HABITAT MANAGEMENT PLAN

LITCHFIELD WETLAND MANAGEMENT DISTRICT
LITCHFIELD, MINNESOTA

US FISH AND WILDLIFE SERVICE
DEPARTMENT OF INTERIOR
January 25, 2012

Habitat Management Plan
For
Litchfield WMD

APPROVALS		
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Litchfield Wetland Management District
Habitat Management Plan

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Executive Summary

The Litchfield Wetland Management District (District) was created in 1978 for the purpose of acquiring, restoring, and managing tracts of land purchased under the Small Wetlands Acquisition Program (SWAP). The District is managed by the U.S. Fish and Wildlife Service as part of the National Wildlife Refuge System. The District manages 152 Waterfowl Production Areas encompassing more than 35,960 acres in fee title ownership. Additionally, the District administers approximately 12,961 acres of wetland and habitat easements; however, we do not actively manage them. Managing natural resources requires long range planning that incorporates and reflects the application of the best science available. The Litchfield Wetland Management District Habitat Management Plan (HMP) provides a long-term vision and specific guidance on managing the habitats for the identified resources of concern within the District. The HMP will provide direction for the station over the next fifteen years (2011 – 2026). New information resulting from research investigations and inventory and monitoring activities will be used to formulate new, and fine-tune, existing management strategies. New information and strategies will be incorporated into the plan during subsequent revisions.

1.0 INTRODUCTION

1.1 Scope and Rationale

In April 2003, the U.S. Fish and Wildlife Service (FWS) published the Final Comprehensive Conservation Plan (CCP) for the Litchfield Wetland Management District (District). As part of the planning and National Environmental Policy Act processes associated with the CCP, the FWS evaluated the effects of implementing a broad range of fish, wildlife, plant, and habitat management programs and techniques to achieve District mission, goals, and objectives. The CCP outlines how the District will address FWS trust resource responsibilities, maintain and, where appropriate, restore biological integrity, diversity, and environmental health, and support achievement of the National Wildlife Refuge System (NWRS) mission to:

> *Administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.*

In addition to the NWRS mission, Minnesota Wetland Management Districts came together in development of station CCPs and adopted the following vision statement that ties Districts together with a cohesive purpose:

> *The Districts will emphasize waterfowl production and ensure the preservation of habitat for migratory birds, threatened and endangered native species, and resident wildlife. The Districts will provide opportunities for the public to hunt, fish, observe and photograph wildlife and increase public understanding and appreciation of the Northern Tallgrass Prairie Ecosystem.*

In 1997, Congress passed the landmark National Wildlife Refuge System Improvement Act, preparing the way for a renewed vision for the future of the Refuge System where:

- Wildlife comes first
- Refuges are anchors for biodiversity and ecosystem-level conservation
- Lands and waters of the System are biologically healthy
- Refuge lands reflect national and international leadership in habitat management and wildlife conservation

This Habitat Management Plan (HMP), which is step-down plan of the District CCP (USFWS 2003), provides more precise guidance for habitat management on the Litchfield District land base. It will help facilitate thoughtful and explicit planning for habitat objectives and management actions. Additionally, the HMP will form the basis from which the District Inventory and Monitoring Plan will be developed.

This plan was prepared according to guidelines for developing HMPs found in the FWS' Habitat Management Plans policy (620 FW 1). It also complies with all applicable laws, regulations, and policies governing the management of units of the NWRS.

The lifespan of this HMP coincides with the 15-year cycle for the District CCP. HMPs may be peer reviewed every five years as necessary. The refuge manager may modify the CCP and/or HMP at any time if new information suggests these plans are inadequate or resources would benefit from changes.

1.2 Legal Mandates

The District was established in 1978 to manage land tracts purchased under the Small Wetlands Acquisition Program. The District also administers units of the Northern Tallgrass Prairie National Wildlife Refuge, which was established in 2000 to preserve, restore, and manage critical tallgrass prairie habitat and associated wetlands. Key provisions are described here, while a detailed list of legal mandates and authorities is found in Appendix A of the Litchfield Wetland Management District (WMD) CCP.

The Migratory Bird Conservation Act was established on February 19, 1929 (45 Stat. 1222) as amended, 16 (U.S.C. 715d, 715e, 715f, to 715k and 715l to 715r). The Act provides for the acquisition of lands determined to be suitable as an inviolate sanctuary for migratory birds.

Waterfowl Production Areas within the District are acquired under the establishing authority of the Migratory Bird Hunting Stamp Act of March 16, 1934 as amended in 1958 (16 U.S.C. 718-718h). The Act authorized the "…acquisition by gift, devise, lease, purchase, or exchange of, small wetland pothole areas, interest therein, and right-of-way to provide access thereto. Such small areas to be designated as 'Waterfowl Production Areas', may be acquired without regard to the limitations and requirements of the Migratory Bird Conservation Act."

"…As Waterfowl Production Areas" subject to "…all the provisions of such Act…except the inviolate sanctuary provisions…" 16 U.S.C. 718c (Migratory Bird Hunting and Conservation Stamp).

Mandate for Farmers Home Administration Easements and Fee title Transfers. ."…for conservation purposes…" 7 U.S.C. at 2002 (Consolidated Farm and Rural Development Act).

The principal source of funding for the Northern Tallgrass Prairie National Wildlife Refuge is the Land and Water Conservation Fund Act of 1965 (16 USC 460l - 460l-11), which provides funding through the sale of surplus Federal land, appropriations from oil and gas receipts from the outer continental shelf, and other sources for land acquisition.

1.3 Relationship to Other Plans

The habitat goals, objectives and management strategies described in this HMP are consistent with other local, regional, and national conservation plans. Plans listed below were key resources used in developing the HMP.

Litchfield WMD Comprehensive Conservation Plan (CCP)
As described above, the HMP is a step-down plan from the District's CCP (USFWS 2003). The CCP is a long-term, comprehensive plan that guides all aspects of conservation in the District, including habitat management, public use, and operations. However, the CCP goals and objectives (Appendix 8) were not habitat management specific enough for the step-down purposes of the HMP. For this reason, the HMP focuses on and refines the broader habitat goals and objectives provided in the CCP. The goals and objectives contained within the HMP support and further achieve the purpose for which the District was established and are consistent with the actions outlined in Alternative 3 (Preferred Alternative) of the Environmental Assessment (USFWS 2003).

Litchfield WMD Fire Management Plan (FMP)
Fire is a key ecological process in prairie and wetland ecosystems, and as such prescribed fire is a primary habitat management tool for Litchfield WMD. The Litchfield WMD FMP (USFWS 2006) is an operational guide for managing the WMD wildland and prescribed fire program. It is written to comply with both Department of Interior and Service-wide requirements that units with burnable vegetation develop a fire management plan (620 DM 1). The FMP outlines a program that accounts for the safest, most cost efficient, and ecologically responsible suppression of all wildland fires and use of prescribed fire.

North American Waterfowl Management Plan (NAWMP)
The North American Waterfowl Management Plan was first signed in 1986 with subsequent revisions in 2000, 2004. The most recent version states, "the purpose of the Plan is to sustain abundant waterfowl populations by conserving landscapes, through partnerships that are guided by sound science" (NAWMP, Plan Committee 2004).

U.S. Shorebird Conservation Plan, Northern Plains/Prairie Potholes Regional Shorebird Conservation Plan
The U.S. Shorebird Conservation Plan outlines shorebird conservation status, populations and priorities, national conservation strategies, recommends monitoring programs, and identifies regional conservation goals and strategies (Brown et al. 2001). The Prairie Potholes Regional Shorebird Conservation Plan provides similar information that is focused on this region (Skagen and Thompson 2000).

North American Waterbird Conservation Plan, Northern Prairie and Parkland Waterbird Conservation Plan
The North American Waterbird Conservation Plan "provides an overarching continental framework and guide for conserving waterbirds" (Kushlan et al. 2002). It focuses on colonial-nesting waterbirds and sea birds, which are only a portion of the waterbird

species that use the Prairie Pothole Region. The Northern Prairie and Parkland Conservation Plan (Beyersbergen et al. 2004) is especially helpful for our area, since it more specifically addresses the species found here.

Partners in Flight (PIF) North American Landbird Conservation Plan, PIF Bird Conservation Plan for the Northern Tallgrass Prairie

The PIF North American Landbird Conservation Plan was developed "to provide a continental synthesis of priorities and objectives that will guide landbird conservation actions at national and international scales" (Rich et al 2004). PIF wrote a regional plan for the Northern Tallgrass Prairie (Physiographic Area 40; Fitzgerald et al 1998), but more recently has updated its species assessment scores by Bird Conservation Regions (Litchfield WMD is primarily in BCR 11 – Prairie Potholes and BCR 23 – Prairie Harwood Transition). Scores can be found at http://www.rmbo.org/pif/pifdb.html.

Prairie Pothole Joint Venture Implementation Plan

The Prairie Pothole Joint Venture (PPJV) was established under the NAWMP, but has since expanded from a focus on waterfowl to planning for "all-bird" conservation. The most recent implementation plan (USFWS 2005) provides stepped-down objectives from the four major species group plans described above (waterfowl, shorebirds, waterbirds and landbirds).

Dakota Skipper Conservation Guidelines

The Dakota Skipper *Hesperia dacotae*, a candidate species for listing under the Endangered Species Act, is known to occur near land managed by the District. The District does have suitable skipper habitat and staff assume these lands likely host viable populations. The conservation guidelines (USFWS 2007) should be referenced when our habitat management actions occur in suitable habitat for this butterfly. District goals and objectives will include consideration for this obligate grassland butterfly species in an effort to conserve their populations as more information on its distribution within the District becomes available.

Tomorrow's Habitat for the Wild and Rare

Tomorrow's Habitat for the Wild and Rare (Minnesota DNR 2006a) is the Minnesota State Wildlife Action Plan. This strategic plan guides management for species in greatest conservation need across the state (SGCN): "native animals whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability." The plan lists 292 SGCN in Minnesota.

Minnesota DNR Long Range Duck Recovery Plan

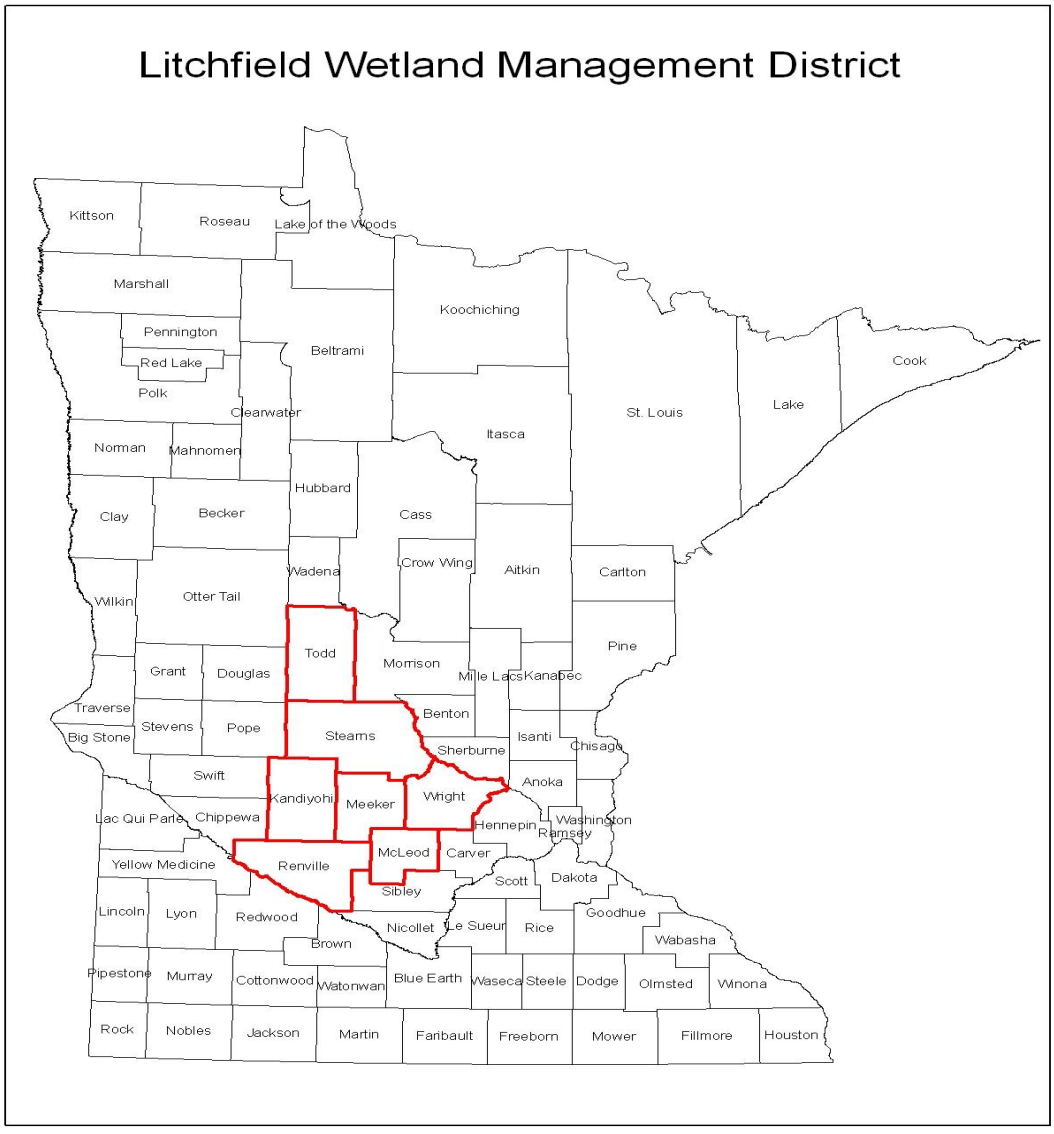
The Minnesota Duck Recovery Plan (MN DNR 2006b) identifies both challenges and strategies to recover "historical breeding and migrating populations of ducks in Minnesota for their ecological, recreational, and economic importance to the citizens of the state." The plan sets a 50-year goal to sustain a breeding duck population of 1 million birds.

2.0 BACKGROUND

2.1 Refuge Location and Description

Litchfield Wetland Management District is located in west-central Minnesota, about 65 miles west of Minneapolis, Minnesota, or 45 miles east of Willmar, Minnesota. The headquarters is located three miles south of Litchfield, on the 165 acre Litchfield WPA. The District manages land in Kandiyohi, Meeker, Wright, McLeod, Stearns, Todd and Renville Counties (Figure 1).

Figure 1. Location of Litchfield WMD in Minnesota.



2.2 Management Units

Lands administered by the District are shown in (Figure 2). The District includes 152 waterfowl production areas (WPAs) totaling 35,960 acres in fee title ownership (See Appendix 7 for complete list). WPAs range in size from the 16 acre Sperry Lake WPA to the 1,225 acre Tyrone Flats WPA. WPAs are primarily upland grasslands and prairie wetlands, purchased by the Service for breeding waterfowl and for hunting. The District administers approximately 9,039 wetland acres "wetland" and "flowage" easements (Figure 3). Wetlands on these easements are permanently protected from being drained, leveled or filled. However, we do not actively manage them. The District manages 1,424 acres of wildlife habitat protection easements, and 2,498 acres of Farmers Home Administration easements, which provide both upland and wetland wildlife habitat.

Figure 2. Lands (Fee title) administered by Litchfield WMD.

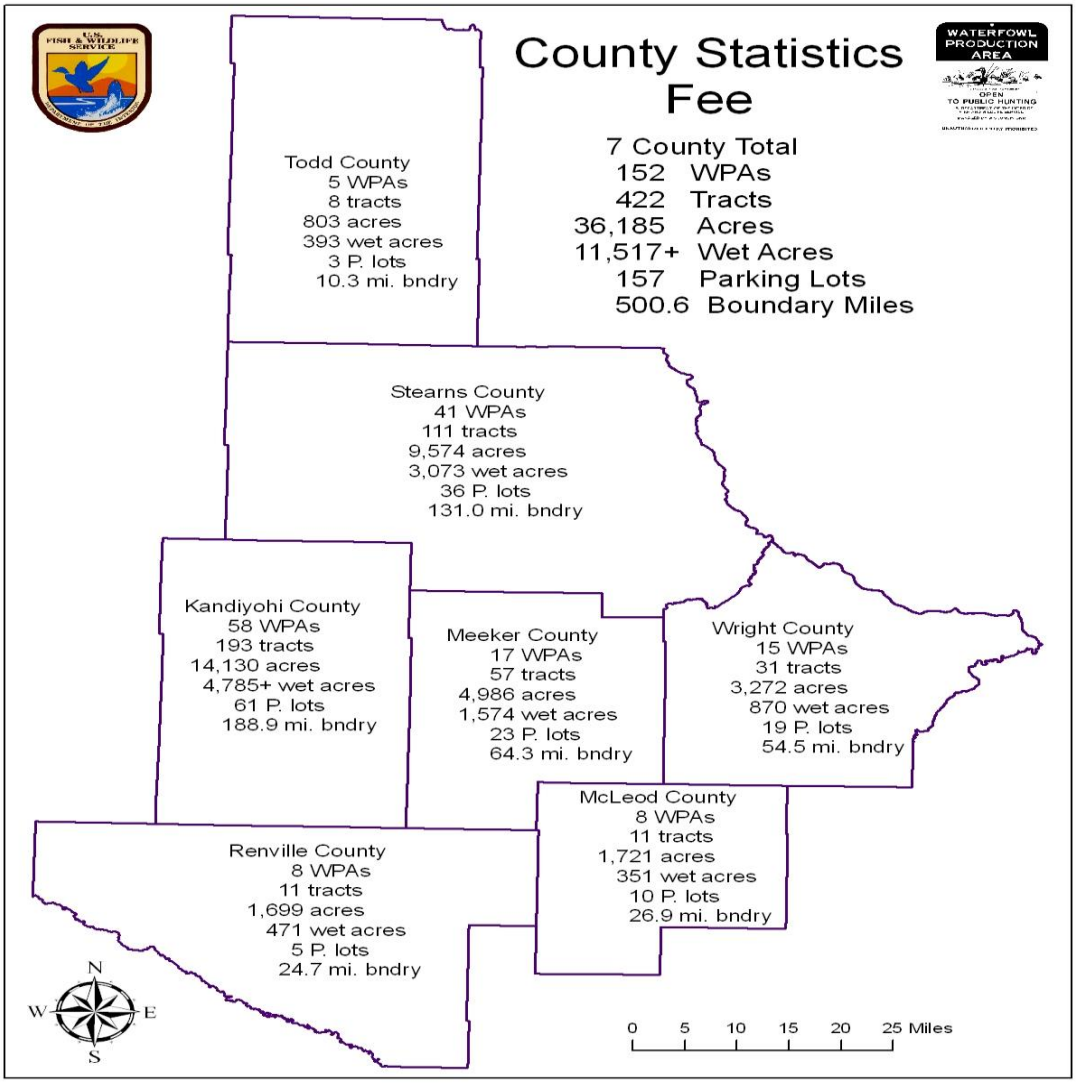
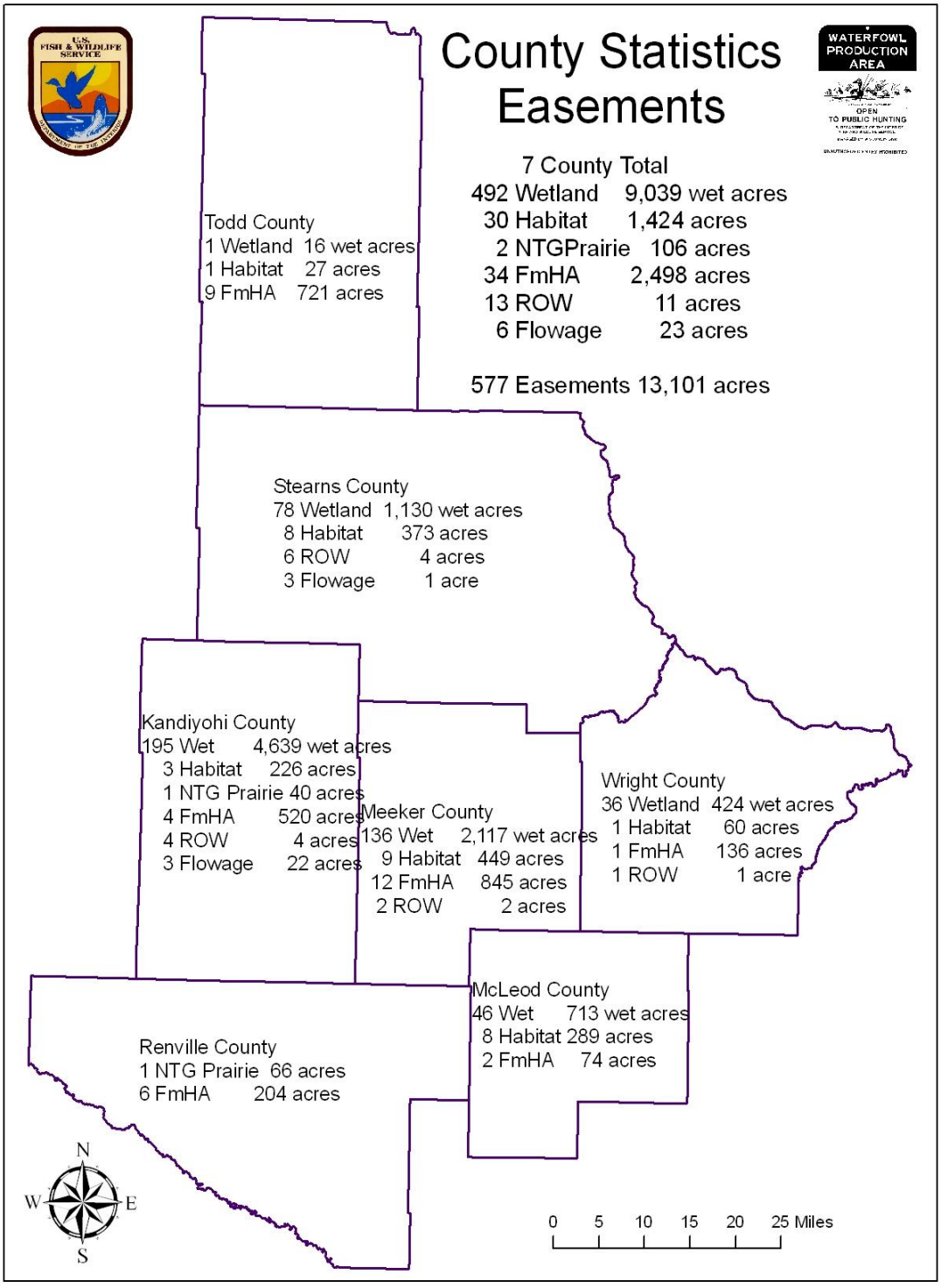
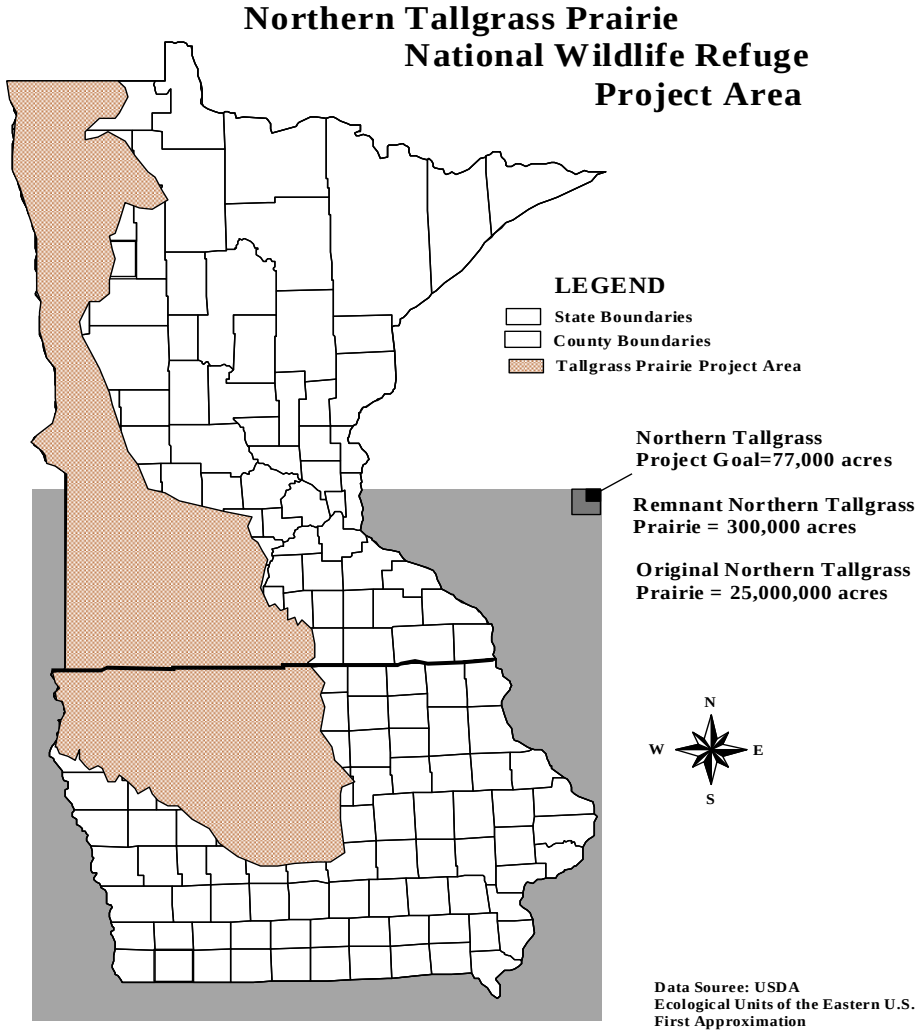


Figure 3. Lands (Easements) administered by the Litchfield WMD.



The District is also responsible for administering fee title and easement tracts of the Northern Tallgrass Prairie National Wildlife Refuge (NTGRP) that fall within the district. The refuge concept is modeled after the small wetlands program and aims to protect 77,000 acres of remaining native tallgrass prairie in scattered tracts in western Minnesota and northwest Iowa (Figure 4). Prairie protection is accomplished through a combination of fee-title and easement acquisition. The District administers two easement tracts totaling 106 acres in Kandiyohi and Renville Counties.

