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Wisconsin Department of Natural Resources

Ecological Restoration and Management Plan

Havenwoods State Forest Rehabilitation

WDNR Project #MKE2007_Hvnwds

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Acronyms and Abbreviations

AHI	Wisconsin Architecture and History Inventory
AOC	Area of Concern
APE	Area of Potential Effects
BUI	Beneficial Use Impairment
DBH	Diameter at Breast Height
DGER	Data Gap Evaluation Report
DPRC	Milwaukee County Department of Parks, Recreation and Culture
EO	Element Occurrence
EPA	Environmental Protection Agency
ERMP	Ecological Restoration and Management Plan
FQA	Floristic Quality Assessment
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
GPS	Global Positioning System
HSF	Havenwoods State Forest
HUC	Hydrologic Unit Code
MU	Management Unit
NHI	Natural Heritage Inventory
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OPC	Opinion of Probable Costs
Project	Havenwoods State Forest Rehabilitation Project
QAPP	Quality Assurance Project Plan
RAP	Remedial Action Plan Update for the Milwaukee Estuary Area of Concern
SHPO	State Historic Preservation Office
SLCI	Species of Local Conservation Interest
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UWMFS	University of Wisconsin Milwaukee Field Station
WDNR	Wisconsin Department of Natural Resources
*w*FQI	Weighted Floristic Quality Index
WHPD	Wisconsin Historic Preservation Database
*w*Mean C	Weighted Mean Coefficient of Conservatism
WWAP	Wisconsin Wildlife Action Plan
WWI	Wisconsin Wetland Inventory

Executive Summary

Introduction

The Milwaukee Estuary Area of Concern (MKE AOC) is one of ten Areas of Concern (AOC) identified under the Great Lakes Restoration Initiative (GLRI) Action Plan III for target completion of all management actions in the next five years. The Milwaukee Estuary system has a long history of ecological degradation and pollution, some of which is ongoing. Under the Great Lakes Water Quality Agreement (GLWQA), the Wisconsin Department of Natural Resources (WDNR) completed a Milwaukee Estuary Stage 1 Remedial Action Plan (RAP) in 1991. The RAP identifies projects requiring restoration and/or remediation. The delisting of the AOC involves performing Management Action Lists (MAL) of projects to address Beneficial Use Impairments (BUIs). The Havenwoods State Forest (HSF) Rehabilitation Project (Project) was selected as a management action specifically for the Degradation of Fish and Wildlife Populations BUI in the 2018-2019 RAP Update for the MKE AOC (WDNR 2021).

An AOC-wide wildlife survey was conducted by the University of Milwaukee Field Station (UWMFS) and Milwaukee County Department of Park, Recreation and Culture (DPRC) from 2014 to 2017. The study concluded that HSF provides important upland/terrestrial habitat for snakes and semi-aquatic habitat for frogs. This Project scored the best possible cost-benefit score, as well as scoring the highest in all 34 high priority AOC projects for benefiting from enhancements to all habitat associated breeding bird populations (forest, wetland, grassland, shrubland, and airspace/urban). This area within the AOC also serves as an important property for supporting forest, wetland, and grassland mammals.

The overall goals of the Project are to address metrics for the MKE AOC. An AOC-wide monitoring effort will be undertaken in the future to measure and assess whether the following goals have been met:

1. Improve the quality of terrestrial habitat types (forest, wetland, shrubland, grassland, semiaquatic, upland/grassland) to support a better population of wildlife indicator species:
   - Species and area of exotic invasive species removed.
   - Amount (area or number) of native species planted to benefit wildlife indicator species.
   - Number and species richness of wildlife indicator species found representing breeding behavior for consecutive years.
   - Amount (area) of habitat types created, enhanced, and/or protected.

2. Improve the quality of aquatic habitat to support a better population of fish indicator species:
   - Amount (length or area) of fish habitat established or enhanced for indicator and sub-indicator species.

3. Improve connectivity between fish and wildlife populations by improving size and connecting gaps or barriers of habitat types:
   - Amount (length) of corridor habitat improved or reconnected.

A key component of measuring success against the RAP is establishing baseline data for vegetation, habitat, and wildlife. The UWMFS and DPRC conducted a comprehensive wildlife assessment of the AOC from 2014-2017 to establish baseline wildlife information; however, detailed baseline vegetation data was lacking for HSF. These data gaps include detailed quantitative observations of existing vegetative cover, composition, and quality by strata, including identification and extent of invasive species, wetland delineation, and delineation of the project's Area of Potential Effects (APE) to inform the location(s) of a future cultural resources investigation. Data collected and presented in this Ecological Restoration and Management Plan

(ERMP) addresses these data gaps and helped inform restoration and management recommendations.

Baseline Assessment

Species Richness, Abundance, and Floristic Quality
RES conducted vegetation meander surveys in spring and summer 2021. Surveys were designed to document plant species presence and abundance (i.e., absolute percent cover) which allowed for calculation of native, non-native, and invasive relative percent cover (i.e., proportion of total vegetative cover) for each Management Unit (MU). RES also determined plant community quality for each MU using Floristic Quality Assessment (FQA) which includes calculation of weighted Mean Coefficient of Conservatism (*w*Mean C) and weighted Floristic Quality Index (*w*FQI).

RES identified a total of 321 plant species throughout HSF in spring 2021 (230 native and 91 non-native) and a total of 281 species in summer 2021 (208 native and 73 non-native). RES identified a total of 363 unique plant species throughout HSF in spring and summer 2021 combined (265 native and 98 non-native).

Native absolute percent cover was highest in MU07 (143%-169%), a portion of southern mesic forest in the southeastern portion of HSF; and was lowest in MU01 (30% in summer) and MU03 (20% in spring), portions of southern mesic forest in the eastern portion of the site. Non-native, invasive absolute cover was highest in MU08 (95%-114%), a portion of southern mesic prairie in the southeastern portion of HSF; and lowest in MU18 (4% in spring) and MU21 (17% in summer), mesic prairie areas in the western portion of the site.

In spring, *w*Mean C and *w*FQI (considering native and non-native species) were lowest in MU20 (0.8 and 1.8 respectively), a portion of southern mesic forest in the central portion of HSF; and highest in MU24 (3.0 and 24.0 respectively), a portion of southern mesic forest in the western portion of HSF. In summer, *w*Mean C and *w*FQI were lowest in MU03 (0.6 and 4.1 respectively), a portion of southern mesic forest in the eastern portion of HSF; and highest in MU18 (*w*Mean C = 3.2) and MU21 (*w*FQI = 28.3), mesic prairie areas in the western portion of HSF. In general, floristic quality was positively correlated with species richness with forested communities scoring highest in spring and prairie communities scoring highest in summer.

Rare Plants and Animals
RES located and mapped several sensitive species during the 2021 growing season, including, prairie Indian plantain (*Arnoglossum plantagineum*, State Special Concern), pale purple coneflower (*Echinacea pallida*, State Threatened), wild quinine (*Parthenium integrifolium*, State Threatened), and American woodcock (*Scolopax minor*, State Special Concern). The plant species were planted/seeded at HSF during past rehabilitation efforts.

Invasive Species
Invasive species such as Canada thistle (*Cirsium arvense*), teasel (*Dipsacus fullonum*), Tartarian honeysuckle (*Lonicera tatarica*), purple loosestrife (*Lythrum salicaria*), wild parsnip (*Pastinaca sativa*), common buckthorn (*Rhamnus cathartica*), crown vetch (*Securigera varia*), narrow-leaved cattail (*Typha angustifolia*), and Siberian elm (*Ulmus pumila*) were found to be prevalent within HSF. RES also documented a small population of gout-weed (*Aegopodium podagraria*) in MU21/MU22 which had not previously been documented within HSF.

Management Recommendations

The following is a summary of management recommendations discussed in more detail in the ERMP:

- Control large populations of woody and herbaceous invasive species via a combination of mechanical and chemical means. This includes forestry mowing large and dense populations of woody invasive shrubs, brushcutting smaller and scattered populations of woody invasive shrubs, broadcast spraying large populations of herbaceous invasive species and spot-spraying smaller populations, and introducing a prescribed fire regime for short- and long-term vegetation management.
- Utilize invasive trees that have been removed or girdled as habitat enhancement features.
- Restore, enhance, expand, and connect a variety of habitats/cover types including southern mesic forest, oak opening, mesic prairie, shrub-carr, wet prairie, emergent marsh, southern hardwood swamp, and floodplain forest through native seed and plant installation.
- Enhancement and create new wetlands through wildlife scrapes.

Introduction

The Milwaukee Estuary Area of Concern (MKE AOC) is one of ten Areas of Concern (AOC) identified under the Great Lakes Restoration Initiative (GLRI) Action Plan III for target completion of all management actions in the next five years. The MKE AOC includes stretches of the Milwaukee, Menomonee, and Kinnickinnic rivers, as well as the inner and outer harbor and nearshore waters of Milwaukee Bay. The MKE AOC was initially listed as an AOC in 1987 under the Great Lakes Water Quality Agreement (GLWQA). The MKE AOC was later expanded in 2008 to include upper portions of the Menomonee and Milwaukee rivers to include legacy contaminants in the Little Menomonee River, Lincoln Creek, and Cedar Creek.

The Milwaukee Estuary system has a long history of ecological degradation and pollution, some of which is ongoing. Under the GLWQA, the Wisconsin Department of Natural Resources (WDNR) completed a Milwaukee Estuary Stage 1 Remedial Action Plan (RAP) in 1991. Updates to the RAP have been performed periodically with the most recent update in August 2020. The RAP identifies projects requiring restoration and/or remediation. The delisting of the AOC involves performing Management Action Lists (MAL) of projects to address Beneficial Use Impairments (BUIs). Table 1 lists the 11 BUIs known to exist in the MKE AOC.

Table 1. Status of Beneficial Use Impairments in the Milwaukee Estuary AOC

BUI #	Beneficial Use Impairment	Status
1	Restriction on fish and wildlife consumption	Impaired
2	Degradation of fish and wildlife populations	Impaired
3	Fish tumors or other deformities	Impaired
4	Bird or animal deformities or reproductive problems	Impaired
5	Degradation of benthos	Impaired
6	Restrictions on dredging activities	Impaired
7	Eutrophication or undesirable algae	Impaired
8	Beach Closings (recreational restrictions)	Impaired
9	Degradation of aesthetics	Removed – Sept 2021
10	Degradation of phytoplankton and zooplankton populations	Impaired
11	Loss of fish and wildlife habitat	Impaired

The Havenwoods State Forest (HSF) Rehabilitation Project (Project) was selected as a management action specifically for the Degradation of Fish and Wildlife Populations BUI in the 2018-2019 RAP Update for the MKE AOC (WDNR 2021).

Background

HSF is an approximately 237-acre urban, state forest in northern Milwaukee, Wisconsin (Appendix A, Figure 1). HSF has a long and well-documented history of widespread and intense disturbance dating back to the 1800's. The history of this property includes family homesteads from the mid-1800's transitioning to the Milwaukee County House of Corrections in the early 1900's. Army Disciplinary Barracks, a Nike Missile site, and Milwaukee landfill were subsequently established in 1945, 1956, and 1974, respectively (Kubicek 2020). The land was eventually set aside as green space and in 1979, the WDNR began ecological rehabilitation and restoration efforts. Due to the disruption of the site over the past 150 years, the landscape is scarred and subject to habitat degradation from soil disturbance and invasive species colonization.

An AOC-wide wildlife survey was conducted by the University of Milwaukee Field Station (UWMFS) and Milwaukee County Department of Park, Recreation and Culture (DPRC) from 2014 to 2017. This study provides important information about habitat conditions that support a variety of species found on this property. The study concluded that HSF provides important upland/terrestrial habitat for snakes and semi-aquatic habitat for frogs. This Project scored the best possible cost-benefit score, as well as scoring the highest in all 34 high priority AOC projects for benefiting from enhancements to all habitat associated breeding bird populations (forest, wetland, grassland, shrubland, and airspace/urban). This area within the AOC also serves as an important property for supporting forest, wetland, and grassland mammals.

Terminology

Several terms used in this ERMP pertaining to wildlife require distinctions: Species of Local Conservation Interest (SLCI), Candidate Focal Species, Indicators, and Focal Species. Casper & Robson (2018) defined SLCI as, "...species that are at least one of the following, and the study area has the potential to support viable populations: a) listed as either state or federally Endangered, Threatened, or Special Concern; b) listed as Species of Greatest Conservation Need in the *State Wildlife Action Plan*; c) considered to be locally rare or declining; or d) are of social value to stakeholders and considered to be desirable to the community". SLCI is an overarching list of species that are important at the scale of the AOC.

Candidate Focal Species are species that were pre-selected to be important as part of a particular habitat type (Forest, Grassland, Wetland, etc.). Indicators are the term that is used as part of the metrics for BUI removal. Focal Species are selected from indicators when restoration recommendations are made for a project location.

Criteria for Measuring Success

The overall goals of the Project are to address metrics for the MKE AOC. An AOC-wide monitoring effort will be undertaken in the future to measure and assess whether the following goals have been met:

1. Improve the quality of terrestrial habitat types (forest, wetland, shrubland, grassland, semiaquatic, upland/grassland) to support a better population of wildlife indicator species:
   - Species and area of exotic invasive species removed.
   - Amount (area or number) of native species planted to benefit wildlife indicator species.
   - Number and species richness of wildlife indicator species found representing breeding behavior for consecutive years.
   - Amount (area) of habitat types created, enhanced, and/or protected.

2. Improve the quality of aquatic habitat to support a better population of fish indicator species:
   - Amount (length or area) of fish habitat established or enhanced for indicator and sub-indicator species.

3. Improve connectivity between fish and wildlife populations by improving size and connecting gaps or barriers of habitat types:
   - Amount (length) of corridor habitat improved or reconnected.

The metrics for BUI removal are based on addressing impaired fish and wildlife populations in the AOC. The HSF Project will contribute to BUI removal by performing habitat rehabilitation efforts. The list of metrics that this project will contribute to can be found in Appendix E of the RAP (WDNR 2021).

Project Description

A key component of measuring success against the RAP is establishing baseline data for vegetation, habitat, and wildlife. The UWMFS and DPRC conducted a comprehensive wildlife assessment of the AOC from 2014-2017 to establish baseline wildlife information; however, detailed baseline vegetation data was lacking for HSF.

A Data Gap Evaluation Report (DGER) was prepared by RES Great Lakes, LLC (RES) that summarizes the suitability of existing data, identifies data gaps, and provides recommendations for additional data collection to inform rehabilitation planning of the habitats comprising HSF (RES 2021a). Data gaps identified include the following:

1. detailed quantitative observations of existing vegetative cover, composition, and quality by strata, including identification and extent of invasive species;
2. wetland delineation;
3. ash tree survey;
4. pre-project wildlife surveys specific to HSF documenting species locations and breeding behavior; and
5. delineation of the project's Area of Potential Effects (APE) to inform the location(s) of a future cultural resources investigation.

Data collected and presented in this Ecological Restoration and Management Plan (ERMP) addresses data gaps 1, 2, and 5 as data gaps 3 and 4 were beyond RES' scope of work.

RES conducted vegetation sampling and mapping with the following objectives:

*   Identify, characterize, and assess plant communities onsite.
*   Collect plant community structure and composition as well as species abundance data.
*   Delineate wetlands.
*   Assess wildlife habitat and floristic quality.
*   Map plant communities, significant invasive species populations, rare plants, and plants species that have not previously been documented in Wisconsin.

