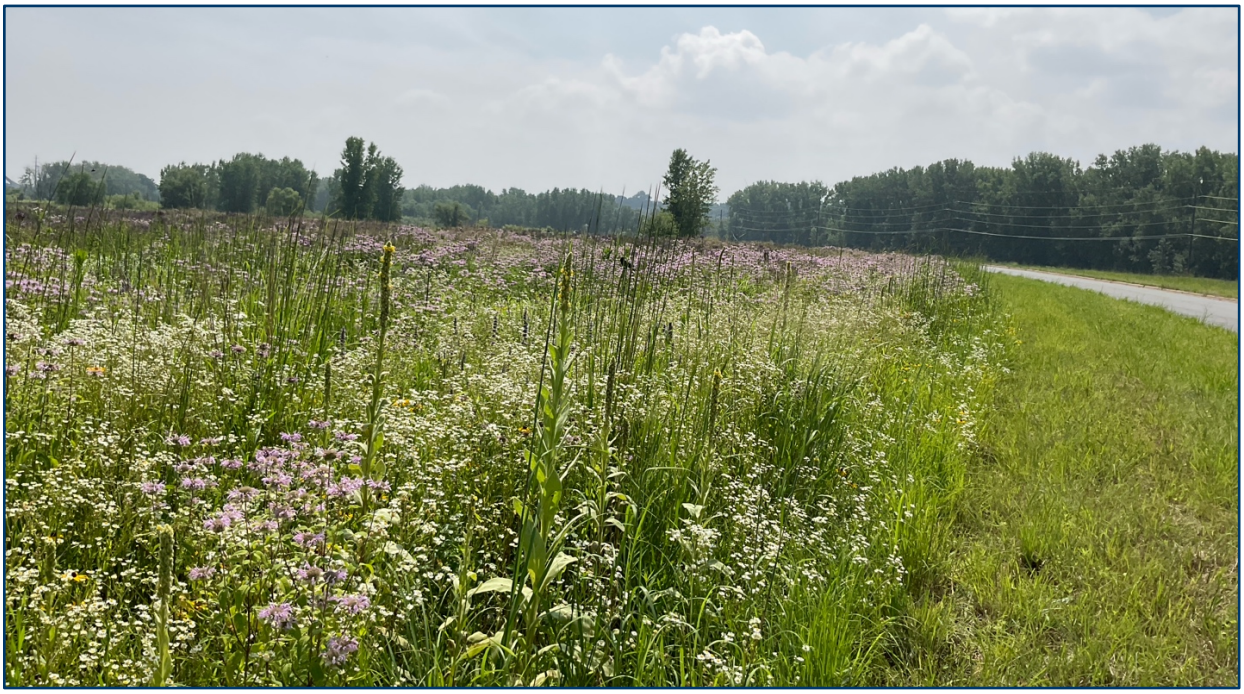

Image 4: An image highlighting a weedier area of the north prairie, taken from the north of the unit looking south along the road. Daisy fleabane and mullein are dominant forbs, while foxtail dominates the understory. A large patch of monarda can be seen in the background.

SOUTH PRAIRIE

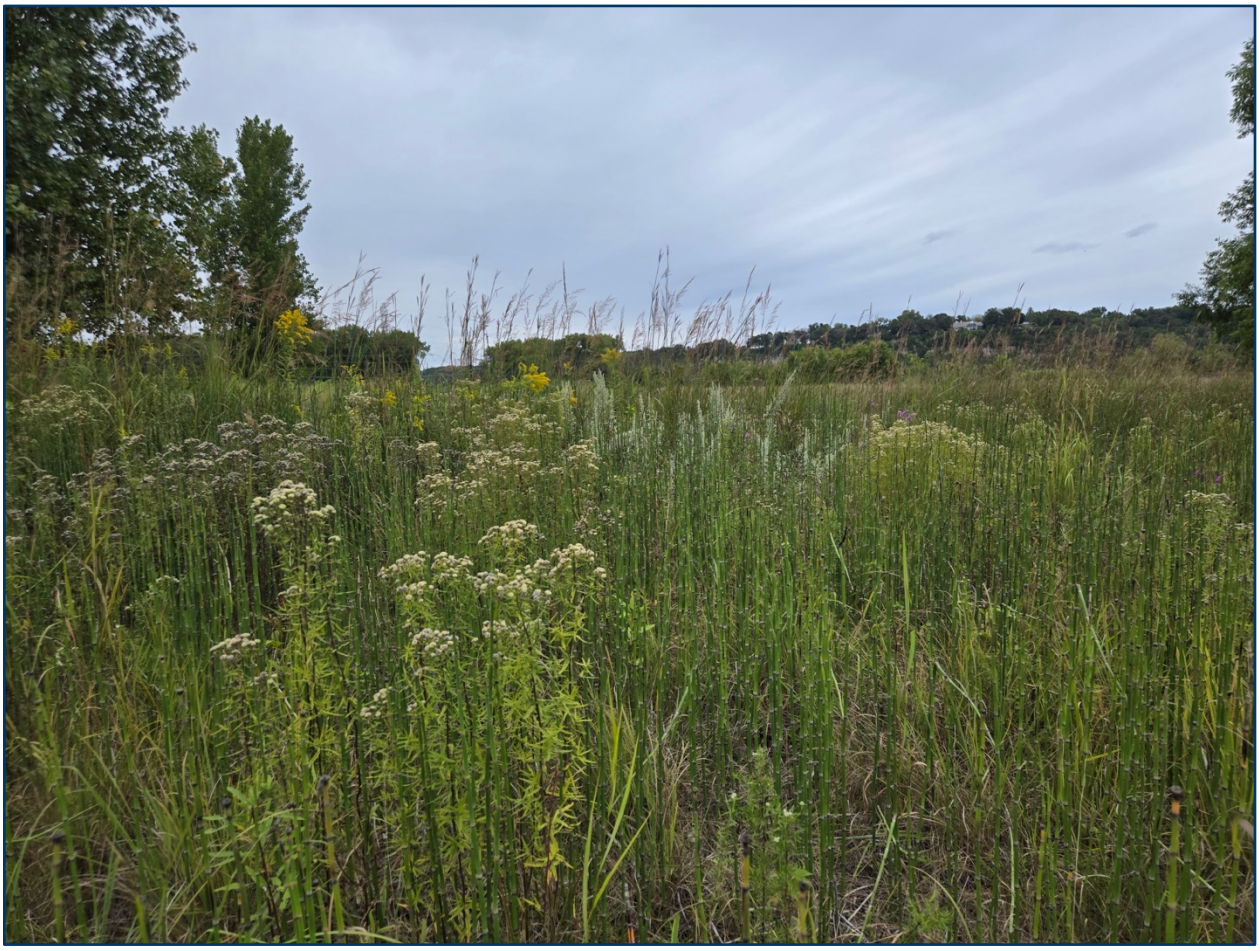

Image 5: A view of the south prairie unit from the northwest corner looking southeast. Mountain mint is in the foreground, with prairie sage, Equisetum spp., showy goldenrod, and big bluestem in the background. A grove of aspens is pictured to the left of the frame.

The South Prairie unit is approximately 10.9 acres and comprises the southeastern half of the park. It is situated between the Mississippi River Greenway (MRG) to the east and Lock and Dam Boulevard to the west. The northern boundary is a paved bike trail that connects Lock and Dam Blvd. to the MRG, and the southern boundary is a parking lot for Jaycee Park and the boat launch. The perimeter of this unit is mowed by City of Hastings staff to allow for visibility.

This unit has more structural complexity than the northern unit, and a slightly different hydrologic regime. The vegetation is a mix of shrub, tree, and prairie cover that creates a heterogeneous complex. The hydrology is not as variable as the north prairie unit, with no areas of consistent standing water. However, there is still occasional flooding, especially along the northern half of the unit. A grove of mature aspen trees dominates approximately 1 acre in the center of this unit. The species diversity beneath the aspen clone is limited to

Equisetum. This aspen colony established after restoration of the unit began in 2003, likely because of limited prescribed burning conducted in the first 15 years of the restoration. At this point, the clone is a feature of the landscape that provides perches and shelter for birds. Surrounding the aspen clone to the east and south, there is a thicket of willow shrubs approximately 8-10 feet tall. The ground layer beneath the willow is dominated by invasive reed canary grass.