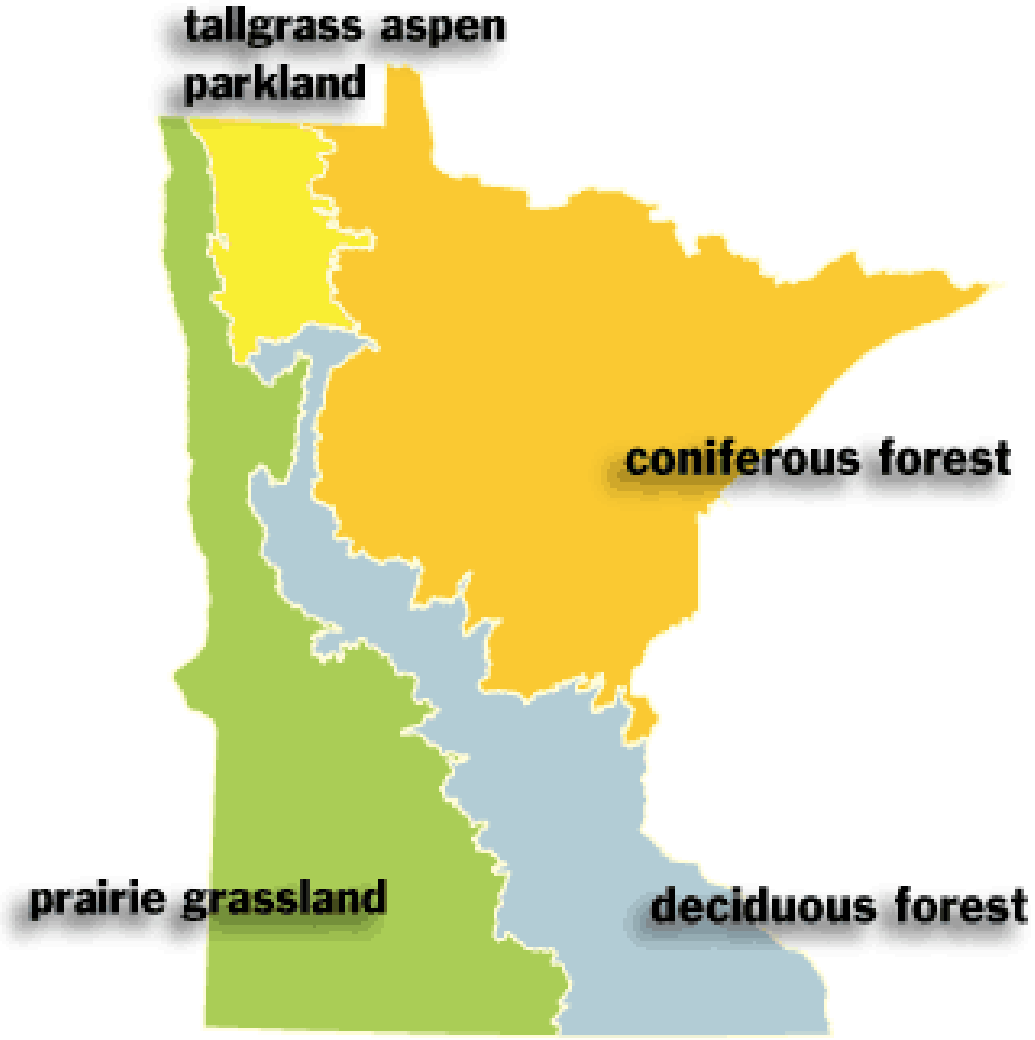
Figure 4. Northern Tallgrass Prairie National Wildlife Refuge boundary.



2.3 Physical/Geographic Setting and Historic Condition.

District lands include portions of the northern coniferous forest, eastern deciduous forests, and tallgrass prairie biomes (Figure 5). Soils, precipitation, climate, water quality, and land use vary greatly, but essentially all areas have been significantly altered and degraded through anthropocentric activities.

Figure 5. Minnesota biomes



The District is at the eastern edge of the Prairie Pothole Region (PPR), which extends from northern Iowa through Alberta, Canada (Figure 6). This portion of the northern Great Plains is characterized by a prairie landscape dotted with shallow depressional wetlands. These "potholes" formed when the last glaciers receded, around 10,000 years ago. The PPR is well known for its importance to breeding waterfowl. The region is responsible for producing over 50% of the continent's waterfowl, earning it the nickname "the Duck Factory of North America."

Figure 6. Prairie pothole region of North America.

A hierarchical Ecological Classification System (ECS) has been defined for Minnesota. The ECS "is used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features…" and "…uses associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation" (MN DNR 2005). In this system, a large portion of District land is within the Prairie Parkland Province. The Prairie Parkland Province in Minnesota has two sections, with the North Central Glaciated Plains (CGP) encompassing half of the District lands and Minnesota and northeast Iowa Morainal the other half (Figure 7). Of the three CGP subsections, the Minnesota River Prairie and Hardwood Hills are the dominant subsection (Figure 8). The remaining District lands are in the Eastern Broadleaf Forest Province with the Big Woods being the dominant subsection. Detailed descriptions of each ECS level (provinces, sections, and subsections) in the District are provided in (Appendix 1).

Figure 7. Ecological sections in Litchfield WMD.

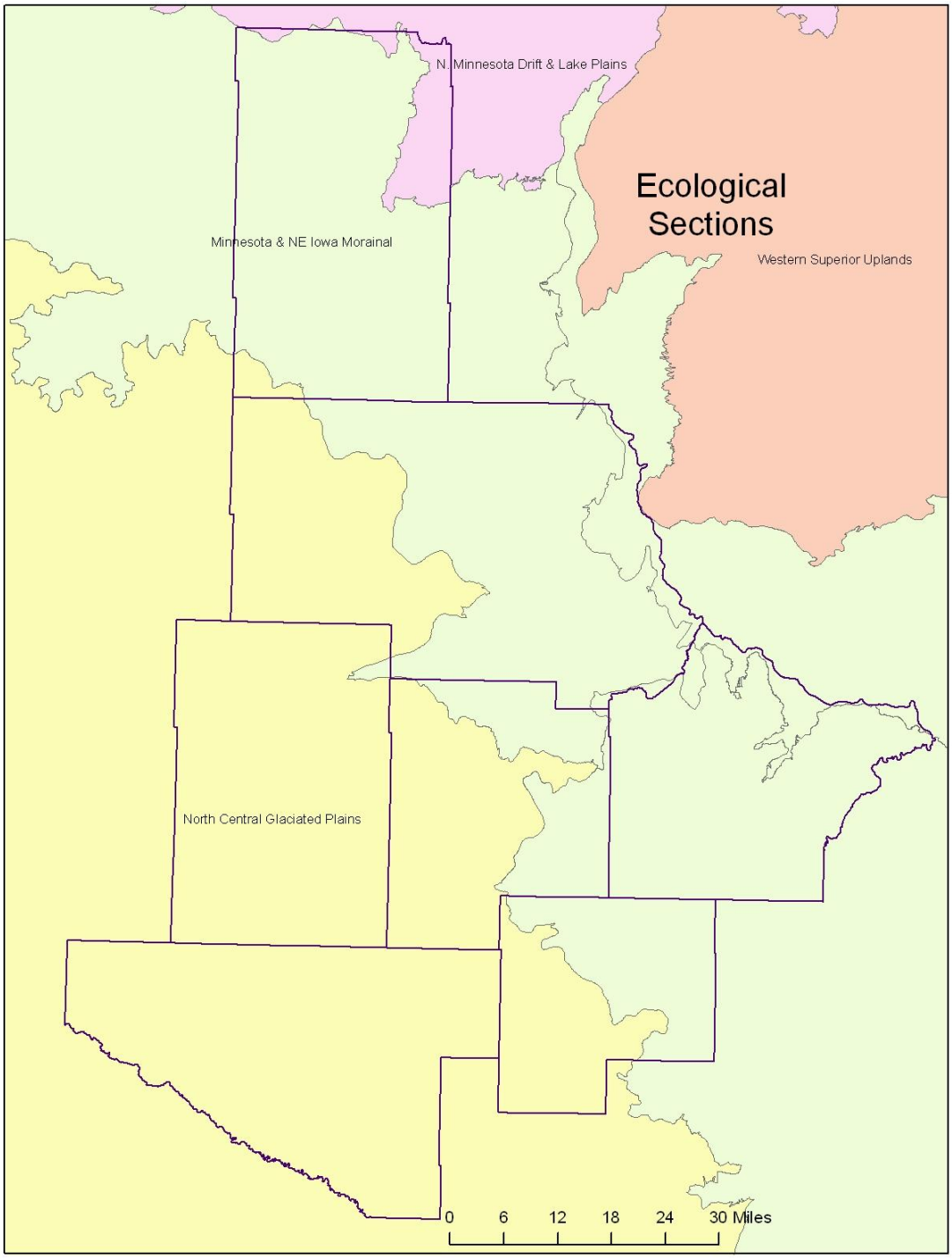
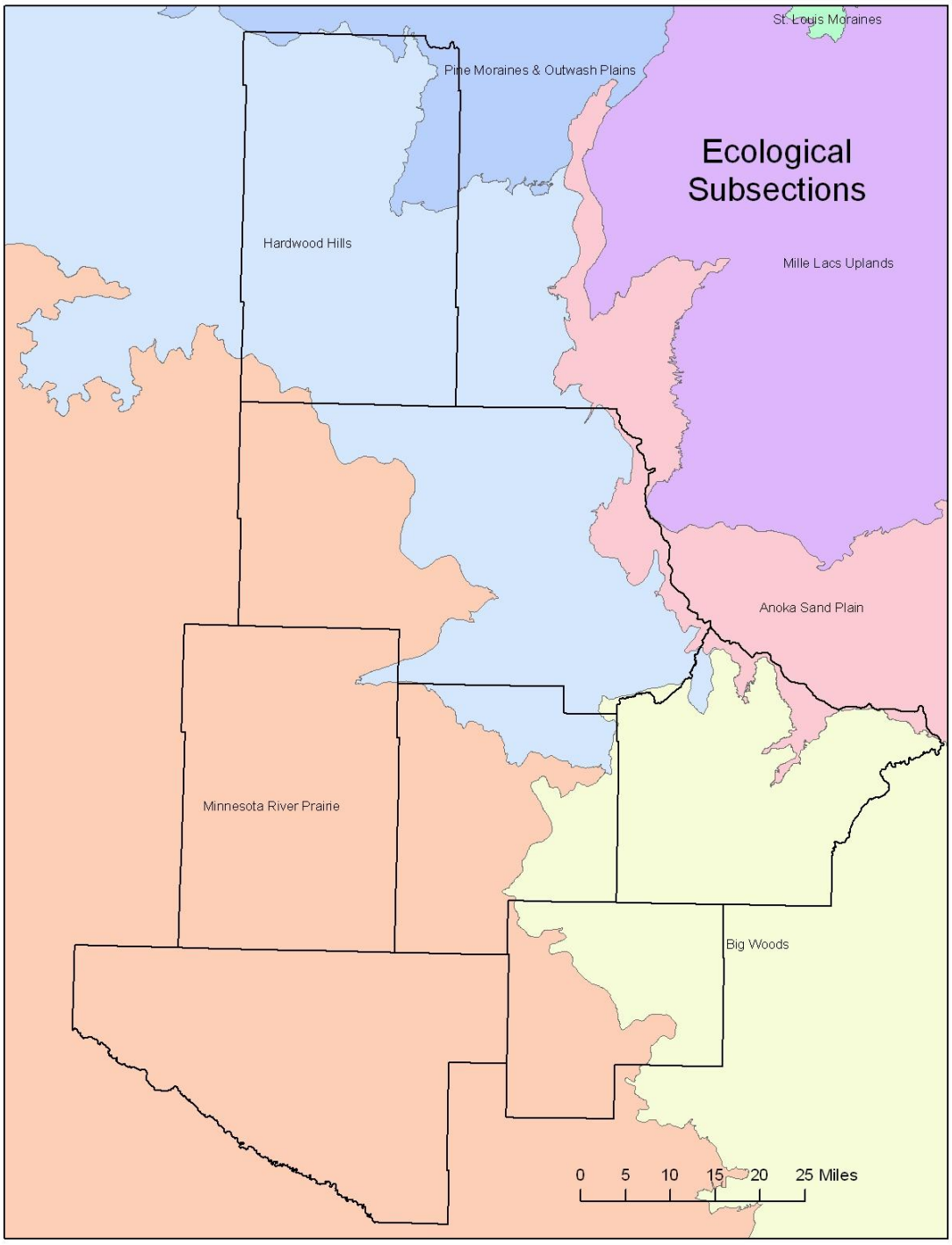
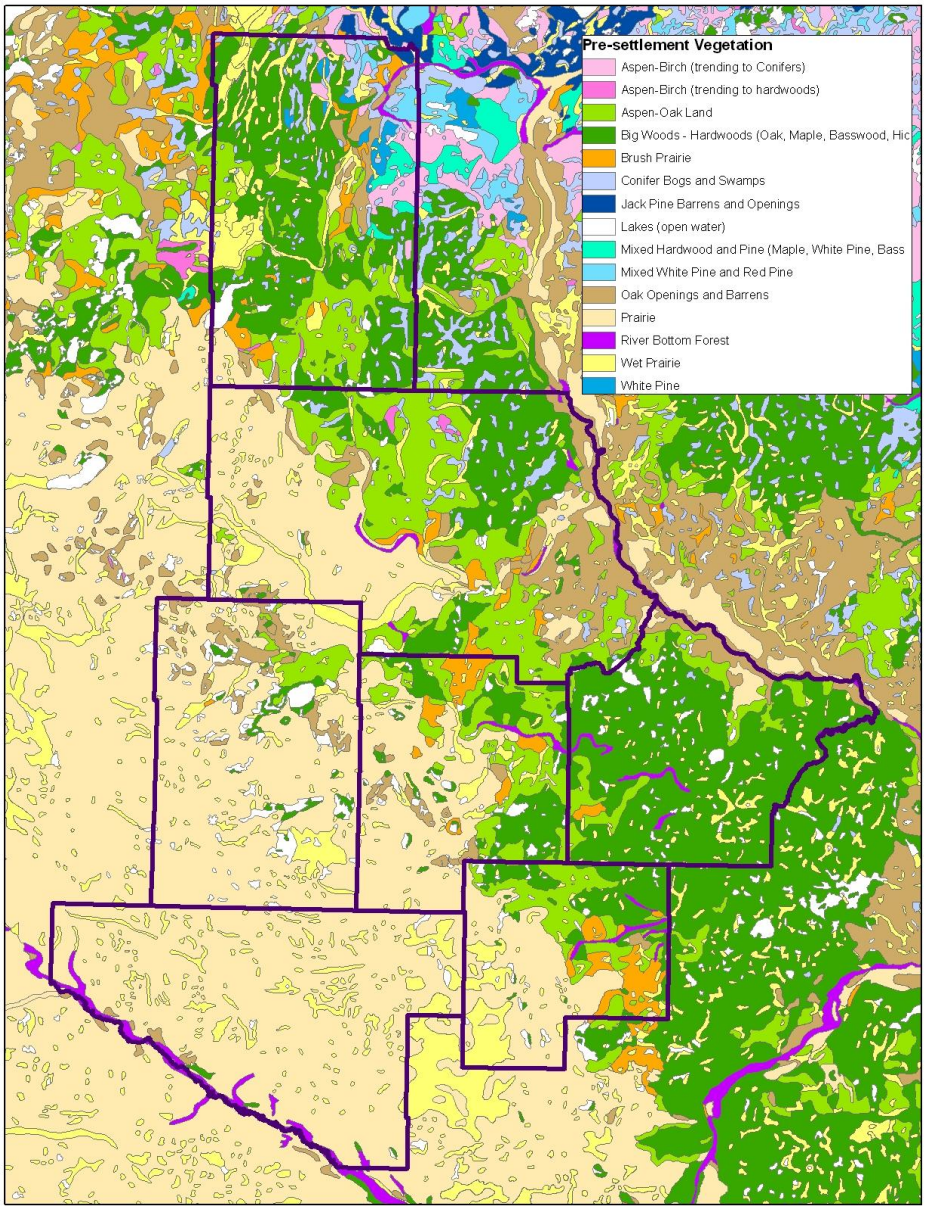


Figure 8. Ecological subsections in Litchfield WMD.



Of the three main subsections in the District, the Minnesota River Prairie was the most fire prone and was dominated historically by upland and wetland prairie plant communities and depressional marshes. Other key biotic ecosystem drivers that maintained treeless plant communities in this subsection include grazing by large ungulates and the relatively dry climate. Marschner's Map of the Original Vegetation of Minnesota (Marschner 1974) supports the dominance of prairie and wet prairie plant communities in west-central Minnesota (Figure 9). Except for some scattered oak and hardwood groves, trees were restricted to the transitional edge of the Hardwood Hills and Big Woods regions and other large water features and river bottoms.

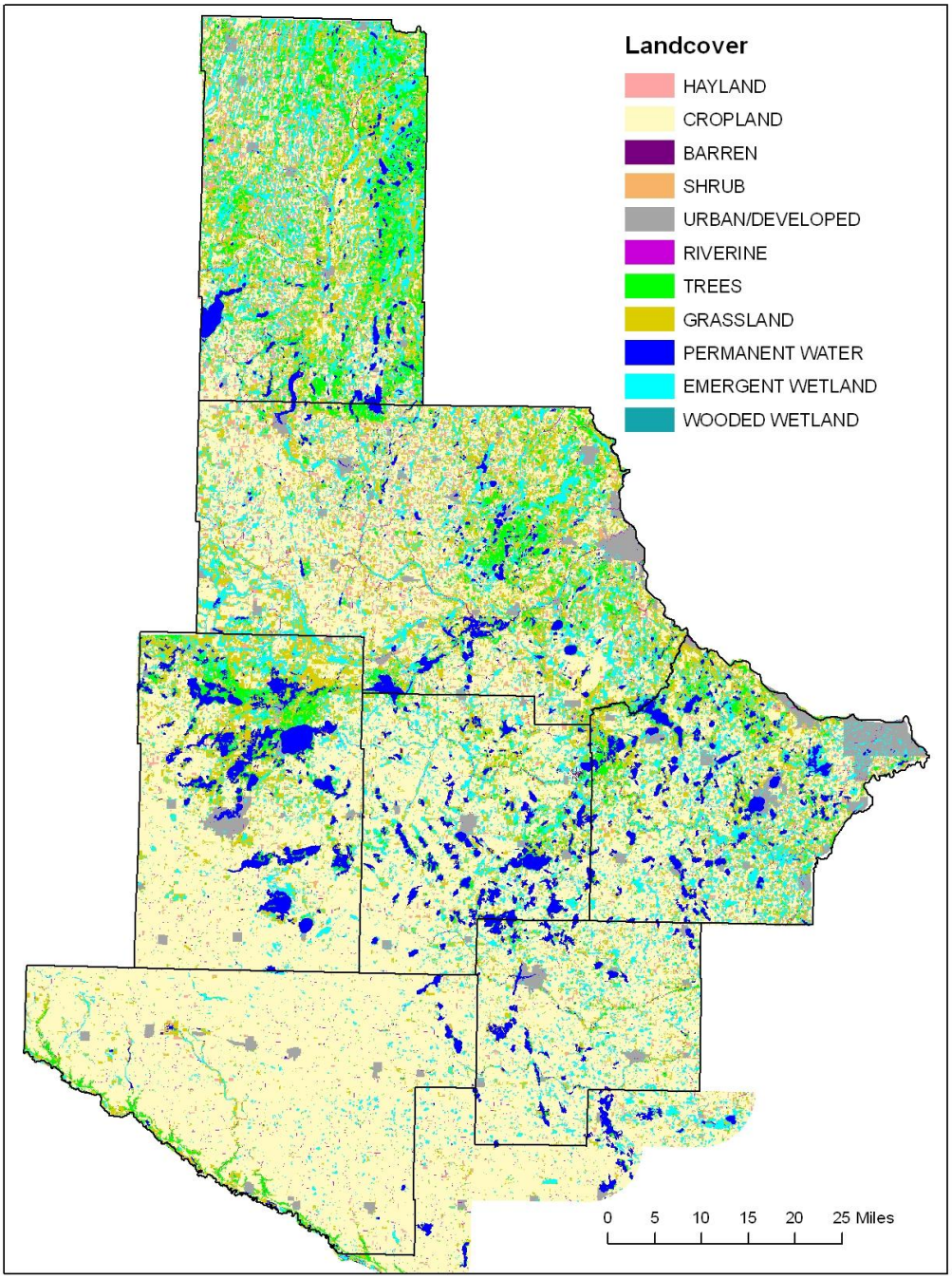
Figure 9. Pre-settlement vegetation in Litchfield WMD.



2.4 Current Condition and Habitat Changes from Historic to Current Condition

Rich soils and abundant prairie wetlands made the region ideal for wildlife, but also highly productive for agriculture. The corn/soybean belt overlaps extensively with the prairie pothole region. Massive conversion of wetlands and prairie to agricultural fields has dramatically altered the landscape, hydrology, and the region's carrying capacity for waterfowl and other prairie and wetland-dependent plants and wildlife (Figure 10).

Figure 10. Current land use in Litchfield WMD.



Less than 1% of Minnesota's original tallgrass prairie remains (Samson et al. 1998). The District manages about 2,353 acres of remnant, unbroken prairie, with varying levels of quality. The high quality prairies in the District may have >100 species of native grasses, forbs, and shrubs. The greatest threat to prairie integrity is a lack of disturbance, which results in invasion by woody vegetation (both native and exotic species), and exotic, cool-season grasses such as Smooth Brome *Bromus inermis*, and Kentucky Bluegrass *Poa pratensis*. Grasses invading wetter prairies also include Reed Canarygrass *Phalaris arundinacea*, Red Top *Agrostis stolonifera* and Quack Grass *Elymus repens*.

In addition to remnant prairie, the District manages 14,310 acres of planted grasslands. These fields are usually dominated by warm season native species such as Big Bluestem *Andropogon gerardii*, Switchgrass *Pancium virgatum*, Indian Grass *Sorghastrum nutans*, Sideoats Grama *Bouteloua curtipendula*, and Little Bluestem *Schyzachyrium scoparium*. Some planted grasslands are old pasture land or dense nesting cover (a mix of grasses and legumes). Newer seedings are more commonly highly diverse prairie reconstructions using local-ecotype seed with up to 40 species planted.

Other upland habitats on lands managed by the District include forest groves, brush land, and occasional cropland (land being farmed in preparation for seeding).

Prairie wetlands have also undergone dramatic losses and degradation since European settlement. Johnson et al. (2008) estimate that 85% of Minnesota pothole wetlands have been drained. Most commonly, they were drained by ditches or subsurface tile to facilitate agricultural production. In Litchfield WMD specifically, approximately 50% of the wetland acres, but 90% of individual wetland basins, have been drained. The smaller wetlands were drained at a disproportionate rate, leaving deeper, more permanently ponded basins. The classification and distribution of remaining wetlands across the District are found in Appendix 2.

Like prairies, the remaining un-drained wetlands are very often in a degraded state. Common problems in our wetlands include colonization by invasive species such as reed canarygrass, invasive cattail *Typha angustifolia*/*Typha glauca*, unnatural populations of Fathead Minnow *Pimephales promelas* and Common Carp *Cyprinus carpio*, low water quality (excessive phosphorus/nitrogen), and artificially deep and stable water levels.

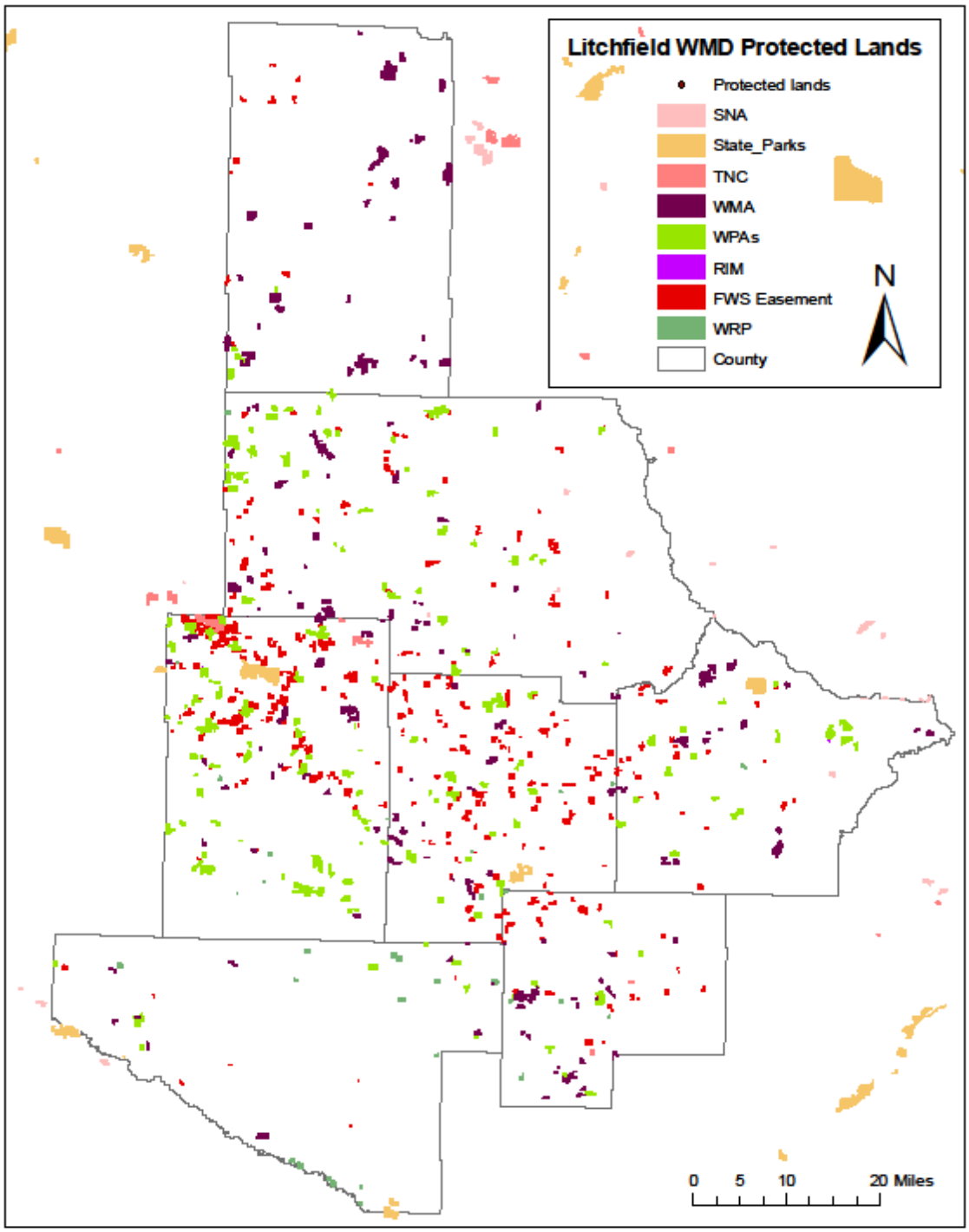
In addition to the overall loss, fragmentation, and degradation of remaining grassland and wetland habitats, WPAs are subject to numerous threats due to their position in the landscape. WPAs are often islands in a sea of intensive agriculture and the surrounding land use can have serious implications for each unit. Natural drainage patterns have been altered throughout the landscape, increasing the frequency, intensity, and duration of water flowing into many administered units. Siltation, nutrient loading, and contamination from point and non-point sources of pollution are a serious problem on many WPAs. With over 500 miles of boundary, general neighbor conflicts are also common, such as farming trespass, dumping, wildfires, and pesticide drift from application on adjacent agricultural land.