Data collected during these field efforts provide baseline vegetative data and helped inform restoration and management recommendations in this ERMP.

Forest Regeneration Project

The Forest Regeneration Project, funded through acquisition of various grants, is currently being conducted in the central and western wooded portion of HSF (Figure 2) and is occurring independently of the HSF Rehabilitation Project. The Forest Regeneration Project consists of initial woody invasive species mowing and mulching occurring in winter/spring 2021, follow-up spot herbicide treatment of resprouts in spring/summer 2021 and 2022, and native tree planting in 2023. Trees will be planted at a density of approximately 680 trees per acre on 8-foot centers and will consist mainly of hardwood species and some conifers with the intent to ultimately create a closed-canopy forest. RES's restoration and management recommendations in this ERMP took into consideration the management plan and the anticipated conditions of areas subject to the Forest Regeneration Project. The proposed restored habitat configurations in this ERMP were in some cases constrained by the pre-existing Forest Regeneration Project reforestation plan.

Baseline Assessment

Methods

RES collected and analyzed data for this Project in accordance with the Project's Quality Assurance Project Plan (QAPP) (RES 2021b). The primary purpose of the baseline assessment was to assess baseline ecological conditions at HSF and to formulate a conceptual restoration plan that aims to improve these conditions while simultaneously addressing AOC metrics. RES' methodological approach included existing data review, wetland delineation, and vegetation surveys and mapping.

Existing Data Review

Existing data and reports reviewed prior to field work included the following:

- Havenwoods Master Plan (WDNR 1981)
- Restoration and Management Plan for Havenwoods State Forest Preserve (Volkert 1986)
- Assorted bird data from 2001-2017
- 2015-2025 Wisconsin Wildlife Action Plan (WWAP) (WDNR 2015)
- Milwaukee Estuary Area of Concern Wildlife Population Assessment Report (Casper & Robson 2018)
- Emerald Ash Borer Management Plan Havenwoods State Forest (Anderson 2019)
- Draft Forestry Management Plan Havenwoods State Forest (Sieger 2019)
- Remedial Action Plan for the Milwaukee Estuary Area of Concern (WDNR 2020)
- Cultural Resources Review (Kubicek 2020)
- Endangered Resources Review for the Proposed Milwaukee AOC Havenwoods State Forest Natural Heritage Inventory (NHI) Review (Dow 2021)
- Natural Resources Conservation Service (NRCS) Soil Survey of Milwaukee and Waukesha Counties
- Wisconsin Wetland Inventory (WWI)
- Milwaukee County 1-foot topographical data

RES used existing information to gain a precursory understanding of the site, create preliminary vegetation and management unit maps, and to identify data gaps where additional information was needed to inform this ERMP and future studies.

Wetland Delineation

RES Ecologist Matt Parsons conducted a wetland delineation at HSF on May 11, 12, and 21, 2021 in accordance with USACE protocol in the 1987 Wetland Delineation Manual (Environmental Laboratory 1987) and Midwest Regional Supplement (USACE 2010). Detailed methodology can be found in the wetland delineation report (RES 2021c).

Vegetation Surveys

On June 1, 2, and 3, 2021, RES Ecologists performed a thorough baseline assessment of all native and non-native vegetative cover types using the NHI system to determine relative population levels and prescribe recommended control/treatments where appropriate. As part of the baseline assessment, RES collected canopy, sub-canopy, shrub, and herbaceous strata composition and percentages (including ash trees) using weighted FQA methodology (Bernthal 2003). The canopy layer was defined as the uppermost vegetative layer formed by mature tree crowns. Trees were defined as woody plants 3 inches or more in diameter at breast height (DBH). The subcanopy layer was defined as the tree crown layer underneath the uppermost canopy typically consisting of small trees. The shrub layer consisted of woody plants less than 3 inches in

DBH. The herbaceous layer was defined as all non-woody plants and woody plants under 3.28 feet in height.

The site was divided into and stratified by preliminary management units (MU) which are areas of similar vegetation composition and structure. Preliminary MUs were based on the WDNR's stand delineation in the Draft Forestry Management Plan (Sieger 2019). The number and precise arrangement of MUs was refined based on field observations during the field assessment. RES performed meander species search surveys throughout the entirety of each MU and prepared comprehensive plant lists for each stratum (i.e., canopy, sub-canopy, shrub, and herbaceous) within each MU. Once the survey within a unit was complete, surveyors estimated the approximate absolute percent cover of each species in each stratum as well as the total absolute cover of each stratum.

These surveys documented species presence and abundance (i.e., absolute percent cover) and allowed for calculation of native, non-native, and invasive relative percent cover (i.e., proportion of total vegetative cover) for each MU. RES also determined plant community quality for each MU using Floristic Quality Assessment (FQA) which includes calculation of weighted Mean Coefficient of Conservatism (*w*Mean C) and weighted Floristic Quality Index (*w*FQI). FQA data were derived using the WDNR FQA Calculator.

Surveys of the herbaceous stratum in MUs not subject to the Forest Regeneration Project (i.e., MU01-MU09, MU10-W2, MU10-W6, MU11, MU12, MU18, MU21-MU23) were repeated on July 22 and July 23, 2021. RES did not resample woody strata during these summer surveys because it was assumed these data would not change appreciably since the spring surveys.

Vegetation Mapping
During vegetation surveys, RES delineated and characterized dominant plant communities in accordance with land use history and the NHI system. RES mapped significant populations of invasive species, especially those characterized as "Restricted" in Wisconsin Administrative Code NR 40, as well as reed canary grass (*Phalaris arundinacea*). RES also mapped rare species encountered. Where practical, plant community boundaries, invasive species populations, and rare plants were surveyed using Global Positioning System (GPS) receivers capable of sub-meter accuracy. However, large and/or discontinuous populations of invasive species were be mapped by hand using air photo interpretation techniques and verified using GPS. Species on the NHI working list that were observed during the surveys were reported to NHI. Species identification verification for rare species was completed and submitted using high resolution photograph vouchers. RES also took georeferenced photographs within each MU in at least one representative photo-point (PP) location.

Photo-documentation
RES established 37 permanent photo-documentation locations (PP01-PP37) at representative locations within each MU (Figure 2). Photographs taken at these locations during this baseline assessment document pre-restoration baseline conditions and can be compared to repeat photographs taken from the same locations and orientations post-restoration. Photographs were also taken at other features of note including rare plants and notable invasive species. Photographs are presented in Appendix B.

Results

Topography
The topography at HSF is relatively level to gently rolling and variable, generally sloping from north to south. Elevations range from approximately 709 feet on a hillslope in the northeastern portion of the site to approximately 669 feet in the southeastern portion of the site.

Soils

HSF is comprised of seven soil map units (Table 2): Ashkum silty clay loam, 0-2% slopes (AsA); clayey land (Cv); Landfill (LDF); loamy land (Lu); Mequon silt loam, 1-3% slopes (MtA); Ozaukee silt loam, carbonate substratum, 2-6% slopes (OuB); and Ozaukee silt loam, high carbonate substratum, 2-6% slopes, eroded (OuB2). Due to extensive soil disturbances that have occurred throughout most of the site, the reliability of the NRCS soil survey map for an accurate representation of existing soil conditions is likely somewhat low; however, it does provide important information regarding the historical vegetation types that were present across the site as well as soil conditions that can be expected in areas that were not filled historically.

Table 2. Havenwoods Soils Data

Soil Map Unit Symbol and Name	% of AOI	Drainage Classification*	Major/Minor Components	Map Unit % Composition	Hydric Soil Rating
AsA, Ashkum silty clay loam, 0-2% slopes	6.5%	Poorly drained	Ashkum, drained	92%	Yes
			Peotone, drained	5%	Yes
			Orthents, clayey	2%	No
			Urban land	1%	No
Cv, Clayey land	7%	Moderately well drained	Clayey land	90%	No
			Ashkum	10%	Yes
LDF, Landfill	0.5%	Not classified	Urban land, landfill	100%	Unranked
Lu, Loamy land	6%	Moderately well drained	Loamy land	90%	No
			Pella	10%	Yes
MtA, Mequon silt loam, 1-3% slopes	29%	Somewhat poorly drained	Mequon	90%	No
			Ashkum	4%	Yes
			Martinton	3%	No
			Ozaukee	3%	No
OuB, Ozaukee silt loam, high carbonate substratum, 2-6% slopes	27%	Moderately well drained	Ozaukee, high carbonate substratum	96%	No
			Ashkum, drained	2%	Yes
			Orthents, clayey	1%	No
			Urban land	1%	No
OuB2, Ozaukee silt loam, high carbonate substratum, 2-6% slopes, eroded	24%	Moderately well drained	Ozaukee, high carbonate substratum, eroded	96%	No
			Ashkum, drained	2%	Yes
			Urban land	1%	No
			Orthents, clayey	1%	No

* Pertains to major component soil.

The dominant soil series are Mequon and Ozaukee silt loams. Both soil types form on moraine landforms under mixed hardwood forest vegetation and are not classified as hydric. Also, of note are the soil map units that indicate anthropogenic soils including Cv, Lu, and LDF. Evidence of past soil disturbance such as landfill caps, reconstructed bank slopes of Lincoln Creek, constructed swales, building pads, and large areas of cut/fill, is prevalent throughout the site.

No soil sampling took place other than the 31 soil test pits that RES excavated for the wetland delineation

effort (RES 2021c). In general, the dominant surface soil texture was silt loam with loam subsurface soils in uplands and silt loam/silty clay loam subsurface soils in wetlands. Hydric soils were identified primarily in the various wetlands onsite. The most common hydric soil indicators observed were Depleted Below Dark Surface (A11) and Depleted Matrix (F3). RES observed evidence of fill in soil pits excavated on the banks of Lincoln Creek. Gravel subsoils were observed in some areas particularly where soil pits were sited close to trails. A more detailed soil investigation outside the scope of this report should be conducted during the planning phase of the Project to identify areas where existing soils may prohibit successful revegetation.

Hydrology
HSF is situated in the southern portion of the Lower Milwaukee River-Frontal Lake Michigan Hydrologic Unit Code (HUC) 10 Watershed within the larger Milwaukee HUC-8 Subbasin. Lincoln Creek, a perennial headwater stream, runs north to south through the western portion of the site and is tributary to the Milwaukee River. The watershed feeding this creek is composed of a combination of residential and industrial development. Lincoln Creek appears to have undergone multiple alignment changes throughout its history. Three constructed flood control basins containing surface water are present along the southeast bank of Lincoln Creek. These features were designed and constructed to attenuate flood flows and sediment and improve downstream water quality.

A second intermittent waterway runs north to south through the southeastern portion of the site and is fed by surface water from the residential area to the north. This feature used to be impounded and is now free-flowing, though much of the basin has filled in with sediment or human-placed fill.

Evidence of drain tiling was observed at the southern end of the intermittent creek at a linear drainage that flows west to east into the creek.

Several other depressional wetlands identified onsite appear to be supported by seasonally high water tables as well as runoff and incident precipitation during precipitation events. Wetland 3 contains surface water at its southern end.

Wetlands
Six wetlands were delineated onsite (Wetlands 1-6) (RES 2021c). Wetland 1 is a 2.21-acre riverine wetland composed of mosaic of forested, scrub, and emergent wetlands in the eastern portion of the site. This unnamed creek flows southerly through a series of trail-crossing culverts at various stages of sedimentation. Wetland 2 is a 0.69-acre depressional forested wetland in the southcentral portion of the site. Wetland 3 is a large 8.37-acre depressional wetland in the central portion of the site comprised of a mosaic of emergent, wet meadow, and scrub wetlands. Wetland 4 is a 6.89-acre segment of Lincoln Creek composed of floodplain scrub, wet meadow, and emergent wetlands in the western portion of the site. The creek flows southerly and contains three constructed stormwater/sediment wetlands along its eastern bank. Wetland 5 is a small 0.08-acre forested ephemeral pond wetland in the northwest portion of the site. Wetland 6 is a small 0.11-acre depressional forested wetland in the southern portion of the site. Water is impounded in this area due to the presence of a raised trail to the north and the railroad bed to the south.

More detailed descriptions of the vegetation composition and structure of these wetlands is described in the Vegetation Section below.

Vegetation
The emphasis of this baseline assessment was to quantify plant species abundance; vegetation cover type structure, composition, quality, and extent; and extent and location of rare and invasive species. RES

delineated 28 MUs (Figure 2) and collected baseline vegetation data within each. The data represent conditions on the dates of the surveys. Contractors for the Forest Regeneration Project were still mowing and mulching woody invasive species in MU25 during the spring vegetation surveys and will be conducting ongoing woody invasive resprout spot-treatments in MU13-MU16, MU19, MU20, MU24, and MU25 through spring 2022.

Vegetation mapping efforts indicate HSF is currently comprised of approximately 97.7 acres of southern mesic forest, 1.2 acres of conifer plantation, 36.4 acres of surrogate grassland, 28.0 acres of shrub-invaded surrogate grassland, 36.8 acres of mesic prairie, and 18.4 acres of wetlands. Types of wetlands present include pond, emergent marsh, wet meadow, shrub-carr, southern hardwoods swamp, and floodplain forest (Figure 3).

Southern mesic forest in the eastern portion of HSF was dominated by American basswood (*Tilia americana*) and sugar maple (*Acer saccharum*) in the overstory, common buckthorn *(Rhamnus cathartica)* in the sapling/shrub stratum, and common buckthorn, garlic mustard (*Alliaria petiolata*), and Virginia waterleaf (*Hydrophyllum virginianum*) in the herbaceous stratum. Southern mesic forest in the central portion of HSF and part of the Forest Regeneration Project was dominated by eastern cottonwood (*Populus deltoides*) and boxelder (*Acer negundo*) in the overstory, and common buckthorn, dame's rocket (*Hesperis matronalis*), wild parsnip (*Pastinaca sativa*), garlic mustard, and Kentucky bluegrass (*Poa pratensis*) in the herbaceous stratum. Southern mesic forest in the western portion of HSF, also part of the Forest Regeneration Project, was dominated by species such as American basswood and American elm (*Ulmus americana*) in the overstory and common buckthorn, Virginia waterleaf, and wild geranium (*Geranium maculatum*) in the herbaceous stratum. The confiner plantation was dominated by planted white pine (*Pinus strobus*) in the overstory, common buckthorn in the sapling/shrub stratum, and common dandelion (*Taraxacum officinale*) and smooth brome (*Bromus inermis*) in the herbaceous stratum.

Surrogate grasslands were dominated by non-native, cool-season grasses such as Kentucky bluegrass and smooth brome. Shrub-invaded surrogate grasslands had a similar herbaceous layer but with high cover of shrubs including common buckthorn, Tartarian honeysuckle (*Lonicera tatarica*), and cockspur hawthorn (*Crataegus crus-galli*). These areas were also heavily invaded by the herbaceous invasive species common teasel (*Dipsacus fullonum*) and wild parsnip. Mesic prairies located in the western portion of the site were dominated by native warm season grasses such as switchgrass (*Panicum virgatum*) and Indian grass (*Sorghastrum nutans*) and had a relatively high proportion of Kentucky bluegrass and reed canary grass. These areas also had high cover of non-native legumes such as bird vetch (*Viccia cracca*), crown vetch (*Securigera varia*), and everlasting pea (*Lathyrus latifolia*).