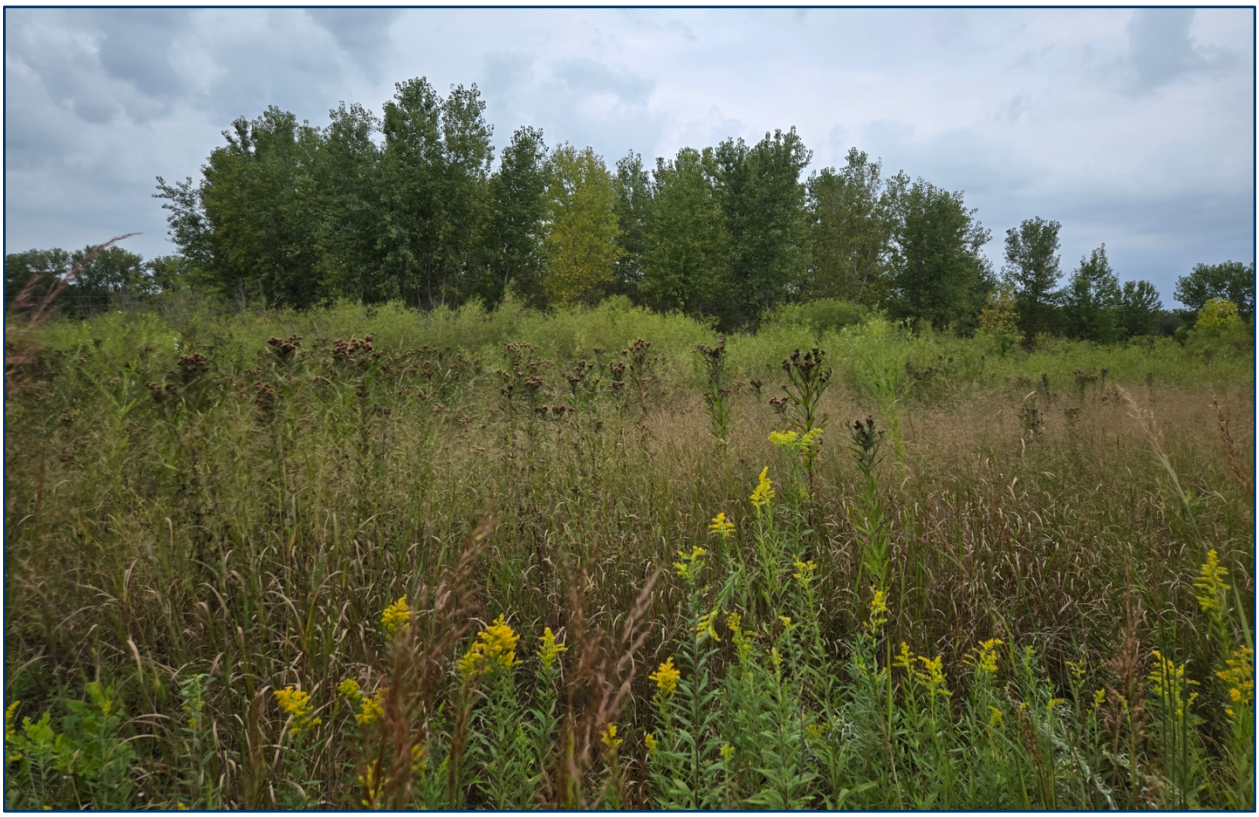

Image 6: A view of the aspen clone from the Mississippi River Greenway bike path looking south. Canada goldenrod and ironweed are present in the foreground. The light green middle layer is the willows, and the tall trees in the background is the aspen grove.

The areas surrounding the aspen clone and willow shrub layer are dominated by native grasses and *Equisetum* spp. Switchgrass, golden prairie grass, and little bluestem are the dominant native grasses. Also dominant are invasive reed canary grass, smooth brome, and foxtail. Forb species composition differs slightly in this unit, likely because of slightly drier conditions and different seed mixes spread in the units over time. Canada goldenrod, hoary vervain, prairie sage, common ragweed, ironweed, and bee balm are the dominant forbs.

The southern quarter of the unit has historically been mowed annually to accommodate overflow parking for Rivertown Days in July. This area has the most invasive species cover, including large areas of smooth brome, foxtail, sweet clover, bird's-foot trefoil, and Siberian

elm. There are also native species adapted to dry soil conditions and disturbance in this unit including common milkweed, whorled milkweed, hoary vervain, and purple lovegrass.

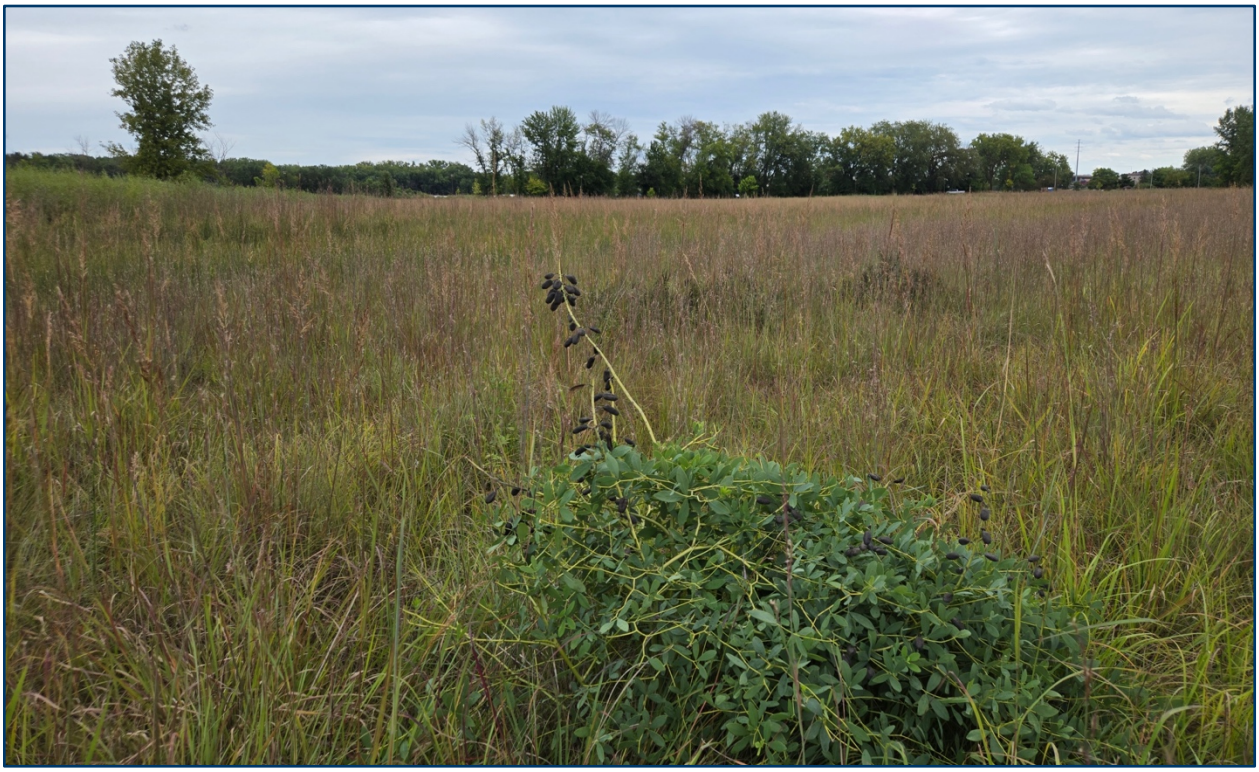

Image 7: Wild indigo present on the edge of an area dominated by warm-season grasses within the unit. This species was included in a 2021 seed mix for the north prairie but has since migrated to the south prairie unit.

Restoration in this unit began in 2003. There have been periods of active and passive management since initial restoration implementation. Overall, the unit is dominated by native species. Forb cover could be increased to provide more floral resources for pollinators. The resulting grade for this wet prairie/wet meadow plant community is a “C”.

DESIRED FUTURE CONDITION

The trajectory for restoration of this unit as indicated in the 2002 management plan was a wet prairie/wet meadow complex. Progress has been made toward this goal, with the current plant community receiving a “C” ranking. A reasonable trajectory for this unit is to work towards a B-quality wet prairie/wet meadow complex, with reduced cover of non-native/invasive species, limited spread of shrub cover, and increased cover of native forbs. A specific description of the Southern Wet Prairie (WPs54) and Southern Seepage Meadow (WMs83) can be found in Appendix C.

MANAGEMENT GOALS AND ACTIONS SUMMARY

The overarching goal in this unit is to increase native species diversity and continue to provide improved habitat for pollinators, migratory birds, and other animals. Spread of established woody species (aspen clone, willow) is limited by regular prescribed burning. This can be accomplished by taking the following actions:

1) Minimize mowing to the greatest extent possible to allow for maximum natural shoreline conditions. Reduce or eliminate fertilizer use in mowed areas.
2) Continue to spot-manage invasive forb species by mowing, spot-spraying, and hand-pulling as needed.
3) Manage invasive cool-season grasses, including smooth brome and reed canary grass. To manage smooth brome, spot spray herbicide that targets cool-season grasses in the spring after burning, prior to other grass emergence. To manage reed canary grass, a combination of mowing and spot treatment is necessary. Eradication is likely impossible.
4) Continue managing with prescribed fire every 2-3 years to reduce woody species spread. If burning does not limit spread, consider forestry mowing or cut/treat/burn scattered populations of woody species. Burn during the dormant season (October 10 – April 9) to eliminate impacts to rusty patched bumblebee.
5) Interseed native grasses and forbs as needed during invasive species management to increase diversity and native cover.
6) Continue ecological monitoring and adaptive management as conditions evolve.