Potential climate change will only compound the challenges and threats described above. The PPR is characterized by a strongly seasonal climate that also undergoes periodic extreme events. The condition and productivity of prairie wetlands and grasslands (and the flora and fauna associated with them) are largely driven by these weather patterns and climatic events. It is reasonable to expect that prairie wetlands and grasslands will be sensitive to climate change. Predicted climate change for the eastern PPR, including District lands, involve higher temperatures, increased precipitation, and a greater frequency of extreme weather events. Warmer temperatures are expected, particularly in winter, resulting in a longer growing season. The increase in precipitation will occur primarily in winter and spring (Johnson et al. 2005 and Karl et al. 2009). Johnson et al. (2005) developed models to explore outcomes of various climate change scenarios. They found that the area of best waterfowl habitat within the PPR will constrict and shift east. In this scenario, the District and other eastern PPR stations will be critical for supporting continental populations of breeding waterfowl much like the PPR of North/South Dakota and Saskatchewan, Canada are today.

Changes in the overall landscape, land use, and vegetative communities clearly had dramatic consequences for the native flora and fauna. Many species of wildlife have been altogether extirpated from the region, such as bison *Bison bison*, Long-billed Curlew *Numenius americanus*, and Gray Wolf *Canis lupus*. Others, like the Eastern Spotted Skunk *Spilogale putorius* and Henslow's Sparrow *Ammodramus heslowii* are only very rarely observed in the District. Waterfowl densities are a shadow of what they once were. The District supports far fewer pairs of dabbling ducks than historically were present. Many other grassland birds are in steep decline (Herkert 1995). The Dakota Skipper *Hesperia dacotae* has been identified within the District and is a prairie-obligate butterfly that is a candidate for listing under the Endangered Species Act. There are 27 state threatened or endangered plants found in the district, two of which are federally threatened (Appendix 3).

Litchfield WMD has many conservation partners working on permanently protected lands scattered throughout the District (Figure 11). The Minnesota Department of Natural Resources administers 36,826 acres spread across 146 Wildlife Management Areas (WMAs), four Scientific and Natural Areas (SNA), three state parks, and one prairie bank easement. The U.S. Department of Agriculture administers 25,700 acres of Wetland Reserve Program (WRP)/Reinvest in Minnesota (RIM) parcels, and The Nature Conservancy (TNC) manages five preserves in the District totaling 1,463 acres. Including all these conservation entities, approximately 2.9% of the District's landmass is permanently protected for conservation purposes.

Figure 11. Permanently protected conservation lands in Litchfield WMD.



Additionally, the District has an active Partners for Fish and Wildlife Program which accomplishes wetland/grassland restoration projects by working closely with private landowners. Private lands work in the District has shifted in recent years from primarily wetland restoration to more upland restoration, including tree removal and grazing plans. A major focus of the Partner's program biologist has been the Working Lands Initiative (WLI), a cooperative effort among Fish and Wildlife Service, MN Department of Natural Resources, MN Board of Soil and Water Resources, local food producers, and many other partners. The WLI is intended to encourage farming practices that both provide agricultural and wildlife benefits. WLI target areas align well with priority management areas in the District, complimenting the work done on WPAs.

3.0 RESOURCES OF CONCERN

3.1 Introduction

Resources of concern are the primary focus of this HMP and are central to the work of the NWRS. The FWS is entrusted with conserving and protecting migratory birds, federally listed threatened and endangered species, inter-jurisdictional fishes, and certain marine mammals (i.e. "trust species"). In addition to the FWS mission, each refuge has one or more purposes for which it was established that guide its management goals and objectives. Further, refuges support other elements of biological diversity including invertebrates, rare plants, unique natural communities, and ecological processes that contribute to biological integrity and environmental health at the refuge, ecosystem, and landscape level.

The Habitat Management Plan policy (620 FW 1) defines "resources of concern" as

> All plant and/or animal species, species groups, or communities specifically identified in Refuge purpose(s), System mission, or international, national, regional, State, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are resources of concern on a refuge whose purpose is to protect "migrating waterfowl and shorebirds." Federal or State threatened and endangered species on that same Refuge are also resources of concern under terms of the respective threatened and endangered species acts.

Given the multitude of purposes, mandates, policies, and plans that can apply to a refuge, it is necessary to explicitly identify resources of concern and identify those resources for which the refuge is best suited to focus its management activities. The following chapter describes the process used by the District, in collaboration with other wetland management districts in Minnesota and Iowa, to identify potential resources of concern, priority resources of concern, and priority habitat types. Priority resources of concern and habitat types were then used to develop habitat goals and objectives and management strategies (chapters 4 and 5 of this document).

3.2 Potential Resources of Concern

A comprehensive list of potential resources of concern for the District is found in Appendix 3. The list was developed by consulting several plans and lists, including national and regional priority documents, state fish and wildlife plans, and Federal and state endangered species lists (Table 1). Generally, any species known to occur or that could reasonably occur in Litchfield WMD that is included in any of the resources consulted was added to the comprehensive list (see Appendix 2 for list of resources used and prioritization process). In addition to the species found in published lists and plans, all waterfowl that breed in Litchfield WMD are included as the refuge purpose is to provide breeding habitat for this guild. Key ecosystems were added because they are

important under the auspices of the Biological Integrity, Diversity, and Ecosystem Health policy (see section 3.3). The potential resources of concern include birds (141 species), mammals (8), reptiles and amphibians (10), fish (14), mussels (16), other invertebrates (15), plants (39), and ecosystems (4).

Table 1. Resources from which potential resources of concern were identified.

Birds	Non-bird species	Plants
• Federal Threatened and Endangered Species • State Threatened and Endangered Species • FWS Birds of Conservation Concern (National, Region 3, and BCR 11 lists) • Region 3 Resource Conservation Priorities • Partners in Flight priorities for BCR 11 • Minnesota Species of Greatest Conservation Need • Plans and Prairie Potholes LCC Focal Species • Prairie Pothole Joint Venture focal species • Consultation with Bob Russell, Region 3	• Federal Threatened and Endangered Species • State Threatened and Endangered Species • Region 3 Resource Conservation Priorities • Minnesota Species of Greatest Conservation Need • Plans and Prairie Potholes LCC Focal Species	• State Threatened and Endangered Species • Region 3 Resource Conservation Priorities

3.3 Biological Integrity, Diversity, and Environmental Health

As described in the Biological Integrity, Diversity, and Environmental Health policy (601 FW 3), the goal of habitat management on units of the National Wildlife Refuge System is to ensure the long-term maintenance and where possible, restoration of healthy populations of native fish, wildlife, plants, and their habitats. In addition to providing habitat for trust species, refuges support other elements of biodiversity including invertebrates, rare plants, unique natural communities, and ecological processes (USFWS 1999). Where possible, refuge management restores or mimics natural ecosystem processes or functions and thereby maintains biological diversity, integrity, and

environmental health. Given the continually changing environmental conditions and landscape patterns of the past and present (e.g., rapid development, potential climate change), relying on natural processes is not always feasible nor always the best management strategy for conserving wildlife resources. Uncertainty about the future requires that the District manage within a natural range of variability rather than emulating an arbitrary point in time. This maintains mechanisms that allow species, genetic strains, and natural communities to evolve with changing conditions, rather than necessarily trying to maintain stability.

3.4 Priority Resources of Concern

The comprehensive list of resources of concern contains many species with a wide array of habitat needs and life history requirements (Table 2). The District has prioritized these species and their associated habitats to determine where we can make the greatest contribution to conservation efforts within the context of the Refuge System, the surrounding landscape, and national priorities. We used the "focal species" concept to guide selection of priority resources of concern. Focal species are highly associated with important habitat attributes or conditions that represent the needs of larger guilds of species that use habitats and respond to management similarly. By managing for focal species, important components of functional, healthy ecosystems will also be addressed. The use of focal species is particularly valuable when addressing FWS trust resources such as migratory birds. This process is consistent with the Service's Strategic Habitat Conservation framework, which uses focal species to identify important habitats at the landscape or ecosystem scale that if protected, restored, or managed facilitate the Service's responsibility to conserve wildlife populations (USFWS 2008a).

Priority resources of concern (Table 2) were selected, including focal species, using the filtering strategy outlined in "Identifying Resources of Concern and Management Priorities for a Refuge: A Handbook" (USFWS 2008b). For each potential resource of concern, District's capabilities to support that resource were considered, the predicted response of the resource to management actions taken by the District, and expert opinions on the District's role for stewardship of the resource. In addition to these filters, we also relied heavily on our own judgment and experiences to choose priority resources of concern.

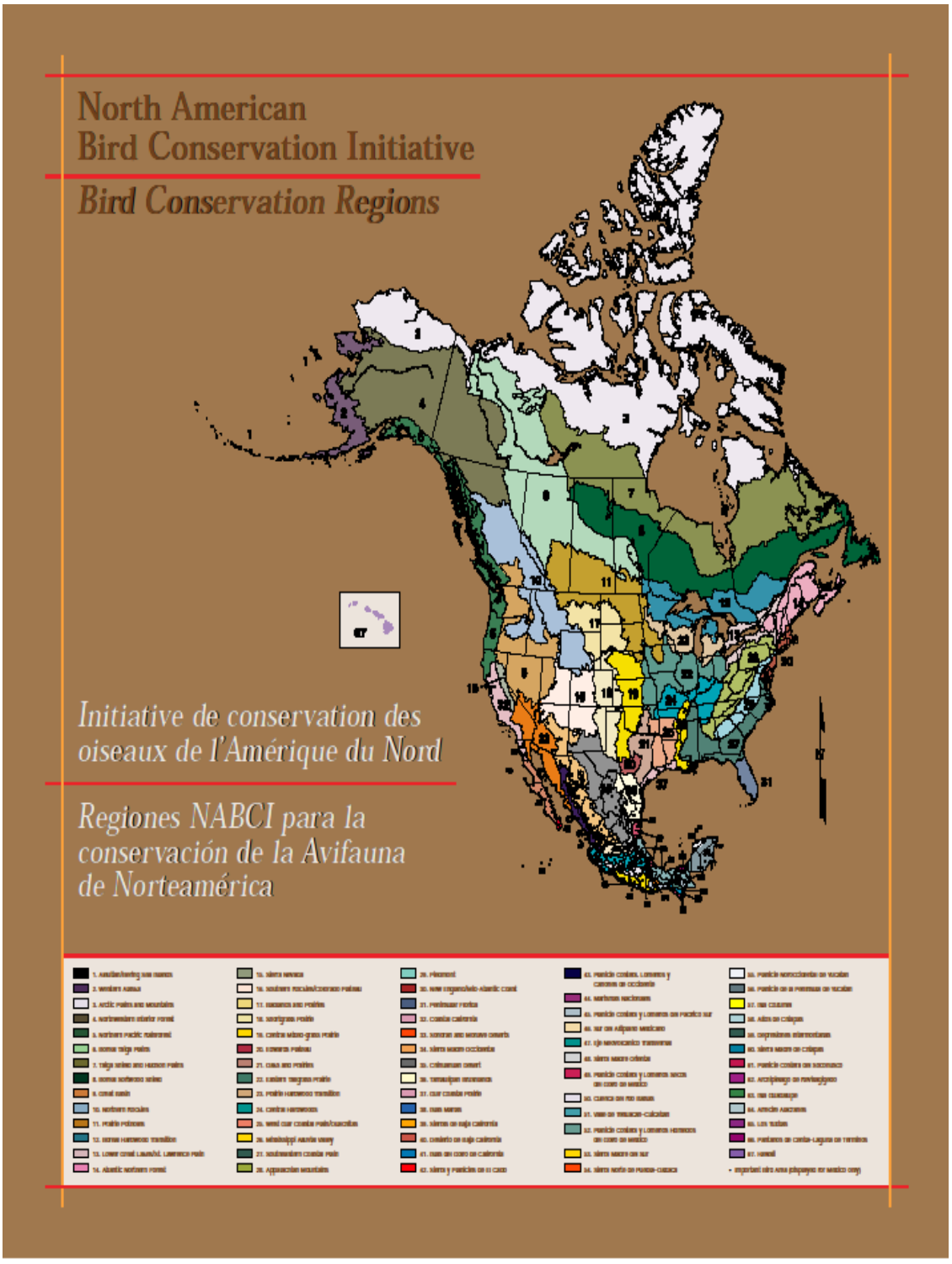
Table 2. Priority resources of concern for Litchfield WMD.

Resource	Comments
Mallard Blue-winged Teal	Waterfowl production is the primary purpose of the District. These species are the two most abundant nesting waterfowl in the District. Both are PPJV focal species. Each requires a grassland/wetland complex that also meets the habitat needs of many other species.
Redhead	The most abundant diving duck in the District. A focal species for other nesting diving ducks and for habitat needs of several species of waterbirds.
Western Meadowlark Greater Prairie-Chicken Marbled Godwit Sedge Wren Grasshopper Sparrow Northern Harrier Upland Sandpiper	Focal species representing the guild of grassland birds. There are sufficient populations of these species in the District to warrant management, and their habitat requirements cover a range of grassland (and wetland) conditions.
Dakota Skipper Powesheik Skipperling Arogos Skipper	Focal species representing the range of habitat needs of prairie-obligate butterflies. The Dakota Skipper is a candidate for listing under the ESA.
Willow Flycatcher	Riparian woodlands and willow/dogwoods are important habitat features. Bird of Conservation Concern (F&WS) and Continental Concern (PIF).
Native prairie remnants Natural wetlands	Native prairie and natural wetlands are rare and often in highly degraded states. Native prairies and some wetlands harbor several state-listed plant species. In addition to the habitat provided, we're concerned about the general ecosystem integrity of these communities.

When developing the priority list, we chose to focus on prairie pothole habitats and Bird Conservation Region (BCR 11) resources. The area that defined the eastern extent of the prairies and western extent of the prairie/forest (transition zone) has fluctuated throughout history. Even current maps vary in how much of the District should be included in the transition zone. Although the BCR maps (Figure 12) show a portion of the District land in BCR 23 (Prairie Hardwood Transition), the lack of specific trust resource data for this region precludes the allocation of District resources at this time. Resource issues will be addressed in 2012 after the roll-up and analysis of waterfowl breeding pair data. The most important contribution the District can make to biological

integrity and ecological health is to focus management actions on the resources of BCR 11 (Prairie Potholes).

Figure 12. Bird conservation regions.



Specific habitat requirements for the identified priority resources of concern (with the exception of the two ecosystems) are listed in (Table 3). The priority resources of concern were chosen in part because we knew that managing for them would additionally benefit many of the resources of concern on the comprehensive list in (Table 4).

The following biological tables detail distribution, ecology, phenology, habitat requirements, the District's contribution to habitat needs, and research and monitoring needs. The information in the species accounts, unless specifically stated, should be attributed to the authors of the various species accounts of the *Birds of North America Series* (Cornell Lab of Ornithology). For ease in reading and to shorten the length of accounts, the authors were cited only once.

Table 3. Habitat requirements for Litchfield WMD priority resources of concern. The bird habitat requirements in this table are summarized from the respective species accounts in Johnson et al. (2002), Johnson et al. (2004), Poole (2005), and expert opinion (S. Lewis, R. Russell, and T. Will, FWS, personal communication). Information for prairie butterflies is from USFWS (2007), Selby (2010), and expert opinion (P. Delphey, FWS, personal communication).

Species	Conservation Focus	Key Habitat Relationships			
		Vegetative Composition	Vegetative Structure	Patch Size	Special Considerations
Mallard	Grassland and wetland complexes	Grasses and forbs, emergent and submergent wetland vegetation	Forage in open to interspersed emergent cover, nest in dense upland vegetation about 60 cm high.	Wetland-upland complex >240 ha is best for waterfowl production	• Tolerates less crowding than other dabblers • Breeding populations closely tied to wetland conditions.
Blue-winged Teal	Grassland and wetland complexes	Grasses and forbs, emergent and submergent wetland vegetation	Forage in open to interspersed emergent cover, nest in moderate to dense upland grassland vegetation, height-density >50 cm	Wetland-upland complex >240 ha is best for waterfowl production	Nest cover is more important than availability of water in limiting the size of breeding populations.
Redhead	Wetlands (semi-permanent and permanent)	Hardstem bulrush, with cattails a second choice and sedges a third for nesting. Submergent aquatic vegetation also important.	Nests over open water in interspersed dense stands of persistent emergent vegetation. Also nests on islands and waterside vegetation within 2 m of water's edge.	Wetland-upland complex >240 ha is best for waterfowl production	• Water levels should be kept constant during laying and incubation • Access to deeper water is important for maturing broods and molting • Increase in redhead numbers may be at the expense of other species due to their parasitic nature

Species	Conservation Focus	Key Habitat Relationships			
		Vegetative Composition	**Vegetative Structure**	**Patch Size**	**Special Considerations**
Western Meadowlark	Grasslands	>90% herbaceous cover comprised of a mix of grasses (25-75% of cover) and forbs	• Use a wide range of vegetation heights and densities, but avoid extremely sparse or tall cover • Only a limited amount (<5% cover) of scattered woody vegetation above 1 m tall is tolerated; fencelines, forbs, and posts, etc. used for perches • Low to moderate litter cover	Male territory size 3-13 ha	Responds positively to light to moderate grazing and negatively to heavy grazing
Marbled Godwit	Wetland complexes, native grasslands	Native grasses and variety of wetland types	• Short/sparse to moderately vegetated. Tall, dense cover is avoided. Height-density at nests lower (<10-15 cm) than broods (15-60 cm) • Avoid dense emergent wetland vegetation, prefer shallow water areas with short, sparse to moderately dense shoreline vegetation. Forages in 5-13 cm water depths • Prefer minimal shrub cover • Moderate to high litter depth (3.8-9.1 cm)	Mean territory size >90 ha of contiguous grassland, high percentage of grass cover, many wetlands, and high wetland diversity	• Grazing, fall burning or haying could provide nesting habitat the following spring, and the denser, taller regrowth (15-60 cm) could provide suitable habitat for broods. • Prefer temporary and seasonal wetlands during breeding season and move toward semi-permanent wetlands in summer
Sedge Wren	Grasslands and wetlands	Mix of grasses/sedges/rushes and forbs	• Tall, dense grasslands and wetland edges with vegetation 20 cm to 1.5 m, dry land or over shallow water • Abundant litter cover with little bare ground	Will use small areas, but favors large prairies	Vegetation structure seems to be more important than habitat area in predicting occurrence

Species	Conservation Focus	Key Habitat Relationships			
		Vegetative Composition	**Vegetative Structure**	**Patch Size**	**Special Considerations**
Grasshopper Sparrow	Grasslands	Grasses and forbs	• Short to intermediate vegetation (5-20 cm height-density) with diverse structure and clumped vegetation. Will use taller grass if vegetation is patchy and not overly dense. Stiff-stemmed forbs used for song perches • Sparse woody cover, and avoids woody edges • Moderately deep litter, but areas with bare soil required.	Average territory size <2 ha but reproductive success improves with >10 ha	• Susceptible to brown-headed cowbird nest parasitism • Vulnerable to early mowing; light to moderate grazing, infrequent and post-season burning or mowing can be beneficial • Low abundance following a burn, increasing 2-4 years post-burn
Northern Harrier	Extensive emergent wetlands or grasslands	Herbaceous vegetation and low shrubs such as western snowberry, with abundant residual vegetation	Dense vegetation with much residual cover and a height 25 - 80 cm tall. Most nests in vegetation >60 cm tall.	Large >40 ha, with extensive wetlands and grassland	• Prefers undisturbed areas • Nests frequently over water on platforms built from nearby vegetation
Upland Sandpiper	Grasslands	Grasses	• Vegetation height at nests range from 10 to 65 cm (rarely uses vegetation >70 cm tall) but feed in vegetation <10 cm tall • Minimal woody cover • Moderate to high litter depth (4-9 cm)	>30 ha	Will forage in recently burned areas

Species	Conservation Focus	Key Habitat Relationships			
		Vegetative Composition	**Vegetative Structure**	**Patch Size**	**Special Considerations**
Willow Flycatcher	Wet grasslands and wetlands	Willow, dogwoods	Prefers moist, shrubby areas, often with standing or running water; high foliage-volume willow cover preferred but with willow clumps separated by openings	.7 ha (1.7 acres)	• Susceptible to cowbird nest parasitism, will make efforts to avoid incubating cowbird eggs • Habitat destruction and degradation and overgrazing by livestock are major causes of decline • Fire during nesting season can destroy nest sites and residual willow habitat
Dakota Skipper	Dry-mesic prairie	• High forb diversity, especially purple coneflower, blanketflower, ground plum • Fine stemmed, short stature bunchgrasses, especially little bluestem	• Stubble heights ≥20 cm in tallgrass prairies • Low to moderate litter		• Brome and bluegrass not adequate larval habitat (because of phenology and structure of stems) • Management prescriptions (timing, configuration) should account for vulnerable life stages • Habitat should be divided into several burn units, burning only a portion of the habitat in a calendar year

Species	Conservation Focus	Key Habitat Relationships			
		Vegetative Composition	**Vegetative Structure**	**Patch Size**	**Special Considerations**
Powesheik Skipperling	Dry-mesic prairie	• High forb diversity, especially false sunflower/purple coneflower (dry sites) or black-eyed Susan/spike lobelia (wet sites) • Fine stemmed, short stature bunchgrasses: prairie dropseed/little bluestem (dry sites) or Carex/spikerush (wet sites)			• Less known about primary larval food sources than other species • Management prescriptions (timing, configuration) should account for vulnerable life stages

Table 4. Priority resources of concern and other benefitting species on Litchfield WMD.
The bird habitat requirements in this table are summarized from the respective species accounts in Johnson et al. (2002), Johnson et al. (2004), Poole (2005), and expert opinion (S. Lewis, R. Russell, and T. Will, FWS, personal communication). Information for prairie butterflies is from USFWS (2007), Selby (2010), and expert opinion (P. Delphey, FWS, personal communication).

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefitting Species
Dakota Skipper Powesheik Skipperling	Dry Prairie	Stubble heights ≥20 cm in tallgrass prairies; low to moderate litter	Whole life cycle	Regal Fritillary, Sharp-tailed Grouse, Dicksissel, Prairie Vole, Plains Pocketmouse, Richardson's Ground Squirrel, Northern Harrier, Savannah Sparrow, Chestnut-collared Longspur, Western Meadowlark
Grasshopper Sparrow Upland Sandpiper		Clumped vegetation interspersed with bare ground; moderate litter	Full season Foraging	
Upland Sandpiper		Moderate to tall, patchy	Brood rearing and nesting	Sedge Wren, Savannah Sparrow, Clay-colored Sparrow, Western Meadowlark
Western Meadowlark	Mesic Prairie	Short, open vegetation	Full season	Short-eared Owl, Plains Pocketmouse, Marbled Godwit
Dakota Skipper Powesheik Skipperling		Moderate to tall, patchy	Whole life cycle	Henslow's Sparrow, Regal Fritillary, Northern Harrier
Blue-winged Teal Western Meadowlark			Nesting Full season	
Mallard Northern Harrier Sedge Wren		Tall, dense	Nesting Full season Full season	Henslow's Sparrow, Common Yellowthroat, Bobolink, American Bittern, Badger
Marled Godwit		Disturbed prairie haying or grazing areas with low vegetation	Breeding	Hudsonian Godwit, Wilson's Phalarope, LeConte's Sparrow (wet years), Black-crowned Night Heron, Veery
Mallard Northern Harrier Sedge Wren	Wet Prairie	Tall, dense	Nesting Full season Full season	Sandhill Crane, Bobolink, American Bittern, Henslow's Sparrow

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefitting Species
Marbled Godwit	Depressional Wetlands	Shallow water, short/sparse to open (low, disturbed) shoreline vegetation Short to intermediate height grassland with < 40% dead vegetation and average cover height 17 cm (7 in.).	Foraging	King Rail, Virginia Rail, Sora, Trumpeter Swan, American Bittern, Least Bittern, Black Tern, Black-crowned Night Heron, Pied-billed Grebe
Mallard Blue-winged Teal		Hemi-marsh, Interspersed vegetation and open water, shallow	Breeding, brood rearing, molting	waterfowl
Northern Harrier Sedge Wren		Tall, dense	Full season	Marsh Wren, Greater Prairie Chicken
Willow Flycatcher		Dense willows and other shrubs	Breeding	Yellow Warbler, Song Sparrow, Swamp Sparrow, Marsh Wren, Black-billed Cuckoo
Redhead Mallard	Shallow Lakes	Open, deep Hemi-marsh, submerged vegetation	Breeding Molting, staging, and migration	waterfowl, Western Grebe, Forster's Tern, Green Heron, King Rail, Virginia Rail, Sora, Trumpeter Swan, Least Bittern, Black Tern, Black-crowned Night Heron, Great Egret, Great Blue Heron, Marsh Wren

3.5 Priority Habitat Types

The purpose of determining the habitat needs for the priority resources of concern was to develop measurable and achievable habitat goals and objectives the District can use in management decisions. The process ensures the selection of appropriate priority habitats and describes appropriate habitat objectives that will account for all of the priority resources of concern. Given the scale at which we manage, the habitats described in the previous tables are often too detailed for this purpose. In the broadest sense, the priority "habitat" for the District could be described as a 4-square mile grassland-wetland complex. This complex would have an upland component consisting of greater than 30% grassland cover, few if any trees, four or more brood marshes and 150 temporary and seasonal wetlands intermingled across the landscape. This is consistent with the main goal of the SWAP which is to purchase a complex of wetlands and uplands that provide habitat in which waterfowl can successfully reproduce. For the purposes of this HMP, we chose to find a middle ground between that broad description and the very detailed habitat needs. In using these priority habitats and the subsequent goals and objectives, however, we must be mindful of both the broad context and the specific habitat needs. We have attempted to develop habitat objectives that will achieve both.

The priority habitats for Litchfield WMD are:

- Remnant (native) prairie
- Temporary and seasonal wetlands
- Semi-permanent wetlands
- Permanent wetlands and shallow lakes
- Seeded grasslands

Table 5. Priority resources of concern related to priority habitats for Litchfield WMD.

	Grassland		Wetland		
	Remnant	**Planted**	**Temporary/ Seasonal**	**Semi-permanent**	**Permanent/ Shallow Lake**
Mallard	X	X	X	X	
Blue-winged Teal	X	X	X	X	
Redhead				X	X
Western Meadowlark	X	X			
Marbled Godwit	X	X	X	X	
Sedge Wren	X	X	X		
Grasshopper Sparrow	X	X			
Northern Harrier	X	X	X	X	
Upland Sandpiper	X	X			
Willow Flycatcher	X	X	X		
Dakota Skipper	X				
Powesheik Skipperling	X				
Remnant Prairie	X				
Natural Wetlands			X	X	X

3.6 Conflicting Habitat Needs

Given the diversity of priority resources of concern, there will be instances where priority resources have conflicting habitat needs. Balancing the types and proportions of habitat conditions on the District will require a thoughtful process for determining the best course of action. Waterfowl are the highest priority for a Wetland Management District, so their needs will take priority in most situations. However, one advantage to working at the landscape scale of a WMD is the ability to constantly look beyond Service fee boundaries to the habitat available in the surrounding area. While there are likely subtle differences in habitat requirements between Grasshopper Sparrows and Mallards, establishing nesting cover for mallards on several tracts across the District will likely provide nesting cover for Grasshopper Sparrows in some of the tracts given the range of other influences like soil conditions, seed mixes, precipitation, management treatments, and tract sizes. Several of the non-waterfowl grassland birds of interest have more restrictive habitat requirements for nesting habitat than Mallards, such as percentage of forb cover. The challenge is to recognize how management actions can be modified to provide even greater value for other grassland birds.