Dominant wetland species included narrow-leaved cattail (*Typha angustifolia*) and river bulrush (*Bolboschoenus fluviatilis*) in emergent marsh wetlands, reed canary grass in wet meadow wetlands, sandbar willow (*Salix interior*) in shrub-carr wetlands, black willow (*Salix nigra*) in bottomland hardwood swamp wetlands, and silver maple (*Acer saccharinum*) in floodplain forest wetlands.

Absolute Percent Cover

In spring 2021, total native percent cover ranged from 20% in MU03 to 169% in MU07 (Table 3). Total non-native percent cover ranged from 25% in MU24 to 166% in MU03. Total invasive species cover ranged from 4% in MU18 to 114% in MU08. Other highly invaded areas in spring included MU04, MU03, and MU02 at 96%, 90%, and 89% invasive cover respectively.

In summer 2021, total native percent cover ranged from 30% in MU01 to 143% in MU07 (Table 4). Total

non-native percent cover ranged from 12% in MU07 to 146% in MU03. Total invasive species cover ranged from 17% in MU21 to 95% in MU08. Other highly invaded areas in summer included MU02, MU04, and MU07 at 93%, 77%, and 74% invasive cover respectively.

The complete percent cover data set for spring and summer surveys is presented in Appendix C.

Floristic Quality Assessment

RES identified a total of 321 plant species throughout HSF in spring 2021 (230 native and 91 non-native) and a total of 281 species in summer 2021 (208 native and 73 non-native) (Appendix D). RES identified a total of 363 unique plant species throughout HSF in spring and summer 2021 combined (265 native and 98 non-native).

In spring 2021, total species richness ranged from 5 in MU25-W5 (a small wetland) to112 in MU15 (Table 5). Native species richness ranged from 4 in MU25-W5 to 73 in MU22. Non-native species richness ranged from 1 in MU25-W5 to 41 in MU15. *w*Mean C, considering all species (native and non-native), ranged from 0.8 in MU20 to 3.0 in MU24 and MU17. *w*FQI, considering all species, ranged from 1.8 in MU20 to 24.0 in MU24.

In summer 2021, total species richness ranged from 22 in MU10-W6 (a small wetland) to 113 in MU22 (Table 6). Native species richness ranged from 15 in MU10-W6 to 85 in MU22. Non-native species richness ranged from 7 in MU10-W6 to 30 in MU01. *w*Mean C, considering all species, ranged from 0.6 in MU03 to 3.2 in MU18. *w*FQI considering all species ranged from 4.1 in MU03 to 28.3 in MU21.

Lower Mean C/FQI scores indicate plant communities dominated by plant species that are relatively tolerant of disturbance while higher Mean C/FQI scores indicate plant communities dominated by plant species that are relatively intolerant of disturbance. Provisional FQA benchmarks have been developed by the WDNR for wetland systems using *w*Mean C (Marti & Bernthal 2019) which is helpful for interpretating the results of this FQA. Five categories of habitat quality exist based on FQA benchmarks: Excellent, Good, Fair, Poor, and Very Poor. Provisional benchmarks do not yet exist for upland habitats making FQA scores in those areas more difficult to interpret.

Using *w*Mean C scores, the wetland communities onsite ranged in quality from Very Poor to Fair. MU05, a floodplain forest wetland, rated as Fair. MU10-W2, MU10-W6, and MW25-W5; all southern hardwood swamp wetlands, rated as Very Poor. MU12, a wet meadow/shrub-carr wetland, rated as Very Poor. MU22, a shrub-carr wetland, rated between Very Poor and Poor depending on the season it was sampled.

MUs with relatively low Mean C/FQI scores were MU02, MU03, MU09, MU10-W6, MU16-E, MU16-W, and MU20. MUs with relatively high Mean C/FQI scores were MU05, MU07, MU17, MU18, MU21, MU22, and MU23. In general, floristic quality was positively correlated with species richness with forested communities scoring highest in spring and prairie communities scoring highest in summer. FQA data collected after restoration activities have been completed will indicate whether the treatments have had a positive effect on habitat quality.

Table 3. Spring 2021 Absolute Percent Cover Data Summary

MU#	Canopy Stratum				Subcanopy Stratum				Sapling/Shrub Stratum				Vine Stratum				Herbaceous Stratum				All Strata Combined			
	T	N	NN	I	T	N	NN	I	T	N	NN	I	T	N	NN	I	T	N	NN	I	T	N	NN	I
01	6%	2%	4%	0%	9%	7%	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	43%	22%	21%	8%	**58%**	**31%**	**27%**	**10%**
02	10%	6%	4%	0%	6%	6%	0%	0%	80%	4%	76%	76%	2%	2%	0%	0%	52%	21%	31%	13%	**150%**	**39%**	**111%**	**89%**
03	75%	4%	71%	0%	0%	0%	0%	0%	63%	2%	61%	61%	0%	0%	0%	0%	48%	14%	34%	29%	**186%**	**20%**	**166%**	**90%**
04	32%	32%	0%	0%	24%	14%	10%	10%	80%	34%	46%	46%	2%	2%	0%	0%	109%	27%	82%	40%	**247%**	**109%**	**138%**	**96%**
05	28%	28%	0%	0%	6%	6%	0%	0%	26%	13%	13%	12%	5%	5%	0%	0%	59%	46%	13%	8%	**124%**	**98%**	**26%**	**20%**
06	10%	9%	1%	0%	8%	5%	3%	2%	11%	9%	2%	2%	0%	0%	0%	0%	81%	13%	68%	36%	**110%**	**36%**	**74%**	**40%**
07	80%	80%	0%	0%	25%	22%	3%	2%	72%	12%	60%	60%	0%	0%	0%	0%	75%	55%	20%	15%	**252%**	**169%**	**83%**	**77%**
08	24%	22%	2%	2%	1%	0%	1%	0%	81%	6%	75%	75%	0%	0%	0%	0%	59%	15%	44%	37%	**165%**	**43%**	**122%**	**114%**
09	8%	7%	1%	0%	5%	4%	1%	1%	16%	9%	7%	7%	1%	1%	0%	0%	103%	34%	69%	13%	**133%**	**55%**	**78%**	**21%**
10-W2	50%	50%	0%	0%	10%	10%	0%	0%	41%	30%	11%	11%	2%	2%	0%	0%	65%	45%	20%	14%	**168%**	**137%**	**31%**	**25%**
10-W6	20%	20%	0%	0%	5%	5%	0%	0%	27%	17%	10%	10%	10%	10%	0%	0%	49%	14%	35%	25%	**111%**	**66%**	**45%**	**35%**
11	1%	1%	0%	0%	0%	0%	0%	0%	8%	7%	1%	1%	0%	0%	0%	0%	101%	25%	76%	6%	**110%**	**33%**	**77%**	**7%**
12	5%	5%	0%	0%	7%	7%	0%	0%	25%	23%	2%	2%	2%	2%	0%	0%	114%	29%	85%	81%	**153%**	**66%**	**87%**	**83%**
13	12%	11%	1%	1%	1%	0%	1%	0%	6%	2%	4%	4%	0%	0%	0%	0%	40%	17%	23%	12%	**59%**	**30%**	**29%**	**17%**
14	50%	47%	3%	1%	2%	1%	1%	0%	6%	1%	5%	5%	0%	0%	0%	0%	77%	13%	64%	47%	**135%**	**62%**	**73%**	**53%**
15	14%	12%	2%	1%	1%	0%	1%	0%	2%	2%	0%	0%	0%	0%	0%	0%	80%	31%	49%	11%	**97%**	**45%**	**52%**	**12%**
16-E	22%	22%	0%	0%	15%	15%	0%	0%	38%	8%	30%	30%	8%	8%	0%	0%	93%	23%	70%	11%	**176%**	**76%**	**100%**	**41%**
16-W	0%	0%	0%	0%	0%	0%	0%	0%	76%	14%	62%	62%	0%	0%	0%	0%	77%	42%	35%	18%	**153%**	**56%**	**97%**	**80%**
17	82%	80%	2%	0%	2%	0%	2%	0%	28%	13%	15%	15%	1%	1%	0%	0%	36%	13%	23%	8%	**149%**	**107%**	**42%**	**23%**
18	2%	2%	0%	0%	0%	0%	0%	0%	2%	1%	1%	1%	0%	0%	0%	0%	113%	53%	60%	3%	**117%**	**56%**	**61%**	**4%**
19	37%	37%	0%	0%	9%	7%	2%	2%	4%	2%	2%	2%	2%	2%	0%	0%	96%	46%	50%	28%	**148%**	**94%**	**54%**	**32%**
20	60%	60%	0%	0%	10%	10%	0%	0%	1%	0%	1%	1%	2%	2%	0%	0%	104%	13%	91%	85%	**177%**	**85%**	**92%**	**86%**
21	2%	1%	1%	1%	3%	2%	1%	1%	16%	14%	2%	2%	0%	0%	0%	0%	148%	74%	74%	35%	**169%**	**91%**	**78%**	**39%**
22	14%	9%	5%	5%	6%	3%	3%	3%	60%	53%	7%	7%	0%	0%	0%	0%	100%	50%	50%	29%	**180%**	**115%**	**65%**	**44%**
23	5%	5%	0%	0%	8%	7%	1%	1%	16%	14%	2%	1%	0%	0%	0%	0%	145%	73%	72%	21%	**174%**	**99%**	**75%**	**23%**
24	51%	51%	0%	0%	16%	15%	1%	1%	12%	7%	5%	5%	0%	0%	0%	0%	75%	56%	19%	13%	**154%**	**129%**	**25%**	**19%**
25	34%	33%	1%	1%	12%	11%	1%	1%	51%	16%	35%	35%	0%	0%	0%	0%	66%	34%	32%	19%	**163%**	**94%**	**69%**	**56%**
25-W5	10%	10%	0%	0%	0%	0%	0%	0%	65%	5%	60%	60%	0%	0%	0%	0%	17%	12%	5%	5%	**92%**	**27%**	**65%**	**65%**

Note: T = Total, N = Native, NN = Non-native, I = Invasive

Table 4. Summer 2021 Absolute Percent Cover Data Summary

MU#	Canopy Stratum				Subcanopy Stratum				Sapling/Shrub Stratum				Vine Stratum				Herbaceous Stratum				All Strata Combined			
	T	N	NN	I	T	N	NN	T	N	NN	I	T	N	N	T	N	NN	I	T	N	T	T	N	NN
01	6%	2%	4%	0%	9%	7%	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	79%	21%	58%	33%	**94%**	**30%**	**64%**	**35%**
02	10%	6%	4%	0%	6%	6%	0%	0%	80%	4%	76%	76%	2%	2%	0%	0%	54%	28%	26%	17%	**152%**	**46%**	**106%**	**93%**
03	75%	4%	71%	0%	0%	0%	0%	0%	63%	2%	61%	61%	0%	0%	0%	0%	45%	31%	14%	8%	**183%**	**37%**	**146%**	**69%**
04	32%	32%	0%	0%	24%	14%	10%	10%	80%	34%	46%	46%	2%	2%	0%	0%	45%	20%	25%	21%	**183%**	**102%**	**81%**	**77%**
05	28%	28%	0%	0%	6%	6%	0%	0%	26%	13%	13%	12%	5%	5%	0%	0%	41%	32%	9%	9%	**106%**	**84%**	**22%**	**21%**
06	10%	9%	1%	0%	8%	5%	3%	2%	11%	9%	2%	2%	0%	0%	0%	0%	80%	21%	59%	21%	**109%**	**44%**	**65%**	**25%**
07	80%	80%	0%	0%	25%	22%	3%	2%	72%	12%	60%	60%	0%	0%	0%	0%	41%	29%	12%	12%	**218%**	**143%**	**12%**	**74%**
08	24%	22%	2%	2%	1%	0%	1%	0%	81%	6%	75%	75%	0%	0%	0%	0%	56%	33%	23%	18%	**162%**	**61%**	**101%**	**95%**
09	8%	7%	1%	0%	5%	4%	1%	1%	16%	9%	7%	7%	1%	1%	0%	0%	108%	10%	98%	28%	**138%**	**31%**	**107%**	**36%**
10-W2	50%	50%	0%	0%	10%	10%	0%	0%	41%	30%	11%	11%	2%	2%	0%	0%	59%	26%	33%	17%	**162%**	**118%**	**44%**	**28%**
10-W6	20%	20%	0%	0%	5%	5%	0%	0%	27%	17%	10%	10%	10%	10%	0%	0%	76%	19%	57%	51%	**138%**	**71%**	**67%**	**61%**
11-E*	1%	1%	0%	0%	0%	0%	0%	0%	8%	7%	1%	1%	0%	0%	0%	0%	152%	54%	98%	17%	**161%**	**62%**	**99%**	**18%**
11-W*	1%	1%	0%	0%	0%	0%	0%	0%	8%	7%	1%	1%	0%	0%	0%	0%	113%	44%	69%	40%	**122%**	**52%**	**70%**	**41%**
12	5%	5%	0%	0%	7%	7%	0%	0%	25%	23%	2%	2%	2%	2%	0%	0%	114%	37%	77%	66%	**153%**	**74%**	**79%**	**67%**
13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16-E	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16-E
16-W	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16-W
17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	2%	2%	0%	0%	0%	0%	0%	0%	2%	1%	1%	1%	0%	0%	0%	0%	114%	97%	17%	5%	**118%**	**100%**	**18%**	**6%**
19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	2%	1%	1%	1%	3%	2%	1%	1%	16%	14%	2%	2%	0%	0%	0%	0%	96%	23%	119%	13%	**140%**	**113%**	**27%**	**17%**
22	14%	9%	5%	5%	6%	3%	3%	3%	60%	53%	7%	7%	0%	0%	0%	0%	87%	53%	34%	25%	**167%**	**118%**	**49%**	**40%**
23	5%	5%	0%	0%	8%	7%	1%	1%	16%	14%	2%	1%	0%	0%	0%	0%	138%	83%	55%	25%	**167%**	**109%**	**58%**	**27%**
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25-W5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note 1: T = Total, N = Native, NN = Non-native, I = Invasive

Note 2: Management Units subject to the Forest Regeneration Project (MU12-MU17, MU19, MU20, MU24, and MU25) were not resampled in summer 2021.

* MU11 was split into two separate units (east and west) during summer vegetation surveys.