RIVERBANK

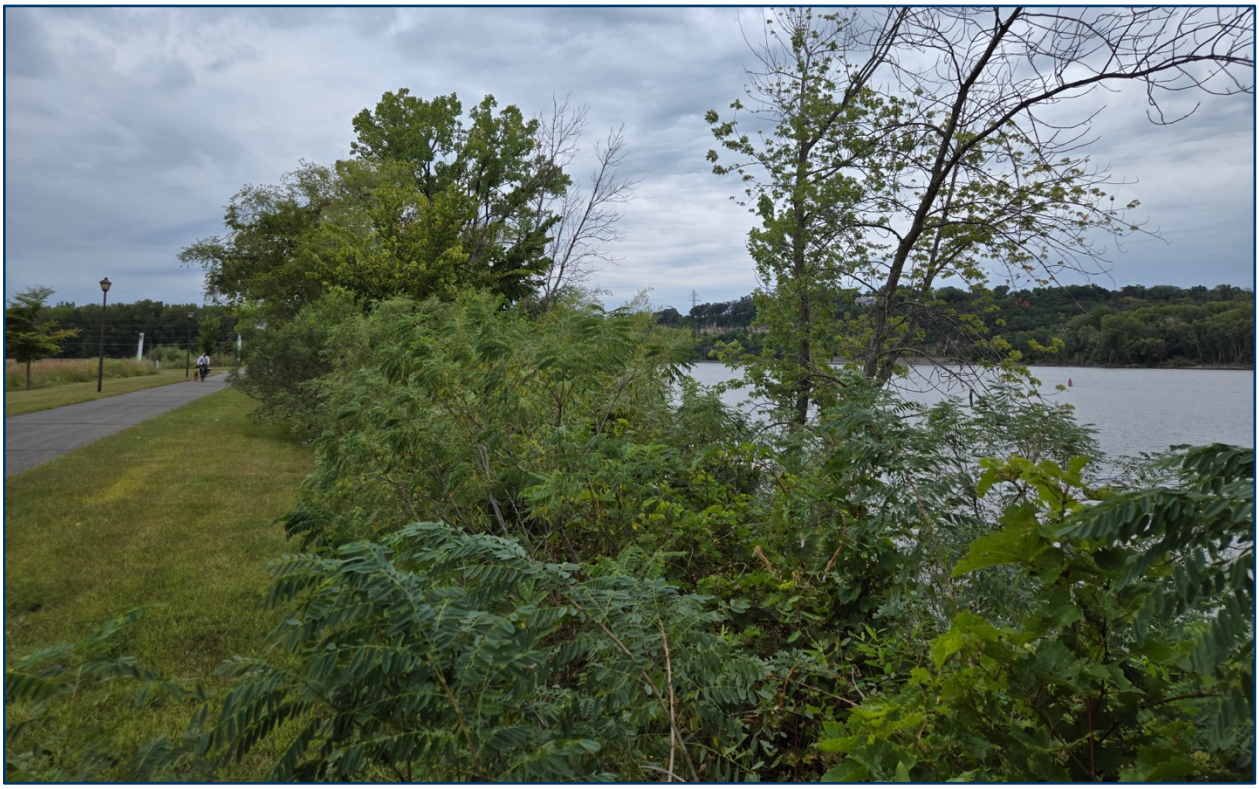

Image 8: A view of the riverbank unit looking north. Native shrubs, like fragrant false indigo, thrive in sunny patches created by dead and dying ash trees.

The Riverbank unit is approximately 3 acres. It is located between the MRG and the Mississippi River. The southern edge of this unit adjacent to the MRG is mowed by City of Hastings staff. Exact acreage is highly variable depending on river water levels at any given point in time.

The vegetation in this unit is highly variable. In higher quality areas, native trees including cottonwood and American elm dominate the tree canopy. There is good native vegetation cover in the subcanopy and understory including red osier dogwood, false wild indigo, and Canada goldenrod. The highest quality areas are located on the northern edge of the unit. Moving south, the vegetation quality is reduced. There are standing dead ash trees, and bare, eroded sandy soils. Further south, there are patches of riprap along the shoreline with weedy species like motherwort and Virginia creeper growing amongst the rocks.

This stretch of the Mississippi River is highly engineered and there are many infrastructure amenities adjacent to the banks and downstream that are important to protect. As such, there are limits to the expectation of habitat restoration within this unit. Overall, the current vegetation quality is a “D” because of the size of the parcel, erosion, and human-challenges associated with restoration.

DESIRED FUTURE CONDITION

The trajectory for restoration of this unit is a sand/gravel/cobble river shore native plant community (RVx32). The current plant community receives a "D" because of its limited native plant diversity and the impacts of human disturbance causing erosion along the shoreline. Improvements can be made, particularly to establish more native vegetation cover in bare spots and limit future erosion, but there is a slim chance this unit will ever achieve high quality, diverse vegetation characteristics of a natural native plant community. A reasonable goal for this unit would be to advance to "C" ranking and make steps towards revegetating bare soil. A specific description of the sand/grave/cobble river shore (RVx32) can be found in Appendix C.

MANAGEMENT GOALS AND ACTIONS SUMMARY

The overarching goal in this unit is to minimize erosion, manage invasive species, and increase native species cover in the herbaceous understory. This can be accomplished by taking the following actions:

1) Manage invasive shrubs including honeysuckle, buckthorn and Siberian elm by cutting and treating the stumps. Material can be piled burned or removed off site.
2) Increase native species cover by seeding graminoid dominant native seed mixes. Grasses generally germinate faster and at higher rates than forbs. Seed areas of exposed soil, and cover seed mix with biodegradable erosion control blanket to protect seed from wash out.
3) Continue to spot manage invasive forb species by mowing, spot spraying, and hand pulling as the need arises.
4) As green ash continue to die and fall from the canopy, replant native canopy species including cottonwood, silver maple, and swamp white oak.
5) Interseed native grasses and forbs as needed during invasive species management to increase diversity and native cover. Hand collected seed from the prairie units can be used in sunny spots to increase forb diversity.
6) Continue ecological monitoring and adaptive management as conditions evolve.

IMPLEMENTATION WORKPLAN

Continued invasive species management and habitat improvements are recommended at Hastings River Flats. The initial implementation steps of restoring wet prairie habitat are complete. The area is dominated by native species found in wet prairie/wet meadow habitats. However, ecological restoration is not static. Native plant communities are constantly changing, responding to their environments and threats. This means that regular monitoring and management actions are required in perpetuity to ensure the habitat is maintained. Long-term management adapts to the needs of the site as they arise. It is relatively easy to manage small populations of invasive or weedy species at this stage before they become established and begin to out-compete native species throughout the restoration. Field work in 2025 identified a few target species to manage in each unit, in addition to the regular prescribed burning regime that wet prairie communities rely on. Task tables and cost estimates for managing the habitat for the next five years are included below.

Table 2: Tasks and costs for 5 years of restoration work in the North Prairie unit.

NORTH PRAIRIE (10.5 AC) TARGET: WET PRAIRIE / WET MEADOW					
Year	Season	Activity	Acres	Unit cost	Total
2026	Late June	Spot mow patch of dense foxtail when plants are in the boot stage (when the seed heads start developing in the sheath). This will prevent seed set for the summer.	4	$ 600.00	$ 2,400.00
	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	10.5	$ 300.00	$ 3,150.00
	Fall	Order enhancement seed for after prescribed burn. Include swamp and common milkweed for monarch habitat.	5	$ 600.00	$ 3,000.00
	After Oct. 10	Prescribed burn.	10.5	$ 600.00	$ 6,300.00
	After Oct. 10	Broadcast native seed in areas of high weed pressure and bare spots.	5	$ 300.00	$ 1,500.00
2027	Late June	Spot mow patch of dense foxtail when plants are in the boot stage (when the seed heads start developing in the sheath). This will prevent seed set for the summer.	4	$ 550.00	$ 2,200.00
	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	10.5	$ 300.00	$ 3,150.00
2028	Late June	Spot mow patch of dense foxtail when plants are in the boot stage (when the seed heads start developing in the sheath). This will prevent seed set for the summer.	3	$ 500.00	$ 1,500.00
	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	10.5	$ 250.00	$ 2,625.00
	Fall	Order enhancement seed for the foxtail patch. Include aggressive native species and milkweeds.	3	$ 600.00	$ 1,800.00
	Winter	Broadcast native seed in foxtail patch	3	$ 300.00	$ 900.00
2029	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, and purple loosestrife.	10.5	$ 250.00	$ 2,625.00
2030	Before April 10	Prescribed burn.	10.5	$ 600.00	$ 6,300.00
	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, and purple loosestrife.	10.5	$ 250.00	$ 2,625.00
NORTH PRAIRIE TOTAL YEARS 1-5					**$40,075**

Table 3: Tasks and costs for 5 years of restoration work in the South Prairie unit.

SOUTH PRAIRIE (10.9 AC) TARGET: WET PRAIRIE / WET MEADOW					
Year	Season	Activity	Acres	Unit cost	Total
2026	Fall-Winter	Forestry mow edges of willow stand to reduce overall shrub covered area. Ground must be frozen.	1.5	$ 1,500.00	$ 2,250.00
2027	Spring	Cool-season grass overspray targeting smooth brome (south end of unit) and reed canary grass (north end of unit).	4	$ 1,000.00	$ 4,000.00
	Fall	Cool-season grass overspray targeting smooth brome (south end of unit) and reed canary grass (north end of unit).	4	$ 1,000.00	$ 4,000.00
	Winter	Order enhancement seed for after prescribed burn. Include swamp and common milkweed in the mix for monarch habitat. Seed is for cool-season grass management areas only - whole unit does not need seed.	4	$ 600.00	$ 2,400.00
2028	Spring, before April 10	Prescribed burn. Time appropriately to top-kill willow resprouts.	10.9	$ 600.00	$ 6,540.00
	Spring	Broadcast native seed in cool-season grass management areas.	4	$ 300.00	$ 1,200.00
	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	10.9	$ 300.00	$ 3,270.00
2029	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	10.9	$ 300.00	$ 3,270.00
2030	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	10.9	$ 250.00	$ 2,725.00
SOUTH PRAIRIE TOTAL YEARS 1-5					**$29,655**

Table 4: Tasks and costs for 3 years of restoration work in the Riverbank unit.