4.0 Habitat Goals and Objectives

4.1 Remnant (Native) Prairie

GOAL: Manage remnant prairie throughout Litchfield WMD to promote the inherent ecological diversity and integrity (both floral and faunal) of native prairie plant communities, and to support populations of grassland dependent wildlife (Appendix 8, CCP Goal 5).

OBJECTIVES: Manage 75% of the native remnant prairie (currently 2,353 ac) throughout Litchfield WMD, with an emphasis on tracts larger than 10 ac, over the next 10 years to achieve the following conditions:

1. Cover dominated by native species (≥50%).
   Rationale: Remnant prairies can vary widely with respect to plant species composition and abundance, and the balance between native species and non-native species. Even degraded native sod, however, is of substantial value with respect to ecological diversity and management efforts should strive to tip the balance in favor of the native plant community. Native remnant prairies can include several state listed endangered and threatened species.

2. State listed primary noxious species are a minor component of the tract (<15% cover).
   Rationale: The presence of state listed noxious species may trigger a weed complaint from the county or township weed inspector and control efforts then become mandatory. Depending on the methods used, controlling noxious species has the potential to have a strong negative impact on the native plants of interest.

3. Trees greater than 1 m tall comprise less than 5% of the cover.
   Rationale: Historically, native prairies in Litchfield WMD were essentially treeless as a result of limited rainfall, frequency of fire, and grazing by large herbivores. Due to changes in land use and cultural practices, trees are now common on the prairie landscape. The literature on this topic indicates that invasive and planted trees in prairie landscapes often negatively affect a variety of bird groups (Bakker 2003).

4. Litter depth within a range from 0-7.5 cm.
   Rationale: The presence of litter is attractive and beneficial for some grassland dependent species but it can also be a problem when it accumulates beyond a certain depth. Relatively deeper litter depths and the resulting cooler soil temperatures favor invasive species such as Kentucky bluegrass and brome at the expense of warm season grasses and forbs typical of native prairies. However, some of the priority grassland birds do prefer moderate litter depths, such as

western meadowlark, grasshopper sparrow, and blue-winged teal. Litter depths will be minimal following management actions such as prescribed fire and will gradually build up in post-treatment years, reaching the upper threshold by around 8-10 years post-treatment.

5. Control the spread of, and where possible, eradicate introduced exotic and/or invasive plants that have adverse impacts on native vegetation.

   Rationale: It is not feasible to try to control all invasive species so it is necessary to select the ones that have the potential to significantly alter the ecology of the native plant community. Control may mean trying to eradicate one species while for another it may mean to limit its spread and control it at an innocuous level. As an example, spotted knapweed can have serious ecological impacts given its ability to chemically exclude other plants, yet it is feasible to attempt to eradicate this plant over a long time frame. Control for brome and Kentucky bluegrass may translate to careful timing of controlled burns or grazing to deplete root reserves of these species and set them back temporarily.

4.2 Planted Grasslands

GOAL: Restore and manage planted grassland communities using native local ecotype seed (species based on soil types – see unit plan) when feasible in Litchfield WMD to provide nesting cover for the benefit of nesting waterfowl and other grassland dependent birds (Appendix 8, CCP Goal 2).

OBJECTIVES: Manage 75% of the existing 24,443 acres of planted grasslands throughout Litchfield WMD over the next 10 years to achieve the following conditions:

1. Visual obstruction (i.e., height-density) ranges from 0.3-1.5 m when measured during full vegetation flush (mid-July to August).

   Rationale: For waterfowl and a number of other grassland nesting birds, the structure of idled vegetation is more important than the plant species composition (Naugle et al. 2000). Sample and Mossman (1997) suggest that diversity of structure (and cover types) should be promoted at a variety of landscape scales, and that the structural diversity should be achieved by planting diverse plant species (see objective 2). The structural requirements for the bird species included in the priority resources of concern span the ranges in the objective. Soil types, local hydrology, and topography can all impact the structural diversity in a seeding.

2. Manage for a floral composition of 6-8 native grasses, 2-4 non native grasses, and 10-15 forbs (>10% cover) on all previous and future grassland reconstructions.

Rationale: *Under the heading of planted grassland habitats, we are including native seedings that incorporate native grasses and forbs as well as nonnative seedings that contain exotic cool season grasses and forbs (the latter includes seed mixes commonly referred to as dense nesting cover or DNC, as well as fields overtaken by brome and/or Kentucky bluegrass). In general, both types of seedings can provide substantial value to grassland nesting waterfowl and nongame birds (see Naugle et al. [2000] for a summary of the value of different grass mixes to wildlife). Sample and Mossman (1997) suggest that structural diversity (see objective 1) should be achieved by having a species-rich plant community with at least 10% forb cover.*

Although good wildlife nesting cover can be created using exotic cool season grasses and forbs, these seedings require intensive management to maintain their productivity. Seedings that consist of native grasses and forbs are more expensive in the short term to establish but are self-perpetuating and require less active management over the long term. The District's focus on using native plants to restore WPA grasslands is in line with the National Wildlife Refuge System Improvement Act (1997), which states that Refuge System units are to promote biological integrity, diversity, and environmental health and attempt the restoration of historical conditions on Refuge System lands.

3. State listed primary noxious species are a minor component of the tract (<15% cover).
   Rationale: The presence of state listed noxious species may trigger a weed complaint from the county or township weed inspector and control efforts then become mandatory. Depending on the methods used, controlling noxious species has the potential to have a strong negative impact on the native plants of interest.

4. Trees greater than 1 m tall comprise less than 5% of the cover.
   Rationale: Historically, native prairies in Litchfield WMD were essentially treeless as a result of limited rainfall, frequency of fire, and grazing by large herbivores. Due to changes in land use and cultural practices, trees are now common on the prairie landscape. The literature on this topic indicates that invasive and planted trees in prairie landscapes often negatively affect a variety of bird groups (Bakker 2003).

5. Litter depth within a range from 0 to 7.5 cm.
   Rationale: The presence of litter is attractive and beneficial for some grassland dependent species but it can also be a problem when it accumulates beyond a certain depth. Relatively deeper litter depths and the resulting cooler soil temperatures favor invasive species such as Kentucky bluegrass and brome at the

expense of warm season grasses and forbs typical of native prairies. However, some of the priority grassland birds do prefer moderate litter depths, such as western meadowlark, grasshopper sparrow, and blue-winged teal. Litter depths will be minimal following management actions such as prescribed fire and will gradually build up in post-treatment years, reaching the upper threshold by around 8-10 years post-treatment.

6. Control the spread of, and where possible, eradicate introduced exotic and/or invasive plants that have adverse impacts on native vegetation.

   Rationale: It is not feasible to try to control all invasive species so it is necessary to select the ones that have the potential to significantly alter the ecology of the native plant community. Control may mean trying to eradicate one species while for another it may mean to limit its spread and manage at an innocuous level. As an example, spotted knapweed can have serious ecological impacts given its ability to chemically exclude other plants, yet it is feasible to attempt to eradicate this plant over a long time frame. Control for brome and Kentucky bluegrass may translate to careful timing of controlled burns or grazing to deplete root reserves of these species and set them back temporarily.

4.3 Temporary and Seasonal Wetlands

GOAL: Manage temporary and seasonal wetlands (547 ac) in Litchfield WMD to provide breeding pair habitat for waterfowl, breeding habitat for other wetland dependent wildlife, and maintain the natural integrity of the wetland (Appendix 8, CCP Goal 2).

OBJECTIVES

1. Maintain vegetation structure consisting of a 50:50 interspersion of emergent vegetation (or flooded residual vegetation) and open water each spring. Using the cover type classification in Stewart and Kantrud (1971), this description would include cover types 2 or 3.

   Rationale: Temporary and seasonal wetlands are critical for waterfowl during the early part of the breeding season, when more permanent wetlands are still frozen. While wetland-scale habitat conditions do not seem well studied for temporary and seasonal wetlands, our professional opinion is that they do not provide adequate waterfowl habitat when they are vegetation choked or completely open. The relationship between vegetation structure and pair use is currently being addressed with an adaptive management effort in several WMDs in Minnesota and Wisconsin. In one North Dakota study, mallard hens with broods preferred seasonal wetlands with an interspersion of vegetation or central expanse of open water surrounded by a ring of vegetation. Those hens also

selected brood-rearing wetlands with high densities of midge larvae (Talent et al. 1982).

2. Maintain a wetland plant community with <50% aerial cover of invasive species.
   Rationale: High quality, naturally occurring wetland basins considered to be benchmarks for evaluating biotic integrity typically have very diverse plant communities. Invasive species such as cattail, reed canarygrass, and willows can form monocultures that can change the function of the wetlands.

4.4. Semi-permanent Wetlands

GOAL: Manage semi-permanent wetlands (3511 ac) in Litchfield WMD to provide breeding pair and brood habitat for waterfowl, breeding habitat for other wetland dependent wildlife, as well as maintain the natural integrity of the wetland (Appendix 8, CCP Goal 2).

OBJECTIVES

1. Maintain the natural productivity cycle and natural range of water conditions in the basin, including hemi-marsh conditions (open water to emergent vegetation ratio ranging from 40:60 to 60:40) in 7 of 10 years, but allowing for periodic drought or flood conditions.
   Rationale: Hemi-marsh conditions are well accepted as ideal conditions for dabbling ducks and many other waterbirds (Weller and Spatcher 1965, Murkin et al. 1982, Murkin et al. 1997). The interspersion of water and vegetation allow for pair isolation, provide escape cover for broods, and encourages an abundant and accessible invertebrate food source. However, prairie wetlands historically existed under dynamic climatic (and thus hydrologic) conditions. Above average precipition in the 1990s and accelerated drainage across the landscape (including pattern tiling) have resulted in many wetland basins having an unnaturally deep and stable water regime. An occasional dry period (drought or artificial drawdown where possible) is important for consolidating wetland sediment, recycling nutrients, and germinating emergent vegetation. Drying semi-permanent wetlands also provide excellent mudflat habitat for shorebirds.

2. Improve or maintain water clarity at a secchi disk reading of ≥0.3 m.
   Rationale: One foot (0.3 m) is the standard water clarity reading used by MN DNR Shallow Lakes staff to assess whether a wetland is in a "clear" state or "turbid" state. The ability for sunlight to penetrate into the water column is critical in developing submerged macrophytes in deeper basins (Ellis 1936; Robel 1961;Dieter1991).

3. Maintain fishless basins.

   Rationale: Fish in wetlands can have dramatic impacts on the ecology of the basin. Fishless basins are more likely to exist in a clear state with abundant macrophytes and invertebrates, all of which are important for migrating and breeding waterfowl and other waterbirds. Fish can also compete directly for invertebrates that are important to wetland wildlife species such as mallards, redheads, and pied-billed grebes (Bouffard & Hanson 1997).

4. In wetland basins with water level management capability, limit wetland bounce following a 10 yr. rainfall event to <0.5 ft (0.15 m) during the nesting season.

   Rationale: The overwater nests of birds, such as redheads and pied-billed grebes, can be destroyed by rising water levels. The recommendations in the objective have been adopted by many wetland managers in western Minnesota when designing wetland pools with outlet structures.

5. Maintain a wetland plant community with <50% aerial cover of invasive species.

   Rationale: High quality, naturally occurring wetland basins considered to be benchmarks for evaluating biotic integrity typically have very diverse plant communities. Invasive species such as cattail and purple loosestrife can form monocultures that can displace native vegetation and change the function of the wetlands.

4.5 Permanent Wetlands and Shallow Lakes

GOAL: Manage permanent wetlands/shallow lakes (7773 ac) throughout the Litchfield WMD in a way that promotes the ecological integrity of the system and supports wetland dependent floral and faunal communities (Appendix 8, CCP Goal 2).

OBJECTIVES

1. Maintain permanent water regimes at a maximum depth of 6.5 ft. (2 m) to promote submergent, floating and floating leaved aquatic plants and associated fauna.

   Rationale: True aquatic (submerged) vegetation is a crucial component of shallow/permanent open water communities. The permanent water regime of these shallow open water habitats are particularly important for waterfowl production, brood rearing, molting, and migration. These wetlands also provide important habitat for overwater nesting waterfowl, colonial waterbirds and other wetland dependent flora and fauna.

2. Maintain phosphorus levels at <90 ppb.

   Rationale: Phosphorus is the primary nutrient polluting Minnesota's surface water (Minnesota House of Representatives Research Dept. 2004). Too much phosphorus causes excessive growth of nuisance algae which can severely impair

aquatic plant growth, reduce available oxygen, and diminish the wetlands value to dependent wildlife. Total phosphorus levels in excess of 90ppb are indicative of an impaired water body and do not meet Minnesota Pollution Control Agency water quality standards for shallow lakes (thresholds: 90 ppb TP Western Cornbelt Plains).

3. Improve or maintain water clarity at a secchi disk reading of ≥1 ft (0.3 m) or ≥50% of the average depth.

   Rationale: One foot is the standard water clarity reading used by MN DNR shallow lakes staff to assess whether a wetland is in a "clear" state or "turbid" state. The ability for sunlight to penetrate into the water column is critical in developing submerged macrophytes in deeper basins.

4. Reduce or eliminate populations of undesirable fish.

   Rationale: Fish in wetlands have a dramatic impact on the ecology of the basin. Fishless basins are more likely to exist in a clear state with abundant macrophytes and invertebrates, which are important for breeding and migrating waterfowl and other wetland dependent species. Rough fish also increase the internal nutrient cycling in a basin leading to low water quality and clarity. Undesirable fish include species such as fathead minnows Pimephales prmelas, common carp Cyprinus carpio, black bullhead Ameiurus melas, and bigmout buffalo Ictiobus cyprinellus.

5. Maintain an aquatic plant community dominated by native species such as sago pondweed *Stukenia pectinata*, wild celery *Vallisneria americana*, hardstem bulrush *Scirpus acutu*, broad-leaved cattail *Typha latifolia*, and water milfoil *Myriophyllumsp*. at ≥80% of established sample points and with aquatic plant species richness of ≥6 species basin-wide.

   Rationale: High quality, naturally occurring wetland basins considered to be benchmarks for evaluating biotic integrity are typically very diverse plant communities. Each of Minnesota's native wetland plant species is an integral part of an ecosystem that includes other plants, animals, and microorganisms. Native species rarely become invasive or troublesome thanks to an established natural balance that keeps each species in check, allowing growth and healthy production in certain conditions while preventing aggressive spreading or single-species domination. Invasive species such as curly-leaf pond weed Potamogeton crispus and Eurasian watermilfoil Myriophyllum spicatum displace native submergent species due to excessive plant growth and their subsequent die-off and decay can cause low oxygen levels and trigger algal blooms.

5.0 Habitat Management Strategies and Prescriptions

This chapter outlines management strategies and prescriptions to address the habitat management goals and objectives identified in Chapter 4. Management strategies detail the tools and techniques (e.g. mowing, water-level manipulation, chemical application, etc.) utilized to achieve the habitat objectives (See Appendix 4). Prescriptions provide the details behind the specific means by which the strategies will be implemented (e.g. timing, frequency, duration, and location). A review of available literature related to potential strategies and prescription was incorporated during their development. The identified treatments were selected in consultation with other refuge biologists, managers, and practitioners to ensure their effectiveness. Many environmental factors including wildlife populations, weather, seasonal variations, and habitat conditions affect the selected prescriptions and their ability to achieve objectives from year to year. As such, many of the details of prescriptions will be identified in the Annual Habitat Work Plan. Prescriptions outlined herein are discussed on a conceptual level.

The natural world contains a myriad of extremely complex and dynamic systems which contain an array of different habitats that support hundreds of plant, fish, and wildlife species. It is important to understand as habitat managers, that one can never fully understand every aspect of these dynamic systems. There will undoubtedly be additional need to address evolving changes to physical, ecological, social, political, and financial factors that may influence the management of the aforementioned natural resources of concern.

The management prescriptions outlined represents a comprehensive effort to guide management over the next ten years. However, it is impossible to predict the full suite of management strategies and prescriptions required over this period. Some additional strategies may need to be added, others listed here may not be utilized.

Potential Management Strategies

A number of the management strategies at Litchfield WMD will be used in multiple habitat types, sometimes to different purposes. In some situations, a combination of management tools will be necessary. This section provides general descriptions of each management strategy, while the subsequent section describes management strategy details (i.e., prescriptions) by habitat type.

Management Strategies by Habitat Type

Remnant (Native) Prairie

Rehabilitation Strategies

- Use prescribed fire when the cool season exotic grass is actively growing. Strive to burn when these grasses are in the boot stage (stem elongation). For smooth brome burn during the 3-5 leaf stage. Prescribed fire is the best strategy for reducing/killing Kentucky bluegrass. In addition, use fall burns to control and set back woody vegetation.

- Expand the livestock grazing program and employ multiple (unit specific) grazing regimes to control smooth brome grass, reed canary grass, and woody species.
- Continue to work with grazing cooperators to make the grazing program more attractive to grazers.
- Utilize high flow skid-steer and shear attachment to cut encroaching trees with 6"-18" dbh and chemically treat stump cambium layer with appropriate chemical.
- Monitor for and spot treat exotic species invasions. Treatment options include chemical, mechanical and cultural.
- Continue to monitor the effectiveness of management strategies and adjust using adaptive management techniques.
- Continue to research new technologies and management techniques for enhancing the floristic quality of the native prairies.
- Potential to use glyphosate herbicide in isolated areas where smooth brome is the only species present and only after monitoring has determined that no cool or warm season native vegetation remains. Reseed areas with native seed collected from the prairies. This is the most extreme strategy and will only be used as a last ditch measure to improve floristic quality.

Maintenance Strategies

- Prescribed fire treatments on an approximate 4 year burn cycle utilizing partial burns.
- Occasional spring graze at a stocking rate of 0.50 - 0.75 AUM. Grazing period to be determined by management staff.
- Utilize high flow skid-steer with carbide cutter/timber-ax attachment to shread encroaching volunteer trees or heavy secondary woody growth with .25"- 6"dbh.
- Monitor for and spot treat exotic species invasions. Treatment options include chemical, mechanical and cultural.

<u>Planted Grasslands</u>

Management Strategies

One of the major priorities for resource managers is to increase native biological and structural diversity on previously altered tracts. These areas are defined as planted grasslands. Different management strategies will be used for restoring partially restored and non-native grasslands.

Partially Restored Grassland Strategies

- Prioritize partially restored and non-native grassland restoration units that are targeted for restoration.
- Prepare field via prescribed fire to remove residual vegetation and litter.
- Use chemical and/or mechanical methods to thin partially restored grasslands. Native, tall, warm season grasses (big bluestem, Indiangrass, switchgrass, Canada wild rye) will be thinned to break the "blanket" look. This will create more space for other species.
- Harvest or collect seed from WPAs, habitat easements, and/or purchase local ecotype seed from growers to use for restoration, reconstruction, and interseeding.
- Interseed a diverse native seed mix containing at minimum 8 species of grass and 25 species of forbs.

- Plant native vegetation after the growing season in the fall (fall dormant seeding) or during the winter with snow cover (snow seeding).
- Clip vegetation when needed during the first two years post-seeding to foster the establishment of native plants.
- Continue to evaluate restoration methodologies and seed mixes.
- Monitor for and spot treat exotic species invasions. Treatment options include chemical, mechanical and cultural.
- Each field will be evaluated to determine the most effective way to restore native vegetation. Some fields may require the vegetation to be removed and the unit farmed for 3 years to prepare an adequate seed bed. If this is the case then refer to Non-native Grassland Strategies.
- Incorporate restored fields into a 4 year burn cycle after the fourth growing season. Burning these fields before the fourth year will prematurely stimulate the grass species and create more difficult conditions for establishing forbs.

Non-native Grassland Strategies

- Prepare field via prescribed fire or haying to remove residual vegetation and litter.
- Develop Cooperative Farming contracts with farmers.
- Farm fields for 3 years using cereal grains. Cooperators may use roundup ready crops.
- Cooperators shall control weeds with glyphosate herbicide. No insecticides may be used on WPAs.
- To prepare a suitable seed bed for seeding native plants soybeans will be the final year crop for all farming agreements.
- Harvest or collect seed from WPAs, habitat easements, and/or purchase local ecotype seed from growers to use for restoration, reconstruction, interseeding, and transplanting purposes.
- Seed a diverse of native seed mix containing at minimum 8 species of grass and 25 species of forbs.
- Plant native vegetation after the growing season in the fall (fall dormant seeding) or during the winter with snow cover (snow seeding).
- Monitor field to evaluate establishment of the planted species. Interseed additional species if needed.
- Monitor for and treat exotic species invasions. Treatment options include chemical, mechanical and cultural.
- Clip vegetation when needed during the first two years post-seeding to foster the establishment of native plants.
- Incorporate restored fields into a 4 year burn cycle after the fourth growing season. Burning these fields before the fourth year will stimulate the grass species and create more difficult conditions for establishing forbs.
- Prescribed fire treatments on an approximate 4 year burn cycle.
- Herbicide spot treat encroaching tree species that are too large to be controlled with fire. Garlon 3A or equivalent herbicide.
- Monitor for and treat exotic species invasions. Treatment options include chemical, mechanical and cultural.

- Clip cultivar grass fields (6 foot tall big bluestem) to provide short vegetation for grassland bird species like upland sandpiper and other resident wildlife.

Temporary and Seasonal Wetlands

Direct Management Strategies

- Temporary and seasonal wetlands often have no surface water by mid-summer. This allows direct vegetation management like mechanical manipulation (mow/hay/crush), scraping sediment, discing, and herbicide application specifically targeted within the wetland basin. The latter three tools should be preceded by some method of defoliation (haying, burning).
- To manage structure, treat in fall or winter. Access and complete treatment is easier when basin is dry. Spring runoff will flood basin in time for spring migratory and breeding waterfowl use.
- If invasive species control is desired, timing will depend on the species of interest. Combination treatments will most likely be necessary, and at least one should be timed when the target species root carbohydrate reserve is lowest.
- Direct treatments have a practical constraint in the time it takes to travel to and treat individual basins; the number of basins we can realistically expect to manage this way will require that we prioritize and apply the treatments only on sites where we expect to see great benefit.
- The frequency of management will depend on the strategy used: the least intensive tools that only remove above ground biomass (mechanical) may need to be repeated annually, while the more intensive tools that actually impact the root system of the plant (scraping, discing) may persist for many years.

Indirect Management Strategies

- Burning, grazing or haying a management unit that includes wetlands will have some effect on those basins. However, a desired or full effect will depend very much on timing. The tradeoff between the ideal timing for meeting upland and wetland habitat objectives must be considered.
- Fall or dormant season burning is most effective to manage structure. Most prescribed burning occurs in spring and early summer, when these wetlands are more likely to be flooded.
- There is evidence that grazing can help maintain a wetland in a state that would meet the above objectives, however it is less clear whether grazing can improve a wetland from a more invaded or choked condition.
- Haying occurs later in the growing season, and so will be more likely to remove a greater amount of wetland vegetation than burning or grazing.
- Like direct management, the frequency of treatments will vary with the treatment used and the environmental conditions at the time of treatment.

- Invasive species control will often require some follow-up treatment after indirect management strategy. For example, a fire may remove rank vegetation

Semi-permanent Wetlands

Management Strategies

- Basins with control structures will have complete drawdowns every 7 to 10 years. Drawdowns will generally begin in mid-summer and be done gradually over the course of the remaining growing season.
- Partial draw-downs can be used occasionally to maintain aquatic habitat and water quality and can reduce the need for more costly and time consuming full draw-downs. These can be especially useful for eliminating fish, if the water levels are low enough to freeze out over winter.
- Control dense stands of cattail using mechanical vegetation manipulation or fire. The best timing for the treatment is in late spring, which will impede carbohydrate strorage during the growing season. However, this can only be done during drought or if the wetland can be artificially drawn down. Flood at least 6" over cattail immediately following and throughout the summer.
- Treatment can also occur late in the growing season when the wetland is drier or in winter over ice. Mechanical treatments after cattail has gone to seed can be difficult because the fluffy, airborne seeds can clog equipment.
- Cattail can also be controlled using approved herbicides such as glyphosate or Habitat imazapyr. Treatment is challenging in flooded basins, and will require application by helicopter or specialized equipment such as a Marsh Master. Control may be optimized by first removing decadent growth (by mechanical means or fire), allowing better contact with living plant parts.
- Rotenone treatments can be applied to semi-permanent basin in an attempt to eliminate planktivorous/bethivorous fish species. Results can be temporary with possible reintroductions if the basin is interconnected. The toxicant is harmful to aquatic invertebrates, tadpoles and juvenile salamanders.
- Biomanipulation is an inexpensive option to control fish populations and improve water quality parameters. It has a short-term effect and will need to be repeated, possibly every other year. Requires working with local DNR Fisheries managers. Requires basins that are deep enough to prevent summer anoxia, without a surface water connection to other wetlands.
- Barriers such as metal grates, electrical barriers, dikes, and velocity culverts can be put in place to prevent fish entry, although effectiveness can vary and initial construction/maintenance costs can be high.
- Reverse aeration, in some situations, could be a useful strategy for controlling anoxia-intolerant fish species in water bodies less than 100 acres in size. This strategy is typically used to eliminate carry over fish (walleye) from prior biomanipulation methods.

Permanent Wetlands and Shallow Lakes

Management Strategies

- On basins with control structures, and depending on marsh productivity, full draw-downs are recommended every 5-7 years to consolidate/aerate bottom sediments, break down organic material, and kill deleterious fish species. This will stimulate aquatic/emergent plant growth, reduce total phosphorus levels and help to induce a shift towards a stable clear-water state.
- Rotenone treatments can be applied to permanent basin in an attempt to eliminate planktivorous/bethivorous fish species. Results can be temporary with possible reintroductions if the basin is interconnected, and the toxicant is harmful to aquatic invertebrates, tadpoles and juvenile salamanders.
- Piscivorous fish species *Sander vitreus* introductions at a rate of 12,000 fry ha^{-1} (biomanipulation) have been shown to reduce planktivorous/benthivorous fish densities (Ward 2003; Herwig et al. 2004), decreasing the internal nutrient cycling in basins and leading to higher water quality.
- Barriers such as metal grates, electrical barriers, dikes, and velocity culverts can be put in place to prevent fish entry, although effectiveness can vary and initial construction/maintenance costs can be high.
- Reverse aeration, in some situations, could be a useful strategy for controlling anoxia-intolerant fish species in water bodies less than 100 acres in size. This strategy is typically used to eliminate carry over fish (walleye) from prior biomanipulation methods.
- Partial draw-downs can be used occasionally to maintain aquatic habitat and water quality and can reduce the need for more costly and time consuming full draw-downs.
- Vegetation will be monitored by conducting shallow lake surveys, using systematic point sampling, calculating aquatic plant distribution, diversity and abundance.
- Water clarity and quality parameters will be monitored periodically using and approved water quality sampling regime and fish presence will be verified by periodic test netting.

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APPENDIX 1.

Detailed description of the ecological provinces, sections and subsections found in the Litchfield WMD.