Table 5. Spring 2021 Floristic Quality Assessment Data Summary

MU#	wMean C		wFQI		Species Richness		
	Native	All	Native	All	Native	Non-native	Total
01	4.1	2.2	20.2	14.5	24	19	43
02	3.0	1.0	20.7	8.8	48	31	79
03	3.2	0.7	20.5	5.5	42	24	66
04	2.4	1.1	13.4	8.3	30	26	56
05	3.1	2.4	24.7	21.9	65	19	84
06	3.2	1.4	23.3	12.7	52	33	85
07	4.1	2.8	27.8	20.8	47	10	57
08	2.9	1.1	22.2	9.9	57	28	85
09	2.4	1.0	13.2	7.6	30	23	53
10-W2	3.0	2.4	17.5	16.5	35	13	48
10-W6	2.0	1.2	6.9	5.2	12	7	19
11	3.3	1.4	24.4	12.7	55	29	84
12	2.8	1.3	17.5	9.8	39	16	55
13	2.4	1.2	12.9	9.5	30	28	58
14	1.9	1.0	12.1	8.8	41	37	78
15	3.5	1.9	29.9	20.6	71	41	112
16-E	1.7	0.8	10.4	6.5	38	29	67
16-W	2.6	1.0	11.7	5.3	20	11	31
17	4.2	3.0	20.2	18.8	23	16	39
18	3.9	1.9	18.2	12.5	22	21	43
19	1.5	1.0	9.0	7.8	34	23	57
20	0.8	0.4	2.5	1.8	9	12	21
21	3.9	2.1	28.3	19.0	52	28	80
22	3.1	2.0	26.2	20.5	73	36	109
23	3.7	2.1	29.4	20.6	62	32	94
24	3.7	3.0	25.2	24.0	47	17	64
25	2.7	1.6	20.1	14.2	57	25	82
25-W5	2.7	0.8	5.5	1.8	4	1	5

Table 6. Summer 2021 Floristic Quality Assessment Data Summary

MU#	*w*Mean C		*w*FQI		Species Richness		
	Native	All	Native	All	Native	Non-native	Total
01	3.0	1.1	17.0	10.5	32	30	62
02	2.9	1.0	19.6	9.0	47	28	75
03	2.7	0.6	14.9	4.1	30	12	42
04	2.7	1.5	13.9	9.9	26	17	43
05	3.1	2.4	21.2	19.2	46	18	64
06	3.3	1.6	21.9	13.0	43	27	70
07	4.3	2.8	26.3	19.3	38	8	46
08	2.8	1.1	17.1	8.4	38	16	54
09	2.7	0.7	14.2	4.9	28	19	47
10-W2	2.9	2.1	15.1	13.3	27	12	39
10-W6	1.9	1.0	7.2	4.5	15	7	22
11-E*	3.9	1.7	23.9	13.0	38	21	59
11-W*	2.8	1.4	17.7	10.6	41	18	59
12	2.7	1.3	16.7	9.8	38	15	53
13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16-E	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16-W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	3.9	3.2	21.4	21.8	30	16	46
19	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	4.0	3.1	30.0	28.3	57	24	81
22	3.1	2.3	29.0	24.0	85	28	113
23	3.9	2.5	31.7	24.2	67	23	90
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25-W5	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: Management Units subject to the Forest Regeneration Project (MU12-MU17, MU19, MU20, MU24, and MU25) were not resampled in summer 2021.

* MU11 was split into two separate units (east and west) during summer vegetation surveys.

Rare Plants

RES located and mapped several sensitive plant species during the 2021 growing season, including, prairie Indian plantain (*Arnoglossum plantagineum*, State Special Concern), pale purple coneflower (*Echinacea pallida*, State Threatened), and wild quinine (*Parthenium integrifolium*, State Threatened). These species were planted/seeded at HSF during past rehabilitation efforts. Locations and extents of these species are shown in Figure 4. No other rare plants were documented onsite during 2021.

Invasive Species

Invasive species such as Canada thistle (*Cirsium arvense*), teasel, Tartarian honeysuckle, purple loosestrife (*Lythrum salicaria*), wild parsnip, common buckthorn, crown vetch, narrow-leaved cattail, and Siberian elm (*Ulmus pumila*) are prevalent within HSF. RES also located and mapped a small population of gout-weed
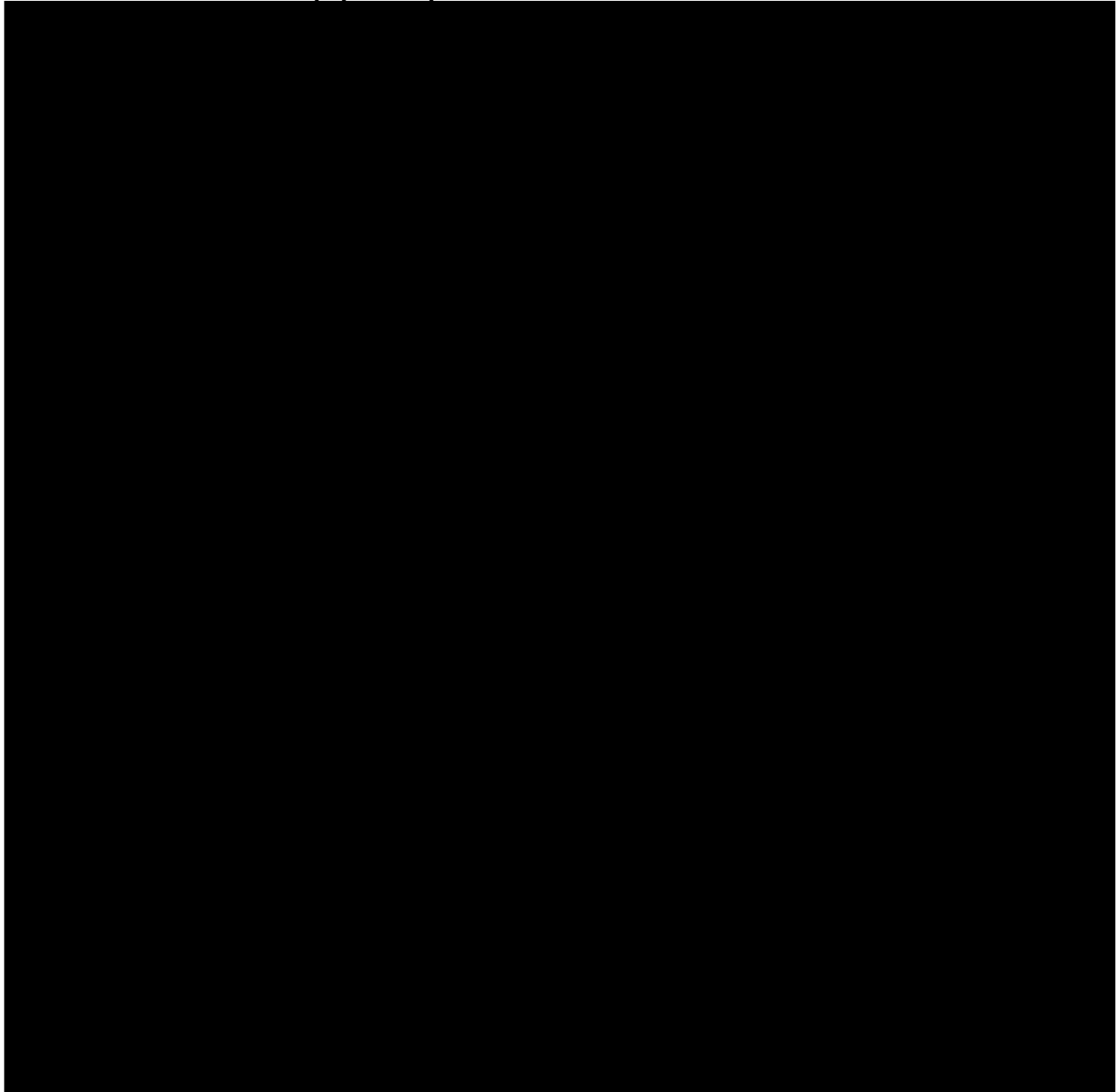
(*Aegopodium podagraria*) in MU21/MU22 which had not previously been documented within HSF. Locations and extents of significant invasive species populations mapped in 2021 are presented in Figure 5.

Wildlife

HSF provides important habitat and serves as a migration corridor for a variety of wildlife species in an otherwise highly urbanized landscape. The UWMFS and DPRC prepared a baseline wildlife population assessment of HSF (and other portions of the Milwaukee Estuary AOC) through compilation and analysis of third party data as well as through original data collection efforts. This assessment pertained to breeding and migratory birds; insects; bats and other mammals; herptiles; fish; Odonates; primary burrowing crayfish; and mussels. A list of SLCI that have been documented in historical or contemporary records on the HSF property is presented in Table 7.
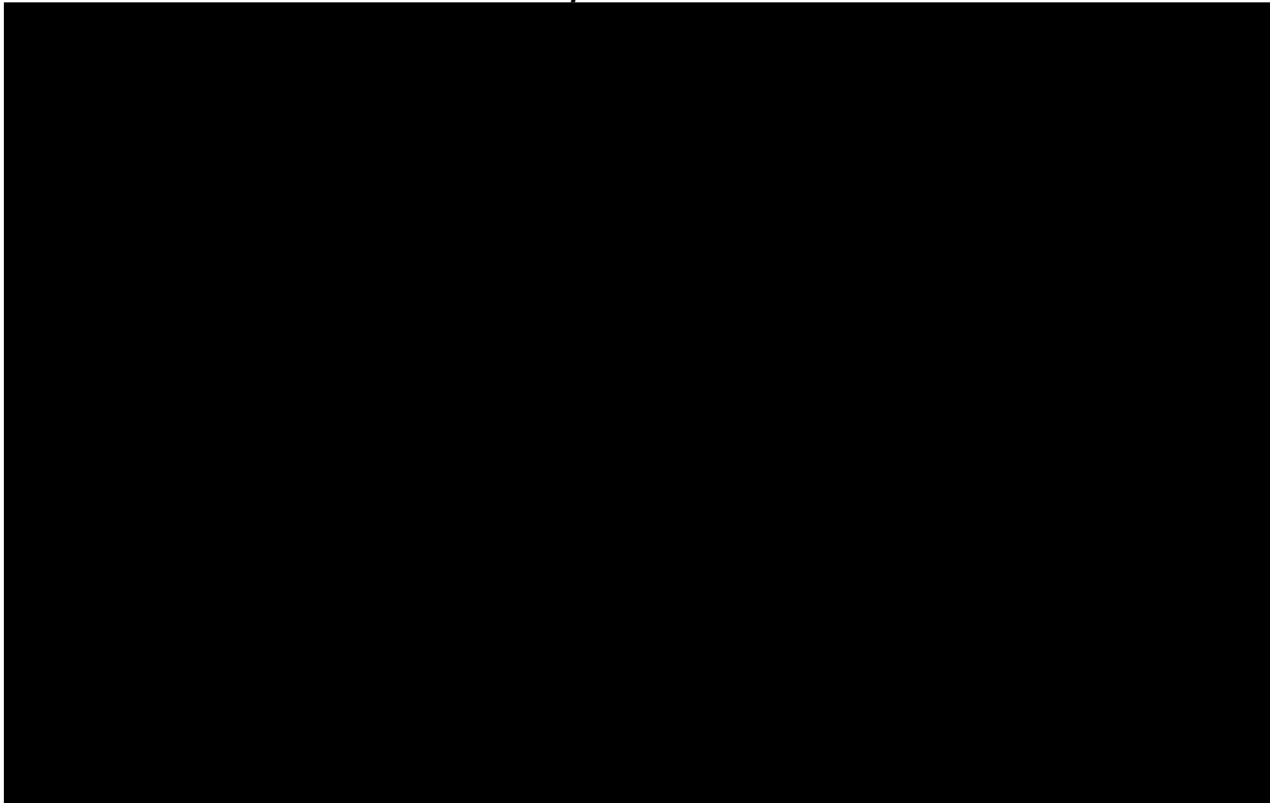
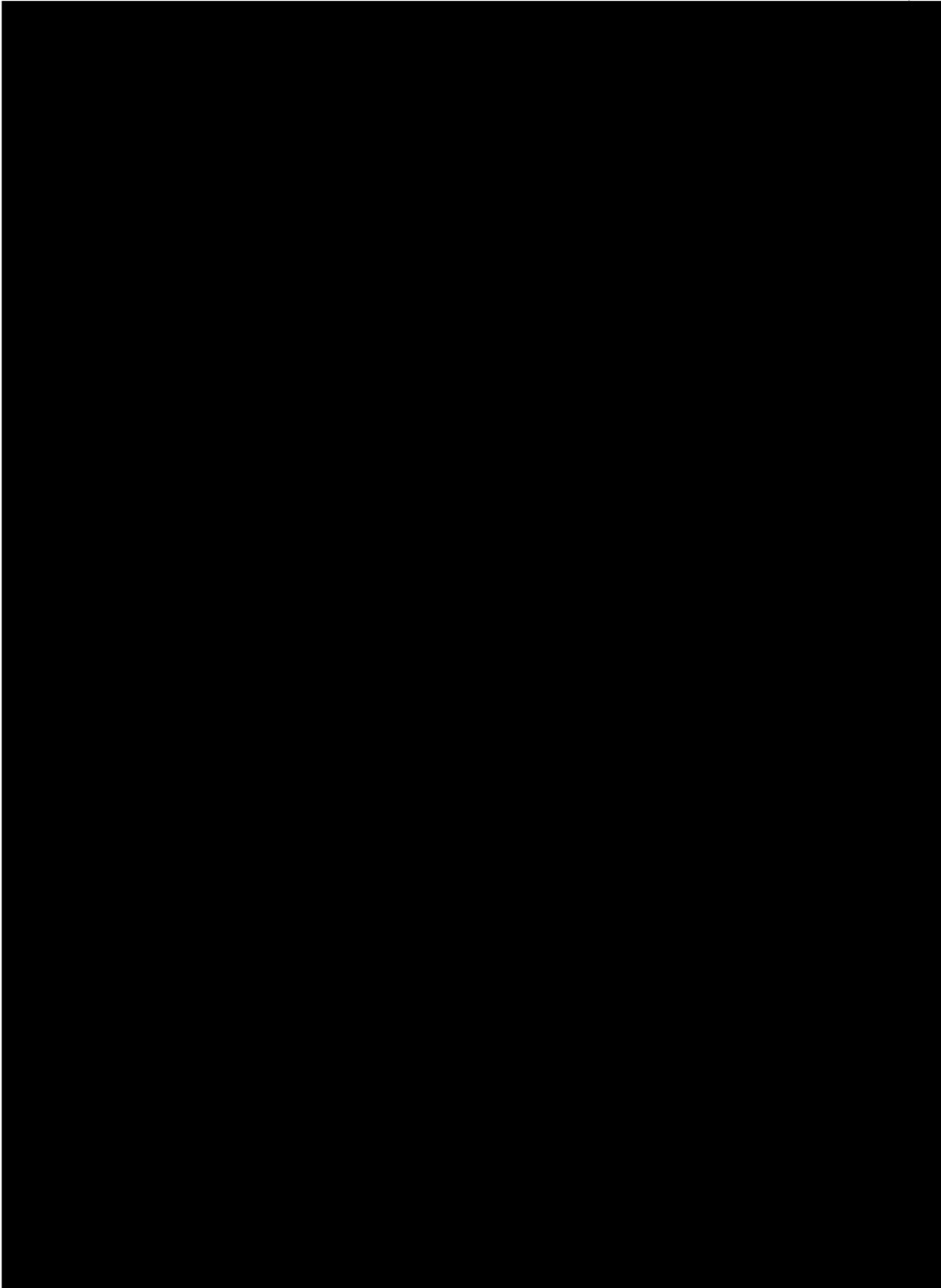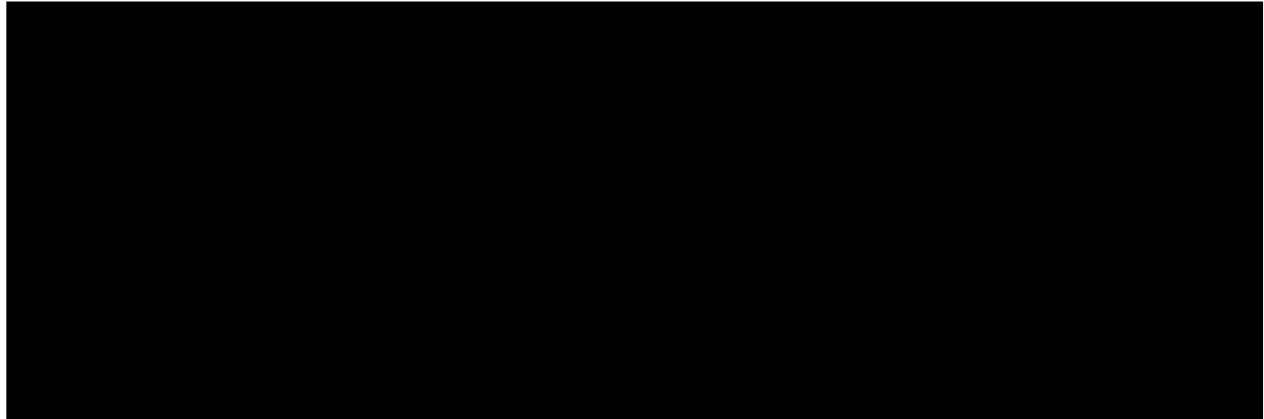***Table 7. Havenwoods List of Species of Local Conservation Interest***
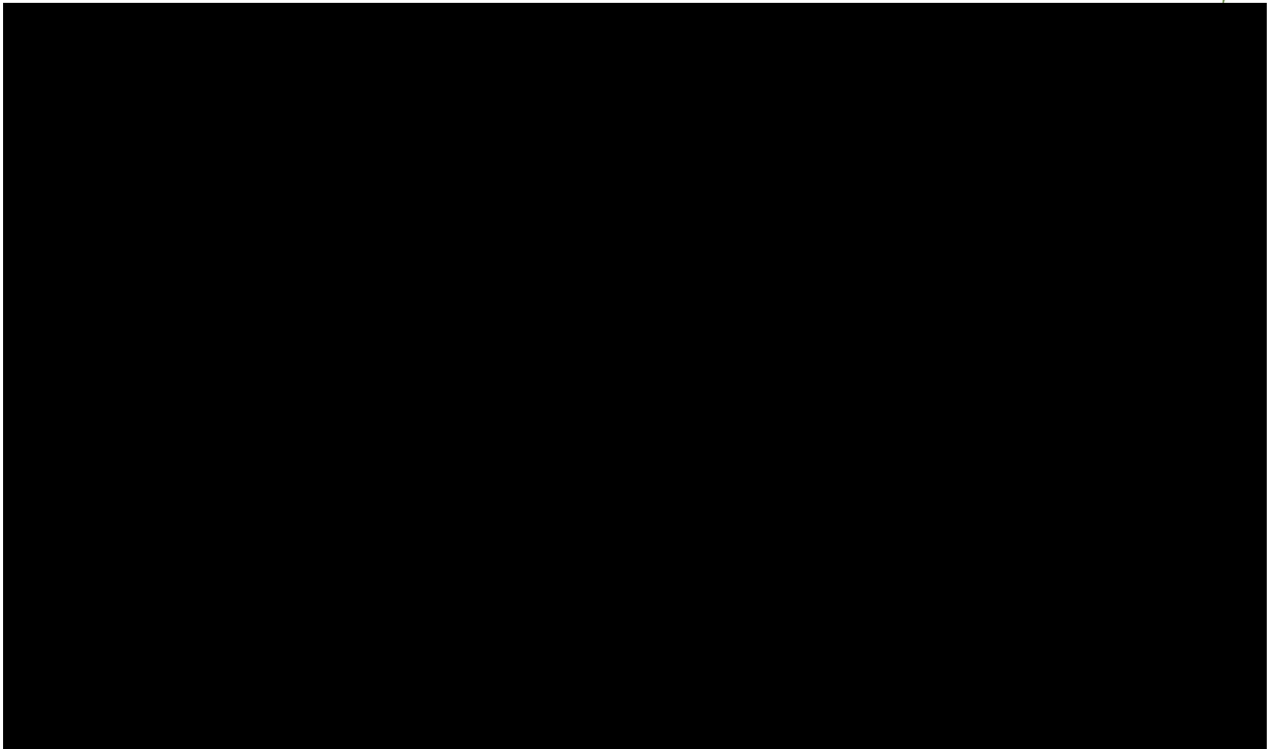
RES also noted incidental wildlife observation during vegetation sampling though no formal wildlife surveys took place (Table 8).