RIVERBANK (3 ac) TARGET: SAND/GRAVEL/COBBLE RIVER SHORE					
Year	Season	Activity	Acres	Unit cost	Total
Year 1*	Winter	Cut/stump treat/stack invasive woody shrubs. Coordinate with the City for brush pile removal.	1	$ 1,500.00	$ 1,500.00
	Winter	Order native graminoid (buckthorn replacement) seed mix.	1	$ 650.00	$ 650.00
	Spring	Broadcast seed native graminoid seed mix in bare patches and areas of invasive woody shrub removal.	1	$ 350.00	$ 350.00
	Spring	In areas of high erosion, protect the seed with biodegradable erosion control blanket. Cost includes supplies and labor.	0.5	$ 3,000.00	$ 1,500.00
	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	3	$ 300.00	$ 900.00
Year 2	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	3	$ 300.00	$ 900.00
	Fall	Volunteer event to collect seed from adjacent prairie units and seed in bare patches in riverbank unit. Focus on increasing forb diversity and native species cover.	1	$ 2,500.00	$ 2,500.00
Year 3	Summer	Spot mow or clip/bag invasive species prior to producing seeds. Focus on common mullein, Siberian motherwort, yellow and white sweet clover, and purple loosestrife.	3	$ 300.00	$ 900.00
	Fall	Plant 10 native trees (silver maple, cottonwood, swamp white oak) in canopy gaps to replace ash cover	10	$ 500.00	$ 5,000.00
RIVERBANK TOTAL YEARS 1-5					**$14,200**

*Note that in this table, years are generic because timeline is flexible.

LONG TERM MANAGEMENT

In general, there are general management actions that are needed periodically to maintain a healthy native plant community into the future, beyond the outlined tasks in this NRMP. The principals of adaptive management require that the habitat is regularly monitored, and decisions are made in response to any threats that are identified. The tasks listed below include the types of tasks that are needed to maintain the habitat, as well as tasks that may be needed in response to threats. Table 5 lists these tasks with associated cost estimates.

Table 5: Long-Term Management Schedule and Cost Estimates

UNIT NAME	LONG-TERM MGMT TASK	FREQUENCY	COST RANGE
Prairie Units	Prescribed burning	Every 2-3 years. Half the acres should be burned at any given time to provide habitat refuge.	$600-$900 per acre
All Units	Seeding	As needed, in areas of invasive species removal or erosion.	Seed cost: $300 - $800 per acre. Contractor implementation cost: $400 per acre
All Units	Invasive species monitoring	3x annually	$1,000 - $1,500 annually
All Units	Invasive species spot mow/clip treatment	As needed	Variable depending on work needed. Contractor cost: $600-$800 per acre, or $90 per labor hour.
All Units	Invasive species herbicide spot-treatment	As needed	Variable depending on work needed. Contractor cost: $1,000 per acre, or $90 per labor hour.
All Units	Invasive species management volunteer event	Annually, as needed	Labor: $2,500 for FMR-sponsored public event, free for Hastings Environmental Protectors event
All Units	Seeding / planting volunteer event	As needed	Plant material: $3 per plug, $10 per live stake. See seed cost above. Labor: see cost above
Prairie Units	Forestry mowing	As needed	$1,500 - $2,000 per acre
Prairie Units	Invasive species spot mowing with equipment	As needed	$500 - $750 per acre

OTHER CONSIDERATIONS

MISSISSIPPI RIVER GREENWAY USAGE

The Mississippi River Greenway (MRG) runs through Hastings River Flats Park. This trail is frequently used by the public for recreation. When working on restoration tasks that could impact public health, it is recommended that signage be posted along the trail. This includes herbicide use and prescribed burning operations. For herbicide use, signs posting the date that herbicide was applied and the recommended period to stay out of the area for humans and animals is required. Dog walking is a frequent use of the MRG, and providing owners with knowledge about safe areas for their pets is necessary. For prescribed burning, signs posted on either end of the MRG through the park alerting the public to prescribed burn operations is advisable. Additionally, burning on days when smoke dissipates quickly is recommended, both for the health of members of the burn crew and members of the public. Coordination with the City of Hastings for public notice of prescribed burning actions is advised. A special use permit to utilize the MRG as a burn break may be needed. Coordination with Dakota County ahead of any burning is also recommended.

TREE DISEASE

BUR OAK BLIGHT

Bur oak blight (BOB) affects only bur oaks and is most injurious to upland individuals in savanna remnants. Caused by a species of fungus in the *Tubaki* genus, BOB causes lesions and discoloration of the veins on the underside of the leaves, eventually causing large portions of the leaf to die. In many cases, severe infections will cause tree death, though individual susceptibility to the disease varies. The fungus can overwinter on leaf petioles that remain attached to trees and is primarily spread by raindrops that move spores throughout the tree. Early results suggest that inoculation of trees with fungicide may help slow or stop the spread of the disease within individual trees. Monitoring existing oaks for symptoms will be an important to slow or stop spread; moreover, if oaks are planted in the future, it may be beneficial to avoid planting the variety *Q. macrocarpa var. oliviformis*, which has shown the most severe susceptibility to BOB. Currently, there are no oak trees at Hastings River Flats and therefore no evidence of BOB presence or spread.

DUTCH ELM DISEASE

There are many elms growing within the floodplain forests along the Mississippi River, including in Lake Rebecca Park, which is adjacent to Hastings River Flats. These trees are not only ecologically valuable but are also at high risk of attack from tree pests. Elms are susceptible to Dutch Elm Disease. These tree pests have caused widespread mortality of native elms throughout the eastern United States and specifically in Minnesota.

Dutch Elm disease is a fungal infection caused by the fungus *Ceratocystis ulmi*, which is native to Asia, and is spread by both native and non-native bark beetles (family: Curculionidae).

Once the fungus is introduced onto a tree, the tree reacts by sealing its own xylem tissues (conduits of water and nutrients) to prevent further spread. This effectively prevents water and nutrients from reaching the upper branches, causing gradual die-off as more and more of the xylem is sealed. Symptoms include a yellowing and browning of leaves spreading from the outer crown toward the trunk. Dutch elm disease was first recorded in Minnesota near Monticello in 1961 and has since spread throughout the state. Minnesota relied heavily on American elms (*Ulmus americana*) as shade trees on streets, with about 140 million in the state at the time of the outbreak. The disease is now present in all Minnesota counties, though elms remain an important component of many Minnesota forests.

EMERALD ASH BORER

Emerald ash borer (EAB) is a non-native wood-boring beetle from Asia that was first identified in the United States in the summer of 2002. Likely transported from Asia to Michigan in ash wood used for pallets and other shipping materials, the beetle has now been confirmed in 36 states, including Minnesota. The beetle works by depositing larvae under the bark of the tree; these larvae then feed on the wood, eventually disrupting enough of the phloem to prevent the transport of nutrients throughout the tree. While Minnesota's cold weather can stymie the spread of the beetle, winter low temperatures often do not get low enough to be very effective, especially with the advent of Climate Change, and thus it continues to infect and kill ash trees within the Metro area, including Dakota County.

Nearly all ash trees adjacent to Hastings River Flats park are infected with EAB and are in various states of decline. Currently, there are no ash trees within the park, so no further action is needed.

OAK WILT

Oak wilt is an increasingly common tree disease caused by the fungus *Bretziella fagacearum*. While the disease is present in many eastern US states, it is most prevalent in the Midwestern US. It is an issue of serious concern within Minnesota in and around the seven-county metro area. Oak wilt affects all of Minnesota's most common oak species (red oak [*Quercus rubra*], pin oak [*Q. ellipsoidalis*], bur oak [*Q. macrocarpa*], and white oak [*Q. alba*]), though it does not affect these species equally. Red and pin oak are the most susceptible species, with infected individuals wilting in six weeks or less. Bur and white oaks may take years to wilt completely and may only do so one branch at a time. The fungus can be transported from tree to tree by sap beetles but most commonly spreads through root grafts. The beetles are attracted to the fungal mats created when mature oaks die from oak wilt and to wounds on uninfected oaks, providing a convenient pathway of spread for the fungus. Oaks commonly form root grafts between individuals, allowing direct transfer of the fungus from infected to healthy individuals.

Oak wilt has not been identified at Hastings River Flats, and there are currently no oak trees within the units at the park. However, there are oak trees within the forest canopy at the

adjacent Lake Rebecca Park. If oak trees were to become established at Hastings River Flats or intentionally planted to transition the site to an oak savanna community, they would need to be monitored for oak wilt. In general, care should also be taken to avoid injuring trees during the early growing season (April to July), when trees are most susceptible to the fungal spread. If a tree is injured during this time, covering the wounds is recommended. If pruning or other activities must be done, waiting for the winter is the safest option.

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APPENDICES

APPENDIX A. VEGETATION SURVEY DATA AT HASTINGS RIVER FLATS

The following plant species were identified at the site by Friends of the Mississippi River. Species in red are nonnative. 0.5 = less than 1% cover, 1 = 1-5% cover, 2 = 6-25% cover, 3 = 26-50% cover, 4 = 51-75% cover, and 5 = 76-100% cover. Cover for forbs, woody plants, and graminoid guilds are listed in bold.