Note: The text for this appendix is quoted directly from the Minnesota Department of Natural Resources' ecological classification system website: http://www.dnr.state.mn.us/ecs/index.html [accessed 5 May 2010].

Prairie Parkland Province

The Prairie Parkland (PPA) Province traverses western Minnesota, extending northwest into Manitoba, west into North Dakota and South Dakota, south into Iowa, Nebraska, Kansas, Oklahoma, and Missouri, and east into Illinois and Indiana. In Minnesota, the province covers just over 16 million acres (6.5 million hectares), coinciding with the part of the state historically dominated by tallgrass prairie. Mean annual temperatures (1971-2000 normals) vary from 36°F (2°C) in the north to 48°F (9°C) in the south. Evapotranspiration is greater than precipitation across much of the province in Minnesota, with deficits reaching -8 inches (-20cm) along the western edge. The extreme southeastern corner of the province is characterized by a small (1 inch [3cm]) precipitation surplus. Precipitation increases from about 18 inches (46cm) annually in the north to 33 inches (84cm) in the south. Low winter precipitation, short duration of snow cover, and desiccating westerly winds promote severe spring fire seasons that favor grassland over forest vegetation.

The land surface of the province was heavily influenced by the most recent glaciation. Ice sheets crossed the province several times during the Wisconsin glaciation, depositing a mantle of drift 100 feet to 600 feet (30 meters to 180 meters) thick in most places. The last lobe of ice, the Des Moines lobe, deposited calcareous drift in the southern part of the province. The ice lobe was fronted to the north by the largest pro-glacial lake in North America, Glacial Lake Agassiz, which deposited deep-water sediments over the northern part of the province in Minnesota. Glacial River Warren, the early outlet at the southern end of Glacial Lake Agassiz, cut a deep, broad valley that bisects the southern half of the province. This valley is now occupied by the Minnesota River. Because of the thick mantle of drift covering most of the province, bedrock exposures are rare, being limited to the deeply down-cut Minnesota River valley and a few places where quartzite bedrock highs protrude through thinner drift in the southwestern corner of the province.

North Central Glaciated Plains Section

The largest portion of the North Central Glaciated Plains Section (CGP) is a level to rolling region of calcareous till deposited by the Des Moines lobe. This region is bisected by the deeply incised Minnesota River valley. The CGP also contains a highland region known as the Prairie Coteau, which flanked the southwestern edge of the Des Moines lobe in Minnesota, South Dakota, and Iowa. The Prairie Coteau is covered with glacial till and loess predating the

Wisconsin glaciation. The historic pattern of vegetation in the CGP reflects features that affected the frequency and severity of fires. Level to rolling till plains, moraines, lake plains, and outwash plains covered much of the section and supported mainly treeless fire-dependent communities, with upland prairie communities by far the most common, covering 82% of the section. These landforms also supported smaller amounts of marsh, wetland prairie, and wet meadow communities. Rugged terrain and lands deeply dissected by rivers supported a mosaic of prairie and wooded communities.

Minnesota River Prairie Subsection

The boundaries of this subsection coincide with large till plains flanking the Minnesota River. The unit is bounded to the southwest by the Prairie Coteau. A series of end moraines define the eastern boundary, starting with the Alexandria Moraine to the northeast and ending with end moraines associated with the Des Moines lobe in the southeast.
This subsection consists of a gently rolling ground moraine about 60 miles wide (Hobbs and Goebel, 1982). The Minnesota River occupies a broad valley that splits the subsection in half. The valley was created by Glacial River Warren, which drained Glacial Lake Agassiz. (Matsch and Wright 1967).

- Landform: Loamy ground moraine (till plain) is the dominant landform, but end moraines, and lake plains also occupy a significant area (Hobbs and Goebel 1982). Ground moraine topography is level to gently rolling. The steepest topography of the subsection is along the Minnesota River and on the Big Stone Moraine, which has steep kames and broad slopes.
- Bedrock geology: Most of this subsection is covered by 100 to 400 feet of glacial drift (0lsen and Mossler 1982). Cretaceous shale, sandstones, and clays are the most common kinds of bedrock. Ordovician dolomite underlies the extreme southeastern edge (Morey 1976). There is a major area of exposed granite bedrock scoured by Glacial River Warren near Ortonville (Wheeler et al. 1992).
- Soils: Well- to moderately well-drained loamy soils formed in gray calcareous till of Des Moines lobe origin is dominant. Some soils are clayey and sandy and gravelly soils are present locally, but these account for only a small percentage of soils in the subsection (Dept. of Soil Science, Univ. of Minnesota 1969, 1979, 1981). Cummins and Grigal (1981) show most of the subsection as Udolls and Aquolls on relatively level topography, generally with 15 feet or less of local relief. Dry prairie soils (primarily Ustolls) are also present on level to gently rolling topography. They occupy convex knobs on the landscape.
- Climate: Annual precipitation ranges from 25 inches in the west to 30 inches in the east, with 11 to 13 inches of growing-season precipitation. Growing-season length is approximately 147 to 152 days. Eleven% of annual precipitation falls from November through February (Midwest Climate Center 1992). This results in extreme desiccation of most woody plants, and contributes to prairie grass dominance (Albert 1993).
- Hydrology: This subsection is drained by the Minnesota River. Smaller rivers and streams eventually empty into the Minnesota or the Upper Iowa River. The drainage network is poorly developed due to landscape characteristics. The subsection has 150 lakes greater than 160 acres in size (Dept. of Soil Science, Univ. of Minnesota 1969,

1979, 1981a). However, many of these are shallow perched lakes. Wetlands were very common before settlement. Most have been drained for cropland.

- Pre-settlement vegetation: The pre-settlement vegetation was primarily tallgrass prairie, with many islands of wet prairie (Kratz and Jensen 1983, Marschner, 1974). Forests of silver maple, elm, cottonwood, and willow grew on floodplains along the Minnesota River and other streams. Portions of the Big Stone Moraine supported dry and dry-mesic prairie (Wheeler et al. 1992). There were also dry gravel prairies on kames (Albert 1993).
- Present vegetation and land use: Agriculture is the dominant land use. This subsection is the heart of the Minnesota Cornbelt (Wright 1972). Wheeler et al. (1992) found upland prairie species to be common throughout most of the subsection (based on herbarium records). Remnant stands of tallgrass prairie are rare.
- Natural disturbance: Fire was the most common natural disturbance before settlement. Fire suppression has allowed woodlands to develop from what were originally oak openings or brush prairies (Wheeler et al. 1992). Other causes of disturbance are floods and tornados.

Eastern Broadleaf Forest Province

The Eastern Broadleaf Forest (EBF) Province traverses Minnesota, Iowa, Wisconsin, Michigan, Ohio, New York, Illinois, Indiana, Kentucky, Tennessee, Missouri, and Arkansas. In Minnesota, the EBF Province covers nearly 12 million acres (4.9 million hectares) of the central and southeastern parts of the state and serves as a transition, or ecotone, between semiarid portions of the state that were historically prairie and semihumid mixed conifer-deciduous forests to the northeast. The western boundary of the province in Minnesota is sharply defined along much of its length as an abrupt transition from forest and woodland to open grassland. The northeastern boundary is more diffuse, with a gradual transition between eastern deciduous forests and the mixed conifer-hardwood forests of northern Minnesota.

The land surface of the province is largely the product of Pleistocene glacial processes. The northwestern and central portions of the province were covered by ice in the last glaciation and are characterized by thick (100–300 feet [30–90 meters]) deposits of glacial drift that is highly calcareous and of Wisconsin Age at its surface. Glacial lakes associated with the last glacial advance contributed large volumes of meltwater to rivers that cut deep valleys along the present course of the Minnesota, St. Croix, and lower Mississippi rivers. In the southeastern part of the province, which was not covered by ice in the last glaciation, headward erosion of streams draining into the deepening Mississippi valley dissected the flanking uplands, exposing Paleozoic bedrock and pre-Wisconsin drift. The waning stages of the glacial lakes contributed massive amounts of sediment to the river valleys and provided a source of silt that was re-deposited by wind as a mantle of loess over the eroded lands in the southeastern part of the province.

The EBF Province coincides roughly with the part of Minnesota where precipitation approximately equals evapotranspiration; it seems likely that this aspect of climate has an important influence on plants, as many forest species reach their western range limits and several prairie species reach their eastern range limits within the province. Precipitation in the province increases from about 24 inches (60cm) annually in the northwestern portion to 35 inches (90cm)

in the southeast, while normal annual temperatures range from 38°F (3°C) in the northwest to 46°F (8°C) in the southeast.

Minnesota and Northeast Iowa Morainal Section

The Minnesota and Northeast Iowa Morainal Section (MIM) is a long band of deciduous forest, woodland, and prairie that stretches nearly 350 miles (560km) from Polk County in northwestern Minnesota to the Iowa border. Over half of this area consists of rugged to hummocky moraines deposited along the eastern margin of the Des Moines ice lobe during the last glaciation. Another quarter of the area consists of rolling till or basal till deposited as drumlins. Small sand plains occur locally within the moraines. A rather large sand plain, the Anoka Sand Plain, is present north of the Twin Cities metropolitan area. This level plain is formed from sand deposited by meltwater from the Grantsburg sublobe, a spur of ice emanating from the east flank of the Des Moines lobe.

The presettlement pattern of upland vegetation in the MIM reflects substrate texture and landform topography. These features affected plants directly through their influence on moisture and nutrient availability, insolation, and local temperature, and also indirectly through their influence on the frequency and severity of fires. Sandy flat areas were dominated by prairie, savanna, and oak and aspen woodlands. This is especially true of the Anoka Sand Plain and sandy terraces along the major rivers. In these areas, droughty soils and absence of impediments to the spread of fire promoted fire-dependent prairie and woodland vegetation. A large area of prairie, savanna, and oak woodland was also present on gently undulating glacial till in the southern part of the section, adjacent to the extensive prairie lands of western Minnesota. The low-relief landscape in this part of the section afforded few impediments to the spread of fire, including fires that spread into the section from the adjacent prairie region. Woodland and forest dominated sites in the section where fire was uncommon or rare. Fine-textured drift deposited in hummocky moraines supported mesic forests dominated by sugar maple, basswood, American elm, and northern red oak. Even small reductions in fire frequency afforded by streams, lakes, or topographic breaks permitted the formation of forest on finer-textured soils, and once formed these forests were highly resistant to burning.

Floodplain and terrace forests were present historically along the valleys of the major rivers, the Mississippi, Minnesota, and St. Croix, and are still prominent today along many stretches of these rivers. Forests of silver maple occupy the active floodplains, while forests of silver maple, cottonwood, box-elder, green ash, and elm occupy terraces that flood infrequently. These valleys are also characterized by herbaceous and shrubby river shore communities along shorelines and on sand bars, and in some areas by cliff communities on steep rocky river bluffs. Closed depressions that pond water in the spring provide open wetlands such as marshes, wet meadows, shrub swamps, and wet prairies. Peatlands are uncommon in the section and usually develop following formation of sedge or moss mats over sediments in former lake basins.

Hardwood Hills Subsection

The Alexandria Moraine Complex forms the western and southern boundary of this subsection. The eastern boundary was delineated based on general landform boundaries and the

separation of lands dominated in the past by northern hardwoods from lands dominated by conifer or aspen-birch forest.

Steep slopes, high hills and lakes formed in glacial end moraines and outwash plains characterize this subsection. Presettlement vegetation included maple-basswood forests interspersed with oak savannas, tallgrass prairies, and oak forests. Much of this region is currently farmed. Where lakes are present, tourism is common.

- Landform: Ice stagnation moraines, end moraines, ground moraines, and outwash plains are major landforms present in this subsection. Kettle lakes are numerous, both on moraine and outwash deposits (Albert 1993). Parent material is primarily calcareous glacial till and outwash sediments. The glacial till is calcareous loamy sediment deposited by the last major glaciation (Wisconsin age).
- Bedrock geology: There are 100 to 500 feet of glacial drift covering most of the bedrock in this subsection. The thickest drift is in the northwestern half (Olsen and Mossler 1982). Middle Precambrian granitic bedrock is locally exposed in the southeast, along the Crow River (Morey 1976, 1981). Bedrock underlying the subsection is diverse. Cretaceous shale, sandstone, and clay and Lower Precambrian granite, meta-sedimentary and metaigneous gneiss, schist, and migmatite underlie the southern half (Morey 1976). To the north are metasedimentary rocks, iron formation, enschist, and metavolcanic rocks (Albert 1993).
- Soils: Soil textures range from loamy sands and sandy loams on outwash plains to loams and clay loams on moraines. Loamy soils are prevalent. Most are classified as Borolls (cold well drained soils developed under grassland) and Aquolls (wet soils developed under grassland), with some Udolls (dry soils developed under grassland, with soil temperatures warmer than Borolls). There are some Alfisols (soils developed under forested or savanna conditions) (Cummins and Grigal 1981).
- Climate: Total annual precipitation ranges from 24 inches in the west to 27 inches in the east. Growing season precipitation ranges from 10.5 to 11.5 inches. The growing season ranges from approximately 122 days in the north to 140 days in the south.
- Hydrology: The Alexandria Moraine forms a high ridge that is the headwaters region of many rivers and streams flowing east and west. The drainage network is young and undeveloped throughout this subsection. Major rivers include the Chippewa, the Long Prairie, the Sauk, and the Crow Wing rivers. The Mississippi River forms a portion of the east boundary. The Continental Divide splits this subsection. North of the divide, water eventually flows into Hudson Bay. South of the divide, water flows into the Mississippi River system. The subsection has numerous lakes, with over 400 lakes greater than 160 acres in size. The majority of these are present on end moraines and pitted outwash plains.
- Presettlement vegetation: Irregular topography and presence of numerous lakes and wetlands provided a partial barrier to fire, resulting in woodland or forest rather than prairie vegetation. A mosaic of tallgrass prairie, aspen-oak land, and oak openings or savanna was present along the prairie boundary to the west (Marschner 1974). Mixed forests of oaks, sugar maple, basswood, and other hardwoods were present in fire protected sites farther east. Tallgrass prairie grew on more level terrain within the subsection.

- Present vegetation and land use: Agriculture is the major land use. Wetlands and lakes in poorly-drained potholes provide opportunities for recreation or wildlife habitat. Some upland forests remain, adjacent to lakes or on steep landscapes. Tourism is important, especially in areas around lakes.
- Natural disturbance: Fire was important in oak savanna development. Wind-throw was common in the sugar maple-basswood forests. Tornados and other high wind events also created natural disturbances (Albert 1993).

Big Woods

The Minnesota River runs through the middle of the once predominantly forested Big Woods Subsection. The Mississippi River forms the northeastern boundary. Lakes and wetlands are common; more than 100 lakes are greater than 160 acres in size, and many are groundwater-controlled with no inlets or outlets. Before settlement by people of European descent, the most common tree species of the Big Woods were red oak, sugar maple, and American elm.

Today, most of the region is farmed, and only a small fraction of the original "Big Woods" remains. Forested areas are widely separated from each other, although a good deal of edge habitat remains. The Twin Cities metropolitan area continues to expand into the subsection, and both farming and urbanization have led to dramatic changes in habitats. Water quality is also a conservation concern in this agricultural landscape.

- Big Woods habitat feature woodland birds such as red-shouldered hawks and warblers, savanna species such as Blanding's turtles and red-headed woodpeckers, and wetland species such as turtles, ospreys, Forester's terns, and black terns.
- The Minnesota River also provides habitat to many species. Smooth softshell turtles utilize exposed sand bars and south-facing cut-banks as basking and nest sites. Forested river terraces are occupied by milk snakes and western fox snakes, while bull snakes and racers live among open sandy terraces.
- Areas important for SGCN include the Minnesota Valley National Wildlife Refuge; Three Rivers Park District's regional park; numerous WMAs; Lake Maria SP; and Wolfsfeld Woods, Whitney Island, Cannon River Trout Lily, and Kasota Prairie SNAs.

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APPENDIX 2.
Wetland classification and distribution on the Litchfield WMD.

UNIT (WPA)	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V	TYPE VI/VII	TOTAL
	Temporary	Seasonal	S. Perm.	Permanent	Permanent	Shrub/Forrest	
(KANDIYOHI)							
ALLEN	.7		9.8	8.1	71.4		90
ARCTANDER	3.7		34.7	56	30.7		125.1
BIG KANDI	9.5		77.3	40.2			127
BJUR			1.25	22.4			23.7
BOMSTA	4.4		57	72.1		.1	133.6
BRENNER LAKE	4.6		17.4	20.6	19.9	2.8	65.3
BROBERG			.5	24.6			25.1
BURBANK	.6		.3	397.6			398.5
BURR OAK	.1		16.9	27	1.5		45.5
CARLSON LAKE	6.1		35.2	26.21	3.8	1.3	72.6
COLFAX	1.7		16.3	74.1	.7		92.8
DEGROOT			54.1				54.1
DENGERUD			6.5	19.2			25.7
ELLA LAKE	1.2		5.7	77.8			84.7
ERICKSON	.6		17.65	6.0			24.3
EVENSON	.4		4.2	24.4	16.4		45.4
FLORIDA SLOUGH	.2	4.8	43.9	226.4			275.3
FREESE	.5		46.3	105.8		16.7	169.3
GILBERTS	.1		22.18				22.3
HANSON	2.3		3.8	36.5			42.6
HARRISON				12.4			12.4
HENJUM					28		28
HENJUM LAKE							33
IRVING	1.1		16.2	25.7			43
JOHNSON	2.7		23.9				26.6
LAKE CHARLOTTE	7		62.7				69.7
LAKE ELIZABETH	.3		.9	32			33.2
LAKE LILLIAN			212	21			233
LAKE MARY			6.2	56.13			62.3
LINDGREN LAKE	3.3		2.6	39.1			45
MAMRE	3.3		27.5	41.3			72.1
MEEKER	.9		36.8	49.4			87.1
MILLER HILLS		2.4	52.3	87.5		12.1	154.3
NEW LONDON	1.9		14.0		30.9		46.8
NORWAY LAKE			13.6				13.6
OLSON LAKE			64.4	29	2.6		110.9
PENNOCK			.4	29.2			29.6

UNIT (WPA)	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V	TYPE VI/VII	TOTAL
(KANDIYOHI)							
PETERSON				16.4			16.4
PRIAM	3.4		36.4				39.8
QUINN	8.4		8	106.3			122.7
RAMBOW	1.1		17	51.6			64.7
RANDALL	3.3		32	68.7	23.3		127.3
RAYMOND	5.2		12.2	49.6			67
REYNOLDS	.2		9.5	61.4			71.1
SWEEP			2.6	11.6		29.1	43.3
SCHUELER	1			18.3			19.3
SHAKOPEE CREEK			15.8	80.8			96.6
SPERRY LAKE	.8			5.5			6.3
SUMMIT LAKE	4			30			34
SUNBURG	.2	3	17.1	7.6	90.3	.5	118.7
SWAN LAKE	8	2.6	60.2	283.1			353.9
SWANSON			9.4	21.7			31.1
UNCLE MATT'S LAKE	7.1		9.9	53.8	6.4		77.2
WEBER	7.4		24.9	80.5	11.0	3.6	127.4
YARMON			16.4	404.9			421.3
ZWEMKE	.3				20.5		20.8
(MCLEOD)							
BAKERS LAKE			55	10			65
BARBER LAKE	10.1		25.7	11.3		.5	47.6
BARTO-OLIVA			64				64
BROWNTON	2.3	4.2	54.9	10			71.4
EAGLE LAKE			19.6				19.6
SOUTH SILVER LAKE	3		76.6				79.6
(MEEKER)							
ACTON	2.4		7.8				10.2
CASEY LAKE	9.6		35.9	10.2	41.5		97.2
CEDAR MILLS							79.1
CLEAR LAKE			67.6				67.6
COSMOS	2.3		8.1	12.8			23.2
FOREST CITY			57.7				57.7
GRASS LAKE							
GREENLEAF	5.1		.6	32.4			33
HANSON LAKE	12.1		19.2	80			111.3
HARVEY	.8		13.3	86.4	55.3		155

UNIT (WPA)	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V	TYPE VI/VII	TOTAL
(MEEKER)							
LAKE HARDEN	2.8		50.3	72.1	27.5		152.6
LITCHFIELD	1.9		7.1	39.5			48.5
MILLER LAKE	.4		18.6	56.8			75.8
PEIFER SCHOOL	3.9		7.2	88			99.1
ROSENDALE	11.2		12.3	149.5			177.9
STONE LAKE							113.7
TYRONE FLATS	27.8	52	66.2	204.4			350.4
(RENVILLE)							
BOON LAKE			67.5				67.5
BROOKFIELD			11				11
PRESTON LAKE	1.8		8.1	77.8			87.7
SACRED HEART		5.9	32.1				38
SACRED HEART			20.2				20.2
TEACHER			37				37
WANG			22.5				22.5
(STEARNS)							
ASHLEY	23.4		63.9	211.8			299.1
BAUMAN	7		6.7	78.8	.3		92.8
BEHNEN	19.32		44.5	69.4			133.2
BIG FISH LAKE			26	12			38
BROCKWAY	.2		9.93	58.8			68.9
CEDAR LAKE			56.7	16.7			73.4
CLAUDE	1.6		.5	32.3			34.4
COLLEGEVILLE			13.4	6.5	38.5		58.4
COSTELLO			6.1	32.1			39.3
CROSIER	.1		2.5	1.7	53.6		57.9
CROW LAKE	1.8		10.7	133.8			146.3
EDEN VALLEY	2.9		51.9	41.3			96.1
FARMING	1.4		.5		76.2		78.1
GETTEL	.1		4	69			73.2
GREENWALD			34.9		9.2		44.1
KENNA	.7	3.6	3.3	87.7			95.3
KRAIN	.5		1.1	41.3			42.9
LAKE GEORGE	.1		.9	49.2			50.2
LAKE HENRY	2.4	3	13.8	66.1			85.3
LOVELL LAKE	3		65.5		422.4	57.1	548

UNIT (WPA)	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V	TYPE VI/VII	TOTAL
(STEARNS)							
MCCORMICK LAKE	1.6		2.2		115.7		119.5
MUD LAKE	1.5	13.2	1.9	6.4			23
MURRAY LAKE	2.5				2.2		4.7
OAK	35.6			5			40.6
PADUA	15.6	12.8	24.6	44.4			97.4
POPE	3		64.1				67.1
PRAIRIE STORM			30				30
RICE	3.3	.2	30.1			2.4	36
ROSCOE	1.3	.9	48.7	73.3			124.2
SAINT MARTIN	2.4		72.2	40.9		49.9	165.4
SAND LAKE	.2	.1	4.5	115.9		48	168.7
SCHURMAN				8			8
SPRING HILL				21.2			21.2
STONEY CREEK			.1	41			41.1
TRISKO	20.6		24.8	111.1			156.5
TWIN LAKE			1.5	43.2	42.4		87.1
UHLENKOLTS	1.3		1.4		12.4		15.1
WHITNEY	7		55.3	2	17	.2	81.5
WIENER	.4		30.1				30.5
ZEHRER	.95		13.1		44.8		58.9
ZION	.8		26.2	19.4			46.4
(TODD)							
FABER	.2		22	5.2			27.4
GEROY	4.1		31.3	10.3		10.2	55.9
SOGGE	.7		25.6	15			41.3
TERFEHR	.8		25.2	5.4			31.4
WEST UNION	4.1		57.9	41.8			103.8
(WRIGHT)							
ALBION	.1	2.2	5.7	2.7	13.7		24.4
ANGUS LAKE	.2	.9	34.8	9.9			45.8
ANNANDALE	3		23.7	40.4			67.1
COKATO		.9	105.1				106
CORINNA				50.7			50.7
FRENCH LAKE			6	57.8			63.8
GOOSE LAKE			64.8				64.8
MARYSVILLE	46.4		.1	87.9			134.4

UNIT (WPA)	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V	TYPE VI/VII	TOTAL
(WRIGHT)							
PELICAN LAKE E			55	165			220
PELICAN LAKE W			4		54		58
ROBINSON	2.8			17.2		13.2	33.2
SILVER CREEK	1.6		6.3	34.8			42.7
TEMPERANCE	2.2		36.3	4.2	12.4		55.1
VICTOR	.4		17.9	43.2			61.5

APPENDIX 3. Comprehensive list of resources of concern for Litchfield WMD.