***Table 8. Havenwoods 2021 Incidental Wildlife Observations***

Though some baseline wildlife data exists for HSF, additional wildlife surveys, especially surveys designed to document breeding behavior of wildlife indicator species, should be conducted prior to the implementation phase of the Project to inform avoidance measures. Surveys documenting breeding behavior should also be conducted after restoration has been implemented. Surveys will be designed later in the implementation and monitoring phases of the Project.

Cultural Resources

A cultural resources investigation was completed by Richard Kubicek (WDNR) in 2020 and one archeological burial site was found to be coincident with the Project area (Kubicek 2020). The site is documented as an unknown prehistoric era campsite/village based on the recovery of eight pieces of lithic material. Phase I and II testing was conducted by the WDNR in the 1980's. The site is recommended as not meeting National Register of Historic Places (NRHP) criteria. No standing structures are listed in the Wisconsin Historic Preservation Database (WHPD) or Wisconsin Architecture and History Inventory (AHI).

The HSF cultural review states that the WDNR, in conjunction with U.S. Environmental Protection Agency (EPA), establish the Project's Area of Potential Effect (APE) with respect to historic properties, including areas of potential ground disturbance and changes to standing structures (Kubicek 2020). Ground disturbance is anticipated to occur in MU01-MU04, MU07, MU08, MU11-E/W, and MU12; therefore, these areas should be considered the preliminary APE. The preliminary APE should be refined, and a cultural resources consultant should determine the locations and types of cultural resources within the APE during the design and permitting phase. These types of investigations typically occur during the 30% design phase in case restoration plans need to be revised based on the findings.

Endangered Resources
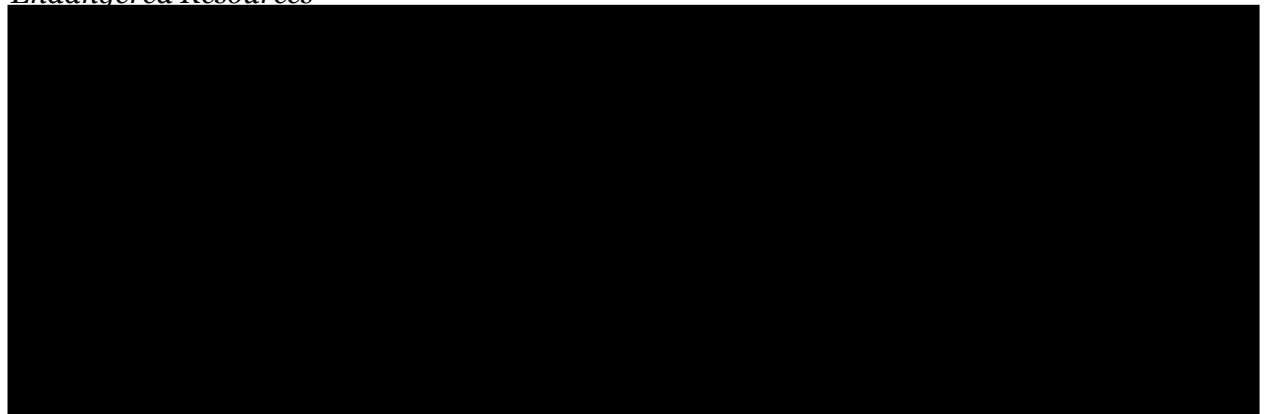
Conceptual Ecological Restoration Plan

Introduction

The target natural communities of this restoration/rehabilitation effort include southern mesic forest, oak opening (oak savanna), mesic prairie, shrub-carr, wet prairie, emergent marsh, southern hardwood swamp, floodplain forest, and conifer plantation (Figure 6). A variety of methods are proposed to accomplish this including invasive species removal, native seeding/planting, prescribed fire, and wildlife scrape construction. This plan was developed to address several goals simultaneously, including achievement of the quantitative success metrics established in the RAP (discussed in the Introduction) as well as the requirements and mission of the WWAP; all while avoiding creation of ecological traps (i.e., improved/restored habitats that attract wildlife but have hidden stressors that ultimately hinder successful breeding). RES anticipates that the bulk of rehabilitation/restoration implementation efforts will begin in the winter of 2024, though we propose some minimal site preparation work begin in summer 2024. The proposed rehabilitation schedule is subject to change based on grant funding availability.

Design Considerations

RES followed several Focal Species habitat restoration guidelines from the Milwaukee Estuary Area of Concern Wildlife Population Assessment Report in developing this ERMP in order to improve habitat for birds, bats, mammals, herptiles, and primary burrowing crayfish.

For birds:

- Increase and enhance habitat extent, connectivity, quality, structure, and buffers.
  - Reduce non-native, invasive species.
  - Install native tree, shrub, and herbaceous species with diverse budburst phenology and fruit/seed diversity in forest and shrubland habitats.
  - Install a diverse mix of native herbaceous species in herbaceous plant communities (e.g., prairies and emergent marshes).
  - Retain/create snags and rookeries.

- Promote prey biomass and foraging areas.
  - Maximize stream and wetland buffers.
  - Implement Integrated Pest Management strategies.

- Avoid disturbance during primary nesting periods.

For bats:

- Maintain linear habitat corridors.
- Retain/create dead and dying trees.
- Avoid summer tree removal and prescribed burning.
- Retain natural vegetation along waterbodies.

For non-bat mammals:

- Restore natural vegetation along waterbodies.
- Restore lands adjacent to railroad rights-of-way.

For herptiles:

- Restore ephemeral wetlands.
- Restore upland hardwoods forest.
- Retain and create downed woody debris.
- Create, restore, and enhance wetlands and ponds.
- Reduce non-native, invasive species.

For primary burrowing crayfish

- Maintain and enhance floodplain and isolated wetlands.
    - Control invasive species.
    - Establish diverse native plant communities.
- Reduce cover of root mat forming species (e.g., cattail and reed canary grass)

Target Plant Communities

Southern Mesic Forest
Approximately 56.3 acres of southern mesic forest within the Forest Regeneration Project area (MU13-A, MU14, MU15-A, MU16, MU19-A, MU20, MU24, and MU25) and 26.6 acres outside the Forest Regeneration Project area (MU01, MU02-A, MU03, MU04-A, MU07, and MU08) are proposed for rehabilitation efforts. Focal Species that may benefit from this habitat improvement include American redstart (*Setophaga ruticilla*), American woodcock, black-billed cuckoo (*Coccyzus erythropthalmus*), ovenbird (*Seiurus aurocapilla*), red-headed woodpecker (*Melanerpes erythrocephalus*), veery (*Catharus fuscescens*), wood thrush (*Hylocichla mustelina*), American mink (*Neovison vison*), boreal chorus frog (*Pseudoacris maculata*), eastern milksnake (*Lampropeltis triangulum*), and northern red-bellied snake (*Storeria occipitomaculata*). Proposed rehabilitation measures include the following:

- Remove all common buckthorn in the subcanopy stratum using chainsaws and common buckthorn and honeysuckle in the sapling/shrub stratum via forestry mower in winter 2024 in MU02-A, MU03, MU04-A, MU07, and MU08. Broadcast-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in these same MUs. Continue aggressive spot-treatment of resprouting woody invasive species in 2026 and 2027.

- Woody invasive species are minimal in the subcanopy and sapling/shrub strata in MU01 so forestry mowing is not anticipated in this MU. Therefore, woody invasive species in this MU should be removed with chainsaws and/or brushcutters and stump-treated with herbicide in winter 2024. Invasive species in the herb stratum of MU01 such as common buckthorn, musk thistle, Canada thistle, teasel, wild parsnip, crown vetch, and reed canary grass should be spot-treated with herbicide in spring 2025 before they flower. Follow-up treatments should occur in early summer 2025. This regiment should continue through 2026 and 2027.

- Cut/chainsaw, stump spray with herbicide, and remove all Siberian elm and black locust trees within 50-feet of trails in winter 2024. Girdle all Siberian elm and black locust trees on the interior (>50 feet from trail) of the southern mesic forest MUs. Retain logs for use as downed woody debris habitat enhancement features throughout the forested portions of HSF. Retain several black locust logs for use as wetland habitat enhancement features in MU11/MU12.

- Girdle 2-3 Norway maple trees on the interior of MU01-MU03 in winter 2024.

- Girdle 2-3 cottonwood and/or boxelder trees on the interior of each of the Forest Regeneration Project MUs (MU13-A, MU14, MU15-A, MU16, MU19-A, MU20, MU24, and MU25) in winter 2024.

- Install native trees and shrubs shown in Table 9 in MU01, MU02-A, MU03, MU04-A, MU07, and MU08 once woody invasive species have been adequately controlled in spring/summer 2026. Broadcast seed these same areas after woody plant installation in fall 2026 per Table 10. Debris left over from forestry mowing may need to be removed prior to seeding if it will inhibit seed/soil contact.

- Invasive species in the herb stratum of the Forest Regeneration Project areas (MU13-A, MU14, MU15-A, MU16, MU19-A, MU20, MU24, and MU25), such as common buckthorn, musk thistle, Canada thistle, teasel, wild parsnip, crown vetch, garlic mustard, dame's rocket, and reed canary grass should be spot-treated with herbicide in spring and again in summer 2025. This process should be repeated in 2026.

- In Forest Regeneration Project areas (MU13-A, MU14, MU15-A, MU16, MU19-A, MU20, MU24, and MU25), install herbaceous understory species plugs in clusters using the species in Table 10 in spring/summer 2025. Each cluster should consist of a 20-30 tightly spaced individuals of the same species planted on 1-foot centers. Clusters should be installed on approximately 100-foot centers.

- Begin long-term management of MUs within the Forest Regeneration Project (MU13-A, MU14, MU15-A, MU16, MU19-A, MU20, MU24, and MU25) in spring 2027 and the other southern mesic forest MUs (MU01-MU04, MU07, MU08) in 2028. This would include annual spot-spraying of invasive species as needed, periodic prescribed burning, and supplemental native seed/plant installation as needed.