Species	Common Name	2002 sp inventory (prior to resto)	2019 All	2019 South Prairie	2019 North Prairie	2021 - weeds only	2025 South Prairie	2025 North Prairie
Forbs					**4**		**2**	**3**
Achillea millefolium	Yarrow	P		0.5	0.5		0.5	
Agastache foeniculum	Anise hyssop				0.5			1
Ambrosia artemisiifolia	Common ragweed	A	1		1		2	2
Amorpha canescens	Leadplant						0.5	
Artemisia ludoviciana	Prairie sage		1	1			2	1
Asclepias incarnata	Swamp milkweed			0.5	0.5			
Asclepias syriaca	Common milkweed		1	1	1		0.5	0.5
Asclepias tuberosa	Butterflyweed		0.5					
Asclepias verticillata	Whorled milkweed			0.5	0.5		0.5	0.5
Baptisia alba	False white indigo		0.5				0.5	
Barbarea orthoceras	Yellow rocket							2
Bidens spp.	Beggarticks spp.		0.5					
Centaurea stoebe	Spotted knapweed		0.5					

Species	Common Name	2002 sp inventory (prior to resto)	2019 All	2019 South Prairie	2019 North Prairie	2021 - weeds only	2025 South Prairie	2025 North Prairie
Chaiturus marrubiastrum	False motherwort							0.5
Chamaenerion angustifolium	Fireweed							0.5
Chenopodium album	Lamb's quarter	P			1			
Cirsium arvense	Canada thistle			x	1	1		
Cirsium discolor	Field thistle						0.5	
Cirsium vulgare	Bull thistle						0.5	
Conyza canadensis	Horseweed	P						1
Dalea candida	White prairie clover		0.5				0.5	
Dalea purpurea	Purple prairie clover						0.5	
Desmodium canadense	Showy tick trefoil		0.5		0.5		0.5	
Erigeron annus	Daisy fleabane	D		2	1		2	2
Eupatorium perfoliatum	Boneset							0.5
Helenium autumnale	Sneezeweed							0.5
Helianthus grosseseratus	Sawtooth sunflower				0.5			0.5
Heliopsis helianthoides	Early Sunflower			0.5				
Heuchera richardsonii	Alumroot		0.5					
Hypericum perfoliatum	Common St. John's-wort	P					1	0.5
Iris versicolor	Blue flag iris				0.5			
Leonurus sibiricus	Siberian motherwort							0.5
Lespedeza capitata	Round-headed bushclover							0.5
Liatris aspera	Button blazing star		0.5					
Lobelia cardinalis	Cardinal flower							0.5
Lobelia siphilitica	Great blue lobelia							0.5

Species	Common Name	2002 sp inventory (prior to resto)	2019 All	2019 South Prairie	2019 North Prairie	2021 - weeds only	2025 South Prairie	2025 North Prairie
Lotus corniculatus	Bird's foot trefoil			1		1	0.5	
Lycopus sp	Bugleweed			0.5				
Lythrum salicaria	Purple loosestrife*		1	1		1	0.5	1
Medicago lupulina	Black medick	P		2		2		
Melilotus alba	White sweet clover	P	occ	0.5		0.5	0.5	
Melilotus officinale	Yellow sweet clover	P				0.5	0.5	
Monarda fistulosa	Bergamot		1	1	0.5		1	2
Monarda punctata	Spotted bee balm						0.5	
Nepeta cataria	Catmint							0.5
Oenothera biennis	Evening primrose		1				0.5	0.5
Penstemon digitalis	Foxglove beardtongue						0.5	
Persicaria pensylvanica	Pennsylvania smartweed							0.5
Physostegia virginiana	Obedient plant							0.5
Plantago patanonica	Wooly plantain	C						
Potentilla norvegica	Rough cinquefoil	P						
Potentilla sp.	Cinquefoil						0.5	
Pycnanthemum virginianum	Mountain mint						0.5	0.5
Ratibida pinnata	Yellow coneflower			1			0.5	
Rudbeckia hirta	Black-eyed Susan	P		1			0.5	0.5
Silene csereii	Balkan catchfly	P						
Silene latifolia	White campion				0.5			
Sisymbrium loeselii	Tall hedge mustard				2	2		
Solidago canadensis	Canada goldenrod		2		2	2	1	0.5

Species	Common Name	2002 sp inventory (prior to resto)	2019 All	2019 South Prairie	2019 North Prairie	2021 - weeds only	2025 South Prairie	2025 North Prairie
Solidago gigantea	Late goldenrod				2			
Solidago graminifolia	Grass-leaved goldenrod		1	1				
Solidago ptarmicoides	Upland white goldenrod						1	1
Solidago rigida	Stiff Goldenrod		1	1	1			0.5
Solidago speciosa	Showy goldenrod		0.5					
Symphyotricum ericoides	Heath aster		0.5					
Thlaspi arvense	Field pennycress							0.5
Trifolium pratense	Red clover			1		0.5		
Typha angustifolia	Narrow-leaf cattail				2	2		1
Urtica dioica	Stinging nettle				2			0.5
Verbascum thapsus	Mullein	P	1	1		1	0.5	1
Verbena hastata	Blue vervain	P	1	1	2		1	3
Verbena stricta	Hoary vervain	P					1	
Vernonia fasciculata	Ironweed		1	1			1	
Veronicastrum virginicum	Culver's Root		1	1				
Xanthium strumarium	Cocklebur				1	1		
Zizia aurea	Golden Alexanders			1				
	Forb species richness		**23**	**23**	**22**	**12**	**32**	**34**
Woody							**3**	**1**
Amorpha fruticosa	False indigo						1	2
Populus deltoides	Cottonwood	C	Patches				2	1
Populus tremuloides	Quaking aspen						2	0.5
Salix sp	Willow						3	2
Ulmus pumila	Siberian elm			1	0.5	0.5	0.5	0.5

Species	Common Name	2002 sp inventory (prior to resto)	2019 All	2019 South Prairie	2019 North Prairie	2021 - weeds only	2025 South Prairie	2025 North Prairie
Vitis riparia	Wild grapevine			1	1		0.5	0.5
	Woody species richness			**2**	**2**	**1**	**6**	**6**
Graminoids					**3**		**4**	**4**
Agropyron repens	Quackgrass	P						
Agropyron trachycaulum	Slender wheatgrass	A						
Andropogon gerardii	Big bluestem		1		1		1	2
Bouteloua curtipendula	Sideoats grama				1		0.5	0.5
Bromus inermis	Smooth brome		2	2	2	2	2	
Dichanthelium scribnerianum	Scribern's panic grass						0.5	
Eleocharis sp	Spikerush			1				
Elymus canadensis	Canada wild rye				2			0.5
Equisetum cf hyemale	Common scouring rush	P					2	2
Eragrostis spectabilis	Purple lovegrass						0.5	0.5
Hordeum jubatum	Foxtail barley	P						
Juncus torreyi	Torrey's rush							0.5
Lepidium densiflorum	Peppergrass	P						
Lolium perenne	Ryegrass	P						
Miscanthus sinensis	Silvergrass				0.5	0.5		
Panicum capillare	Witchgrass							0.5
Panicum virgatum	Switchgrass		1	2	1		2	0.5
Phalaris arundinacea	Reed canary grass				0.5	0.5	2	1
Phleum pratense	Timothy	P						
Poa pretensis	Kentucky bluegrss		2		2	2		
Schyzachrium scoparium	Little bluestem		2	2			2	1

Scirpus spp.	Bulrush spp.			2	1			
Setaria faberi	Giant foxtail				2	2		2
Species	**Common Name**	**2002 sp inventory (prior to resto)**	**2019 All**	**2019 South Prairie**	**2019 North Prairie**	**2021 - weeds only**	**2025 South Prairie**	**2025 North Prairie**
Setaria viridula	Green foxtail		2		2	2	1	5
Sorghastrum nutans	Indian grass		2		2		4	2
Spartina pectinata	Prairie cordgrass		1					
	Graminoid species richness		**8**	**8**	**12**	**6**	**11**	**13**

APPENDIX B. BIRD SURVEY DATA AT HASTINGS RIVER FLATS

The following table lists breeding bird survey data from 2002, 2020, and 2021. Breeding bird survey data is collected during two site visits in June and documents bird species found within a 1000 m transect through the north and south prairie units. Species in blue are species of greatest conservation need identified by the MN DNR.

Hastings River Flats Breeding Bird Survey
30-acre grassland/wetland
50 min transect (1000 m)

	Common Name	Code	2002	2020	2021
1	American Crow	AMCR	7		3
2	American Goldfinch	AMGO	16	12	3
3	American Redstart	AMRE		2	4
4	American Robin	AMRO	4	6	2
5	Bald Eagle	BAEA			6
6	Baltimore Oriole	BAOR	1	1	3
7	Barn Swallow	BASW	8		1
8	Black-capped Chickadee	BCCH		1	3
9	Blue Jay	BLJA			3
10	Bobolink	BOBO	4		
11	Brown-headed Cowbird	BHCO	8	3	2
12	Cedar Waxwing	CEWA	2	2	2
13	Chipping Sparrow	CHSP	4		
14	Cliff Swallow	CLSW	2		
15	Common grackle	COGR		2	5
16	Common Yellowthroat	COYE	6		
17	Downy Woodpecker	DOWO		1	1
18	Eastern Phoebe	EAPH	1	1	
19	Eastern wood pewee	EWPE	1		1
20	European Starling	EUST	7	1	
21	Great-crested Flycatcher	GCFL		1	3
22	Green Heron	GRHE	1		
23	Hairy Woodpecker	HAWO	1		
24	House Finch	HOFI	14		
25	House Sparrow	HOSP	32		
26	Indigo Bunting	INBU		1	
27	Killdeer	KILL	4		

28	Least Flycatcher	LEFL		1	1
29	Mallard	MALL	17	1	
30	Mourning Dove	MODO	13	2	2
31	Northern cardinal	NOCA		1	1
32	Northern Rough-winged Swallow	NRWS	15	1	1
33	Red-bellied woodpecker	RBWO	1	1	
34	Red-eyed Vireo	REVI	1		
35	Red-tailed Hawk	RTHA	1		6
36	Red-winged Blackbird	RWBL	8	14	3
37	Rose-breasted Grosbeak	RBGR	1		
38	Song Sparrow	SOSP	6	14	7
39	Sora	SORA	2		
40	Spotted Sandpiper	SPSA	3		
41	Tree Swallow	TRSW	8	9	8
42	Turkey Vulture	TUVU			1
43	Warbling Vireo	WAVI	9	3	3
44	Yellow Warbler	YEWA	4	4	5
		# Species	33	24	26
		# Birds	212	85	80

APPENDIX C. TARGET NATIVE PLANT COMMUNITIES

Content abbreviated from the Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province.