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Acadian Flycatcher	*Empidonax virescens*		SC	R			*x*		x	x		
American Avocet	*Recurvirostra americana*									x		
American Bittern	*Botaurus lentiginosus*			R	x	x	x	x	x	x		
American Golden-plover	*Pluvialis dominica*									x		
American White Pelican	*Pelecanus erythrorhynchos*		SC						x	x		
American Woodcock	*Scolopax minor*			Rec/R					x	x		
Bachman's Sparrow	*Aimophila aestivalis*											
Baird's Sparrow	*Ammodramus bairdii*		E		x				x	x	CC/RC/CS/RS	x
Bald Eagle	*Haliaeetus leucocephalus*		SC	D/Tr	x	x	x	x	x	x		
Barn Owl	*Tyto alba*											
Bell's Vireo	*Vireo bellii*						*x*		x	x		
Bewick's Wren	*Thryomanes bewickii*						*x*					
Black Rail	*Laterallus jamaicensis*						*x*					
Black Tern	*Chlidonias niger*			R	x	x	*x*	x	x	x		x
Black-billed Cuckoo	*Coccyzus erythropthalmus*			R	x		*x*	x	x	x	RC/RS	x
Black-billed Magpie	*Pica hudsonia*										RS	x
Black-crowned Night Heron	*Nycticorax nycticorax*			R			*x*		x	x		
Blue-winged Teal	*Anas discors*			Rec/R								
Blue-winged Warbler	*Vermivora pinus*						*x*	x		x		
Bobolink	*Dolichonyx orizivorus*			R				x	x	x		
Brown Thrasher	*Toxostoma rufum*							x		x	RC	
Buff-breasted Sandpiper	*Tryngites subruficollis*			R	x	x	*x*	x		x		
Burrowing Owl	*Athene cunicularia*		E							U	RC	x
Canada Goose (migrant pops.)	*Branta canadensis*			Rec								
Canada Goose (resident pop.)	*Branta canadensis*			Rec/N								
Canada Warbler	*Wilsonia canadensis*			R		x			x			
Canvasback	*Aythya valisineria*			Rec					x			
Cerulean Warbler	*Dendroica cerulea*		SC				*x*	x	x	x		
Chestnut-collared Longspur	*Calcarius ornatus*		E		x				x	U	RC/CS/RS	x

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Chuck-will's-widow	*Caprimulgus carolinensis*											
Clay-colored Sparrow	*Spizella pallida*										RC/RS	
Common Loon	*Gavia immer*			R						x		
Common Moorhen	*Gallinula chloropus*		SC	R					x	x		
Common Nighthawk	*Chordeiles minor*									x		
Common Tern	*Sterna hirundo*		T	R***		x	*x*	x***	x			
Connecticut Warbler	*Oporornis agilis*			R					x	x		
Dickcissel	*Spiza americana*			R	x		*x*	x	x	x	CC/RC/	
Double-crested Cormorant	*Phalacrocorax auritus*			N								
Dunlin	*Calidris alpina*									x		
Eared Grebe	*Podiceps nigricollis*									x		
Eastern Meadowlark	*Sturnella magna*			R						x		
Eastern Wood-pewee	*Contopus virens*									x		
Ferruginous Hawk	*Buteo regalis*										RC/RS	x
Field Sparrow	*Spizella pusilla*			R			*x*			x		
Forster's Tern	*Sterna forsteri*		SC	R					x	x		
Franklin's Gull	*Larus pipixcan*		SC						x	x		
Golden Eagle	*Aquila chrysaetos*										RC	
Golden-winged Warbler	*Vermivora chrysoptera*			R		x		x	x			
Grasshopper Sparrow	*Ammodramus savannarum*			R	x		*x*			x	RC	x
Great Gray Owl	*Strix nebulosa*								x			
Greater Prairie-Chicken	*Tympanuchus cupido*		SC						x	x	CC/RC	x
Greater Sage-Grouse	*Centrocerus urophasianus*										CC/RC	
Greater Yellowlegs	*Tringa melanoleuca*			R						x		
Henslow's Sparrow	*Ammodramus henslowii*		E	R		x	*x*	x	x	x		x
Hooded Warbler	*Wilsonia citrina*		SC						x			
Horned Grebe	*Podiceps auritus*		T		x	x	*x*	x	x	U		
Horned Lark	*Eremophila alpestris*										RC/RS	
Hudsonian Godwit	*Limosa haemastica*			R	x	x	*x*	x	x	x		
Kentucky Warbler	*Oporornis formosus*			R			*x*					
King Rail	*Rallus elegans*		E	R						x		
Lark Bunting	*Calamospiza melanocorys*										RC	x
Le Conte's Sparrow	*Ammodramus leconteii*			R					x	x	RC	

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Least Bittern	*Ixobrychus exilis*			R	x		*x*	x	x	x		
Least Flycatcher	*Empidonax minimus*									x		
Least Tern (Interior pop.)	*Sterna antillarum*	E										
Lesser Scaup	*Aythya affinis*			Rec/R					x	x		
Loggerhead Shrike	*Lanius ludovicianus*		T	R			*x*		x	x	RC	
Long-billed Curlew	*Numenius americanus*											x
Long-eared Owl	*Asio otus*			R								
Louisiana Waterthrush	*Seiurus motacilla*		SC	R					x			
Mallard	*Anas platyrhynchos*			Rec								x
Marbled Godwit	*Limosa fedoa*		SC	R	x	x	*x*	x	x	x		x
Marsh Wren	*Cistothorus palustris*									x		
McCown's Longspur	*Calcarius mccownii*				x						CC/RC/CS/RS	x
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*		SC	R	x				x	x	CC/RC/RS	
Northern Flicker	*Colaptes auratus*			R			*x*				RC	
Northern Goshawk	*Accipiter gentilis*			R					x	x		
Northern Harrier	*Circus cyaneus*			R						x	RC/RS	x
Northern Pintail	*Anas acuta*			Rec/R					x	x		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*									x		
Olive-sided Flycatcher	*Contopus cooperi*			R		x			x	x		
Orchard Oriole	*Icterus spurius*			R								
Ovenbird	*Seiurus aurocapilla*									x		
Peregrine Falcon	*Falco peregrinus*		T	R/D/ Rec	x	x	*x*	x	x			
Pied-billed Grebe	*Podilymbus podiceps*					x	*x*	x				x
Piping Plover (Great Lakes pop.)	*Charadrius melodus*	E	E*						x*			
Piping Plover (Great Plains pop.)	*Charadrius melodus*	T	E*						x*			x
Prairie Falcon	*Falco mexicanus*										RC	
Prothonotary Warbler	*Prothonotary citrea*			R			*x*		x	x		
Red-headed Woodpecker	*Melanerpes erythrocephalus*			R	x	x	*x*	x	x	x	CC/RC/RS	
Red-necked Grebe	*Podiceps grisegena*									x		

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Red-shouldered Hawk	*Buteo lineatus*		SC	R					x			
Red Knot (*rufa*)	Calidris canutus rufa					x	*x*	x				
Red Knot (*roselarri*)	*Calidris canutus roselarri*							x				
Rose-breasted Grosbeak	*Pheucticus ludovicianus*									x		
Ruddy Turnstone	*Arenaria interpres*									x		
Rusty Blackbird	*Euphagus carolinus*					x	*x*	x				
Sanderling	*Calidris alba*											
Sandhill Crane	*Grus canadensis*											
Sedge Wren	*Cistothorus platensis*			R						x	RS	x
Semipalmated Sandpiper	*Calidris pusilla*									x		
Sharp-tailed Grouse	*Tympanuchus phasianellus*								x	x	RC/CS/RS	x
Short-billed Dowitcher	*Limnodromus griseus*			R	x	x	*x*	x		x		
Short-eared Owl	*Asio flammeus*		SC	R	x		*x*	x	x	x	CC/RC	
Smith's Longspur	*Calcarius pictus*				x		*x*					
Snow Goose	*Chen caerulescens*			Rec/N								
Solitary Sandpiper	*Anthus spragueii*				x	x	x	x				
Sprague's Pipit	*Anthus spragueii*		E		x				x	x	CC/RC/CS/RS	x
Stilt Sandpiper	*Calidris himantopus*			R								
Swainson's Hawk	*Buteo swainsoni*			R	x					x	CC/RC/RS	
Swainson's Warbler	*Lymnothlypis swainsonii*											
Swamp Sparrow	*Melospiza georgiana*									x		
Trumpeter Swan	*Cygnus buccinator*		T	R/Rec					x	x		
Upland Sandpiper	*Bartramia longicauda*			R	x	x	*x*	x	x	x		
Veery	*Catharus fuscescens*									x		
Virginia Rail	*Rallus limicola*									x		
Western Grebe	*Aechmophorus occidentalis*									x		
Western Meadowlark	*Sturnella neglecta*			R							RC	
Whimbrel	*Numenius phaeopus*			R		x	x	x		x		
Whip-poor-will	*Caprimulgus vociferus*			x			*x*		x	x		
White-rumped Sandpiper	*Calidris fuscicollis*			R						x		
White-throated Sparrow	*Zonotrichia albicollis*									x		

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Whooping Crane	*Grus americana*	E							x			
Willet	*Tringa semipalmata*											
Willow Flycatcher	*Empidonax traillii*							x		x	CC	
Wilson's Phalarope	*Phalaropus tricolor*		T	R					x	x		x
Winter Wren	*Troglodytes troglodytes*									x		
Wood Duck	*Aix sponsa*			Rec								
Wood Thrush	*Hylocichla mustelina*			R		x	*x*		x	x		
Worm-eating Warbler	*Helmitheros vermivorus*											
Yellow Rail	*Coturnicops noveboracensis*		SC	R	x	x		x	x	x		x
Yellow-bellied Sapsucker	*Sphyrapicus varius*									x		
breeding diving ducks												
breeding puddle ducks												
exemplary native plant comm.												
native prairie												
oak savanna												
American badger	*Taxidea taxus*									x		
Eastern pipistrelle	*Pipistrellus subflavus*		SC							x		
Eastern spotted skunk	*Spilogale putorius*		T							x		
Franklin's ground squirrel	*Spermophilus franklinii*									x		
Gray wolf**	*Canis lupus*		SC	E/T/Tr						x		
Least shrew	*Cryptotis parva*		SC							x		
Least weasel	*Mustela nivalis*		SC							x		
Northern Grasshopper Mouse	*Onychomys leucogaster*									U		
Northern Pocket Gopher	*Thomomys talpoides*		SC							x		
Plains Pocket Mouse	*Perognathus flavescens*		SC							x		
Prairie Vole	*Microtus ochrogaster*		SC							x		
Richardson's ground squirrel	*Spermophilus richardsonii*									U		
Western Harvest Mouse	*Reithrodontomys megalotis*									x		
Common Mudpuppy	*Necturus maculosus*									x		

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Hellbender	*Cryptobranchus allenganiensis*			R								
Northern Cricket Frog	*Acris crepitans*		SC							x		
Blanding's turtle	*Emydoidea blandingii*		T							x		
Common snapping turtle	*Chelydra serpentina*									x		
Eastern Fox Snake	*Elaphe vulpina*									x		
Five-lined skink	*Eumeces fasciatus*		SC							x		
Gopher snake	*Pituophis catenifer*		SC							x		
Lined snake	*Tropidoclonion lineatum*									U		
Milk snake	*Lampropeltis triangulum*									x		
Smooth green snake	*Liochlorophis vernalis*									x		
Western hognose snake	*Heterodon nasicus*		SC							x		
American brook lamprey	*Lampetra appendix*									x		
Blue sucker	*Cycleptus elongatus*		SC	R								
Brook trout - Inland pop.	*Salvelinus fontinalis*			R/Rec /Tr								
Central mudminnow	*Umbra limi*											x
Flathead Chub	*Platygobio gracilis*									x		
Lake sturgeon - Inland pop.	*Acipenser fulvescens*		SC	R/Rec /tr						x		
Largescale stoneroller	*Campostoma oligolepis*									x		
Least Darter	*Etheostoma microperca*		SC							x		
Paddlefish	*Polyodon spathula*		T	R, Rec								x
Plains topminnow	*Fundulus sciadicus*		SC							U		
Pugnose Shiner	*Notropis anogenus*		SC							x		
Red Shiner	*Cyprinella lutrensis*									U		
Shovelnose sturgeon	*Scaphirhynchus platorynchus*			Rec								
Skipjack herring	*Alosa chrysochloris*		SC							x		
Topeka shiner	*Notropis topeka*		SC							U		x
Black sandshell	*Ligumia recta*			R						x		
Creek heelsplitter	*Lasmigona compressa*									x		

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Elktoe	*Alasmidonta marginata*			R						x		
Ellipse	*Venustaconcha ellipsiformis*									x		
Fawnsfoot	*Truncilla donaciformis*									x		
Fluted-shell	*Lasmigona costata*									x		
Hickorynut	*Obovaria olivaria*									x		
Mapleleaf	*Quadrula quadrula*			Rec								
Monkeyface	*Quadrula metanevra*			R						x		
Mucket Mussel	*Actinonaias ligamentina*									x		
Pistolgrip	*Tritogonia verrucosa*									x		
Round pigtoe	*Pleurobema coccineum*			R								
Salamander mussel	*Simpsonaias ambigua*									x		
Spike	*Elliptio dilatata*									x		
Threeridge	*Amblema plicata*			Rec								
Winged mapleleaf	*Quadrula fragosa*			E								
Zebra mussel	*Dreissena polymorpha*			N								
Bluff vertigo (snail)	*Vertigo meramecensis*			R								
Snail (no Common Name)	*Vertigo bollesiana*			R								
Snail (no Common Name)	*Vertigo cristata*			R								
Snail (no Common Name)	*Vertigo morsei*			R								
Snail (no Common Name)	*Vertigo paradoxa*			R								
A Jumping Spider	*Habronattus texanus*									x		
A Jumping Spider	*Marpissa grata*		SC							x		
A Jumping Spider	*Metaphidippus arizonensis*		SC							x		
A Jumping Spider	*Paradamoetas fontana*		SC							x		
A Jumping Spider	*Phidippus pius*		SC							x		
A Tiger Beetle	*Cicindela fugida fulgida*		E							U		
A Tiger Beetle	*Cicindela fugida westbournei*		T							U		
American burying beetle	*Nicrophorus americanus*			E								
Arogos Skipper	*Atrytone arogos*		SC							x		

Common Name	Scientific Name	Fed Stat	MN Stat	RCP MSH	BCC (BCR 11)	BCC (BCR 12)	BCC (BCR 22)	BCC (BCR 23)	Audubon MN Action List	SGCN	PIF (BCR 11)	PPP LCC
Assiniboia Skipper	*Hesperia comma assiniboia*		E							x		
Blazing star stem borer	*Papaipema beeriana*									x		
Dakota skipper	*Hesperia dacotae*	C	T	R						x		
Disa Alpine			SC									
Garita Skipper	*Oarisma garita*		T							U		
Grizzled Skipper			SC									
Karner blue butterfly	*Lycaeides melissa samuelis*	E	E	E								
Leonardus Skipper	*Hesperia leonardus*		SC									
Little White Tiger Beetle	*Cicindela lepida*		T							x		
Nabokov's Blue			SC									
Ottoe skipper	*Hesperia ottoe*		T	R						x		
Pawnee skipper	*Hesperia leonardus pawnee*									U		
Persius Dusky Wing			E									
Phlox Moth	*Schinia indiana*		SC							x		
Powesheik skipper	*Oarisma powesheik*		SC	R						x		
Red Tailed Prairie Leafhopper	*Aflexia rubranura*		SC							x		
Regal Fritillary	*Speyeria idalia*		SC							x		
Uhler's Arctic	*Oeneis uhleri varuna*		E							U		
Uncas Skipper	*Hesperia uncas*		E							x		
Rusty Crayfish	*Orconectes rusticus*			N								
Earleaf Foxglove	*Agalinis auriculata*		E	R								
Prairie Bush-clover	*Lespedeza leptostachya*	T	T	T								
Roundstem Foxglove	*Agalinis gattingeri*			R								
Western Prairie Fringed Orchid	*Platanthera praeclara*	T	E	T								
A Species of Lichen	*Buellia nigra*		E									

APPENDIX 4.

Resources used to assemble the comprehensive list of resources of concern for Litchfield WMD.

REFUGE PURPOSE
The enabling legislation for Wetland Management Districts authorizes us to purchase small wetlands for waterfowl production areas. Included in this checklist are waterfowl that breed in Litchfield WMD.

BIOLOGICAL INTEGRITY, HEALTH AND DIVERSITY POLICY
As described in the Biological Integrity, Diversity, and Environmental Health policy (601 FW 3), the goal of habitat management on units of the NWRS is to ensure the long-term maintenance and where possible, restoration of healthy populations of native fish, wildlife, plants, and their habitats. While nearly everything on the list could be included with BIDEH, this column added some critical ecosystems to the list of resources of concern.

FEDERAL ENDANGERED AND THREATENED SPECIES
There are 17 species listed under the Endangered Species Act in Minnesota. Our comprehensive species list includes species listed in MN per the FWS Ecos website [http://ecos.fws.gov/tess_public/pub/stateListingIndividual.jsp?state=MN&status=listed] (accessed 1/4/10), only excluding those that have no evidence of existing in the Litchfield WMD (e.g., no natural heritage records, not shown in NatureServe list, etc). This list is intentionally very inclusive, so even some extirpated species are on the list. Though it isn't listed for MN, also included is the eastern population of the Whooping Crane since we have had at least two individuals visit from the Necedah NWR reared birds in recent years.

In addition, there are four candidate species in Minnesota.
http://ecos.fws.gov/tess_public/pub/stateListingIndividual.jsp?state=MN&status=candidate (accessed 1/4/10) and the same procedure was used to determine whether to include them in our list.

MINNESOTA ENDANGERED, THREATENED AND SPECIAL CONCERN SPECIES
Minnesota's List of Endangered, Threatened, and Special Concern Species was last revised in 1996 and is currently undergoing a review process (the current MN list is located at http://files.dnr.state.mn.us/natural_resources/ets/endlist.pdf [accessed 1/4/10]). A filtered search on the DNR's Rare Species Guide website (http://www.dnr.state.mn.us/rsg/index.html) was used to identify State endangered, threatened, or special concern species in the seven Litchfield WMD counties. The search returned 81 results, all of which are included on the comprehensive list.

FWS BIRDS OF CONSERVATION CONCERN
FWS updated the Birds of Conservation Concern (BCC) list in 2008. The BCC document has lists for multiple scales (national, regional, and bird conservation region). Region 3 migratory bird staff provided us with a spreadsheet to help navigate the various bird conservation priority lists; in addition to showing which species are BCC for the region and for each Bird

Conservation Region (BCR) in the region, it provides information regarding seasonality and extent of occurrence (e.g., there are species on BCR lists that are only accidental in Region 3). As this information is readily available from the spreadsheet, BCC species were only included if they were on the National, Region 3, or BCR 11 list, and are present in the Region 3 portion of BCR 11. An "x" in one of the columns indicates that it is on the BCC for that geographic scale. Included is the seasonal/abundance status (when shown in the migratory birds provided spreadsheet) in the BCR 11 column.

FWS REGION 3 RESOURCE CONSERVATION PRIORITIES

Region 3's list of Resource Conservation Priorities was last updated in 2002. Litchfield WMD is in the Mississippi Headwaters/Tallgrass Prairie ecosystem, so species from that ecosystem that are known in the district were included. Some forest species (e.g., grey wolf, red-shouldered hawk) were excluded although they are listed for the MSH ecosystem.

PARTNERS IN FLIGHT PRIORITY

The current list of Partners in Flight Species of Regional Importance can be found at http://www.rmbo.org/pif/pifdb.html although the information is much easier to navigate from the spreadsheet (mentioned under BCC lists) that Region 3 migratory bird staff provided.

STATE SPECIES OF GREATEST CONSERVATION NEED

Minnesota's Species of Greatest Conservation Need are listed in the 2006 State Wildlife Action Plan "Tomorrow's Habitat for the Wild and Rare." Species included here are from the species list for the Prairie Parkland Province, excluding those that are not known in the Litchfield WMD.

PLAINS AND PRAIRIE POTHOLE LANDSCAPE CONSERVATION COOPERATIVE FOCAL SPECIES

The Plains and Prairie Pothole Landscape Conservation Cooperative published a preliminary implementation plan in December 2009. Our list includes the focal species from that plan, only excluding those that have ranges outside the Litchfield WMD (e.g., Topeka shiner, black footed ferret).

PRAIRIE POTHOLE JOINT VENTURE IMPLEMENTATION PLAN

The Prairie Pothole Joint Venture (PPJV) Implementation Plan (2005) includes chapters for waterfowl, shorebirds, waterbirds, and landbirds. Each includes a list of focal species and our list includes those that are known in the Litchfield WMD.

EXPERT OPINION

Local experts provided a list of shorebird species for which Litchfield WMD can make a contribution, either during breeding or migration.

APPENDIX 5.

Management strategies

POTENTIAL HABITAT MANAGEMENT STRATEGIES

This section identifies potential management tools or strategies that are available to land managers to achieve desired habitat objectives. These strategies were identified through successful refuge application, literature review and in consultation with other land managers.

GRASSLAND MANAGEMENT

Cool season grasses (i.e. grasses that are most actively growing in the spring and fall when soil temperatures are 65 degrees or lower) grow during the start growing in spring as soon as the snow melts and the days start to warm up. They grow best in spring and fall and tend to stop growing during the hot dry days of summer. They are usually relatively short and do not grow as densely bunched as many warm season grasses. Conversely, warm season grasses do not start growing until late spring and grow best during the hot dry summer months. They generally grow taller and denser than cool season grasses.

Currently, most cool season grasses within the District are exotic species brought over from Europe as forage for livestock such as Smooth Brome *Bromus inermis* and Kentucky Bluegrass *Poa pratensis*. Most warm season grasses are native to the North American prairie such Big Bluestem *Andropogon gerardi* and Indian Grass *Sorghastrum nutans*. Exotic cool season and native warm season grasses are readily available from seed companies across the country. Some seed companies are beginning to propagate native cool season grasses making them more available for planting, but still at a relatively high price.

Many species of grassland birds require relatively large blocks of treeless habitat for nesting areas. Some species, such as Upland Sandpiper *Bartramia longicauda* and Henslow's Sparrow *Ammodramus henslowii* are not likely to be found in grassland patches of less than 75 acres. Other species patch size requirements are smaller, but grasslands of less than 25 acres generally do not meet the requirements for most grassland nesting birds and may be better managed as a different habitat type (e.g., shrubland) (Mitchell et al. 2000).

Populations of grassland birds are declining as grassland habitats are lost in the core of their ranges in the Midwest. While a lot of the grasslands of the District are not sizable enough (110 acres on average) to provide suitable breeding habitat, they can be managed to improve their biological integrity/diversity and provide quality habitat for species migrating through the District.

<u>Prescribed Fire</u>

Fire constitutes one of the most important ecological processes of the prairie ecosystem. Whether human-caused or started by lightning, fire has been a part of the prairie ecosystem for thousands

of years. Grassland species of the northern tallgrass prairie evolved under periodic disturbance and defoliation from large ungulates and fire. This periodic disturbance kept the grasslands healthy for thousands of years and is needed to keep them healthy today. Accumulated litter and residual vegetation is consumed by fire. It kills or reduces vigor in some plants and stimulates and invigorates others. Nutrients in the form of ash are quickly reabsorbed into the soil which stimulate root systems and is made available for plant uptake. Prescribed fire mimics this natural process.

Prescribed fire is an effective tool when applied during appropriate time frames which is driven by resource objectives and current vegetative conditions. Dormant season (vegetation dormant) fires consume residual vegetation and litter. These burns can stimulate cool season grasses and forbs. In a healthy (diverse) prairie, dormant burns will stimulate growth and productivity of cool season native grasses and forbs. However, while in a degraded state (lack of native species and diversity), these fires only act to stimulate exotic species like Kentucky bluegrass and smooth brome. Dormant season burns can also be used as a site preparation tool in combination with herbicide for controlling exotic species like Canada thistle. In addition, fire can be used to remove residual vegetation in site preparation for restoration.

Prescribed fire is most commonly used when cool season grasses are actively growing during the spring (March-May) and fall (Sept.-Oct.) seasons. The best time to control Kentucky Bluegrass, Smooth Brome and Reed Canarygrass is when the plants are in the boot stage (mid-late May). Prescribed fire is the best strategy for reducing/killing Kentucky Bluegrass. In addition, spring and fall fires are conducted to kill and/or set back woody vegetation and to injure or kill second year growth (seed production) of Sweet Clover *Melitotus alba, M. officinalis*.

Prescribed or controlled burning is completed under a "prescription" which sets upper and lower limits to various factors under which a fire may be initiated in relation to burn plan objectives and safety consideration. Weather factors such as temperature, wind speed and direction, relative humidity, and smoke lift are considered. Other factors include vegetative conditions (height, litter depth, green-up stage), resource qualifications and availability (personnel, equipment, and contingencies), and drought status. A variety of firing techniques (backing, flanking, and head fire) are used depending on the objectives for the fire. Combinations of these firing techniques are typically used during prescribed fire treatments.

Backing fire. Backing fire (burning into the wind) provides low to moderate fire intensity depending on the vegetation, the lowest rates of fire spread, and the longest residence time. This firing technique is used to slowly burn through the vegetation and provides effective litter consumption. Backing fire is typically used around sensitive structures (granite outcrops, fences, power poles, etc.) and to establish control lines.

Flanking fire. Flanking fire (burning parallel to the wind direction) creates moderate fire intensity and moderate rates of fire spread. In a flanking fire, the leading edge of fire backs through the vegetation. Along the heel side of the fire (flank), short bursts of head fire (burning with the wind) burn back toward the previously burned area (black). This technique is typically used to expand fire control lines or where high temperatures (at ground level) over a long duration are needed.

Head fire. The most intense fire behavior with rapid rates of spread and shorter residence time occurs during a head fire. Fire is ignited and burns with the wind. Very intense heat and flames quickly burn through the vegetation. Litter consumption ranges from light to complete depending on the vegetation. After the exterior burn unit control lines have been established, head fire is most commonly used method to consume the remaining interior vegetation.

Mowing/Haying

Mowing is useful for controlling woody vegetation and undesirable plant species (e.g. Canada thistle). Mowing also provides opportunity to control height of residual vegetation. Haying is useful for weed control, provides us with the ability to remove the cut vegetation, and thus reduce the litter layer if cuttings are raked. Both of these practices are similar in many ways and will be called mowing in this section. Mowing is an effective tool for maintaining an open canopy for plant establishment in restoration fields and for creating control lines for prescribed fire operations. Mowing can also be an effective tool to create a short structure vegetative state in tall dense grasses, such as, dense six foot tall big bluestem. This creates open habitat for species like Western Meadowlark *Sturnella neglecta*, Grasshopper Sparrow *Ammodramus savannarum*, Vesper Sparrow *Pooecetes gramineus*, Upland Sandpiper, and Marbled Godwit *Lemosa fedoa*.

Plant species diversity can be altered from mowing operations. Mid-summer mowing tends to suppress native, warm-season grasses and helps to foster and maintain native forbs, (especially spring flowering species), as well as cool-season grasses. Other native forbs (summer flowering) are reduced by mid-summer mowing (e.g. wild Bergamot *Monarda fistulosa* or Prairie Blazing Star *Ciatris pycnostachya*. The mid –late summer flowering species benefit most from mowing or burning in the dormant season of early spring (March-May) or late fall (Sept.-Nov.).

On lands managed for wildlife conservation purposes, it is advisable to delay mowing until after July 15. Mowing after this date will allow most bird species a chance to raise at least one brood and move away from the brood site. However, in some cases late spring mowing (mid to late June) is needed to control exotic species like Canada Thistle and sweetclover. There are also some instances where late-nesting species such as Dickcissels *Spiza americana* and Sedge Wrens *Cistothorus platensis* are the target of management; in this case, mowing should be delayed until early August. If more than one mowing is conducted or if mowing is required after the breeding season for some other purpose, the last mowing of the year should generally be early enough to promote some fall re-growth, to provide residual vegetative cover the following spring. In the west-central Minnesota, this means mowing should be completed by early September for cool-season grasses and early August for warm-season grasses in most years. Grassland birds respond to mowing in various ways and some of them are described below.

- Some species abandon fields mowed during breeding activities, including Bobolink *Dolichonyx oryzivorus*, Red-winged Blackbird *Agelaius phoeniceus,* Diskcissel, sedge Wren, Ring-necked Pheasant *Phasianus colchicus*, Eastern Meadowlark *Sturnella magna*, and Henslow's and Swamp Sparrow *Melospiza Georgiana*.

- Some species remain in cut fields to re-nest or increase in density after mowing, including Upland Sandpiper, Savannah, Grasshopper, and Vesper Sparrow, Western Meadowlark, and Horned Lark.
- Some species colonize recently cut fields or fields prior to spring green-up, primarily to forage. These include Mourning Dove *Zenaida macroura*, Killdeer *Charadrius vociferous*, Common Grackle *Quiscalus quiscula*, American Robin *Turdus migratorius*, Red-winged Blackbird, Northern Flicker *Turdus migratorius*, Rock Dove *Columba livia*, Upland Sandpiper, and Eastern Meadowlark.

Grazing

Grassland species of the northern tallgrass prairie evolved under periodic disturbance and defoliation from large ungulates and fire. Massive herds of bison provided periodic disturbance which kept the grasslands healthy. Grazing is an effective tool when used properly for managing grasslands. Livestock grazing (primarily cattle and sheep on occasion) will be used to meet specific habitat objectives.

Fire is an effective tool for controlling Kentucky Bluegrass and young woody species. However, grazing is a more effective means to control exotic cool season grasses such as Smooth Brome and Reed Canarygrass. Both these species have dense rhizomatous root systems and reproduce by seed and creeping rhizomes. The most effective time for injuring these species is when the root systems are low in carbohydrate reserves. For brome this occurs twice during the growing season. The first period (mid May – mid June) is when the tillers are actively growing (i.e., stem elongation and leaf development). The second period (late June) is when the plant is developing floral structures.