Table 9. Southern Mesic Forest Woody Plant Palette

Scientific Name	Common Name	Density (trees/shrubs per acre)
Acer saccharum	sugar maple	10
Carpinus caroliniana	muscle-wood	10
Carya cordiformis	bitternut hickory	20
Corylus americana	hazelnut	15
Hamamelis virginiana	American witch-hazel	10
Prunus americana	wild plum	10
Quercus alba	white oak	15
Quercus macrocarpa	bur oak	15
Quercus rubra	red oak	15
Ribes americanum	American black currant	15
Tilia americana	American basswood	15
	Total	**150**

Table 10. Southern Mesic Forest Herbaceous Plant Palette

Scientific Name	Common Name	% of Seed Mix[1]	Planting Density[2] (plants per acre)
Allium cernuum	nodding wild onion	1%	15
Anemone canadensis	meadow anemone	1%	
Anemone virginiana	Virginia anemone	1%	
Anemonella thalictroides	rue anemone	1%	
Aquilegia canadensis	wild columbine	2%	20
Bromus pubescens	woodland brome	1%	
Carex blanda	eastern woodland sedge	2%	15
Carex normalis	spreading oval sedge	4%	15
Carex radiata	curly wood sedge	1%	15

Scientific Name	Common Name	% of Seed Mix[1]	Planting Density[2] (plants per acre)
Carex shortiana	short's sedge	1%	15
Carex sprengelii	long-beaked sedge	1%	15
Claytonia virginica	spring beauty	1%	
Dicentra cucullaria	dutchman's britches	1%	15
Dodecatheon meadia	shooting star	1%	15
Elymus canadensis	Canada wild rye	7%	
Elymus hystrix	bottlebrush grass	14%	30
Elymus villosus	silky wild rye	10%	
Eupatorium altissimum	tall boneset	3%	
Eutrochium purpureum	purple joe pye weed	2%	20
Geranium maculatum	wild geranium	1%	
Helianthus strumosus	pale-leaved sunflower	1%	
Heuchera richardsonii	prairie alum root	12%	
Luzula multiflora	common wood rush	1%	
Muhlenbergia mexicana	leafy satin grass	1%	
Phlox divaricata	blue phlox	1%	
Podophyllum peltatum	may apple	1%	
Polemonium reptans	Jacob's ladder	1%	
Polygonatum biflorum	smooth Solomon's seal	1%	15
Rudbeckia triloba	brown-eyed susan	3%	
Sanguinaria canadensis	bloodroot	1%	15
Solidago flexicaulis	broad-leaved goldenrod	1%	
Solidago juncea	early goldenrod	4%	15
Solidago ulmifolia	elm-leaved goldenrod	3%	
Symphyotrichum laeve	smooth blue aster	5%	15
Thalictrum dasycarpum	purple meadow rue	1%	20
Uvularia sessilifolia	sessile bellwort	1%	15
Veronicastrum virginicum	Culver's root	6%	15
Rate = 2 lbs/ac	Total	100%	300

[1] Seed mix applies to MU01-MU04, MU07, and MU08 only.
[2] Plug planting applies to MU13-16, MU19, MU20, MU24, and MU25 (Forest Regeneration Project areas) only.

Oak Opening

Approximately 25.8 acres of invaded surrogate grassland is proposed to be restored to oak opening in MU06 and MU09. In addition, 9.2 acres of southern mesic forest is proposed to be converted to oak opening in MU02-B, MU04-B, MU13-B, MU15-B, and MU19-B. Focal Species that may benefit from this habitat improvement include American woodcock, brown thrasher (*Toxostoma rufum*), red-headed woodpecker, field sparrow (*Spizella pusilla*), common gartersnake (*Thamnophis sirtalis*), eastern milksnake, and northern red-bellied snake. Proposed restoration measures include the following:

- Remove all common buckthorn in the subcanopy stratum using chainsaws and heavy infestations of common buckthorn, honeysuckle, and Russian olive (*Elaeagnus angustifolia*) in the sapling/shrub stratum via forestry mower in winter 2024 in MU06 and MU09. Small/scattered patches of common buckthorn, honeysuckle, and Russian olive should be cut with brushcutters. Broadcast-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in these same MUs. Continue aggressive spot-treatment of resprouting woody invasive species in 2026 and 2027.

- Cut/chainsaw, stump spray with herbicide, and remove all Siberian elm and black locust trees within 50-feet of trails in winter 2024. Girdle all Siberian elm and black locust trees on the interior (>50 feet from trail). Retain logs for use as downed woody debris habitat enhancement features throughout the forested portions of HSF.

- Remove all boxelder, apple (*Malus* sp.), cottonwood, Norway spruce (*Picea abies*), American elm, Siberian elm, and red elm (*Ulmus rubra*) trees in MU02-B, MU04-B, MU13-B, MU15-B, and MU19-B only in winter 2024. Retain logs for use as downed woody debris habitat enhancement features throughout the forested portions of HSF.

- Broadcast-spray the initial flush of cool-season grasses in early spring 2025 with a grass-specific herbicide prior to the first flush of warm season vegetation.

- Broadcast-spray heavy infestations of teasel and wild parsnip with herbicide in spring 2025. Spot-spray smaller patches of teasel, wild parsnip, Canada thistle, and dame's rocket in spring and again in summer 2025. Repeat spot-spraying in 2026 and 2027.

- Conduct prescribed burns in MU02-B, MU04-B, MU06, MU09, MU13-B, MU15-B, and MU19-B in fall 2025 to prepare the soil for native seeding. Broadcast seed these same areas in fall 2025 per Table 11. Debris left over from forestry mowing may need to be removed prior to seeding if it will inhibit seed/soil contact. Excessive debris will need to be removed from around the base of trees to be preserved prior to burning.

- In seeded areas where annual weeds are prevalent, vegetation should be mowed to a height of 12 inches once it reaches approximately 24 inches in height in May or June 2026. Two additional mowing events should occur in mid- and late-summer. Repeat this process in 2027.

- Install native trees and shrubs shown in Table 12 in MU02-B, MU04-B, MU06, MU09, MU13-B, MU15-B, and MU19-B in spring/summer 2026. Trees should be planted in a scattered distribution while shrubs should be planted in clusters of several individuals.

- Begin long-term management of MU02-B, MU04-B, MU06, MU09, MU13-B, MU15-B, and MU19-B in spring 2028. This would include annual spot-spraying of invasive species as needed, periodic prescribed burning, and supplemental native seed/plant installation as needed.

Table 11. Oak Opening Herbaceous Seed Mix

Scientific Name	Common Name	% of Seed Mix
Allium cernuum	nodding wild onion	1%
Andropogon gerardii	big bluestem	8%
Asclepias syriaca	common milkweed	1%
Asclepias tuberosa	butterfly weed	1%
Bouteloua curtipendula	side oats grama	2%
Carex bicknellii	Bicknell's sedge	4%
Chamaecrista fasciculata	partridge pea	1%
Coreopsis palmata	prairie coreopsis	1%
Dalea purpurea	purple prairie clover	2%
Desmodium canadense	Canada tick trefoil	1%
Echinacea pallida	pale purple coneflower	1%
Elymus canadensis	Canada wild rye	8%
Hypericum ascyron	great St. John's wort	2%
Monarda fistulosa	wild bergamot	3%
Oligoneuron rigidum	stiff goldenrod	1%
Panicum virgatum	switch grass	6%
Pycnanthemum tenuifolium	slender mountain mint	5%
Ratibida pinnata	yellow coneflower	1%
Rudbeckia hirta	black-eyed Susan	5%
Rudbeckia subtomentosa	sweet black-eyed Susan	1%
Schizachyrium scoparium	little bluestem	12%
Silphium laciniatum	compass plant	1%

Scientific Name	Common Name	% of Seed Mix
Silphium terebinthinaceum	prairie dock	1%
Solidago juncea	early goldenrod	5%
Solidago speciosa	showy goldenrod	2%
Sorghastrum nutans	Indian grass	12%
Symphyotrichum laeve	smooth blue aster	1%
Symphyotrichum novae-angliae	New England aster	2%
Symphyotrichum oolentangiense	sky-blue aster	1%
Verbena stricta	hoary vervain	3%
Veronicastrum virginicum	Culver's root	4%
Zizia aurea	golden alexanders	1%
Rate = 8 lbs/ac	**Total**	**100%**

Table 12. Oak Opening Woody Plant Palette

Scientific Name	Common Name	Density (trees per acre)
Quercus alba	white oak	25
Quercus macrocarpa	bur oak	25
Quercus velutina	black oak	25
	Total	**75**

Mesic Prairie

Approximately 35.4 acres of surrogate grassland is proposed to be restored to mesic prairie and 36.8 acres of existing mesic prairie is proposed for rehabilitation (MU11, MU18, MU21, and MU23). In addition, 8.0 acres of southern mesic forest is proposed to be converted to mesic prairie in MU13-C and MU15-C. Focal Species that may benefit from this habitat improvement include American woodcock, bobolink (*Dolichonyx oryzivorus*), eastern meadowlark (*Sturnella magna*), field sparrow, northern leopard frog (*Lithobates pipiens*), Butler's gartersnake (*Thamnophis butleri*), common gartersnake, eastern milksnake, and northern red-bellied snake. Proposed restoration/rehabilitation measures include the following:

- Brushcut and stump-treat with herbicide all common buckthorn, honeysuckle, and other woody invasive species in the sapling/shrub stratum in winter 2024 in MU011, MU18, MU21, and MU23. Spot-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in these same MUs. Continue aggressive spot-treatment of resprouting woody invasive species in 2026.

- Cut/chainsaw, stump spray with herbicide, and remove all Siberian elm trees within 50-feet of trails in winter 2024. Girdle all Siberian elm trees on the interior (>50 feet from trail). Retain logs for use as downed woody debris habitat enhancement features throughout the forested portions of HSF.

- Remove all boxelder, apple, cottonwood, Norway spruce, American elm, Siberian elm, and red elm trees in MU13-C and MU15-C only in winter 2024. Retain logs for use as downed woody debris habitat enhancement features throughout the forested portions of HSF.

- An approximately 2.3-acre wildlife scrape is proposed for the northwest portion of MU12 (Figure 6). Approximately 2 acres of mesic prairie area in MU11-W may be suitable for spreading spoils from scrape excavation. Scrape construction is planned for late-fall/winter 2024 so the designated area will receive the spoils at that time. Create topographic interest in spoils area by grading several mounds. Once at finish grade, the spoils area should be broadcast seeded with a cover crop of winter wheat per Table 13. Steeper portions of this area may need to be stabilized with straw mulch or erosion blanket. Other erosion control measures will be required to ensure the downslope wetlands are protected from sediment. Soils were investigated in the vicinity of the proposed

scrape during the wetland delineation and they were found to be hydric; however, the water table was not encountered. Hydrologic studies will need to be undertaken during the design phase to determine optimal excavation depths.

- Broadcast-spray the initial flush of cool-season grasses in early spring 2025 with a grass-specific herbicide prior to the first flush of warm season vegetation.

- Broadcast-spray heavy infestations of reed canary grass, crown vetch, teasel, and wild parsnip with herbicide in spring 2025. Spot-spray smaller patches of reed canary grass, crown vetch, teasel, wild parsnip, and Canada thistle in spring and again in summer 2025. Repeat spot-spraying in 2026 and 2027.

- Conduct prescribed burns in MU11, MU18, MU21, and MU23 in fall 2025 to prepare the soil for native seeding. Broadcast seed these areas after burning in fall 2025 per Table 13.

- In seeded areas where annual weeds are prevalent, vegetation should be mowed to a height of 12 inches once it reaches approximately 24 inches in height in May or June 2026. Two additional mowing events should occur in mid- and late-summer. Repeat this process in 2027.

- Begin long-term management of MU11, MU18, MU21, and MU23 in spring 2028. This would include annual spot-spraying of invasive species as needed, periodic prescribed burning, and supplemental native seed/plant installation as needed.

Table 13. Mesic Prairie Herbaceous Seed Mix

Scientific Name	Common Name	% of Seed Mix
Allium cernuum	nodding wild onion	1%
Andropogon gerardii	big bluestem	8%
Asclepias syriaca	common milkweed	1%
Asclepias tuberosa	butterfly weed	1%
Bouteloua curtipendula	side oats grama	2%
Carex bicknellii	Bicknell's sedge	4%
Chamaecrista fasciculata	partridge pea	1%
Coreopsis palmata	prairie coreopsis	1%
Dalea purpurea	purple prairie clover	2%
Desmodium canadense	Canada tick trefoil	1%
Echinacea pallida	pale purple coneflower	1%
Elymus canadensis	Canada wild rye	8%
Hypericum ascyron	great St. Johns wort	2%
Monarda fistulosa	wild bergamot	3%
Oligoneuron rigidum	stiff goldenrod	1%
Panicum virgatum	switch grass	6%
Pycnanthemum tenuifolium	slender mountain mint	5%
Ratibida pinnata	yellow coneflower	1%
Rudbeckia hirta	black-eyed Susan	5%
Rudbeckia subtomentosa	sweet black-eyed Susan	1%
Schizachyrium scoparium	little bluestem	12%
Silphium laciniatum	compass plant	1%
Silphium terebinthinaceum	prairie dock	1%
Solidago juncea	early goldenrod	5%
Solidago speciosa	showy goldenrod	2%
Sorghastrum nutans	Indian grass	12%
Symphyotrichum laeve	smooth blue aster	1%
Symphyotrichum novae-angliae	New England aster	2%
Symphyotrichum oolentangiense	sky-blue aster	1%
Verbena stricta	hoary vervain	3%

Scientific Name	Common Name	% of Seed Mix
Veronicastrum virginicum	Culver's root	4%
Zizia aurea	golden alexanders	1%
Rate = 8 lbs/ac	**Total**	**100%**
Scrape Spoils Area Cover Crop		
Triticum aestivum	winter wheat	100%
Rate = 30 lbs/ac	**Total**	**100%**

Shrub-carr

Approximately 5.8 acres of shrub-carr is proposed for rehabilitation in MU12 and MU22. Focal Species that may benefit from this habitat improvement include American woodcock, brown thrasher, willow flycatcher (*Empidonax traillii*), and American mink. Proposed rehabilitation measures include the following:

- Brushcut and stump-treat with herbicide all common buckthorn, honeysuckle, and other woody invasive species in the sapling/shrub stratum in winter 2024 in MU12 and MU22. Spot-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in these same MUs. Continue aggressive spot-treatment of resprouting woody invasive species in 2026.

- Cut/chainsaw, stump spray with herbicide, and remove all Siberian elm trees within 50-feet of trails in winter 2024. Girdle all Siberian elm trees on the interior (>50 feet from trail). Retain logs for use as downed woody debris habitat enhancement features throughout the forested portions of HSF.

- Conduct prescribed burns in MU12 and MU22 in early spring 2025 to help control sandbar willow.

- Conduct herbicide treatments on reed canary grass, garlic mustard, Canada thistle, crown vetch, teasel, wild parsnip, narrow-leaved cattail, and purple loosestrife in spring and summer. Repeat this process in 2026 and 2027.

- Install native shrubs shown in Table 14 in MU12 and MU22 in spring/summer 2026. Broadcast seed these same areas after woody plant installation in fall 2026 using the species shown in Table 15.

- Begin long-term management of MU12 and MU22 in spring 2028. This would include annual spot-spraying of invasive species as needed, periodic prescribed burning, and supplemental native seed/plant installation as needed.