SOUTHERN WET PRAIRIE (WPs54)

Description: Grass-dominated but forb-rich herbaceous communities on poorly drained to very poorly drained loam soils formed in lacustrine sediments, unsorted glacial till, or less frequently outwash deposits. Typically in slight depressions, sometimes on very gentle slopes. Flooded for brief periods at most; upper part of rooting zone is not saturated for most of growing season, but saturation usually persists in lower zone for much of season.

Graminoid cover is usually continuous (75-100%). Tallgrass dominate, but several midheight and low grasses and sedges are also important. Prairie cordgrass (*Spartina pectinata*), and big bluestem (*Andropogon gerardii*), are the dominant tallgrasses; Indian grass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*) are frequently important. Narrow reedgrass (*Calamagrostis stricta*) is a major species in the western part of the state. Wooly sedge (*Carex pellita*) is often an important component, and rigid sedge (*C. tetanica*) and flattedned spikerush (*Eleocharis compressa*) are frequently present. Mat muhly grass (*Muhlenbergia richardsonis*) is sometimes abundant, growing under taller species or even forming most of the cover on saline sites in western Minnesota.

Forb cover is sparse to patchy (5-50%). Canada goldenrod (*Solidago Canadensis*) and giant, sawtooth, or Nuttall's sunflower (*Helianthus giganteus, H. grosseserratus, or H. nuttallii*) are typically most common.Other common taller forbs are giant goldenrod (*Solidago gigantea),* tall meadow-rue (*Thalictrum dasycarpum*), eastern panicled aster (*Aster lanceolatus*), and great blazing star (*Liatris pycnostachys*). Common midheight species are heath aster (*Aster ericoides*), clasping dogbane (*Apocynum sibiricum*), Virginia mountain mint (*Pycnanthemum virginianum*), and golden alexanders (*Zizia aurea*). Common strawberry (*Fragaria virginiana*), golden or false golden ragwort (*Senecio aureus or S. pseudaureus*), and stemless blue violets (*Viola sororia* and *V. nephrophylla*) are typically common in the lowest layer. Forb diversity and height decrease where soil salinity is elevated.

Shrub layer is absent to sparse (0-25% cover). The low semi-shrub prairie rose (*Rosa arkansana*) is most frequent; red-osier dogwood (*Cornus sericeus*) and pussy willow (*Salix discolor*) are occasional.

SOUTHERN SEEPAGE MEADOW/CARR (WMs83)

Description: Open wetlands dominated by a dense cover of hummock-forming broad-leaved sedges or tall shrubs. Present in areas of groundwater seepage along streams and drainageways, on sloping terraces, and at bases of slopes.
Graminoid cover is interrupted to continuous (50–100%); typically dominated by tussock sedge (*Carex stricta*) or aquatic sedge (*C. aquatilis*) with bluejoint (*Calamagrostis canadensis*),

lake sedge (*C. lacustris*), prairie sedge (*C. prairea*), woolly sedge (*C. pellita*), and fowl manna grass (*Glyceria striata*) common. Hairy-fruited sedge (*Carex trichocarpa*) is dominant on some sites.

Forb cover is variable (5–75%); common species include spotted Joe pye weed (*Eupatorium maculatum*), great water dock (*Rumex orbiculatus*), common boneset (*Eupatorium perfoliatum*), marsh bellflower (*Campanula aparinoides*), red-stemmed aster (*Aster puniceus*), swamp milkweed (*Asclepias incarnata*), northern and cut-leaved bugleweeds (*Lycopus uniflorus* and *L. americanus*), common marsh marigold (*Caltha palustris*), giant sunflower (*Helianthus giganteus*), and touch-me-nots (*Impatiens* spp.)

Shrub cover is variable. Tall shrubs, if present, include red-osier dogwood (*Cornus sericea*), pussy willow (*Salix discolor*), slender willow (*S. petiolaris*), and Bebb's willow (*S. bebbiana*).

SAND/GRAVEL/COBBLE RIVER SHORE (RVx32)

Description: Sparsely to densely vegetated plant communities on sand, gravel, or small cobbles on river shores. Characterized by annual herbaceous species, firmly rooted perennial species tolerant of inundation, and species dispersed by tubers and other floating propagules. Scoured annually during spring breakup and flooding by ice and currents, and following heavy rains. Vegetation cover may be relatively stable or may be variable and ephemeral, changing seasonally with change in water level. Community is distinctly zonal, usually with an upper beach zone and one or more lower beach zones.

Upper zone is inundated during highest water levels, typically following spring runoff and repeated heavy summer rains; otherwise the upper zone is exposed and often droughty, especially in sunny settings. Vegetation is composed of woody species and annual and perennial herbaceous species. Cover and composition are highly variable. Sandbar willow (*Salix exigua*) often forms thickets. False indigo (*Amorpha fruticosa*) and seedlings of willow trees, cottonwood, and silver maple are often present. Common herbaceous species include bunched ironweed (*Vernonia fasciculata*), blue vervain (*Verbena hastata*), swamp milkweed (*Asclepias incarnata*), obedient plant (*Physostegia virginiana*), clammy weed (*Polanisia dodecandra*), horseweed (*Conyza canadensis*), and woundwort (*Stachys palustris*). Emory's sedge (*Carex emoryi*) may form dense patches in shaded settings. The highly invasive species reed canary grass (*Phalaris arundinacea*) is often abundant in this zone.

Lower zone is generally exposed during normal to low water levels, typically from midsummer to fall. Receding waters may deposit a thin layer of silt or clay in this zone, but it is removed when water levels rise again. Vegetation is highly variable in cover and composition but often is characterized by annual herbaceous species, especially on sand substrates. On gravel or cobble substrates, vascular plants are mostly restricted to patches of finer material that collects in interstitial spaces between cobbles. Creeping lovegrass (*Eragrostis hypnoides*) and awned umbrella sedge (*Cyperus squarrosus*) are often abundant.

Other typical species include tufted lovegrass (*Eragrostis pectinacea*), Frank's lovegrass (*E. frankii*), barnyard grasses (*Echinochloa* spp.), witch grass (*Panicum capillare*), Philadelphia panic grass (*P. philadelphicum*), brook nut sedge (*Cyperus bipartitus*), fragrant cyperus (*Cyperus odoratus*), spikerushes (*Eleocharis erythropoda*, *E. intermedia*, and *E. ovata*), knotty rush (*Juncus nodosus*), hemicarpha (*Hemicarpha micrantha*), water stargrass (*Zosterella dubia*), blue monkey flower (*Mimulus ringens*), ditch stonecrop (*Penthorum sedoides*), golden dock (*Rumex maritimus*), yellow-seeded false pimpernel (*Lindernia dubia*), common plantain (*Plantago major*), Rugel's plantain (*P. rugelii*), large-bracted vervain (*Verbena bracteata*), low cudweed (*Gnaphalium uliginosum*), speedwells (*Veronica catenata* and *V. americana*), carpetweed (*Mollugo verticillata*), and beggarticks (*Bidens* spp.). Emergent aquatic plants and floating-leaved or submerged aquatic plants tolerant of stranding are sometimes present, especially during low water levels. These include river bulrush (*Scirpus fluviatile*), sessile-fruited arrowhead (*Sagittaria rigida*), and arum-leaved arrowhead (*S. cuneata*).

APPENDIX D. METHODS FOR CONTROLLING NON-NATIVE AND INVASIVE PLANTS

INVASIVE TREES AND SHRUBS

COMMON BUCKTHORN, TATARIAN HONEYSUCKLE, SIBERIAN ELM AND BLACK LOCUST

These are some of the most common invasive woody species likely to invade native woodlands or prairies in Minnesota. Buckthorn and honeysuckle are European species that escaped and invaded woodlands in many parts of the country. They are exceedingly aggressive and, lacking natural diseases and predators, can out-compete native species. They remain photosynthetically active longer than most other native shrubs and trees, which gives them a competitive advantage. The seeds are disseminated by birds, which make them especially problematic in open woodlands, savannas, and overgrown prairies. They also benefit from the net actions of invasive earthworms, fire suppression, and high deer populations, forming a synergy that helps set the stage for their establishment and dominance. Invasions eventually result in dense, impenetrable brush thickets that greatly reduce ground-level light availability and can cause declines in native species abundance and diversity.