After emergence in early spring, Reed Canarygrass spends about six weeks utilizing carbohydrate reserves to promote stem and floral development. Following seed maturation the stems die back. However, the leaves remain green and continue to use carbohydrate stores for rhizome development.

Repeated defoliation during the growing season by grazing will significantly stress exotic species (e.g. smooth brome) and favor native warm season grasses and forbs. Single defoliation treatments can actually stimulate the plants, therefore, repeated defoliation is required.

Grazing can also control Canada thistle, second year sweet clover, and some shrubs, increase biomass, and provide vegetative structural diversity across the landscape. In addition, grazing can remove or decrease the depth of the litter understory thereby creating openings that allow seeds to germinate or encourage colonization by native grasses and forbs. Livestock can serve as dispersal agents of native seeds, thereby creating patches of desirable plants (Archer and Pyke 1991). Furthermore, cattle will consume early growing cattail and break down residual vegetation through hoof action. The most effective way for this is to have the cattle confined to the wetland area of interest.

Grazing units will be determined during annual habitat management planning. Grazing frequency, duration, and stocking rates will be based on current and desired habitat conditions, weather, and flexibility of livestock cooperators. Specific grazing regimes (high intensity-short duration, season long, and patch burn-grazing) will be tailored to best achieve habitat objectives for each grazing unit. The duration and stocking rates will be based on the level of exotic species infestation as determined by vegetation surveys. For example, if a unit is composed mostly (≥75%) of smooth brome it may be grazed in successive years, stocked at a high rate (1.0-1.5 AUM), or for a longer duration, depending on soil stability. Light stocking rates (0.5 AUM) may be appropriate when a unit is composed of mostly (75%) native species with patches of exotics and the objective is to target primarily the exotics and not the natives.

Season-long grazing can be used to reduce warm-season grasses where they have become overly dominant and to increase diversity and vitality of non-dominant species. Season long grazing with a light stocking rate can also be used to introduce patchiness in the structural diversity. In areas where cool season exotic grasses are co-dominate with native vegetation or areas dominated with reed canarygrass and cattail, a combination of prescribed fire and grazing (known as patch-burn graze) can be used to enhance and restore native plant communities. A portion of the unit to be grazed is prescribed burned before grazing. Cattle will then selectively graze on the more palatable and nutritious re-growth found in these disturbed patches.

As a general rule, bird species that prefer short vegetation occur in heavily grazed pastures, just as species preferring moderate and tall vegetation inhabit moderately and lightly grazed pastures, respectively. However, because pastures are often not grazed evenly, there is the likelihood that several ranges of vegetation height and density will be represented in a single pasture, especially large ones. The following are generalizations about species responses to grazing from research in the Midwest.

- Tallgrass bird species such as Sedge Wren and Henslow's and Le Conte's Sparrow *Ammodramus leconteii* are relatively intolerant of all but very light grazing.
- Light grazing can benefit species such as Northern Harrier, Dickcissel, Bobolink, and Eastern Meadowlark.
- Species that may occur in pastures that are moderately grazed include Upland Sandpiper, Savannah and Grasshopper Sparrow, Western Meadowlark, and Brewer's Blackbird.
- Heavily grazed pasture is occasionally used for foraging by many birds and is nesting habitat for Horned Lark and Killdeer.
- Pastures with scattered shrubs can benefit Loggerhead Shrike, and Brewer's Blackbird.

Inter-seeding

Inter-seeding reconstructed grasslands is a management technique that is used to improve existing low diversity grasslands thru the mechanical planting of additional grass/forb species directly into existing stands. Increased stand diversity benefits a greater assortment of grassland dependent species. The following describes the Board of Water and Soil Resources (BWSR) guidelines for inter-seeding restored grasslands to enhance native species diversity.

Stand Requirements Inter-seeding is most effective where grass is not overly dominant. It does not work well in monocultures of Switchgrass or Reed Canary Grass or in Kentucky Bluegrass sod.

Seed/Species Forbs and grasses can be inter-seeded. Forb seeds are generally broadcast seeded while grass seed are typically drilled. Individual species should be chosen based on specific site characteristics and project goals.

Site preparation Site preparation involves removal of thatch through burning or haying to provide light for seedlings. Weed removal through herbicide treatment is sometimes needed to reduce competition, decrease existing stand density and open areas for establishment. Repeated mowing of inter-seeded stand to 6-8 inches is recommended during the first year to allow light for seedlings. Mowing into the second season may also be beneficial and is recommended where stand vigor is lacking.

Node establishment In stands of native or non-native grasses a technique that has been effective involves establishing 15'X15' nodes (plots) within grass-dominated stands. Approximately 25 percent of the site should be covered by nodes. Nodes should be prepared with a tractor mounted roto-tiller in October followed by dormant (late October) broadcast seeding. As the nodes establish they will generate a source of propagules to colonize the surrounding vegetation matrix and increase species diversity (Grygiel et al. 2009).

Inter-seeding remnant native prairie

In most cases, only seed collected from the remnant communities is used. Seed from outside a remnant is sometimes used but only if it's from a local ecotype source. Seeding after prescribed fire is the most common method of inter-seeding remnants. Disking or other soil disturbance should not be used in remnants as a means of incorporating seed. Chemical herbicides are non-selective and their use should be avoided on all native prairies. Seeds should be broadcast in stand openings or areas that are occupied at low stem densities.

Tree Removal

Lack of available grassland nesting cover is an important factor limiting waterfowl and grassland nesting bird populations. Grassland habitat should be structurally open and free of major linear wood edges such as woodlots, hedgerows, and woody fence lines that fragment the habitat and create edges for nest parasites, provide predator habitat, and corridors for predator movement. Landscapes managed for grassland birds/waterfowl should contain minimal woody cover (maximum 5% of grassland habitat), and grassland patches should be separated from woody cover as much as possible (at least 110 yards from any major woody edge or development). Woody plants have the potential for intruding into any grassland. Although fire prevents some woody species from competing with prairie plants, fire alone may not be enough to control the most aggressive species in areas with high soil moisture or where invasive tree species are able to exploit grassland habitat. Wherever woody invasive plants appear, fire in accordance with the prescribed fire cycle, should constitute initial treatment. Secondary treatment will consist of cutting suckers and applying herbicide to the stump. Additional intensive woody plant treatment

may be done where woody suckers are abundant. The process consists of mechanically cutting shrubs/trees at least three times during the growing season (May-Aug.) to weaken stock and deplete root reserves. Mechanical treatment is most effective if completed the year before or after a prescribed fire, since the result would be two consecutive years of treatment. Only use mechanical treatment for one year so that the mechanical cutting does not have long-term effects on desirable prairie species. Follow up with hand cutting and stump-treatment as needed.

Historically, fire has been the primary disturbance that prevented smaller woody species from encroaching into grassland habitats. However, fire effectiveness declines as tree size increases, unless catastrophic levels of fire severity are reached (extreme drought). Due to safety issues related to severity levels, additional strategies are required to remove woody cover.

Cutting Physical removal via chainsaws, skid-steer mounted shears (6"-18"dbh), carbide shredder (.25-6"dbh), and timber-ax chipper (.25-4") are the primary mechanical means of removal treatment of woody vegetation. Cutting alone fails to eliminate the entire problem as durable skeletons of felled trees continue to occupy 70% of the space of the living tree. Cut trees need to be piled, dried and burned to make the habitat once occupied by the tree available to wildlife. In addition, the removal of some species of trees requires that the stump be chemically treated to eliminate the suckering potential of root reserves of Green Ash *Fraxinus Pennsylvanica*, Siberium Elm *Ulmus pumila*, and Box Elder *Acer negundo*.

Girdling Cutting through the cambium around the entire tree circumference is an effective means of killing individual trees or excluding a particular tree species. Severing the cambium restricts and/or prevents the flow of nutrients and water between the roots, leaves, and branches. Over time, the tree dies from lack of water and/or nutrients. Phloem is located in the outermost section of the cambium and is severed by a shallower cut than xylem located below the phloem. Severing the phloem prevents the flow of carbohydrates from the leaves to the roots. If only the phloem layer is severed, it will take several years for the tree to die. Severing the deeper xylem layer results in quicker mortality, but sometimes triggers increased suckering below the cut. Spring and summer (April-Aug.) is the most effective time to girdle trees. After initial spring growth, root resources have been depleted. Bark and cambium are looser and easier to remove at this time than in fall. Girdled trees typically die slowly over several years, allowing understory species to adapt gradually. Eventually, dead trees need to be felled and removed through cutting or fire.

Chemical Control Basal bark treatments are effective for controlling woody vines, shrubs, saplings, trees and other sensitive species <2 in base diameter. Basal applications offer the advantage of a low profile application and selective control of target species. Selected stems are removed to enable desirable plants to naturally and rapidly occupy sites. When properly applied, complete control of foliage, stems and roots is possible. Applications can be made year-round, but the fall is most efficient time when easy access to the base is possible and rapid chemical transport to the root system occurs. The basal spray method is highly selective and involves the application of an oil-based herbicide to the bottom portion of a plant's stem. The oil penetrates the plant's bark and carries the herbicide into the cambium for translocation to the roots. Basal spray formulations can also be applied to cut-stumps that have begun to re-sprout. Basal

treatments can be used in combination with cut surface treatments when large undesirable trees are mixed with smaller stems.

Foliage treatments are also effective for controlling shrubs and trees less than four inches in base diameter. Ground based broadcast spray equipment and hand-held sprayers are used for these applications. The Triclopyr chemical is absorbed by the leaf structures and translocated to the root system. Broadcast applications are only used occasionally to treat heavy infestations of shrub and tree saplings such as Siberian elm and willow. Hand-held sprayer applications are used for spot treating scattered trees and for small concentrated patches of woody vegetation. Herbicide is applied to wet the leaves, and applicators should avoid over spraying.

Herbicides

Woody plants or broadleaf forbs can be sprayed with herbicide during the growing season (April-Aug) to control their spread within a grassland. There are a wide variety of chemicals that are toxic to plant and animal species. Herbicides work in different ways and are very target specific, or affect a wide range of species.

Herbicides may be "pre-emergent," that is, applied prior to germination to prevent germination or kill the seedling, or "post-emergent" and may have various modes of action (auxin mimic, amino acid inhibitor, mitosis inhibitor, photosynthesis inhibitor, lipid biosynthesis inhibitor). Products may come in granular, pelleted, dust or liquid forms. Liquid herbicides are commonly diluted to an appropriate formula and mixed with other chemicals that facilitate mixing, application, or efficacy. Common application methods include foliar spray, basal bark, hack and squirt, injection, and cut stump.

The timing of applications is critical to achieve effective control, as the growth stage at which an organism will be most effectively controlled, varies by species. The advantage of herbicide use is that the right chemicals, applied correctly, can produce desired results over a large area for a reasonable cost. The disadvantages are that the chemicals may affect non-target species at the site (including the applicator) and/or contaminate surface or groundwater. Proper planning includes using the selection of the most target-specific, least hazardous (humans and the environment), and most effective chemical to meet the habitat objectives. Additionally, the minimum effective dosage should be applied, as the chemical labels often give higher than necessary concentrations.

Herbicides are often most effective when used in combination with mechanical methods described above. Attention to personal protective equipment, licensing requirements, and other regulations is required. U.S. Fish and Wildlife Service policy provides guidelines for pesticide and other chemical applications (including adjutants designed to enhance effectiveness) and requires a Pesticide Use Proposal (PUP) for all pesticide applications be submitted and approved annually.

Grassland Establishment/Restoration

Selection of species to be planted and local sources of seed (within 25 miles of the county's border but not across an ecotype region boundary) is a critical step in restoration of grassland habitat. While many species of grass and forbs are commercially available for grassland restoration, few are from local sources. Using local ecotype seed is important in restoration as plants have wide genetic diversity and differing photo periods across geographic areas. Specific guidance, state statutes, and region map for the use of local ecotype seed can be found in Appendix 8.

Initial seedbed preparation to decrease the weed (Canada thistle) seed bank is critical to successful grassland establishment. Former agricultural fields make up the majority of our restoration projects and are ideal sites for grassland establishment if Canada thistle problems are already under control. The field or site should be disked or sprayed with herbicide in spring prior to seeding as soon as the soil is dry enough.

As warm season grasses are slow to germinate and have less seedling vigor than do cool season grasses, weed/sod control, both before and after planting, is much more critical when establishing warm-season species than when establishing cool season grass stands.

When establishing warm season grasses, weed control throughout the growing season is just as critical as it is prior to planting. Normally, it takes at least two growing seasons to establish a warm season grass stand. This makes weed control during the first growing season critical. As warm season grasses are not shade tolerant, weed canopies will reduce seedling vigor. Moisture competition from weeds and cool season grasses may also further reduce seedling vigor. To establish warm season grasses, weeds are usually controlled by clipping with a sicklebar/bat-wing mower set at a height (8-12") where only the weeds shading the warm season grass seedlings are cut. Cutting at this height will reduce shading competition but not injure the emerging grass seedlings. Mowing weeds before flowering will also prevent seed production. Mowing 2-3 times may be necessary during the establishment year. However, if clipped too frequently, weeds may "stool out" (grow out instead of up) (NRCS-USDA 2006).

Broadcast seeding followed by cultipacking is recommended to increase seed to soil contact. This is especially true on sites where ground has been disked and leveled. Broadcast seeding reduces the rows associated with drilling methods of seeding. Recent research on District lands (Evaluation of Restoration Methods to Minimize Canada Thistle 2005-present) suggest that broadcast seeding is more effective at reducing the weed infestations often associated with restored grasslands.

Another method of seeding warm season grasses is with a no-till drill such as (Truax™). When using a drill in recently tilled seedbeds, it is best to culti-pack the tilled soil before seeding. Whether drilling or broadcasting on tilled soil, it is essential to culti-pack after seeding. It is further recommended to culti-pack twice after broadcasting, with the second culti-packing 90 degrees to the first (NRCS-USDA 2006).

WETLAND MANAGEMENT (VEGETATION)

There are temporary and seasonal wetlands scattered across the District where manipulations are possible (Appendix 2). The following strategies may be employed to enhance both wetlands with both water-level control capabilities and naturally occurring wetlands with no control capacity.

Water Level Manipulation

Water level management (timed drawdown and flooding) is a strategy used to mimic the dynamic water regime of some natural wetlands. Drawdowns are typically timed to benefit shorebirds, wading birds, and/or waterfowl. The ecological functions of shallow lakes and wetlands are adapted to periods of low water or drought, and such systems often deteriorate during periods of high water or absence of drought. Drawdowns (dewatering) are used to mimic natural droughts, which occur less frequently than in the past and are the best approach to reestablishing emergent and submergent vegetation.

Complete drawdowns or dewatering, consolidate and oxidize bottom sediments which cause organic material to be broken down to elemental stages that can then be assimilated by plants thus stimulating growth and vigor. The seeds of most species of emergent aquatic vegetation require a period of drying for germination to occur. During a draw down, mudflats and shallow water areas are created which provide foraging habitat for shorebirds, wading birds and waterfowl. May drawdowns stimulate shoot, cover, and seed production of desirable species Hardstem Bulrush *Scirpus acutus* during the first season and allow deeper (30cm-50cm) flooding the following year, thereby providing the most habitat for breeding waterfowl and their broods (Merendino and Smith 1991).

As moist-soil annual vegetation (Smart Weed *polygonum sp*., Barnyard Grass *Echinochloa crus-galli*) grows, shallow (not to exceed 1/3 plant height) flooding can be used to irrigate growing vegetation, create shallow water foraging habitat for waterfowl or discourage growth of perennial or invasive plants. Water levels are usually returned to the desired management level prior to fall migration, or the following spring migration if water is not available in the fall. Generally, slow (over several weeks) drawdowns will provide a greater diversity of moist-soil plants than faster (over a few days) drawdowns (Frederickson and Taylor 1982).

In dry years with little or no snow, there is potential to gradually draw down wetlands during April and May. Mudflats are exposed and as they warm, and start to dry, desirable moist soil plants germinate like Smartweed *Polygonum spp*., Softstem *Scirpus validus* and Hardstem Bulrush, Spikerush *Eleocharis acicularis*, and Giant Bur-reed *Sparganium spp.*. These species exhibit rapid growth. Desirable species like smartweeds will germinate when soil temperatures are in the low 60° F while others like cattail *typha* spp. germinate when soil temperatures reach 77-86° F. As water is gradually drawn down, vegetation zones with different species develop. Most aquatic species vegetation can withstand short periods of water inundation due to precipitation events. Water level may be gradually raised during the fall (Sept. – Oct.) to provide access to robust, seed rich food resources to migrating waterfowl.

Alternatively, high water elevations mimic flood conditions and help set back emergent vegetation, like dense cattail, by drowning. To manipulate the aquatic vegetation, the high water must be maintained throughout the growing season and through the fall. In some instances, high water should be maintained for two years to accomplish objectives. Where feasible the best management practice would be to pre-treat the vegetation via fire, mowing or disking before flooding. Flooding should be to a depth of at least two feet above the remaining vegetation to assure that species don't reach the waterline and oxygen.

Fire

Temporary and seasonal wetland vegetation can also be treated with prescribed fire. Fire will consume dormant wetland vegetation and accumulated dead biomass that has a tendency to suppress stand growth and become dense. Fire refreshes the wetlands by allowing light penetration into the water column to promote aquatic vegetative growth. Some wetlands can be dewatered and the basins allowed to dry out completely. The resulting dried vegetation can then be treated with fire to remove the thatch layer and heat damage species like cattail. Burn severity in the cattail root zone can significantly injure the root system because it will sever the aerenchyma link that provides oxygen between the rhizomes and leaves of cattails during dormancy. Refilling the wetland with water (2 feet over the cattail) can kill the cattail.

Mowing/Shearing

Mowing and shearing involves the use of rotary and flail mowers, though forestry mulching type equipment (Fecon™) may be used. Flail and forestry mulchers chop up vegetative material better than a rotary mower. A forestry mower has the added advantage of providing ground tillage if conditions allow. Mowing can be completed anytime dry conditions allow access to the wetland basin. However, control may be best achieved if cutting in late summer or early fall (where possible) to prevent nutrients from reaching root stores. Winter over-ice treatments have a potential to be successful particularly if a dry fall allows access into the basin and the cutting is followed by a wet spring to submerge the cut stems. Clipping cattails too early in the growing season may stimulate growth and lead to higher stem density the following year. Cutting in early spring is not feasible in most years due to the extremely dry conditions needed to allow for equipment access. However, mowing wetlands infested with cattail and/or reed canary grass will temporarily provide important shallow open water habitat during the spring waterfowl migration.

Crushing/Rolling

Crushing and/or rolling have the potential of, at least temporarily, controlling vegetation in temporary and seasonal wetlands. Equipment may include a cultipacker, roller drum or other type of equipment (Marsh Master™, Argo™, ATV, etc.). Vegetation can be manipulated any time conditions allow, though Weller (1974) found that cattails crushed and re-flooded in June had poor recoveries. If spring (May-June) timing is not feasible, the vegetation can be crushed during the fall (Aug.-Sept.) when conditions are drier. Treated wetlands should then be refilled during the early spring. In wetlands with water level management capabilities, strive to over top the crushed vegetation with a minimum of two feet of water.

Disking

Disking in wetlands to control cattail can provide effective results. The wetland vegetation must be pretreated to remove above ground biomass. Pretreatment may include fire or other biomass removal techniques. Key to success of this technique is to break the cattail root layer or mass. Shallow disking (0-6 inches) will decrease the chances for success because the cattatil root mass lies 6-10" below the soil surface. Deep disking (below root mass) can retard shoot formation and damage the rhizomes. The disturbance decreases plant survival by exposing the roots to continued drying and freezing in fall and early winter. If a wetland can be kept dry enough to repeatedly disc for 2-3 successive seasons, cattails may be eliminated or their stem densities severely reduced. Disking does have some major drawbacks and they include: 1) the equipment and personnel needed to carry out this method of control are costly and, 2) a heavy disk (20') is necessary and will disturb the site. Disturbance may result in the loss of other native plants in the wetland. However, the soil disturbance also exposes the seed bank possibly stimulating growth of dormant species. On dense stands of cattail, several passes with equipment may be necessary to remove the erect stems, breakup the extensive rhizome layer, and incorporate the soil. Unfortunately, disking is only possible when soil conditions are dry enough to support equipment.

Sediment Removal

Removing accumulated sediment from formerly cropped temporary and seasonal wetlands offers one option for the reduction of cattail dominated wetlands. Farmed wetlands often endured decades of conventional cropland tillage across the adjacent uplands resulting in increased erosion of the topsoil into the wetlands. Removal of the accumulated sediment layer above the original soil horizon may return some hydrological and vegetative functionality to the wetland.

Sediment removal from wetlands works most effectively when the wetland is not inundated or saturated, usually in the fall of the year. A prescribed burn on the wetland with dense vegetation (i.e. cattails) prior to excavation also increases the efficiency of the process, and in many circumstances is a necessary pre-treatment tool. While using excavation as a method for restoration, ensure that the actions do not change the original water regime of the wetland (i.e. convert a temporary wetland to a seasonal). An individual wetland may have both seasonal and temporary zones where sediment depths may vary. Therefore, excavation depths may vary across a single wetland.

Sediment excavation requires proper planning to ensure that the placement of the removed material will not negatively impact the restored wetland. Material should be either transported off site or spread in the uplands. The excess material must not be placed within the wetland boundary or even adjacent to the wetland. Consideration should also be given to the seed bank within the removed sediment layer. Undesirable plant species such as reed-canary grass may be present and may grow from the excess soil material to 'infest' habitats where the material was placed.

Equipment used for excavation may include excavator, bulldozer, and sometimes a scraper. On small, temporary wetlands the excavator works well, as it is more precise than the bulldozer.

Larger temporary wetlands and seasonal basins may require use of a bulldozer. The latter is a less precise piece of equipment and generally results in the removal of 2-4" plus or minus the targeted sediment removal amount. Scrapers only work if it is dry enough, but can move a large amount of dirt in a shorter amount of time resulting in lower costs, especially in larger wetlands.

Muskrat Population Management

Muskrats *Ondatra zibethicus* are efficient at reducing the cover of robust perennial vegetation (Danell 1977). The impoundment should be held high (above ordinary high water mark) for at least one year. Muskrat trapping in the impoundment interior should be allowed when the cover of robust perennial vegetation needs to be decreased. However, if perennial vegetative cover is lower than desired, muskrat control should be conducted. Muskrat trapping also should be employed when muskrat populations are high and burrowing has caused damage to dikes or water control structures. Trapping of muskrats should occur in the fall and winter, during state-established trapping seasons.

Herbicide

The most commonly used herbicide for controlling invasive and over-dominant aquatic emergent vegetation in wetlands is glyphosate™. Methods of application include spot-treatment using backpack or ATV mounted sprayer, or aerial application. Spot-treatment is more targeted (avoiding neighboring plants), but can be labor intensive when treating large areas. Aerial application is less labor-intensive, but is not as target-specific, and requires extensive planning to execute. Herbicides are applied during flowering and prior to seed set to maximize effectiveness.

Beaver Control

Because beavers are part of the natural landscape, and can be beneficial in terms of creating wetland habitats, harvest of nuisance beavers will only be conducted when negative impacts are determined to be excessive or damaging to adjacent landowner holdings. Beavers interfere with wetland management by damaging or clogging water control structures or tile lines and altering water levels on surrounding lands that may interfere with the landowner's use of their land. Whenever possible, water control structures and drainage pipes should be fitted with guards to prevent beavers from clogging the pipes or damaging the structures. Trapping is the most effective method of removing problem beavers and may be conducted either during fur season or by trapping nuisance beaver through the issuance of a Special Use Permit and appropriate State permits outside of the season dates.

WETLAND MANAGEMENT (FISH CONTROL)

Anthropocentric changes to the PPR have forever altered the landscape and its hydrology. Smaller temporary wetlands have been mostly drained. Deeper interconnected wetlands which favor a more semipermanent/permanent water regime largely represent what's left of the undrained wetlands on the landscape. These deeper basins rarely dry out and have become an ideal oasis for undesirable fish species.

All wetlands occur in one of two trophic states; a clear-water state with abundant hydrophytic vegetation, and the other a turbid (degraded) state characterized by high phytoplankton populations with few hydrophytic plants (Scheffer et al. 1993). Basins in either of these states tend to be stable until a perturbation to the system causes a shift from one state to the other. Perturbations that cause this trophic shift are not fully understood, but involve both abiotic as well as biotic factors.

Fish are thought to be a major biotic factor that, coupled with other abiotic factors (e.g., nutrients), play a major role in inducing a change in wetlands from a clear to turbid state (Hanson and Butler 1994; Parkos et al. 2003; Zimmer et al. 2001a, 2001b, 2002). Although not considered to be a definite predictive factor, fish are often associated with a turbid trophic state. Zooplanktivorous fish, such as Fathead Minnows *Pimephales promelas* and benthivorous fish, such as Bullheads *Ictalurus sp.* and Common Carp *Cyprinus carpio* are the most common species associated with turbid wetlands in the PPR.

Research suggest that benthivorous fish may be more responsible for shifting basins to a turbid state, while zooplanktivorous fish may play a role in maintaining the turbid condition (Hanson and Herwig MN DNR, personal communication). In wetlands, zooplanktivorous fish contribute to eutrophication chiefly by eliminating zooplankton biomass and hence relieving phytoplankton from zooplankton predation. Eutrophication can also be exacerbated by the consumption of detritus by fish and subsequent excretion of nutrients into the water column in a form readily available for uptake by phytoplankton (Zimmer et al. 2006). The resulting high phytoplankton biomass contributes to high turbidity, which in turn constrains macrophytic growth that is known to be associated with healthy clear state wetlands.

Benthivorous fish increase nutrient availability to phytoplankton by transferring sediment bound nutrients to the water column during both bottom foraging and excretion activities (Meijer et al. 1990). Benthivores may also contribute to non-algal turbidity via resuspension of sediment particles, and causing direct feeding damage to submerged macrophytes (Crivelli 1983, Brabrand et al. 1990). Resulting high non-algal turbidity and nutrient loading associated with benthivores is thought to indirectly reduce zooplankton biomass and increase total ammonia/phosphorus levels. Too much phosphorus can drive aquatic eutrophication and cause excessive growth of algae which can create the turbid conditions conducive to decreased macrophytic plant growth important to wetland dependent species such as waterfowl.

Both benthivores/zooplanktivores fish are tolerant of low oxygen levels and high water temperatures. This adaptability, coupled with their high fecundity rates, means they can quickly dominate the water resource in a wetland ecosystem. Deterioration of water quality in

permanent/semipermanent wetlands in the Prairie Pothole Region is due in a large part to the proliferation and resilience of the aforementioned fish species. Their ubiquitous nature and potential for exponential population growth has been shown to strongly influence community characteristics causing detrimental ecological problems for wetlands, including reduced invertebrate populations, and creating conditions that favor high phytoplankton biomass, low water transparency and reduced submerged aquatic vegetation (Zimmer et al. 2000, 2001a, 2003). The following management techniques have been shown to reduce or eliminate fish populations in wetlands.