Table 14. Shrub-carr Woody Plant Palette

Scientific Name	Common Name	Density (shrubs per acre)
Aronia melanocarpa	black chokeberry	10
Cornus amomum	silky dogwood	5
Cornus sericea	red osier dogwood	10
Physocarpus opulifolius	ninebark	15
Salix bebbiana	beaked willow	15
Sambucus canadensis	elderberry	15
Spiraea alba	white meadow-sweet	15
Viburnum lentago	nannyberry	15
	Total	**100**

Table 15. Shrub-carr Herbaceous Seed Mix

Scientific Name	Common Name	% of Seed Mix
Angelica atropurpurea	great angelica	10%
Calamagrostis canadensis	blue-joint grass	10%
Carex crinita	fringed sedge	10%
Carex gracillima	graceful sedge	5%
Carex grayi	Gray's sedge	10%
Carex lupulina	hop sedge	5%

Scientific Name	Common Name	% of Seed Mix
Carex sprengelii	long-beaked sedge	5%
Carex stipata	awl fruited sedge	5%
Elymus virginicus	Virginia wild rye	15%
Eutrochium maculatum	spotted Joe-pye weed	10%
Lycopus americanus	water horehound	5%
Rosa setigera	savanna rose	5%
Thalictrum dasycarpum	purple meadow rue	5%
Rate = 2 lbs/ac	**Total**	**100%**

Wet Prairie

Approximately 4.0 acres of existing wet meadow within the MU12 wetland complex are proposed for rehabilitation to wet prairie. Construction of a wetland scrape is also proposed in MU12 to enhance existing wetlands and create approximately 1 acre of new wet prairie wetlands. Focal Species that may benefit from this habitat improvement include northern leopard frog, American mink, Butler's gartersnake, and prairie crayfish (*Procambarus gracilis*). Proposed rehabilitation/creation measures include the following:

- Brushcut and stump-treat with herbicide all common buckthorn, honeysuckle, and other woody invasive species in the sapling/shrub stratum in winter 2024 in MU12. Spot-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in this same MU. Continue aggressive spot-treatment of resprouting woody invasive species in 2026.

- An approximately 2.3-acre wildlife scrape is proposed for the northwest portion of MU12 (Figure 6) with an average cut depth of approximately 2 feet. The scrape should be constructed following the NRCS Wetland Scrape Design specifications (WDNR 2021b) in winter 2024. Spoils should be land-spread onsite, potentially in uplands immediately to the west of the proposed scrape. The scrape footprint should be broadcast-sprayed with herbicide in early- and late-summer 2024 prior to scrape construction. The top 6 inches to 1 foot of the scrape area should be excavated and placed as the base layer of the spoils area with subsequent lifts burying this first lift. Create topographic interest of spoils area by grading several mounds. Finish grade portions of the scrape should have at least 1 foot of topsoil so topsoil salvage may be necessary in areas with shallow topsoil and/or deep cut depths. Soils were investigated in the vicinity of the proposed scrape during the wetland delineation and they were found to be hydric; however, the water table was not encountered. Hydrologic studies will need to be undertaken during the design phase to determine optimal excavation depths.

- Seed a cover crop of winter wheat throughout the approximately 2-acre post-construction scrape area per Table 16 once the area is at finish grade. Steeper portions of this area may need to be stabilized with straw mulch or erosion blanket. Other erosion control measures will be required to ensure the downslope wetlands are protected from sediment.

- Broadcast spray large reed canary grass infestations outside the scrape area in early- and late-summer 2024 using herbicide approved for use in aquatic settings. This should occur at the same time the scrape area is broadcast-sprayed.

- Spot-treat invasive species such as reed canary grass, garlic mustard, Canada thistle, crown vetch, teasel, wild parsnip, narrow-leaved cattail, and purple loosestrife in spring and summer 2025. Repeat this process as needed in 2026 and 2027.

- Conduct prescribed burns in wet prairie portions of MU12 in fall 2025 to prepare the soil for native

seeding. Broadcast seed these areas after burning in fall 2025 per Table 16.

- In seeded areas where annual weeds are prevalent, vegetation should be mowed to a height of 12 inches once it reaches approximately 24 inches in height in May or June 2026. Two additional mowing events should occur in mid- and late-summer. Repeat this process in 2027.

- Begin long-term management of MU12 in spring 2028. This would include annual spot-spraying of invasive species as needed, periodic prescribed burning, and supplemental native seed/plant installation as needed.

Table 16. Wet Prairie Herbaceous Seed Mix

Scientific Name	Common Name	% of Seed Mix
Asclepias incarnata	marsh milkweed	3%
Angelica atropurpurea	great angelica	1%
Bidens cernua	nodding bur marigold	1%
Boltonia asteroides	false aster	4%
Bromus ciliatus	fringed brome	3%
Calamagrostis canadensis	Canada blue-joint grass	10%
Carex annectens	yellow-fruited sedge	3%
Carex bebbii	Bebb's sedge	3%
Carex emoryi	Emory's sedge	3%
Carex scoparia	pointed broom sedge	3%
Carex stipata	awl fruited sedge	3%
Carex vulpinoidea	fox sedge	3%
Elymus virginicus	Virginia wild rye	15%
Eupatorium perfoliatum	boneset	4%
Euthamia graminifolia	grass-leaf goldenrod	3%
Eutrochium maculatum	Joe pye-weed	3%
Helianthus grosseserratus	sawtooth sunflower	1%
Iris virginica	Virginia iris	1%
Liatris spicata	marsh blazing star	1%
Lythrum alatum	winged loosestrife	1%
Oligoneuron riddellii	Riddell's goldenrod	1%
Pedicularis lanceolata	swamp betony	1%
Pycnanthemum virginianum	Virginia mountain mint	1%
Scirpus atrovirens	dark green bulrush	3%
Senna hebecarpa	wild senna	1%
Silphium perfoliatum	cup plant	1%
Spartina pectinata	prairie cordgrass	7%
Symphyotrichum lanceolatum	panicle aster	3%
Symphyotrichum novae-angliae	New England aster	3%
Symphyotrichum puniceum	red-stem aster	3%
Verbesina alternifolia	wingstem	1%
Vernonia fasciculata	common ironweed	1%
Veronicastrum virginicum	Culver's root	4%
Zizia aurea	golden alexanders	1%
Rate = 8 lbs/ac	**Total**	**100%**
Scrape Area Cover Crop		
Triticum aestivum	winter wheat	100%
Rate = 30 lbs/ac	**Total**	**100%**

Emergent Marsh

Approximately 4.1 acres of existing emergent marsh is proposed for enhancement in MU12 and MU22. RES also anticipates creation of up to approximately 1 acre of emergent wetlands within the MU12 wetland complex after construction of the wildlife scrape in this area. Focal Species that may benefit from this habitat improvement include blue-winged teal *(Spatula discors)*, sora *(Porzana carolina)*, Butler's

gartersnake, boreal chorus frog, green frog (*Lithobates clamitans*), northern leopard frog, American mink, and prairie crayfish. Proposed enhancement/restoration measures include the following:

- Treat invasive species such as narrow-leaved cattail, reed canary grass, and purple loosestrife in the emergent zones with an herbicide approved for use in aquatic environments in spring/summer 2025. Repeat this process in 2026 and 2027.

- Conduct prescribed burns in emergent portions of MU12 in fall 2025 to prepare the soil for native seeding. Broadcast seed these areas after burning in fall 2025 per Table 17.

- Install emergent plant plugs and broadcast seed per Table 17 in spring 2026 within the emergent zones of MU12 and MU22.

- Hydrologic studies in the vicinity of the proposed scrape will need to be undertaken during the design phase to determine optimal excavation depths.

- Begin long-term management of MU12 and MU22 in spring 2028. This would include annual spot-spraying of invasive species and supplemental native seed/plant installation as needed.

Table 17. Emergent Marsh Plant Palette

Scientific Name	Common Name	% of Seed Mix	Planting Density (plants per acre)
Alisma subcordatum	water plantain	16%	
Asclepias incarnata	marsh milkweed	3%	
Carex lacustris	lake sedge	5%	
Iris virginica	Virginia iris	20%	100
Juncus effusus	soft rush	2%	
Leersia oryzoides	rice-cut grass	5%	
Pontederia cordata	pickerel weed		200
Rumex orbiculatus	water dock	3%	
Sagittaria latifolia	arrowhead	5%	
Scirpus cyperinus	woolgrass	10%	
Scirpus fluviatilis	river bulrush		100
Schoenoplectus tabernaemontani	soft-stem bulrush	15%	100
Sparganium eurycarpum	giant bur reed	16%	
Rate = 6 lbs/ac	**Total**	**100%**	**500**

Southern Hardwood Swamp

Approximately 1.7 acres of southern hardwood swamp is proposed for enhancement in MU10 and MU25. The small hardwood swamp wetland in the northwestern portion of the site (MU25-W5) is proposed to be expanded by approximately 0.9 acres via seeding of hardwood swamp species into the lower-lying portions of MU25. No hydrologic or soil manipulations are proposed to restore wetlands in this area. Focal Species that may benefit from this habitat improvement include American woodcock, boreal chorus frog, common garter snake, eastern milksnake, and northern red-bellied snake. Proposed enhancement/restoration measures include the following:

- Brushcut and stump-treat with herbicide all glossy buckthorn (*Frangula alnus*), common buckthorn, honeysuckle, and other woody invasive species in the sapling/shrub stratum in winter 2024 in MU10. Spot-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in MU10 and MU25-W5. Continue aggressive spot-treatment of resprouting woody invasive species in 2026 and 2027.

- Treat invasive species such as reed canary grass in the southern hardwood swamp zones with an

herbicide approved for use in aquatic environments in spring/summer 2025. Repeat this process as needed in 2026 and 2027.

- Install trees and shrubs in MU10 and MU25-W5 per Table 18 in spring/early summer 2026 and broadcast seed these MUs per Table 19 in fall 2026.

- Begin long-term management of MU10 and MU25-W5 in spring 2028. This would include annual spot-spraying of invasive species and supplemental native seed/plant installation as needed.

Table 18. Southern Hardwood Swamp Woody Plant Palette

Scientific Name	Common Name	Density (trees/shrubs per acre)
Acer rubrum	red maple	10
Celtis occidentalis	hackberry	10
Cornus amomum	silky dogwood	5
Cornus sericea	red osier dogwood	10
Ilex verticillata	common winterberry	10
Physocarpus opulifolius	ninebark	10
Quercus bicolor	swamp white oak	15
Quercus macrocarpa	bur oak	10
Sambucus canadensis	elderberry	10
Viburnum lentago	nannyberry	10
	Total	**100**

Table 19. Southern Hardwood Swamp Herbaceous Seed Mix

Scientific Name	Common Name	% of Seed Mix
Anemone canadensis	meadow anemone	1%
Boltonia asteroides	false aster	5%
Calamagrostis canadensis	blue-joint grass	4%
Campanulastrum americanum	tall bellflower	5%
Carex bromoides	brome-like sedge	4%
Carex crinita	fringed sedge	4%
Carex gracillima	graceful sedge	4%
Carex grayi	Gray's sedge	4%
Carex lacustris	lake sedge	4%
Carex lupulina	hop sedge	4%
Carex sprengelii	long-beaked sedge	4%
Carex stipata	awl fruited sedge	4%
Cinna arundinacea	wood reed grass	7%
Clematis virginiana	virgin's bower	1%
Elymus virginicus	Virginia wild rye	17%
Eutrochium purpureum	purple joe pye weed	4%
Glyceria striata	fowl manna grass	4%
Hypericum ascyron	great St. Johns wort	1%
Lobelia cardinalis	cardinal flower	2%
Lysimachia ciliata	fringed loosestrife	1%
Muhlenbergia mexicana	leafy satin grass	5%
Rosa setigera	savanna rose	1%
Rudbeckia laciniata	tall coneflower	2%
Rudbeckia subtomentosa	sweet black-eyed Susan	1%
Sphenopholis obtusata	prairie wedge grass	3%
Symphyotrichum lateriflorum	side-flowering aster	2%
Verbesina alternifolia	wingstem	1%
Zizia aurea	golden alexanders	1%
Rate = 2 lbs/ac	**Total**	**100%**

Floodplain Forest

Approximately 2.2 acres of floodplain forest is proposed for enhancement in MU05. Focal Species that may benefit from this habitat improvement include American woodcock, boreal chorus frog, common garter snake, eastern milksnake, and northern red-bellied snake. Proposed enhancement/restoration measures include the following:

- Brushcut and stump-treat with herbicide all common buckthorn, honeysuckle, and other woody invasive species in the sapling/shrub stratum in winter 2024 in MU05. Spot-spray resprouting buckthorn and honeysuckle with herbicide in spring/early summer 2025 in this same MU. Continue aggressive spot-treatment of resprouting woody invasive species in 2026 and 2027.

- Treat invasive species such as reed canary grass, garlic mustard, creeping bellflower, teasel, and dame's rocket in the floodplain forest zones with an herbicide approved for use in aquatic environments in spring/summer 2025. Repeat this process in 2026 and 2027.

- Install trees and shrubs MU05 per Table 20 in spring/early summer 2026 and broadcast seed this same MU per Table 21 in fall 2026.

- Begin long-term management of MU05 in spring 2027. This would include annual spot-spraying of invasive species and supplemental native seed/plant installation as needed.

Table 20. Floodplain Forest Woody Plant Palette

Scientific Name	Common Name	Density (trees/shrubs per acre)
Betula nigra	river birch	10
Celtis occidentalis	hackberry	10
Cephalanthus occidentalis	buttonbush	15
Cornus sericea	red osier dogwood	10
Quercus bicolor	swamp white oak	15
Quercus macrocarpa	bur oak	15
Sambucus canadensis	elderberry	15
	Total	**90**

Table 21. Floodplain Forest Herbaceous Seed Mix

Scientific Name	Common Name	% of Seed Mix
Anemone canadensis	meadow anemone	1%
Boltonia asteroides	false aster	5%
Calamagrostis canadensis	blue-joint grass	4%
Campanulastrum americanum	tall bellflower	5%
Carex crinita	fringed sedge	4%
Carex gracillima	graceful sedge	4%
Carex grayi	Gray's sedge	4%
Carex lacustris	lake sedge	4%
Carex lupulina	hop sedge	4%
Carex sprengelii	long-beaked sedge	4%
Carex stipata	awl fruited sedge	4%
Carex typhina	cattail sedge	4%
Cinna arundinacea	wood reed grass	7%
Clematis virginiana	virgin's bower	1%
Elymus virginicus	Virginia wild rye	17%
Eutrochium purpureum	purple joe pye weed	4%
Glyceria striata	fowl manna grass	4%
Helenium autumnale	sneezeweed	1%
Lobelia cardinalis	cardinal flower	2%
Lysimachia ciliata	fringed loosestrife	1%
Muhlenbergia mexicana	leafy satin grass	5%

Scientific Name	Common Name	% of Seed Mix
Rosa setigera	savanna rose	1%
Rudbeckia laciniata	tall coneflower	2%
Rudbeckia subtomentosa	sweet black-eyed Susan	1%
Sphenopholis obtusata	prairie wedge grass	3%
Symphyotrichum lateriflorum	side-flowering aster	2%
Verbesina alternifolia	wingstem	1%
Zizia aurea	golden alexanders	1%
Rate = 2 lbs/ac	**Total**	**100%**

Conifer Plantation

Approximately 1.2 acres of conifer plantation is proposed for rehabilitation in MU17. Proposed rehabilitation measures include the following:

- Brushcut and stump-treat with herbicide all common buckthorn in the sapling/shrub stratum in winter 2024 in MU017. Spot-spray resprouting buckthorn with herbicide in spring/early summer 2025 in these same MUs. Continue aggressive spot-treatment of resprouting woody invasive species in 2026 and 2027.

- Spot-spray reed canary grass and wild parsnip with herbicide in spring and summer 2025. Repeat this process in 2026 and 2027.

- Begin long-term management of MU17 in spring 2028. This would include annual spot-spraying of invasive species as needed.