Siberian elm, native to eastern Asia, grows vigorously, especially in disturbed and low-nutrient soils with low moisture. Seed germination is high, and seedlings establish quickly in sparse vegetation. It can invade and dominate disturbed areas in just a few years. Black locust is native to the southeastern United States and the very southeastern corner of Minnesota. It has been planted outside its natural range (it was promoted as an erosion control species and a soil stabilizer, partly because it was falsely assumed to be a nitrogen fixer, and since it quickly colonizes bare slopes) and readily invades disturbed areas. It reproduces vigorously by root suckering and can form monotypic stands.

BIOLOGICAL CONTROL

Newer research from the Minnesota Invasive Terrestrial Plants and Pests Center (MITPPC) is investigating the use of fungal biocontrol for common and glossy buckthorn. Initial findings are promising, and this methodology could be a key tool in managing buckthorn infestations. (https://mitppc.umn.edu/research/research-projects/biological-control-buckthorn-using-fungi)

CHEMICAL CONTROL

The most efficient way to remove woody plants that are 1/2 inch or more in diameter is to cut the stems close to the ground and treat the cut stumps with herbicide immediately after they are cut, when the stumps are fresh, and the chemicals are most readily absorbed. Failure to treat the stumps will result in resprouting, creating the need for future management interventions.

In non-freezing temperatures, a glyphosate herbicide such as Roundup can be used for most woody species. It is important to obtain the concentrated formula and dilute it with water to

achieve 10% glyphosate concentration. Adding a marker dye helps to make treated stumps more visible, improving accuracy and overall efficiency. In winter months, an herbicide with the active ingredient triclopyr must be used. *Garlon 4* is a common brand name and it must be mixed with a penetrating oil, such as diluent blue. *Garlon* 4 will also work throughout the year. Do not use diesel fuel, as it is much more toxic in the environment and to humans.

Brush removal work can be done at any time of year except during spring sap flow, but late fall is often ideal because buckthorn retains its leaves longer than other species and is more readily identified. Moreover, once native plants have senesced, herbicide will have fewer non-target effects on native vegetation. Cutting can be accomplished with loppers or handsaws in many cases. Larger shrubs may require brush cutters and chainsaws, used only by properly trained professionals.

For plants in the pea family, such as black locust, an herbicide with the active ingredient clopyralid can be more effective than glyphosate. Common brand names for clopyralid herbicides are Transline, Stinger, and Reclaim.

In the year following initial cutting and stump treatment, there will be a flush of new seedlings as well as possible resprouting from some of the cut plants. Herbicide can be applied to the foliage of these plants. Fall is the best time to do this, when desirable native plants are dormant and when the plant is pulling resources from the leaves down into the roots. Glyphosate, triclopyr and Krenite (active ingredient – fosamine ammonium) are the most commonly used herbicides for foliar application. Krenite prevents bud formation so the plants do not grow in the spring. This herbicide can be effective, but results are highly variable. Glyphosate or a triclopyr herbicide such as Garlon can also be used. Glyphosate is non-specific and will kill anything green, while triclopyr targets broadleaf plants and does not harm graminoids. All herbicides should be applied by licensed applicators and should not be applied on windy days. Care should be taken to avoid application to other plants. “Weed Wands” or other devices that allow dabbing of the product can be used rather than spraying, especially for stump treatment. Basal bark herbicide treatment is another effective control method. A triclopyr herbicide such as Garlon 4, mixed with a penetrating oil, is applied all around the lower 6-12 inches of the tree or shrub, taking care so that it does not run off. If the herbicide runs off it can kill other plants nearby. More herbicide is needed for effective treatment of plants that are four inches or more in diameter.

Undesirable trees and shrubs can also be destroyed without cutting them down. Girdling is a method suitable for small numbers of large trees. Bark is removed in a band around the tree, just to the outside of the wood. If girdled too deeply, the tree will respond by resprouting from the roots. Girdled trees die slowly over the course of one to two years. Girdling should be done in late spring to mid-summer when sap is flowing and the bark easily peels away from the sapwood. Herbicide can also be used in combination with girdling for a more effective treatment. Girdling has the added benefit of creating snags for wildlife habitat. While girdling

a large number of trees is not feasible, girdling the occasional large tree will provide a matrix of habitat for species that depend on standing dead trees for food or nesting opportunities.

MECHANICAL CONTROL

Three mechanical methods for woody plant removal are hand pulling (only useful on small seedlings and only if few in number), weed wrenching (using a weed wrench tool to pull stems of one to two inches diameter), and repeated or "critical" cutting. Pulling and weed wrenching can be done any time when the soil is moist and not frozen. The disadvantage to both methods is that they are somewhat time-consuming, as the soil from each stem should be shaken off. Weed wrenching also creates a great deal of soil disturbance and should not be used on steep slopes or anywhere that desirable native forbs are growing. The soil disturbance also creates opportunities for colonization by other non-native plants. This method is the least preferable and is probably best used in areas that have hardly any desirable native plant cover.

Repeated cutting consists of cutting the plants (by hand or with a brush cutter) at critical stages in its growth cycle, typically twice per growing season. Cutting in mid spring (late May) intercepts the flow of nutrients from the roots to the leaves and cutting in fall (about mid-October) intercepts the flow of nutrients from the leaves to the roots. Depending on the size of the stem, the plants typically die within three years, with two cuttings per year.

PRESCRIBED FIRE

Prescribed burning is the most efficient, cost effective, and least harmful way to control very small stems, seedlings, and resprouts of all woody plants. It also restores an important natural process to fire-dependent natural communities (oak forests, for example). Burning can only be accomplished if adequate fuel (fine fuels such as grasses and sedges, and leaf litter, especially oak leaves) is present and can be done in late fall or early spring, depending on site conditions.

INVASIVE NATIVE SHRUBS

PRICKLY ASH

A common native shrub, prickly ash can become excessively abundant, especially in areas that have been disturbed or grazed. Complete eradication is not necessary, but management typically targets reducing the extent of a population. Removal is most easily accomplished in the same manner as for buckthorn – cutting shrubs and treating cut stumps with glyphosate herbicide. Cutting can be completed at any time of the year.

SMOOTH SUMAC

Like prickly ash, smooth sumac can become excessively abundant in grasslands and savannas, especially in areas where fire has been suppressed for long periods of time. It can form dense, clonal stands that dominate other vegetation. Unlike prickly ash or buckthorn, however, controlling smooth sumac does not require herbicide applications, since that would require a tremendous amount of herbicide, be quite labor intensive, and probably cause

heavy damage to surrounding plants. Control of smooth sumac can be easily accomplished by cutting and burning, or a combination of these two methods. To be effective, the sumac must be burned or cut twice a year: the first time in the late spring, just after it has fully leafed out (expended maximum energy), and the second time in late summer, after it has re-sprouted. Repeat this method annually for two to five years to deplete the clone of its energy, working back at the edges of the clone and reducing cover from the outside of the area towards the center. If cutting or burning is performed only once a season, the clone will persist, since this will not be enough to drain the root system of stored energy. Cutting twice a year without burning will be effective, but burning is doubly so, since fire tends to benefit herbaceous plants and suppress woody ones.

DISPOSAL

The easiest and most cost-effective method to handle large amounts of woody brush is usually to stack it and burn it. This is most typically done during winter to lessen the impacts to soil (compaction, erosion, rutting, etc.), though often brush will be piled soon after the removal and burned during the winter. In areas where brush is not dense, it can be cut up into smaller pieces, scattered, and left on the ground where it will decompose in one to three years (this method is especially useful on slopes to reduce erosion potential). Small brush piles can also be left in the woods as wildlife cover. Where there is an abundance of larger trees, cut trees may be hauled and chipped and used for mulch or as a biofuel. Alternatively, the wood can be cut and used for firewood, if a recipient can be found, or perhaps saved to be used later as waterbars for slope stabilization.

FORBS

SPOTTED KNAPWEED

Knapweed is a perennial species that has become a troublesome prairie invader. Of all the typical prairie weeds, spotted knapweed is probably the most difficult to manage. It cannot be controlled with burning—like sweet clover it actually increases with fire. Hand-pulling individuals or small groups of individuals can be effective for small infestations, and is often a good volunteer group task. However, knapweed has a fairly large tap root and can be difficult to pull. Pulling is typically more difficult when soil is hard (dry), clayey, or compacted, but easier when soil is wet (following a rain), sandy, and friable. If knapweed populations are large, a bio-control (knapweed beetles--weevils) is recommended. Knapweed beetles (weevils) are released during the summer. Weevils can be purchased online and they are sent via the mail. Knapweed populations should be monitored each year to keep a record of the effectiveness of the bio-control.

Weevils are effective for long-term control, but not a good short-term control option. Spot treatment with a systemic herbicide such as Milestone or Transline can be effective for short-term control. Applying herbicide to prairie restoration areas should be done with care. Remnants with high diversity should be spot treated, not broadcast-treated. It is recommended to treat first with the least impactful chemical, monitor to see if that works,

and then try another if it does not work. Degraded and highly disturbed areas can be treated a little less gently, perhaps using broadcast applications. Always follow the product label when using any chemical for weed control. Treatment should be done before the target plants form seed, so late spring and early summer are best. Professional pesticide applicators are required for herbicide treatment.