Water Level Manipulation

On basins with drawdown capabilities (water control structures), it's possible to reduce water to levels that will produce the conditions necessary to effectively eliminate rough fish populations. Drawdown's should be timed so that maximum low level conditions are achieved during mid-summer and winter months. This ensures that remaining low lying pools, capable of supporting fish, are sufficiently heated or frozen enough to effectively kill any enduring fish populations.

Fish Barriers

Fish barriers are engineered devices designed to prevent nuisance fish from entering a water body. Commonly used barriers include velocity tubes, finger grates, and stop log water control structures. Fish barriers are placed on the inlets and outlets of shallow lakes and wetlands where fish enter the wetland from feeder streams and ditches. Water passes through the structure, but fish are prevented from passing either through physical obstruction or water velocity. Complete elimination of rough fish is often unlikely when using metal finger grates since small fry can pass through to the basin. Barriers have the disadvantage that initial costs are high compared to other methods because they require construction and installation, as well as future operation and maintenance costs. Potential adverse effects may also include interference or restriction of spawning runs of desirable fish species and the mussel species they support, restriction of boats on larger bodies of water, and collection of debris, restricting water flow.

Chemical Fish Kill

Rotenone ™ is a naturally occurring compound derived from the roots of certain tropical and subtropical legume plants. Humans have used it for centuries to harvest fish and manipulate fish communities. Rotenone kills by interfering with cellular use of oxygen. It affects all gill-breathing animals such as fish, amphibians and insects. At labeled application rates, mammals, birds and reptiles are not affected as their skins inhibit absorption and enzymes in their digestive systems break down small amounts into harmless by-products. Rotenone™ should be applied at water temperatures greater than 20° C for optimum fish kill and detoxification. Natural detoxification occurs within two days to two weeks in late summer. Warm water temperatures, high alkalinity, and sunlight in clear waters will accelerate detoxification while turbidity and decreased light penetration in deep water will inhibit the process. Fall applications before ice formation eliminate the odor from decomposing fish, reduce need for disposal of dead fish, and detoxify by the time the ice breaks up (Wydoski and Wiley 1999).

Effectiveness of treatments depends on several factors including water clarity, fish exposure time, repeated exposure, and life stage. Turbid water reduces effectiveness of Rotenone™ as does repeated treatments which may cause some fish to develop a tolerance to the chemical. Dosage and exposure durations may also be influenced by water chemistry. Common carp at different life stages will exhibit different resistances to Rotenone™. Eyed carp eggs have 50 times greater resistance than do larvae (Wydoski and Wiley 1999). The greatest adverse impact from Rotenone™ control is its high toxicity to many invertebrate species. Zooplankton communities may be drastically reduced, though populations usually recover within two to twelve months. However, with spot treatments, recolonization from adjacent untreated water may occur in as little as one week.

Reverse Aeration

Reverse aeration is a far less expensive process to control rough fish when compared to Rotenone™ treatments. An aerator situated on the basin bottom is turned on in the winter when a basin containing rough fish is covered in a thick layer of ice and dissolved oxygen levels are low. The bubbling aerator circulates the oxygen-depleted water on the bottom throughout the body of water from bottom to top. The cold water absorbs oxygen at a fast rate and lowers the dissolved oxygen levels so quickly that all fish die. This method is employed in the deep, permanent wetlands where natural winterkill is less likely to occur and chemical methods are less effective.

Biomanipulation

Research strongly suggests that a fishless wetland is the healthiest system in the PPR (Herwig 2004). Fish stocking may have a positive influence on the ecological processes of wetlands through biomanipulation (e.g., walleye fry stocking) of basins containing robust populations of Fathead Minnows. Where Fathead Minnows are present, stocked Walleye *Stizostedion vitreum* have the potential to suppress minnow populations through direct competition and predation, allowing zooplankton and other invertebrates to flourish, the water to clear, and submerged aquatic plants to respond with growth (Potthoff et al. 2008). These beneficial effects can be very robust, but short lived, requiring repeated, intensive management. The best sites for this treatment are wetlands that are deep enough to prevent summer anoxia of walleye, have no surface water connection to other wetlands, and with a fish community that is limited to Fathead Minnow or other minnow population (B. Herwig, personal communication).

INVASIVE SPECIES MANAGEMENT

Controlling and managing invasive species is a strategy for maintaining the biological integrity and diversity of all habitats. The Fulfilling the Promise National Invasive Species Management Strategy Team developed a national strategy for management of invasive species for the National Wildlife Refuge System (USFWS 2002). The strategy recommends the following priority order of action for invasive species management:

1. Prevent invasion of potential invaders.
2. Eradicate new and/or small infestations.
3. Control and/or contain large established infestations.

Management strategies for prevention, control and prioritization of efforts for established invasive species, are described in detail below. Prior to the initiation of invasive species control efforts, the Refuge manager must understand the biology of the species to be controlled. A number of resources are available on the internet to assist refuge managers with invasive species management. This is a partial list of helpful websites.

- USFWSManagingInvasivePlantsModules http://www.fws.gov/invasives/staffTrainingModule/index.html
- National Invasive Species Information Center: http://invasivespeciesinfo.gov/index.shtml
- NationalBiologicalInformationInfrastructureInvasiveSpeciesInformation Node:http://invasivespecies.nbii.gov/
- The Global Invasive Species Initiative: http://tncweeds.ucdavis.edu/control.html
- USGS Invasive Species Program: http://biology.usgs.gov/invasive/

District staff should conduct monitoring before, during, and after any management activity to determine whether pest management goals are achieved and whether the activity had any significant unanticipated effects. The lowest risk, most targeted approach for managing invasive species should always be utilized (Department of Interior 2007).

Work with Partners

Control efforts within the District will have no lasting, long-term impact, if the surrounding lands and waters are infested with invasive species. Relationships with other federal, state, county, and non-profit agencies should be maintained and fostered to stay informed regarding invasive species issues on neighboring lands.

Incorporate Invasive Species Prevention in All Facilities and Construction Projects

In order to reduce the conditions conducive to invasive species exploitation, efforts should be made to minimize ground disturbance and restore disturbed areas during earth moving projects. Require mulch, sand, gravel, dirt, and other construction materials to be certified as free of noxious weed seeds. Avoid stockpiles of weed infested materials.

To prevent the spread of invasives along travel corridors, maintain invasive species-free

zones along trails, around parking lots and boat launches, and at other related facilities. Inspect these areas often and control new infestations immediately.

Remove all mud, dirt, and plant parts from all equipment between projects or when equipment is moved from one location to another.

Incorporate Invasive Species Prevention in Wetland Design and Management

In order to reduce invasive species colonization conditions in wetlands, restorations should minimize infrastructure development in managed wetland units to reduce unnecessary dikes, waterways, and access roads. These often are sources of infestation and pathways for spread. Plant a native cool season grass mix that will establish quickly to stabilize banks and dikes and to prevent the establishment of invasive species.

Water manipulation activities, such as flooding and drawdowns, should be timed to minimize the germination and spread of invasive plant seeds and to encourage the growth of native species. Flooding may also be used to stunt the growth of some invasive species as described below under water level management.

Early Detection and Rapid Response

Where prevention is not possible, early detection and rapid response is the next best strategy. Success will depend, in part, on participation by all staff, contractors, volunteers, and visitors in efforts to report and respond to invasions. When small infestations are discovered, they should be eradicated as soon as possible. The site must be monitored for several years to ensure control efforts are effective.

Prioritizing Invasive Species Control Efforts

The first step in prioritizing invasive species control efforts is to determine the abundance and distribution of invasive species within the District or management unit. However, control efforts should not be delayed to collect statistically rigorous survey data. Invasive species observations should be documented and mapped. If a more formalized mapping procedure is desired the North American Weed Management Association (http://www.nawma.org) has information on mapping procedures.

There are a number of ranking tools to assist land managers with the task of prioritizing their invasive plant control efforts. The Fulfilling the Promise National Invasive Species Management Strategy Team recommended using the following order of priority to determine appropriate actions:

1. Smallest scale of infestation
2. Poses greatest threat to land management objectives
3. Greatest ease of control.

When limited resources prevent the treatment of entire populations, the following order of priority is recommended:

1. Treat the smallest infestations (satellite populations).
2. Treat infestations on pathways of spread.
3. Treat the perimeter and advancing front of large infestations.

Restore Altered Habitats and Reintroduce Native Plants

Restoration is critically important as conditions responsible for the initial invasion will expose the site to a resurgence of the invasive species, as well as a secondary invasion of one or more different species. Furthermore, restoration of disturbed areas before the initial invasion may preclude the need for further control efforts. The goal is to conserve and promote natural processes and native species that will inherently suppress potential pest populations (USFWS 2007).

If funding or personnel are not available to restore highly disturbed areas in a timely manner, consider planting a cover crop for several years to stabilize the site prior to reintroducing native plants. This action will prevent more invasive seeds from entering the environment until the site can be restored. Native plants may then be established by direct seeding or planting with less competition from invasive species in the seed bank. When practical, local genotype of native species should be used.

Biological Control

Biological control is the use of animals or disease organisms that feed upon or parasitize the invasive species target. Usually, the control agent is imported from the invasive species' native country, and artificially high numbers of the control agent are fostered and maintained. There are also "conservation" or "augmentation" biological control methods where populations of biological agents already in the environment (usually native) are maintained or enhanced to target an invasive species. The advantages of this method are that it avoids the use of chemicals and can provide relatively inexpensive and permanent control over large areas. Appropriate control agents do not exist for all invasive species. Petitions must be submitted, and approved by, the Unites States Department of Agriculture on weed biological control before any proposed biological control agent can be released in the United States.

The only noxious weeds within the District for which effective biocontrol exists is Leafy Spurge *Euphorbia esula* L. and Purple Loosestrife *Lythrum Salicaria*. The primary controlling actions for Leafy Spurge include consumption of above-ground plant material, consumption of root material, and blocking seed production. Three biocontrol agents have been released on the District to control leafy spurge. These include two species of flea beetles *Aphthona nigriscutis* and *Aphthona lacertosa* and one stem-boring beetle *Oberea erythrocephala*. Flea beetles have produced the greatest impact on leafy spurge. Adults from both species feed on spurge leaves and floral parts and further impact the plant by ovipositing eggs at the base of the plant. Larvae hatch, burrow into the soil, and begin feeding on very small leafy spurge roots and root hairs. As

they develop, the larvae utilize progressively larger spurge roots. Mature larvae may also be found burrowing within large lateral roots and root buds. The stem-boring beetle adults feed on the spurge stems and leaves. The female will mine a hole in the stem and lay eggs. The larvae mine their way down the stem into the root system. The affected stems wilt and die. All three biocontrol agents feed on the leafy spurge stems, leaves, and roots. They increase plant morbidity, reduce plant health and create pathways for the introduction of plant pathogens. Research indicates that flea beetles can reduce leafy spurge stem densities by as much as 80-90% in release areas (Kirby et al. 2000).

The District began using two leaf-beetles, *Galerucella calmariensis* and *G. pusill*a, to control Purple Loosestrife in the mid-1990s. Loosestrife beetles are good fliers and can disperse up to four miles in a year. They have been found more than 12 miles from their original release site on unmanaged Purple Loosestrife infestations (MN DNR 2000). They tolerate a wide range of conditions but prefer full sun and fairly stable water levels. Adult and larval beetles defoliate plants, effectively stressing the plant to the point of reducing shoot height and sometimes inhibit flowering (Wilson et al. undated).

Adult Loosestrife beetles emerge in early spring (April-May) and feed on leaves and young shoots of the loosestrife plant. Eggs are laid on leaves and stems. Initially, the larvae feed on leaf buds, moving to leaves and stems as they grow larger. The larvae pupate in the leaf litter below the plant, or, if the plant is in flooded water, in the aerenchyma in the stem. New adults emerge in mid-June to mid-July, feed for a short time, and then overwinter in the litter (Wilson et al. undated).

Grazing

In some situations, integrating prescribed fire or grazing on Leafy Spurge biocontrol sites can enhance control. Carefully timed prescribed fire, when the adults are not active (early spring and fall), will not harm established colonies of *A. nigriscutis*, and may improve recruitment on new release sites (Fellows and Newton 1999). Grazing sheep or goats in combination with biological control agents may provide a more rapid reduction of Leafy Spurge stem density and vigor than the biological control agents alone (Bourcheir et al. 2006). In part, these results may be affected by the litter layer in the grassland – a very thick litter layer may result in females laying eggs too far from the soil surface or may inhibit emergence in the spring.

The Refuge Biologist and Manager should evaluate various biological control agents as they become available for field application to target the invasive species found on the District. Discussions with USDA Animal and Plant Health Inspection Service staff may help provide an overview of available research, development of biological control agents, and potential for application of species-specific controls.

Manual and Mechanical Control

Mechanical removal of invasive organisms can be effective against some herbaceous plants, shrubs and saplings, and aquatic organisms. This is particularly effective for plants that are annuals or have a taproot. Care should be taken to minimize soil disturbance to prevent creating

conditions ideal for weed seed germination. Repeated cutting over a growing period is needed for effective control of many invasive plant species. Care should be taken to properly remove and dispose of any plant parts that can re-sprout. Treatments should be timed to prevent seed set and re-sprouting. The following methods are available: hand-pulling, pulling with hand tools (weed wrench, etc.), mowing, brush-hogging, weed-eating, stabbing (cutting roots while leaving in place), girdling (removing cambium layer), mulching, tilling, smothering (black plastic or other), and flooding.

The advantages of mechanical treatment are low cost for equipment and supplies and minimal damage to neighboring plants and the environment. The disadvantages are higher costs for labor and inability to control large areas. For many invasive species, mechanical treatments alone are not effective, especially for mature or well-established plants. For some invasive plants, mechanical treatments alone exacerbate the problem by causing vigorous suckering. Mechanical treatments are most effective when combined with herbicide treatments (e.g. girdle and herbicide

Herbicides

A wide variety of chemicals are toxic to plant and animal species. They may work in different ways and be very target specific, or affect a wide range of species. Herbicides may be "pre-emergent," that is, applied prior to germination to prevent germination or kill the seedling, or "post-emergent" and may have various modes of action (auxin mimic, amino acid inhibitor, mitosis inhibitor, photosynthesis inhibitor and lipid biosynthesis inhibitor). Products may come in granular, pelleted, dust or liquid forms. Liquid herbicides are commonly diluted to an appropriate formula and mixed with other chemicals that facilitate mixing, application, or efficacy. Common application methods include foliar spray, basal bark, hack and squirt, injection, and cut stump. The timing of applications is critical to achieve good control, as the growth stage at which an organism will be most effectively controlled varies with different species. The advantages are that the chemicals, applied correctly, can produce desired results over a large area for a reasonable cost. The disadvantages are that the chemicals may affect non-target species at the site (including the applicator) and/or contaminate surface or groundwater. Proper planning includes using the most target-specific, least hazardous (to humans and the environment), and selecting the most effective chemical for the job. Additionally, one should research minimum effective dosage, as the chemical labels often give higher than necessary concentrations. Herbicides often are most effective when used in combination with mechanical methods described above. Attention to protective gear, licensing requirements and other regulations is essential. In the U.S. Fish and Wildlife Service, all pesticide and other chemical applications (including adjuvants designed to enhance effectiveness) are covered by Service and departmental regulations, and a Pesticide Use Proposal (PUP) is required for all pesticide applications.

APPENDIX 6.

WPAs with remnant, native prairie on Litchfield WMD

UNIT (WPA)	COUNTY	TOTAL ACRES	NATIVE PRAIRIE ACRES
ALLEN	KANDIYOHI	201	1
ARCTANDER		368	20
BIG KANDIYOHI LK.		841	10
BJUR		40	2
BOMSTA		282	35
BRENNER LAKE		273	76
BROBERG		64	2
BUR OAK LAKE		330	10
BURBANK		902	40
CARLSON LAKE		289	31
CENTURY		159	9
COLFAX		320	10
DEGROOT		130	2
DENGERUD		97	12
DOG LAKE		200	1
ELLA LAKE		418	15
ERICKSON		47	3
EVENSON		140	6
FLORIDA SLOUGH		521	15
FREESE		369	99
GILBERTS		49	4
HANSON		116	2
HARRISON		25	3
HENJUM		45	2
HENJUM LAKE		275	7
IRVING		132	15
JOHNSON		80	3
LAKE CHARLOTTE		255	5
LAKE ELIZABETH		56	1
LAKE LILLIAN		312	5
LAKE MARY		112	24
LINDGREN LAKE		157	10
MAMRE		228	10
MEEKER		200	13
MILLER HILLS		388	180
NEW LONDON		337	25
NORWAY LAKE		43	7
OLSON LAKE		453	42
PENNOCK		50	1
PETERSON		37	2

UNIT (WPA)	COUNTY	TOTAL ACRES	NATIVE PRAIRIE ACRES
PRIAM	KANDIYOHI	115	2
QUINN		269	42
RAMBOW		138	8
RANDALL		560	135
RAYMOND		373	47
REYNOLDS		136	11
SCHUELER		46	6
SHAOKOPEE CREEK		146	8
SPERRY LAKE		16	1
SUMMIT LAKE		99	14
SUNBURG		255	24
SWAN LAKE		741	32
SWANSON		96	4
SWEEP		86	27
UNCLE MATT'S		265	28
WEBER		421	100
YARMON		828	40
ZWEMKE		32	1
TOTAL			(1290)
ACTON	MEEKER	80	1
CASEY LAKE		305	18
CEDAR MILLS		231	5
CLEAR LAKE		197	7
COSMOS		160	3
FOREST CITY		220	22
GRASS LAKE		45	1
GREENLEAF		80	6
HANSON LAKE		313	14
HARVEY		445	24
LAKE HARDEN		380	15
LITCHFIELD		168	3
MILLER LAKE		225	12
PEIFFER SCHOOL		286	25
ROSENDALE		481	21
STONE LAKE		146	6
TYRONE FLATS		1225	75
TOTAL			(258)
BAKERS LAKE	MCLEOD	168	1
BARBER LAKE		226	8
BROWNTON		174	12
EAGLE LAKE		78	7

UNIT (WPA)	COUNTY	TOTAL ACRES	NATIVE PRAIRIE ACRES
PENN	MCLEOD	198	9
PHASIANUS		571	2
SOUTH SILVER LAKE		155	3
TOTAL			(42)
BOON LAKE	RENVILLE	200	3
BROOKFIELD		44	1
CREAM CITY		320	38
PHARE LAKE		150	6
PRESTON LAKE		160	3
SACRED HEART		548	9
TEACHERS		153	1
WANG		128	2
TOTAL			(63)
ASHLEY	STEARNS	876	25
BAUMAN		306	4
BEHNEN		371	52
BIG FISH LAKE		78	2
BROCKWAY		180	5
CEDAR LAKE		151	5
CLAUDE		62	4
COLLEGEVILLE		121	4
COSTELLO		105	12
CROSIER		98	1
CROW LAKE		379	15
EDEN VALLEY		394	5
FARMING		163	5
GETTEL		115	12
GREENWALD		252	8
KENNA		251	5
KRAIN		159	4
LAKE GEORGE		76	3
LAKE HENRY		171	40
LOVELL LAKE		910	45
MCCORMIC LAKE		245	3
MUD LAKE		82	1
MURRAY LAKE		60	2
OAK		144	2
PADUA		721	175

UNIT (WPA)	COUNTY	TOTAL ACRES	NATIVE PRAIRIE ACRES
POPE	STEARNS	155	19
PRAIRIE STORM		318	20
RICE LAKE		184	3
ROSCOE		281	4
SAND LAKE		315	18
SCHURMANN		18	1
SPRING HILL		36	3
ST. MARTIN		442	12
STONEY CREEK		48	4
TRISKO		397	15
TWIN LAKES		162	2
UHLENKOLTS		56	1
WHITNEY		346	48
WIENER		100	25
ZEHRER		145	2
ZION		118	48
TOTAL			(664)
FABER	TODD	90	10
SOGGE		132	3
TERFEHR		71	2
WEST UNION		307	18
			(33)
SILVER CREEK	WRIGHT	82	3
TOTAL			(3)

APPENDIX 7.
Litchfield WMD units (WPAs)

UNIT (WPA)	COUNTY	TOTAL ACRES
ALLEN	KANDIYOHI	201
ARCTANDER		368
BIG KANDIYOHI LK.		841
BJUR		40
BOMSTA		282
BRENNER LAKE		273
BROBERG		64
BURR OAK LAKE		330
BURBANK		902
CARLSON LAKE		289
CENTURY		159
COLFAX		320
DEGROOT		130
DENGERUD		97
DOG LAKE		200
ELLA LAKE		418
ERICKSON		47
EVENSON		140
FLORIDA SLOUGH		521
FREESE		369
GILBERTS		49
HANSON		116
HARRISON		25
HENJUM		45
HENJUM LAKE		275
IRVING		132
JOHNSON		80
LAKE CHARLOTTE		255
LAKE ELIZABETH		56
LAKE LILLIAN		312
LAKE MARY		112
LINDGREN LAKE		157
MAMRE		228
MEEKER		200
MILLER HILLS		388
NEW LONDON		337
NORWAY LAKE		43
OLSON LAKE		453
PENNOCK		50
PETERSON		37
PRIAM		115

UNIT (WPA)	COUNTY	TOTAL ACRES
QUINN	KANDIYOHI	269
RAMBOW		138
RANDALL		560
RAYMOND		373
REYNOLDS		136
SCHUELER		46
SHAOKOPEE CREEK		146
SPERRY LAKE		16
SUMMIT LAKE		99
SUNBURG		255
SWAN LAKE		741
SWANSON		96
SWEEP		86
UNCLE MATT'S		265
WEBER		421
YARMON		828
ZWEMKE		32
ACTON	MEEKER	80
CASEY LAKE		305
CEDAR MILLS		231
CLEAR LAKE		197
COSMOS		160
FOREST CITY		220
GRASS LAKE		45
GREENLEAF		80
HANSON LAKE		313
HARVEY		445
LAKE HARDEN		380
LITCHFIELD		168
MILLER LAKE		225
PEIFFER SCHOOL		286
ROSENDALE		481
STONE LAKE		146
TYRONE FLATS		1225
BAKERS LAKE	MCLEOD	168
BARBER LAKE		226
BARTO-OLIVA		158
BROWNTON		174
EAGLE LAKE		78

UNIT (WPA)	COUNTY	TOTAL ACRES
PENN	MCLEOD	198
PHASIANUS		571
SOUTH SILVER LAKE		155
BOON LAKE	RENVILLE	200
BROOKFIELD		44
CREAM CITY		320
PHARE LAKE		150
PRESTON LAKE		160
SACRED HEART		548
TEACHER		153
WANG		128
ASHLEY	STEARNS	876
BAUMAN		306
BEHNEN		371
BIG FISH LAKE		78
BROCKWAY		180
CEDAR LAKE		151
CLAUDE		62
COLLEGEVILLE		121
COSTELLO		105
CROSIER		98
CROW LAKE		379
EDEN VALLEY		394
FARMING		163
GETTEL		115
GREENWALD		252
KENNA		251
KRAIN		159
LAKE GEORGE		76
LAKE HENRY		171
LOVELL LAKE		910
MCCORMIC LAKE		245
MUD LAKE		82
MURRAY LAKE		60
OAK		144
PADUA		721
POPE		155
PRAIRIE STORM		318

UNIT (WPA)	COUNTY	TOTAL ACRES
RICE LAKE	STEARNS	184
ROSCOE		281
SAND LAKE		315
SCHURMANN		18
SPRING HILL		36
ST. MARTIN		442
STONEY CREEK		48
TRISKO		397
TWIN LAKES		162
UHLENKOLTS		56
WHITNEY		346
WIENER		100
ZEHRER		145
ZION		118
FABER	TODD	90
GE ROY		122
SOGGE		132
TERFEHR		71
WEST UNION		307
ALBION	WRIGHT	142
ANGUS LAKE		177
ANNANDALE		160
COKATO		218
CORINNA		133
FRENCH LAKE		167
GOOSE LAKE		340
MARYSVILLE		306
PELICAN LAKE EAST		510
PELICAN LAKE NORTH		239
PELICAN LAKE WEST		410
ROBINSON		103
SILVER CREEK		82
TEMPERANCE		136
VICTOR		149

APPENDIX 8.
Litchfield 2003 CCP habitat goals

Wildlife and Habitat

Goal 1: Wildlife

Strive to preserve and maintain diversity and increase the abundance of waterfowl and other key wildlife species in the Northern Tallgrass Prairie Ecosystem. Seek sustainable solutions to the impact of Canada geese on adjacent private croplands. Preserve, restore, and enhance resident wildlife populations where compatible with waterfowl and the preservation of other trust species.

Goal 2: Habitat

Restore native prairie plant communities of the Northern Tallgrass Prairie Ecosystem using local ecotypes of seed and maintain the vigor of these stands through natural processes. Restore functioning wetland complexes and maintain cyclic productivity of wetlands. Continue efforts for long-term solutions to the problem of invasive species with the increased emphasis on biological control to minimize damage to aquatic and terrestrial communities. Continue efforts to better define the role of each District in assisting private landowners with wetland, upland and riparian restorations.

Goal 3: Acquisition

Within current acquisition acreage goals, identify the highest priority acres for acquisition taking into account block size and waterfowl productivity data. These priority areas should drive acquisition efforts whenever possible. Service land acquisition should have no negative impact on net revenues to local government. Understand and communicate the economic effects of federal land ownership on local communities.

Goal 4: Monitoring

Collect baseline information on plants, fish and wildlife and monitoring critical parameters and trends of key species and/or species groups on and around District units. Promote the use of coordinated, standardized, cost effective, and defensible methods for gathering and analyzing habitat and population data. Management decisions will be based on the resulting data.

Goal 5: Endangered Species / Unique Communities

Preserve, enhance, and restore rare native northern tallgrass prairie, flora and fauna that are or may become endangered. Where feasible in both ecological and social/economic terms, reintroduce native species on WPAs in cooperation with the Minnesota DNR.

Goal 6: Public Use / Environmental Education

Provide opportunities for the public to use the WPAs in a way that promotes understanding and appreciation of the Prairie Pothole Region. Promote greater understanding and awareness of the Wetland Management District's programs, goals, and objectives. Advance stewardship and understanding of the Prairie Pothole Region through environmental education, outreach and partnership development.

Goal 7: Development Plan

Preparation of WPA Development Plans: Complete Geographic Information System (GIS) based WPA Development Plans for each unit in each District. Provide Districts with GIS to assist with acquisition, restoration, management and protection of public and private lands.

Goal 8: Support Staff, Facilities and Equipment

Provide necessary levels of maintenance, technician and administrative support staff to achieve other Wetland Management District goals. Provide all Districts with adequate and safe office, maintenance and equipment storage facilities. Acquire adequate equipment and vehicles to achieve other District goals. Maintain District equipment at or above Service standards.

Goal 9: Annual Capital Development Funds

Ensure that annual capital general development funds are large enough to meet necessary development of new WPA land and permit completion of maintenance needs for each Districts current land base of WPAs.

Goal 10: Consistency

Develop and apply consistent policies for habitat, public use, and resource protection and ensure frequent coordination among Districts, both in Minnesota and in neighboring states with WPAs (North and South Dakota, Iowa, and Wisconsin).