Focal Species

RES wildlife experts conducted a Focal Species Analysis to determine a subset of SLCI that have the best chance of exhibiting breeding behavior in response to proposed management actions. The Focal Species list and associated management actions and avoidance measures are presented in Table 22.

Table 22. Havenwoods Focal Species

Common Name	WI Status	Appendix 4.D.1 Project Recommendation	Targeted Management Action	Avoidance & Minimization Measures
Breeding Birds - Grassland	N/A	Breeding Birds - Grassland	Prairie Expansion/Connectivity, Cool Season Grass Removal, Native Seeding, Prescribed Fire	Preconstruction nest surveys should be conducted to locate nests. Avoid broadcast herbicide application, mowing, or burning in grasslands in the vicinity of active nests.
Migratory Birds, Bats, & Insects	N/A	Migratory Birds, Bats, & Insects	Tree Girdling, Woody and Herbaceous Invasive Species Removal, Scrape Construction, Native Seeding/Planting	Work will occur outside the migration season.
American Redstart	N/A	Breeding Birds - Forest	Woody Invasive Species Removal, Native Seeding/Planting	No woody plant removal during mating and nesting period (May-July).
American Woodcock	Special Concern	Breeding Birds – Forest, Shrubland, Wetland	Woody Invasive Species Removal, Native Seeding/Planting	No woody plant removal during mating and nesting period (April-July).
Black-billed Cuckoo	N/A	Breeding Birds – Forest, Shrubland	Woody Invasive Species Removal	No woody plant removal during mating and nesting period (May-July).

Common Name	WI Status	Appendix 4.D.1 Project Recommendation	Targeted Management Action	Avoidance & Minimization Measures
Ovenbird	N/A	Breeding Birds - Forest	Woody Invasive Species Removal, Native Seeding/Planting	No woody plant removal during mating and nesting period (May-July).
Red-headed Woodpecker	Special Concern	Breeding Birds - Forest	Woody Invasive Species Removal, Native Seeding/Planting, Tree Girdling	Remove woody plants in winter (late November-early March).
Veery	N/A	Breeding Birds – Forest, Shrubland, Wetland	Woody Invasive Species Removal, Native Seeding/Planting	No woody plant removal during mating and nesting period (May-July).
Wood Thrush	N/A	Breeding Birds - Forest	Woody Invasive Species Removal, Native Seeding/Planting	No woody plant removal during mating and nesting period (May-July).
Brown Thrasher	N/A	Breeding Birds - Shrubland	Woody Invasive Species Removal, Cool Season Grass Removal, Native Shrub Planting in Oak Openings, Prescribed Fire	No woody plant removal during mating and nesting period (May-July).
Willow Flycatcher	N/A	Breeding Birds - Shrubland	Reed Canary Grass and Cattail Removal, Prescribed Fire	No woody plant removal during mating and nesting period (May-July).
Blue-winged Teal	N/A	Breeding Birds – Wetland, Grassland	Reed Canary Grass and Cattail Removal, Prescribed Fire	Limit excavation of ponds to November-February.
Sora	N/A	Breeding Birds - Wetland	Native Wet Prairie and Emergent Marsh Seeding/Planting	Preconstruction nest surveys should be conducted to locate nests. Avoid clearing of emergent vegetation in the vicinity of active nests.
Bobolink	Special Concern	Breeding Birds - Grassland	Herbaceous Invasives Removal, Native Seeding, Prescribed Fire	Preconstruction nest surveys should be conducted to locate nests. Avoid broadcast herbicide application, mowing, or burning in grasslands in the vicinity of active nests.
Eastern Meadowlark	Special Concern	Breeding Birds - Grassland	Herbaceous Invasives Removal, Native Seeding, Prescribed Fire	Preconstruction nest surveys should be conducted to locate nests. Avoid broadcast herbicide application, mowing, or burning in grasslands in the vicinity of active nests.
Field Sparrow	N/A	Breeding Birds - Grassland	Herbaceous Invasives Removal, Native Seeding, Prescribed Fire	Preconstruction nest surveys should be conducted to locate nests. Avoid broadcast herbicide application, mowing, or burning in grasslands in the vicinity of active nests.
American Mink	N/A	Mammals – Forest, Wetland	Reed Canary Grass and Cattail Removal, Native Seeding/Planting	Avoid putting young-of-the-year at risk before they can escape with mother by only using wheeled equipment and mowers after August 1 along Lincoln Creek. Limit prescribed burning near creek and ponds to fall, winter, or before April 15, and do not employ a ring burning technique.
Boreal Chorus Frog	N/A	Herptiles – Semi-aquatic	Reed Canary Grass and Cattail Removal, Native Seeding/Planting, Scrape Construction	Limit broadcast herbicide applications in habitat during the breeding season (late March-May).

Common Name	WI Status	Appendix 4.D.1 Project Recommendation	Targeted Management Action	Avoidance & Minimization Measures
Green Frog	N/A	Herptiles – Semi-aquatic	Reed Canary Grass and Cattail Removal, Native Seeding/Planting, Scrape Construction	Limit broadcast herbicide applications in habitat during the breeding season (May-mid August).
Northern Leopard Frog	N/A*	Herptiles – Semi-aquatic	Reed Canary Grass and Cattail Removal, Native Seeding/Planting, Scrape Construction	Limit broadcast herbicide applications in habitat during the breeding season (late March-mid June).
Butler's Gartersnake	Special Concern	Herptiles – Upland/Grassland	Non-native Cool Season Grass Removal, Native Seeding, Scrape Construction, Prescribed Fire	Burns should be done in small patches. Work can be done on hot or cool (<50F) days, as snake is underground at those times. Employ prescribed burning methods that allow snakes to escape approaching flames, i.e., no ring fires.
Common Gartersnake	N/A	Herptiles – Upland/Grassland	Non-native Cool Season Grass Removal, Native Seeding, Prescribed Fire	Burns should be done in small patches. Work can be done on hot or cool (<50ºF) days, as snake is underground at those times. Employ prescribed burning methods that allow snakes to escape approaching flames, i.e., no ring fires.
Eastern Milksnake	N/A	Herptiles – Upland/Grassland	Woody Invasives Removal, Native Seeding/Planting, Woody Debris Installation, Prescribed Fire	Identify and avoid hibernacula locations; employ prescribed burning methods that allow snakes to escape approaching flames, i.e., no ring fires.
Northern Red-bellied Snake	N/A	Herptiles – Upland/Grassland	Woody Invasives Removal Native Seeding/Planting, Woody Debris Installation, Prescribed Fire	Identify and avoid hibernacula locations; employ prescribed burning methods that allow snakes to escape approaching flames, i.e., no ring fires.
Prairie Crayfish	Special Concern	Primary Burrowing Crayfish	Reed Canary Grass and Cattail Removal, Native Seeding/Planting, Scrape Construction	Avoid disturbance to pond edges and areas of sparse vegetation and moist soil where burrows may be located.

* Federal Species of Concern.

Schedule

Table 23 summarizes the proposed restoration implementation schedule. This schedule is subject to change based on grant funding availability.

Wildlife Surveys and Sensitive Species Avoidance Measures

Preconstruction Wildlife Surveys
Because scrape construction is proposed to occur within wetlands in winter 2024, which is the time and habitat that Butler's gartersnake is over-wintering, preconstruction surveys and relocation efforts should be conducted. Snake exclusion fencing should be installed in accordance with the *Amphibian and Reptile Exclusion Fencing Protocol* along the perimeter of the scrape construction area during the spring prior to scrape construction. A qualified biologist should walk in front of the fencing equipment to relocate any snakes found during installation. Plywood cover boards (0.75 inches x 32 inches x 48 inches) should be placed in early spring in the fenced area before vegetation green-up. The number of cover boards will depend on the size of the exclusion area. Cover boards should first be checked in early-May and checked a total of 12-15 times on non-consecutive days through August. Boards are most productive when checked no more than three hours before sunset on warm (> 65° F) sunny days. Captured snakes should be relocated to nearby suitable, undisturbed habitat. Fencing should be checked regularly for tears or defects and repaired immediately. A Scientific Collector's Permit or Research License may be required to conduct preconstruction surveys for Butler's gartersnake.

Avoidance Measures
Handsome sedge and forked aster and their associated habitats are not known to exist onsite. If the State-threatened plants, handsome sedge and forked aster are located in the HSF, to avoid impacts during the implementation phase, broadcast spraying herbicide should be avoided in the vicinity of these (and other NHI-listed) species identified onsite. Additional care should be taken when spot-praying in their vicinity. Figure 4 shows areas of known sensitive species locations. Preconstruction plant surveys should be considered to locate or confirm absence of these and other listed species.

Avoidance measures for other Focal Species were presented previously in Table 22.

Post-restoration Wildlife Monitoring
A wide variety of methods were used to gather taxa-specific baseline wildlife data (Casper & Robson 2018). Post-restoration survey methods should include monitoring for indications of breeding or breeding behaviors. These observations should confirm occupancy and reproductive status. Therefore, we recommend the incorporation of a future fish and wildlife post-implementation verification monitoring plan for the Degradation of Fish and Wildlife Populations BUI in the MKE AOC that outlines how reproductive success is determined of the proposed focal species at HSF and SLCI throughout the AOC.

Permits
Grading associated with the wildlife scrape proposed in MU11/MU12 will likely require permits from USACE, WDNR, and potentially local agencies. This work would likely qualify for a USACE Nationwide Permit 27 or similar permit, as well as a WDNR Wetland Conservation General Permit or similar permit. Because the earthwork footprint would exceed 1 acre, a Notice of Intent (NOI) would need to be filed to request coverage under Wisconsin's Construction Site Storm Water Runoff General Permit. Local permits may also be required through the County and/or City. A pre-application meeting with USACE, WDNR, and local agencies should be held early in the planning/permitting phase of the project to ensure the proper permits are sought.

A burn permit will need to be acquired from the WDNR or City of Milwaukee prior to beginning a prescribed fire program. This will include preparation of a burn plan and close coordination with the local Milwaukee

Fire Department Fire Chief.

A Scientific Collector's Permit or Research License may be required to conduct preconstruction surveys for Butler's gartersnake.

Adaptive Management

Adaptive management is defined as the day to day, season to season refinements in restoration programming needed to achieve success against the performance criteria. Any adaptive refinements are an anticipated, normal process on restoration projects. Restoration programs require flexibility because of temporal and spatial variability exhibited by natural systems. Adaptive management affords WDNR the option to take advantage of the latest scientific and technological techniques for successful restoration.

This ERMP is a starting point in an ongoing process of restoring HSF's biodiversity and natural processes. Regular monitoring will provide feedback on the ERMP's effectiveness and will generate information to evaluate and justify the need for changes. This process of evaluation, adjustment, refinement, and change is termed "Adaptive Management." Adaptive management is a fundamental tool for use in the restoration, management, and maintenance work.

If needed, potential remedial actions include over-seeding of low diversity or poorly growing areas with native seed collected on site or nearby or purchased from an outside vendor, use of equipment and vehicles to conduct seeding and woody species replacement, using appropriate equipment as needed for stabilizing slopes with cover crop and other typical slope protection strategies such as erosion blanketing, limited rock placement, straw bale use, and installation of water deterrence barriers to prevent/stop erosion.

Management Plan

Short-term (3 years) and long-term (>3 years) vegetation management/maintenance programs should be implemented at HSF to ensure long-term success of the site. Short-term management is when major efforts are undertaken to restore and enhance vegetation and biological diversity and ensure that the appropriate soil conditions are present for seeding and planting. The restoration phase includes tasks such as reducing non-native species prior to seeding and planting, initial prescribed burning, native seeding/planting, and tree removal. Routine management activities including herbicide application and mowing will occur during the early years of the restoration phase.

After achieving initial vegetation management goals there will be a shift to a lower-cost, reduced-intervention management program. This phase will begin in the 4th year following initial restoration treatments and will continue in perpetuity. This phase generally requires less intensive management efforts. Tasks during the management phase will include one or more of the following: spot herbicide treatments, remedial plantings, prescribed burning, and/or other management activities. Some mowing still may occur during this phase. Tasks are performed on a regular schedule, guided by periodic ecological assessments.

It is during the long-term management phase where opportunities for long-lasting personal involvement by volunteers and/or employees in land stewardship typically begin. Direct involvement in site stewardship and wildlife observations can provide an important and meaningful way to engage the community in the restoration project.

Monitoring

A qualified ecologist should supervise portions of the initial implementation activities such as scrape construction and plant installation. The ecologist should also conduct qualitative site assessments at least once per growing season during the short-term management phase to assess success and communicate maintenance needs.

Invasive Species Control

Invasive species are the most significant ecological stressor at HSF and diligent control efforts are needed to reduce their prevalence. Because of the extent and variety of invasive species, numerous methods will need to be used to control them, including forestry mowing/brushcutting, broadcast and spot-spraying herbicide, mowing, hand-pulling, and prescribed fire. Invasive species management during the short-term management phase was well-defined in the Conceptual Ecological Restoration Plan.

Invasive species management during the long-term management phase should include herbicide spot-treatment events conducted throughout each MU in spring and summer of Year-4 and Year-5. Spot-spraying frequency and extent can likely be reduced in subsequent years assuming invasive species have been adequately controlled. Mowing can also be employed prior to flowering/seed set as an alternative to herbicide treatments or if certain invasive species populations missed treatment. Regular prescribed burns (every 2-3 years) should also be instituted particularly in prairie and savanna areas, but also less frequently in forested areas.

HSF experiences relatively heavy use by students and the general public so it will be a priority to protect park users from herbicide exposure. Effective communication between the herbicide application contractor and park staff will be critical to ensure appropriate trail closure during and after herbicide application events. Herbicides will only be applied by licensed contractors following WDNR pesticide use policies and the Pesticide Use Manual Code (4230.1).

Supplemental Planting and Seeding

Supplemental seeding and/or plant installation may be needed in areas with significant native plant mortality and seeding failure as determined qualitatively by a qualified ecologist. Tree and shrub replanting should occur in spring or early summer and supplemental seeding should occur in spring or fall. Species selection should follow the plant palettes and seed mixes presented in the Conceptual Ecological Restoration Plan for the appropriate zones.

Prescribed Fire

Reintroducing fire to HSF is a critical step to reducing shrub invasion into the prairies and savannas and to create suitable conditions for native species establishment. Prescribed burning should occur in the prairie and savanna portions of HSF every year but on a rotational basis with each area being burned on a 2 to 3 year interval in either early spring or late-summer/fall. Fire can also periodically be used in forested habitats.

Prescribed burns must only be conducted by qualified, permitted personnel when environmental conditions (wind speed/direction, relative humidity, and fuel load/moisture) are optimal. Burns should not be conducted during periods of drought or when air quality advisories are in place. Because HSF is surrounded by dense, urban development, smoke management will be critical so that smoke-sensitive areas are not affected. Burn permits and approvals must be acquired from the City of Milwaukee/Milwaukee Fire Department by the WDNR prior to burning.

Further investigation of known landfills at HSF should be completed prior to implementation of this ERMP to define the limits of waste, type of cap soils, and amount of methane production and ensure safe conditions during prescribed burns.

Mowing of prairie and oak opening areas should be conducted in lieu of prescribed fire in the event that implementing burns is infeasible. Restored prairie and oak savanna areas should be mowed every two to three years during the long-term management phase.

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