CANADA THISTLE

While native thistles are not generally problematic, exotics such as Canada thistle are clone-forming perennials that can greatly reduce species diversity in old fields and restoration areas (Hoffman and Kearns 1997). A combination of chemical and mechanical control methods may be needed. Chemical control is most effective when the plants are in the rosette stage and least effective when the plants are flowering. Where native grasses and sedges are present, use of a broadleaf herbicide such as 2,4-D is recommended, since 2,4-D only affects dicots. 2,4-D is most effective when applied 10-14 days before the flowering stems bolt. It is applied at a rate of 2-4 lb/acre using a backpack or tractor-mounted sprayer or in granular form. Dicamba could also be used, with the advantages that it can be applied earlier in the spring at a rate of 1 lb/acre. Another chemical that has been used for thistles is aminopyralid ("Milestone"), which can be applied at bud stage. Aminopyralid will affect other species and it has longer residual activity than some other chemicals, so use with caution—typically use it on large patches/clones of thistles and avoid areas of higher diversity. Plants that do not respond to treatment or that are more widely dispersed could be controlled mechanically.

Mechanical control, involving several cuttings per year for three or four years, can reduce an infestation if timed correctly. The best time to cut is when the plants are just beginning to bud because their food reserves are at their lowest. If plants are cut after flowers have opened, the cut plants should be removed because the seed may be viable. Plants should be cut at least three times throughout the season. Late spring burns can also discourage this species, but early spring burns can encourage it. Burning may be more effective in an established prairie, where competition from other species is strong, rather than in an old field, where competition is likely to be weaker.

SWEET CLOVER

White and yellow sweet clover are very aggressive biennial species that *increase* with fire. Where sweet clover is found, it should be controlled in conjunction with treatment that attempts to eliminate smooth brome, if prairie restoration occurs. Sweet clovers are common plants in agricultural areas, so if restoration is implemented, the project area should be surveyed for this species on an annual basis. Often times, following initial brush removal and/or burning, a flush of weedy annuals and biennials such as sweet clover can occur. Well-timed mows and burnings are usually adequate to control these species. Mowing the site, as is typically prescribed for prairie restoration maintenance, should occur when all plants on the site (including sweet clovers) are approximately 12 inches in height. Sweet clover can bloom even at a height of 6 inches, but if it is burned or mowed in the following year in the late spring, it should be controlled. On steep sites, brush cutting can be substituted for

mowing. Individual plants or small populations can be removed by hand-pulling. If seed production occurs, prodigious amounts of seed can be produced and spread, so pull before seeds appear or bag seed producing plants. Competition from native species also helps control sweet clovers and other weedy annuals and biennials.

To some extent, common burdock and common mullein can be treated similarly to sweet clover, since they are both exotic, biennial forbs that are typically found in disturbed areas or restoration projects.

GARLIC MUSTARD

Garlic mustard is an exotic biennial forb of woodlands and woodland edges that is very invasive and aggressive. Following the introduction of just a few plants, populations can rapidly increase and a dramatic "explosion" of garlic mustard plants can occur. In some areas it can form monotypic stands that crowd out other species, while recent studies have shown that in other locations it may simply occupy open ecological niches. Nevertheless, garlic mustard can be very invasive in woodlands, and it is recommended to monitor and remove it as soon as it is detected (early detection and rapid response). Garlic mustard also produces a flavonoid (root exudate) that suppresses mycorrhizal inoculation. Thus species that are mycorrhizae dependent, like oaks, will become stunted and easily out-competed by garlic mustard. The flavinoid persists in the soil years after garlic mustard plants are removed, which is a good reason to keep woodlands garlic mustard-free.

Probably the best way to control garlic mustard is to closely monitor your site, and if garlic mustard is found, hand pull it before it spreads. Hand-pulling should occur before siliques (seed pods) form. Once siliques form, removed plants should be bagged and transported from the site, since the plant may have enough energy in the stem and root to make viable seeds, even though it is not growing in the ground. If bagging and transporting are not an option, making weed piles is an option, but prepare to deal with garlic mustard plants in the future at each pile. Garlic mustard plants produce hundreds of seeds per plant—they are very prolific. When pulling garlic mustard plants, take care to remove the entire root, since they may re-sprout if part of the root is left in the ground. This can be difficult, since roots are "S-shaped" and tend to break off at ground level.

Chemical control is not recommended except in cases where garlic mustard is growing in large monoculture patches. In such cases, a systemic herbicide may be appropriate. Glyphosate is non-specific and will kill any actively growing plant. One technique that has been effective is applying a water-soluble herbicide during warm days in the winter, when no snow cover or only a thin snow cover exists. Garlic mustard rosettes (first-year plants) remain green mostly all year round, and can be killed during the winter when nearly all other plants are dormant. Another successful technique is to use an herbicide specific to broadleaved plants, like triclopyr ("Garlon"), but one that is water soluble, which can be dispensed with a backpack sprayer or the like; this will not kill grasses or sedges.

There are studies underway by the Minnesota DNR and University of Minnesota that show good potential for biocontrol of garlic mustard via an exotic weevil (http://www.legacy.leg.mn/projects/biological-control-european-buckthorn-and-garlic-mustard). The testing phase is complete, but the approval process still needs to be performed. If approved, this method could revolutionize garlic mustard control. However, whether it will be effective or not on a landscape scale is yet to be determined.

GRASSES

SMOOTH BROME

Smooth brome is a cool-season grass —active early in the growing season in southern Minnesota (April-May-June) and then going semi-dormant in July-September. It reproduces by means of underground stems (stolons and rhizomes) called "tillers". The most effective treatment is timed to occur at the same time as the brome is "tillering"—mid to late May in southern Minnesota. Burning two years in a row (late-season burns in June) followed by seeding has been shown to be effective in controlling smooth brome. Consider that this timing may be a week or two earlier on steep south-facing slopes or in very sandy or sand-gravel soils. Following this method will usually be sufficient to control smooth brome. Seeding following burns, preferably with native seed collected on-site, or purchased from a seller that provides local ecotypes, is important for restoring cover at the site. Evaluation can occur each year, and especially after two years. If this is not working, perhaps try a cool-season overspray of a grass-specific herbicide either in the spring (April) or in the fall (October). Using glyphosate as a cool-season overspray herbicide application is a last resort, since it is non-specific and can kill everything.

Kentucky bluegrass and creeping fescue can be treated similarly to smooth brome, since like smooth brome, they are both exotic, stoloniferous, cool-season grasses. Spring burns are the most effective tool against all of these species.

REED CANARY GRASS

This species is extremely difficult to eradicate and requires repeated treatment over a period of one to three years. A combination of burning, chemical treatment and mowing can be used in accessible areas, or chemical treatment alone in inaccessible areas. The combination method starts by burning in late spring to remove dead vegetation and to stimulate new growth. When new sprouts have reached a height of 4 to 6 inches, the site can be sprayed with a 5% solution of a glyphosate herbicide appropriate for wetland habitat (e.g., Rodeo). The site is then mowed in late summer, followed by chemical application after re-growth. This treatment will stimulate new growth and germination to deplete the seed bank. The sequence of chemical treatment and mowing are repeated for at least a second season, and possibly a third until the grass is completely eradicated. Then native grass and forb seed can be broadcast or drilled.

If reed canary grass is eradicated from an area, future management of the grassland, namely burning, will likely keep the reed canary in check. Monitoring and mapping new individuals or clumps should continue, however, and those individuals should be treated if burning is not adequately controlling them. If the plants are small, they can be removed by digging out the entire root. Generally, though, chemical treatment is more feasible. If plants are clumped, they can be treated by tying them together, cutting the blades, and treating the cut surface with herbicide. Otherwise, herbicide should only be applied in native planted areas on very calm days to avoid drift to non-target plants.

APPENDIX E. ECOLOGICAL CONTRACTORS

Following is a list of contractors to consider for implementing the management plans. While this is not an exhaustive list, it does include firms with ecologists who are very knowledgeable with natural resource management. Unless otherwise noted, all firms do prescribed burning. Many other brush removal companies are listed in the yellow pages (under tree care), but most do not have knowledge or understanding of native plant communities. We recommend hiring firms that can provide ecological expertise. Additional firm listings can be found on the DNR website: http://www.dnr.state.mn.us/gardens/nativeplants/index.html

Friends of the Mississippi River (FMR) has extensive experience working with landowners to implement natural resource management plans. FMR can assist landowners with obtaining funding for restoration and management projects and providing project management, including contractor negotiations, coordinating restoration and management work, and site monitoring and evaluation.

Conservation Corps Minnesota
60 Plato Blvd E Ste 210
Saint Paul, MN 55107
(651) 209-9900
www.conservationcorps.org

Great River Greening
251 Starkey St #2200
St Paul, MN 55107
(651) 665-9500
www.greatrivergreening.org

Minnesota Native Landscapes (MNL)
8740 77th St NE
Otsego, MN 55362
(763) 295-0010
www.mnlcorp.com

Prairie Restorations, Inc.
31646 128th St.,
Princeton, MN 55371
(763) 389-4342
www.prairieresto.com

Stantec
733 Marquette Avenue, Suite 1000
Minneapolis, MN 55402
(612) 712-2000
www.stantec.com

Resource Environmental Solutions, LLC (RES)
20276 Delaware Avenue
Jordan, MN 55352
(217) 979-2415
www.res.us

Native Resource Preservation
260 Wentworth Ave E Suite 155
West St Paul, MN 55118
(320) 413-0015
www.nativeresourcepreservation.com

Natural Resource Services, Inc.
PO Box 544
Cambridge, MN 55008
(763) 656-8587
www.naturalresourceservice.com

Landbridge Ecological, Inc.
670 Vandalia St.
St Paul, MN 55114
(612) 503-4420
www.landbridge.eco